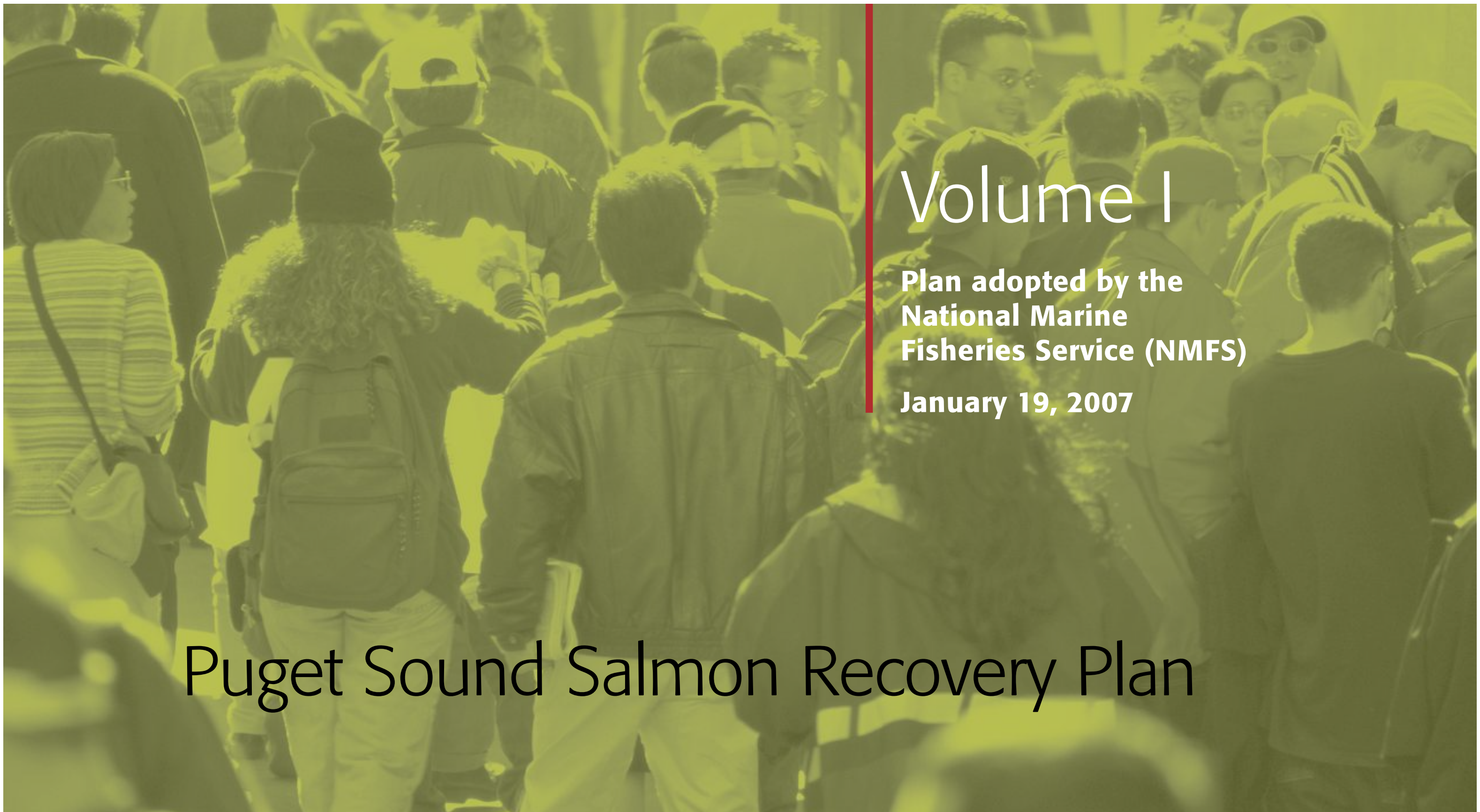

Volume I

Plan adopted by the National Marine Fisheries Service (NMFS)

January 19, 2007

Puget Sound Salmon Recovery Plan

Submitted by the Shared Strategy Development Committee

Executive Summary

A Shared Vision — Creating a Future for People and Fish

"We have an opportunity to do something extraordinary — to save a species from expiring, not only on our watch, but on the watch of our great grandchildren."

King County Executive Ron Sims (Shared Strategy Summit 2005)

Across Puget Sound, leaders at all levels aspire for a future in which the Puget Sound region has demonstrated to the world that economic prosperity, more people and a healthy environment can co-exist. The many contributors to this draft Puget Sound Salmon Recovery Plan (the plan) hope that fifty years from now, their great-grandchildren will be able to say:

***Our elders got it right. They listened to what the salmon were telling them.* Anticipating the region's growth, the choices they made in the early 2000's and the hard work that followed, created the vibrant community we share today, where both people and nature thrive and the salmon are once again teeming in our rivers and streams.**

The collective, overarching goal shared by the contributors to this plan is:

To recover self-sustaining, harvestable salmon runs in a manner that contributes to the overall health of Puget Sound and its watersheds and allows us to enjoy and use this precious resource in concert with our region's economic vitality and prosperity.

Puget Sound was once home to more populations of Chinook salmon with a greater diversity of traits than we have today. There are currently 22 Chinook populations remaining. It is hard to know precisely, but scientists believe we have lost over 15 Chinook runs and most of those losses were runs that returned in the spring to their spawning grounds. Currently, Puget Sound Chinook salmon are at only 10% of historic numbers; in some river basins that goes down to 1% and this is during favorable ocean conditions.

Photo by Domonique Lewis

The long-term goal is to achieve self-sustaining levels of Puget Sound Chinook numbers, distribution and diversity. Plan contributors will strive to achieve this goal in the context of a rapidly growing human population; well over a million people are expected to settle around the Sound in the next fifteen years. That's the equivalent of adding a city the size of Portland with its accompanying infrastructure. In addition to the broad vision and goals for the overall region, each of the fourteen local planning areas across the Sound has its own set of qualitative and quantitative goals.

Since many of the actions to recover Chinook are also expected to help Coastal/Puget Sound bull trout, this draft plan also supports US Fish and Wildlife Service's stated goal for bull trout (USFWS, 2004): To ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the Coastal-Puget Sound Distinct Population Segment, so that the species can be de-listed. Not only will bull trout benefit from this plan, it has become clear that many of our watershed's ecological processes (including those that shape the land, control water flow and content, and govern biological activity) have evolved with and depend on salmon. For this reason, there has been a growing consensus in the scientific community that salmon are a key species whose recovery will benefit the overall ecosystem health and biodiversity of the Puget Sound.

One Region, One Plan for Salmon Recovery

The Puget Sound community has a rich history of success in restoring its environment. Cleaning up Lake Washington in the 1960's, initiating recycling in the 1980's, creating the Mountains to Sound Greenway in the 1990s are just a few examples. Based on this history, the Shared Strategy for Puget Sound (Shared Strategy) was founded on the conviction that people in Puget Sound have the creativity, knowledge and resources to find lasting solutions to complex ecological, economic and community challenges.

The number of communities and governments that came together in Puget Sound under a Shared Strategy to save a species from extinction is unprecedented in the history of the Endangered Species Act. Shared Strategy leaders believe that issues as complex as salmon recovery that span urban and rural landscapes, multiple jurisdictions and involve actions affecting many sectors of a community cannot be satisfactorily solved by a single entity or point of view. So from the start, participants in the Shared Strategy salmon recovery initiative agreed to a voluntary, collaborative process involving federal, state, tribal and local governments, business representatives, the agricultural and forestry industries, conservation and environmental groups along with the local watershed planning areas to develop technically sound solutions that communities can embrace.

By the time of the listing as threatened in 1999 of Puget Sound Chinook, Coastal/Puget Sound bull trout and Hood Canal summer chum, many people had already been working for years to protect and restore salmon habitat, and improve harvest and hatchery management with conservation as well as harvest goals in mind. Rather than re-invent the wheel, state and regional leaders agreed that it made sense to build on efforts already underway in the fourteen local Puget Sound watersheds along with regional efforts for the marine waters of Puget Sound. In 2002, the Shared Strategy created a nonprofit organization to facilitate recovery plan development through a five-step process agreed to by over 200 participants. While both bull trout and Hood Canal summer chum have their own plans, the strategies and actions identified in those plans and this Puget Sound salmon recovery plan are synergistic and expected to provide benefits to all three listed species.

Most recovery plans are typically written by the federal agencies responsible for administering the Endangered Species Act (ESA). Leaders in Puget Sound took a different path because they wanted more assurance the plan would be implemented.

They believed that involving local people in the development of the plan would increase the commitment to implement it and restore our salmon runs. In this case, the National Oceanic and Atmospheric Administration-Fisheries (NOAA) and the U.S. Fish and Wildlife Service (USFWS), endorsed the Shared Strategy approach and were active participants in the collaborative process to develop this plan.

Under the Endangered Species Act (ESA), a recovery plan must have quantitative recovery criteria and goals, identify threats to survival, site specific management strategies and actions necessary to address the threats, cost estimates of the actions, and a schedule for implementation. A monitoring and adaptive management program should also be included. In addition to the general requirements, this plan was directed by the recovery criteria developed by the group of scientists appointed by NOAA Fisheries, the Puget Sound Technical Recovery Team (TRT). The scientists believe the Puget Sound Evolutionarily Significant Unit (ESU) of Chinook will have a negligible risk of extinction if:

- All watersheds improve from current conditions, resulting in improving status for the fish.
- At least two to four Chinook populations in each of five bio-geographical regions of Puget Sound attain a low risk status over the long-term.
- At least one or more populations from major diversity groups historically present in each of the five Puget Sound regions attain a low risk status.

This plan meets the ESA recovery plan requirements under section 4(f) and if implemented in a timely fashion will meet the criteria recommended by the scientists.

This plan's primary strengths rest upon three factors: 1) the needs of fish and people are addressed together; 2) the plan is built on the foundation of the fourteen local watershed planning areas across Puget Sound with a tailored approach for recovery based on local characteristics and conditions; and 3) although this plan focuses on Chinook recovery, it is done with the whole ecosystem in mind and the environmental and biological processes that create a healthy place for the salmon. Over 137 species of birds, mammals, amphibians and reptiles depend on salmon for one or more stages of their life, so they too will benefit from the protection and restoration actions to recover salmon.

The contributors to this plan believe that the Shared Strategy's collaborative approach and partnership with local communities created a better and more sustainable plan than might otherwise have been developed. The plan's contributors understand that this type of approach, particularly the tailoring at the local watershed level, will need to continue and expand dramatically in many communities during the implementation phase to build commitments to action, continue to solve problems together, and increase the likelihood of achieving the Puget Sound community's vision and goals.

Building upon a Legacy of Success

"Hope is believing despite the evidence and then watching the evidence change."

Jim Wallis

Based on the history of success in Puget Sound, Shared Strategy participants gained confidence that they can accomplish seemingly difficult tasks. This confidence allowed them to base the plan on several key assumptions. These assumptions are fundamental to salmon recovery and the region's prosperity. To make the assumptions come true, leaders from all sectors and communities must step up as their predecessors did to make the tough decisions and search for innovative solutions.

The key assumptions are:

More People and More Salmon: Perhaps the most far-reaching assumption of this plan is that

Photo by Dan Kowalski

this region can accommodate human population growth and recover salmon runs at the same time. Over a million more people are projected to live in Puget Sound in the next 15 years. During this same period, the Recovery Plan aspires to add many more salmon, on the order of a 20% increase. Achieving the salmon goals will require protecting existing habitats and building more homes for salmon (habitat restoration) as we build more homes for people. This plan provides the blueprint for how we can accomplish such a Herculean task.

There Still Are Enough Fish and Habitats to Build on For Recovery: Another fundamental assumption of this plan is that the Puget Sound region still has sufficient Chinook populations left to achieve recovery in the long-term. The 22 populations left in Puget Sound represent significant reduction in diversity from the over 30 populations believed to have existed in the past. All remaining populations are important. Some are temporarily stable at low levels and others are still in decline. Scientists contributing to this plan believe we must act quickly to protect remaining populations and to restore the productivity of all Puget Sound watersheds and marine waters. While science doesn't have the answers to all the tough questions, there is enough information to act now. Delaying or weakly stepping into implementation will diminish our options and opportunities to achieve recovery.

Science Can Help Us Make Wise Policy Decisions: This plan was developed with a strong partnership between scientists and policy makers at local and regional levels. The intent behind such a partnership is to make the best decisions to achieve a future that supports people and the environment. This plan is based on years of scientific observation, testing of hypotheses, multiple lines of evidence, monitoring and learning. The policy and technical elements in this plan incorporate current scientific knowledge about how to recover salmon. This plan relies upon the continuation of a strong interface between science and policy as new scientific information through a robust adaptive management and monitoring program comes to bear on future policy decisions.

Inclusive, transparent collaborative processes create better and more sustainable results: At the start of the Shared Strategy salmon recovery initiative, participants agreed to a voluntary, collaborative process. Collaborative processes have their limitations too, sometimes justly criticized for taking too long and succumbing to the lowest common denominator. However, if done right, they still offer the best opportunity for finding creative solutions that address multiple interests. When people with

What does the term "Recovery" mean?

"A regaining of something lost; a return to health; a regaining of balance, etc."

Webster's New World Dictionary

a stake in the outcome have a say in the decisions, they are more likely to implement them.

"Citizens are turning to these collaborative processes with increased frequency in the West as they realize that in many cases they are the only path out of gridlock...the real virtue of democracy is that it is a school. In it we learn how to manage the public aspects of our lives, and thus, unlike other systems of government, it is progressive-we can actually get better at it as time goes on."

William D. Ruckelshaus
(from Restoring Trust in Government, or Get in the Boat and Row, 1-13-04)

Local Communities are the Essence of Success: A fundamental assumption of this plan is that local watershed efforts are the engine that will lead the region to recovery. This is because many groups had already been working for years before the listing to improve conditions for salmon in their local river basins. Each local watershed area has unique assets in terms of technical ability, partnerships and regulatory frameworks; this plan tailors recovery strategies and actions to the political, cultural, economic, and ecosystem needs of individual watersheds across the Sound. These groups know the most about what is needed and what will work best both technically and politically in their local areas.

Photo by Domonique Lewis

This recovery plan provides a scientifically-based, practical and cost-effective guide for restoring and protecting salmon runs across Puget Sound. Through this plan, the people living and working in Puget Sound hope to secure a future with healthy watersheds, plentiful fish, strong communities and a viable economy.

Both Protection and Restoration of the Ecosystem will be Necessary

The plan recognizes the dynamic and evolving nature of salmon recovery. It should be read and understood as a living document. The plan calls for a combination of protection and restoration actions as well as integrated harvest, hatchery and habitat management approaches.

"Puget Sound is like a large water bucket, full of habitat and life. Habitat losses are the holes in the bucket, and many small holes can eventually drain it. Restoration is the process of plugging the holes while protection is to prevent new holes from being formed, allowing the bucket to fill once again through natural processes."

Jacques White, The Nature Conservancy

In the face of increased human population growth (projected at 1.4 million people by 2020) and the impact of ongoing land use activities, the ability to recover Chinook salmon can only occur through a combination of habitat restoration and protection. Today's remaining Chinook populations depend on existing quality and quantity of salmon habitat in the Sound's fresh and marine waters. Any further reductions in habitat quality and quantity will require more restoration to achieve recovery goals. In other words, if the 'Puget Sound bucket' keeps on getting new holes, even while we plug old holes, we won't get very far toward achieving recovery goals. And eventually, given how ecosystems work, there can come a point when there are so many holes that the system can no

Photo by Dan Kowalski

longer be restored. Protection is needed at the individual habitat site as well as at the ecosystem scale to ensure the processes that create habitat continue to function.

This recovery plan proposes substantial increases in the abundance, productivity, spatial distribution and diversity of existing Chinook populations to recover their health and ensure their long-term sustainability. The Puget Sound Technical Recovery Team (PSTRT) identified protection of existing and functioning habitat as most important in their technical guidance to watersheds (PSTRT, 2002). Protection is a more certain strategy than restoration because we know that untrammeled habitats are more likely to support species. In contrast, restoration approaches are relatively untested, especially at large scales. Unless we protect what we have, habitat will continue to degrade and restoration activities may not gain enough ground to achieve recovery goals.

In their local plans, watersheds identified the various regulatory, conservation, incentive and educational programs in their areas to protect salmon habitats and the processes that create them. The regional protection strategy in the plan discusses existing protection mechanisms, both voluntary and regulatory. It points out that this region has preserved ecological function on huge tracts of land that are designated as national and state wilderness areas, parks and forest lands, especially in the upper elevations of Puget Sound watersheds. State and local governments have also developed and refined their regulatory programs since the 1970's to address impacts from land development on the ecosystem (The Growth Management Act, The Shorelines Management Act, The Water Resources Act, and the Forest Practices Act as amended in 2002). These combined with the State Hydraulics Code and local government regulatory programs have improved many land and water use practices over the last several decades.

One protection element that is often overlooked is the contribution by private citizens as land stewards. There are still many areas in Puget Sound along streams, rivers and marine shores that support salmon due in significant part to the care and action of these individuals. Many of these folks have a strong ethic for preserving both private property rights and taking responsibility for caring for their land; a responsibility they take seriously and often pass on from one generation to the next. Understanding these citizens' interests and concerns is a critical component of a successful protection strategy.

> *"Property owners have a lot at stake when it comes to protecting salmon in Puget Sound and we feel like we should be part of the process, but the only way we're going to get the biggest advantage is if government works closely together, cooperatively with property owners. The big stick of regulation will not take us where we want to go. Salmon are very important in our lives and so are property rights, and the long lived American dream of home ownership needs protecting."*
>
> *Vivian Henderson, Executive Director*
> *Kitsap Alliance of Property Owners*

The plan includes significant proposals to beef up incentive-based protection programs. These programs recognize and increase good land stewardship and salmon conservation efforts by private property owners, farmers and foresters. They also help preserve working farm and forest lands-land uses which, if managed with environmental conservation goals in mind, tend to be better for fish than more developed human land uses.

What is not clear is how these different tools (voluntary and regulatory) combine to provide the level of protection needed for salmon recovery-that is, what are the expected results for fish from these programs? Not knowing the degree to which protection mechanisms are effective is a key weakness of this strategy. This is especially true given that scientists identified the protection of existing high-quality habitat as an immediate short-term need to preserve options and increase the chance of success. The plan calls for improving the certainty of results of the various protection efforts by conducting an analysis of the effects of existing programs on habitats and fish, then implementing changes based on the findings.

It's clear from the region's experience with Growth Management and environmental regulations that these are highly controversial issues. Finding the appropriate balance for using all the available protection tools, both voluntary and regulatory, may be one of the greatest challenges in securing the protection needed. Cumulative actions by many people in a watershed can add up to significant impacts. Protecting private property rights must be balanced with the need to protect public resources. Both are important. A dialogue that begins to bridge the needs of private property owners with the needs of the public resources, and moves beyond the mostly polarized responses of recent times, would help interested parties find solutions not otherwise apparent.

Top Ten Actions Needed for Salmon

Although each watershed area has its own individualized, tailored plan, there are common types of actions that all watersheds included in their chapters. These actions are related to the threats or limiting factors affecting salmon. The magnitude of each factor varies by watershed, as well as how they propose to address it and how they measure success. For this reason it is difficult to compare detailed actions and results across watersheds, but the list of actions below summarizes the common set of factors, why they are important to salmon, and how people also benefit from restoring or protecting the values described.

This plan advocates taking an ecosystem approach to recovery. This means that the physical and biological factors that create fish habitat must be addressed. Among the physical and chemical processes basic to habitat formation and salmon persistence are floods and droughts, sediment transport, heat and light transfers, nutrient cycling, water chemistry, riparian dynamics and woody debris recruitment and floodplain dynamics. Important salmon biological processes in salmon that depend on habitat dynamics include migration, adaptation, the complex energy transfers of the food chain, and the metabolism of the fish.

The structural diversity in streams, estuaries and marine waters that enabled salmon to thrive was built over centuries by the complex interaction of light, water, soil, vegetation, and nutrient cycles. Salmon evolved to stream conditions that had disturbances varying by days, decades and centuries. Human activities modified these constant cycles of change by increasing the frequency of disturbance, altering the magnitude of disruption, and thereby affected the ability of the stream channel to respond. It is not just a matter of how we protect and restore the water environment, it is also essential to manage how we alter the land and streams in the whole watershed to protect and rehabilitate the natural processes.

In addition to habitat actions, harvest and hatchery actions must build on existing processes for co-managing salmon fisheries and adjust over time to allow recovery to occur. The key to this plan's success will be the adaptive management and monitoring program at both local and regional levels to make sure that the proposals have the desired effect.

The actions listed below are not in any priority order and the examples following the descriptions are meant to be illustrative not comprehensive-all watersheds with independent spawning populations have proposals for these items to some degree. Four planning areas (South Sound, East Kitsap, Whidbey/Camano, and San Juan) without independent spawning populations focus primarily on land use and fresh and salt-water issues related to the nearshore and marine waters surrounding their shores. The ten common actions are:

1. **Estuaries** — the biological change salmon must undergo to swim from fresh to saltwater and back again is immense. Estuaries and river deltas are the transition zone that enables this change to occur. They are also a rich source of food, provide places to hide from predators, give young salmon a safe harbor to grow strong for their ocean migrations, and are a key part of the migratory corridor salmon use to travel in and out of the rivers.

The loss of estuarine functions across Puget Sound has been dramatic over the last two hundred years. These same areas so critical to salmon also support productive farmlands, bustling ports, major cities, private shoreline residences and industrial complexes. Restoring estuarine areas near population centers, such as in Everett, can provide people a special opportunity to experience and enjoy a respite from urban living by having a natural wildlife environment in close proximity to work or home. Examples of estuarine restoration include reconnecting large blind tidal channels and sloughs isolated behind dikes, and improving connectivity between channels, sloughs, and marshes that provide rearing habitat for juvenile salmon, filter water, and absorb flood level flows.

Examples of proposed actions to address this issue:

- The majority of these actions are planned for public and tribal lands. In cases where local plans identified restoration or protection needs along private property, the plans recognize the need to work in collaboration with land owners. Estuarine restoration and protection actions in six areas will provide almost 6,000 acres of estuarine habitat.
- In the Nisqually basin, as one specific example, the goal is to restore or protect 80% of the historic estuary area. In the next twelve years, the watershed plans to restore 800 acres (100 of which is on tribal land and the rest is in the Wildlife Refuge).
- The Snohomish watershed includes proposals to protect 1,483 acres of existing critical estuarine habitat, and gain 1,237 acres of

tidal marsh habitat through restoration and acquisition. The plan recommends restoring the habitat on existing public lands first, where habitat gains will be highest and where existing projects can be expanded. Achieving the goal of 2,720 acres would almost double the available estuarine habitat in this watershed.

2. Floodplain areas — historically floodplain areas contained wetlands, side and braided channels, and oxbow lakes. Floodplains perform a variety of functions and in the process prove valuable to both humans and fish and wildlife species. Important functions include: flood water storage, water quality maintenance, fish and wildlife habitat, and recreation/open space.

Under natural conditions, when rivers reached high volumes, water overflows the bank and spills into the floodplain, preventing catastrophic flooding events downstream and providing safe places for young fish to wait out the flood. Dikes, levees and other actions to control lower river reaches have significantly reduced these nourishing places for juvenile salmon to feed and grow. As riverbanks were armored to protect property for agricultural, residential or industrial purposes, these important habitats were disconnected from the river. Levee setbacks, dike breaching and other restoration actions will reconnect these habitats and by replicating the natural hydrological functions of a floodplain, will also help control flooding on people's properties.

Examples of proposed actions to address this issue:

- The Nooksack watershed plans to establish channel migration zones across which the river has been known to meander in the last 100 years. Once delineated and approved by the Whatcom County Council and Washington Department of Ecology, the channel migration zones will be incorporated into the County's Shoreline Management Program and the Comprehensive Flood Hazard Management Plan. These zones will provide physical and biological processes for fish and also protect important human infrastructures. This work is already underway and is expected to be complete by early 2006.
- The Puyallup/White River basin plans to set back 1300 feet of levees at Old Soldiers Home near the city of Orting and will restore 67 acres of floodplain to the river. Additional side channels will be recreated in the lower river near Fife and Tacoma.

3. Riparian Areas — trees and shrubs alongside streams, rivers and marine beaches are important for salmon for a variety of reasons. Riparian vegetation helps support insects that are food for salmon, provides cover from predators, and keeps water temperatures cool. Tree roots stabilize stream banks and create habitat structure in the stream. Decaying trees form log jams that provide cover and help create pool and side channel refuges for young salmon, away from high velocity flows and predators.

In most watersheds, riparian buffers have decreased in area due to clearing land to support various land uses such as agriculture, forestry, road building, and residential and urban development. Such loss impairs a river's flows and impacts habitat from the higher elevations to the estuary and out to the marine waters of the Sound. People too can benefit from keeping or restoring riparian habitat: root systems maintain bank stability and prevent erosion on property, trees and shrubs filter out chemicals from upriver sources, help control floods and provide habitat for other wildlife enjoyed by humans.

Examples of proposed actions to address this issue:

- The Stillaguamish watershed has just over half (52%) of their riparian areas remaining, mostly in the middle and upper parts of the

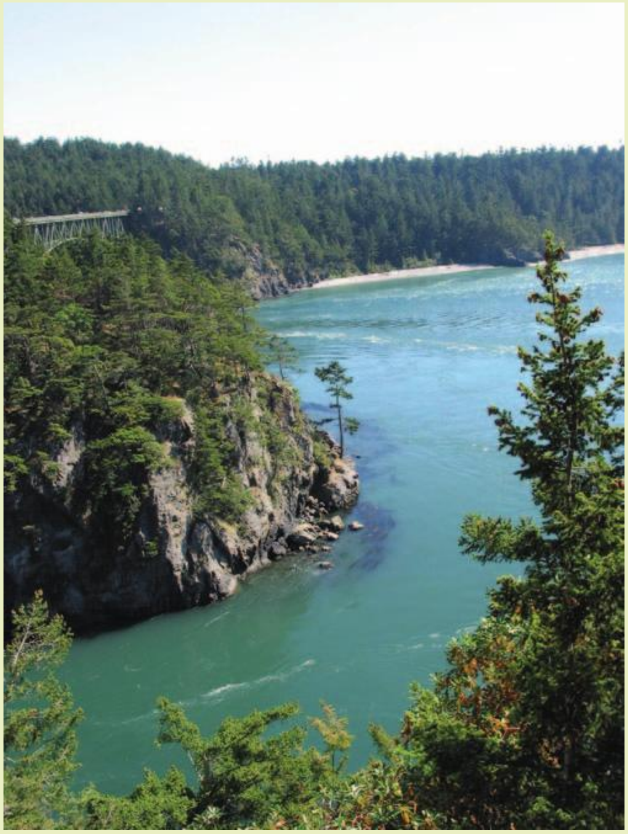

Photo by Domonique Lewis

basin. Along the lower reaches, only 16% of the area still has riparian vegetation. The Stillaguamish plan calls for restoring 400 acres of riparian buffers in the next ten years with the ultimate long-term goal (~50 years) of restoring 7,600 acres.

- As a direct result of implementing their recovery plan, the Nisqually watershed has already protected over 67% of mainstem Nisqually River riparian habitat. The goal is to acquire, protect or restore habitat values on 90% of 84 miles of shore lands along the mainstem.

4. Water quantity — it may be obvious to say that salmon need water. What is often less obvious is that both too much water (i.e. floods) and too little water can be problems for the fish. Low flows are generally related to water withdrawals for agricultural irrigation, drinking water and other human uses. Low flows can be exacerbated in years of low snow pack or rain. Flows affect habitat processes and functions throughout a river system from the upper reaches and down through the estuary and nearshore.

High water flow can be hazardous to salmon at all life stages. This condition can result in eggs being covered by silt and other materials, can cause eggs to wash out of the gravel, move juveniles downstream too quickly, and make it too difficult for spawners to return upstream.

Low water can isolate eggs and juveniles in pools whose temperatures increase while the dissolved oxygen content decreases, and also causes them to be more susceptible to predation. Low water makes it difficult or impossible for out-migrating juveniles and in-migrating spawners to reach their destinations.

Scientists agrees that instream flows need to remain at the top of any salmon recovery agenda, even while they also agree that more research is necessary to know what salmon need in terms of flows. More information is also needed to understand more about the current causes of flow problems. The overall plan for water quantity is in three parts: a) set instream flows, b) achieve flows, and c) conduct needed research to design suites of actions aimed at maintaining instream flows at watershed scales.

Examples of proposed actions to address this issue:

- People in the Dungeness River basin have been working for over ten years to address the chronic low flow problems there. The Agricultural Water Users Association and Jamestown S'Klallam Tribe obtained federal and state funding to improve irrigation infrastructure and conveyance efficiency. In the last five years, these actions have helped reduce the amount of water used for irrigation by one third, leaving more water in the river at times when salmon most need it. Additional conservation projects to improve summer flows are proposed in the Dungeness plan.

- In two of the most urban watersheds, King County's Comprehensive Plan and Regional Wastewater Service Plan both support the use of reclaimed water to help meet the region's diverse water supply needs. A specific goal is to use reclaimed water to assist the region in balancing needs of the environment and people. In 2004, King County used or distributed 268 million gallons of reclaimed water in place of drawing new potable water. Through substituting reclaimed water for potable water in operations at its two wastewater treatment plants alone, King County is leaving approximately 700,000 gallons of water per day in streams and rivers. This represents only a fraction of the potential of reclaimed water to benefit instream flows for salmon in the region, and King County is embarking on a regional water supply plan to bring a larger supply of reclaimed water to the region.

5. **Water quality/pollution** — Both people and salmon depend on clean water to survive and many of the local salmon recovery chapters recognize the importance of water quality. Pollution can come from point sources and non-point sources. Point sources of pollution include industrial discharges, sewage treatment plants, and drainage system discharge.

Non-point source pollution is considered to be any water pollution without a distinct source. Non-point pollution can include fecal coliform bacteria, pesticides, sediments, and excess nutrients. Sources of this pollution include runoff from agriculture, forestry, rooftops, paved streets, highways, and parking lots as well as hard grassy surfaces like lawns and playing fields.

Non-point source pollution is a major cause of water pollution in Washington and poses a major health and economic threat. In general, untreated stormwater is unsafe for people and for fish. It contains toxic metals, organic compounds, and bacterial and viral pathogens. Virtually all of our urban embankments, creeks, streams, and rivers are harmed by urban stormwater, making it the leading contributor to water quality pollution of urban waterways.

Pollutants from non-point and point sources can also end up trapped in sediments in our rivers and marine areas. Exposure to contaminated marine sediments also pose significant health risks to juvenile salmon and other marine species, including favorite seafood such as shellfish enjoyed by humans.

Examples of proposed actions to address this issue:

- In Commencement Bay (Puyallup/White watershed), on the St. Paul Waterway, private companies, the Port of Tacoma, tribes, NOAA, EPA and the City of Tacoma are cleaning contamination from past releases of hazardous substances and creating 17 acres of new intertidal habitat. Along the NE shore between the mouth of the Hylebos Waterway and Brownes Point, the Washington Department of Natural Resources will restore 8.3 acres of state-owned aquatic lands.
- In the Green/Duwamish watershed, five miles of the lower stretch of the Duwamish River are designated as a superfund site and scheduled for sediment clean-up and restoration; 10 acres of intertidal habitat have already been restored.
- One example of how the plan connects and integrates with existing programs is the City of Bellevue's comprehensive stormwater management program — one of the first stormwater utilities in the nation. The program protects the water quality and habitat of over 60 miles of streams, 800 acres of wetlands, and three small lakes. In addition to operating and maintaining the storm drainage system,

Bellevue assures that privately owned and operated systems are properly functioning and also provides private residential drainage advice, educational programs such as Stream Team, and 24-hour emergency response for flooding and water quality incidents. Property acquisition and construction of capital investment projects reduce flooding, manage flows, stabilize stream banks, and improve culverts for fish passage.

6. **Fish access** — Several major dams block access to historic Chinook salmon spawning and rearing habitat in Puget Sound. In addition, other blockages for water diversion, road culverts, and small hydro development also exist throughout the Sound. Some tributary barriers such as culverts may not block access for Chinook spawning and rearing specifically (since Chinook primarily use mainstem reaches); yet they may still generate downstream impacts to mainstem river areas by interrupting sediment transport, and large woody debris recruitment and transport

   Physical barriers also alter stream flow which increases salmon mortality in several ways — migration can be delayed by insufficient flows or habitat blockages; loss of usable habitat due to dewatering; stranding of fish resulting from rapid flow fluctuations; and juvenile fish becoming entrained from high velocity waters at poorly screened diversions. Reduced flows also diminish fish habitat by decreasing recruitment of new spawning gravels, and allow the encroachment of non-native vegetation into spawning and rearing areas.

Examples of proposed actions to address this issue:

- The most significant passage barrier restoration in terms of sheer magnitude is the removal of the Glines Canyon and Elwha dams on the Elwha River. Dam removal actions are scheduled to begin in October, 2008. The removal of the two dams is the single most important step in restoring the Elwha Chinook population and will restore anadromous fish access to the upper watershed, allow for the natural habitat forming processes to occur through the accumulation and deposition of sediment and wood to the lower watershed and nearshore, and restore natural flow and temperature regimes to the river.
- In the Nooksack watershed, the Middle Fork Diversion Dam limits access to 16 miles of spawning and rearing habitat for the North Fork (NF) Chinook population. Removing this dam is expected to increase the NF population abundance by 30.8%, increase productivity by 12.1% and increase the diversity index by 47.6% (based on EDT analysis and estimates of future habitat use).

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group

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7. **Puget Sound shoreline and marine areas (nearshore)** — All of the above factors covered so far also affect the saltwater environment along the shorelines on either side of river mouths and out to about 30 feet of the Sound. Scientists now understand that the estuaries, Puget Sound, and the ocean have to be treated together with freshwater environments as one interconnected system that must be protected and restored. Salmon populations mix in these environments and the fish depend on each part of the ecosystem to function successfully for their survival.

   The marine shorelines have changed significantly over the last two hundred years affecting the natural processes that created and maintained key salmon and marine life habitat. A significant portion of shoreline trees and vegetation has been removed, which once provided shade and habitat for insects eaten by juvenile fish. Approximately thirty-three percent of Puget Sound shorelines have been filled and armored by concrete or rocks, mostly to protect single family homes. There are over 3,500 docks and piers, 29,000 small boat slips, and 700 large ship slips. These structures change how the ecosystem functions. Combined, these changes affect migration corridors, transition of the fish from fresh to salt water, their eating habitats, and their ability to forage and seek refuge from predators.

   Examples of proposed actions to address this issue:

   - In East Kitsap, the City of Bainbridge Island passed an ordinance restricting dock construction to protect the nearshore ecosystem in a specific part of the watershed.

   - Both Island and San Juan counties still have a significant amount of functioning nearshore habitat. For example, to date only 25% of Island County's and 5% of San Juan County's shorelines have been hardened. Both of these watersheds are focusing their initial efforts on protecting the valuable resources they still have. Protection efforts focus on marine riparian areas, forage fish spawning beaches, eelgrass meadows, features which support sediment transport and high quality freshwater inputs, and habitat connectivity.

8. **Harvest management** — Harvest management strategies that would ensure the return of a portion of the salmon runs to their home spawning grounds have been implemented for thousands of years in the Pacific Northwest. Until the mid-19th century, aboriginal people spread their harvest patterns across different locations and times, sometimes using weekly closure periods to pass salmon upstream. These measures, combined with pristine habitat, allowed salmon runs to flourish over many millennia.

   The combination of accelerated habitat loss and modification, and the advent of industrial fishing methods, in the late 19th century resulted in an almost immediate decline in salmon abundance. Harvest can negatively impact salmon populations through direct mortality, and also through selectively reducing the size and age at which individuals reproduce. Because harvest occurs late in the life cycle of the salmon, the risk of over-fishing has a direct and potentially substantial effect on the population that is left to return home and reproduce (NRC, 1996).

   Harvest is important to the Puget Sound region culturally and economically. The salmon themselves are inherently productive; and when populations are healthy, they can sustain harvest without jeopardizing their ability to sustain themselves.

   Today's harvest management objectives emphasize bolstering the survival and recovery of the wild salmon populations. The overall harvest management strategy is to ensure that fishery-related mortality will not impede the rebuilding of natural Puget Sound Chinook salmon populations, while maintaining consistency with treaty-reserved fishing rights and international agreements. The Harvest Management Component of the Comprehensive Chinook Management Plan (PSTT and WDFW, 2004) sets limits on annual fishery-related mortality through the establishment of harvest rate ceilings and thresholds of low Chinook abundance that trigger additional conservation measures. Harvest limits for Canadian and Alaskan fisheries occurring on Puget Sound fish are established through the Pacific Salmon Treaty.

Examples of proposed actions to address this issue:

- In the Snohomish basin, there is currently no fishery (tribal, commercial or recreational) that targets wild Skykomish or Snoqualmie Chinook. Harvest rates on Chinook from the Snohomish basin have been reduced to 20-30% which represents fish caught incidentally during mixed stock fisheries that target other species and hatchery Chinook. These reduced harvest rates have coincided with increased numbers of fish that return to spawn, indicating that such strategies are consistent with improving salmon population status. The current goal of harvest management is to maintain fishing rates low enough (24%) so that wild Chinook can take advantage of the protected and restored habitat. Over time, this will allow the populations to expand. In addition, controls on the timing and location of fisheries targeted toward hatchery fish are designed to help reduce the incidental harvest of wild fish.
- In the Nooksack watershed, current exploitation rates from all fisheries have been reduced to at or below 20% since 1996. Working with NOAA Fisheries, the tribes and state will continue to develop an exploitation rate that can be used to equitably adjust fisheries to meet the recovery objectives of the two listed Chinook populations. This approach is especially important for the Nooksack populations whose numbers are very low and whose fish are caught in local, Canadian and Alaskan fisheries. The Pacific Salmon Treaty which guides the international harvest expires in 2008, and will be open for new considerations.

9. **Hatchery management** — The artificial propagation of salmon in Puget Sound began with a hatchery on the Baker River in 1896. Hatcheries were traditionally operated for two main purposes-to mitigate for the reduction of salmon runs due to the construction of dams and other habitat loss, and to increase the number of fish available for harvest.

   The science and practice of hatchery operation has advanced significantly over the past 100 years, but hatchery intervention into salmon runs has created long term genetic and evolutionary consequences that may never be fully mended. Some hatchery programs today still seek to provide opportunity for fishers where the negative consequences of artificial propagation can be reduced and isolated. Many other hatchery programs are now also used as tools to bolster the remaining salmon populations and to help maintain them as they rebuild to self-sustaining and harvestable levels. Hatcheries alone cannot achieve this goal, and it is widely recognized that they must operate hand-in-hand with habitat restoration if future salmon are to find a home.

   Long term awareness of issues such as loss of fitness and genetic diversity, ecological impacts to naturally spawning populations through predation and competition, disease transfer, and the habitat disruption of the facilities themselves have led to a number of hatchery reform efforts in recent decades.

   The Puget Sound and Coastal Washington Hatchery Reform Project was launched in 2000 by the U.S. Congress and created an independent review panel, the Hatchery Scientific Review Group. The Project reviewed all Puget

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Sound hatchery programs, made recommendations for reform, created scientific tools to help implement recommendations, and created principles to make hatchery reform operational and ongoing. It also provided funding for related studies, hatchery operational changes, and some funding for modifications to facilities where appropriate.

In 2004, WDFW and Puget Sound treaty tribes completed the hatchery component of the Comprehensive Chinook Resource Management Plan (RMP), building upon other assessments submitted to NMFS in response to the listing of Puget Sound Chinook under the Endangered Species Act. The Hatchery RMP contains 42 specific Hatchery Genetic Management Plans designed to limit adverse impacts to threatened populations of salmon from hatchery programs and operations. This is part of an existing NEPA/EIS review.

Examples of proposed actions to address this issue:

- The Nooksack chapter identifies two main hatchery strategies to protect and restore the South Fork Chinook population. The first is a rebuilding program (Skookum Supplementation Program) to maintain this population's genetic diversity by increasing its abundance. The second is to reduce the number of hatchery strays into the South Fork. Actions include improving the Lummi Bay facility to attract returning hatchery fish, maintaining or reducing late-run Chinook releases in the lower river, and investigating and implementing alternate release strategies to minimize straying potential.

- The Dungeness Chinook population is at critically low abundance levels. In response, the watershed has had a captive brood program since 1992 to bolster Chinook production. Adult Chinook returns in recent years indicate that the captive brood program has been successful in increasing adult returns-escapement has averaged 575 spawners in the three-year period from 2001-2003. These higher returns will now accommodate implementing a conventional Chinook brood stock program. The new program is intended to maintain the higher adult return rates until the habitat can support a naturally sustainable Chinook population.

10. H-Integration — Salmon recovery faces enormous challenges in tying together actions across all watersheds, jurisdictions and decision-making forums affecting the Puget Sound Chinook Evolutionarily Significant Unit (ESU). The major factors that affect the abundance, productivity, spatial structure and diversity of salmon populations are often lumped into the "H Factors" of harvest, hatcheries and habitat (including hydropower).

Each of these factors independently affects the status of salmon populations, but they also have cumulative and synergistic effects throughout the salmon life cycle. The achievement of viability at the population and ESU level depends on the concerted effort of all three factors working together, not canceling each other out, and adjusting over time as population conditions change.

Examples of proposed actions to address this issue:

- The Snohomish basin has a comprehensive H-Integration strategy; strategies and actions in each of the H factors are identified for the four VSP parameters (abundance, productivity, spatial structure, and diversity). In the near-term, reduced harvest will help rebuild run sizes as substantial habitat improvements are made. Hatchery management will allow migration above hatchery weirs to provide additional habitat for larger numbers of adult returns, increasing spatial structure. As the plan is implemented, harvest, hatchery and habitat actions will be monitored and their underlying hypotheses tested. Adaptive management will ensure appropriate sequencing, consistency among strategies, and efficiency.

- The Stillaguamish watershed plans to monitor the status of both of their Chinook populations. Consistent negative trends in abundance will trigger short-term harvest and hatchery modifications; these can be adjusted quickly and show immediate responses. 10-year habitat actions combined with the existing harvest and hatchery management actions are modeled to produce roughly a 30% increase in the fish populations.

Timeframe for Success

"Salmon recovery is a symbol for Washington's future because it is a story of people learning to live with nature. We have the ability to save some of the world's greatest salmon runs, it is in our control. The question is whether we will do what we need to do fast enough...."

Joan Crooks, Executive Director, Washington Environmental Council.

The plan lays out long-term recovery goals and strategies, but its primary focus is on the next ten years of actions to place this region on a path toward recovery. This is because the ultimate success of the plan depends upon the various authorities and responsible parties stepping up to commit to implement the strategies and actions described in the plan. A ten-year timeframe is a reasonable period of time to ask for commitments and begin to see progress and results. Significant results in this period will hopefully demonstrate to future leaders and decision-makers in years eleven and beyond why they should continue to support recovery activities.

Although this plan meets the ESA recovery plan requirements and if implemented will improve conditions for the salmon, it does not claim to have all the answers nor to solve all the chronic problems and threats affecting the species. It does however identify the threats and issues that must be addressed, identifies at least preliminary approaches for dealing with them, and has a schedule for making progress on those issues for which there are no easy answers. It also lays out the framework for a monitoring and adaptive management program with details to be developed through the summer and fall of 2005 in time for the federal register notice and public review process.

Each local planning area used a different process to develop their plans-some used extensive multi-stakeholder community decision processes, some had one or two lead entities or co-managers write portions of their plan. As expected, the chapters vary in terms of their level of detail, how they address issues of habitat, harvest and hatcheries, and how they are organized. The regional elements of the plan, especially the regional strategies and adaptive management chapters, pick up where watershed chapters leave off; they include items that need both a regional and local approach to increase the certainty of achieving ESU recovery goals.

Shared Strategy leaders are committed to continue to build the needed commitments throughout the rest of 2005 and beyond to implement the first ten years of actions. If implemented, strategies and actions in this plan will put the region on a significant path toward recovering the Puget Sound Chinook ESU.

What will this plan cost?

"...one of the things in terms of salmon recovery, and being smart about conservation is that you engage folks that live here in dialogue.... Starting at the grassroots, with people living in their neighborhoods and their communities, along the Cedar, in Bear Creek around Lake Washington...We found they were ready to respond, that they did care about this place and the more they learned about

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what was happening to salmon the more they wanted to step up and do something about it."

Larry Phillips Chair King County Council (D)

"As Larry says ....if citizens are with you and they understand what is going on, than that is what empowers people who have the responsibility for deciding how much money to spend and where to spend it, that empowers them to go ahead and say yes we can do this... but you wouldn't get anywhere with out the citizens with you."

Louise Miller, former King Councilmember (R)

The watershed and regional strategies and actions combined comprise a thoughtful, practical and cost-effective plan that will lead to tangible, visible results. Watersheds identified ten-year priority actions and cost estimates, assumed to be the period 2006-2015. In addition to the watershed-specific work to identify and estimate costs for priority actions, the Shared Strategy staff developed estimates for three programs that span multiple watersheds: hatchery improvements, nearshore and marine habitat protection and restoration, and incentive programs aimed at conservation on private farms and small forest parcels.

Based on the estimates, making significant progress toward achieving recovery in the next ten years will require a doubling of the effort from an average of $60M/year currently to $120M/year. Of the total watershed and regional costs, 85% is projected to be needed for capital projects--largely habitat-related--and the remaining 15% is proposed for key non-capital activities such as adaptive management and monitoring.

The financing strategy is to maximize existing funding sources, and draw on additional existing sources that could be, but have not been, used for salmon recovery priorities (e.g. mitigation, federal farm bill, public and private grant programs). If these sources fall short of goals, the strategy is to explore alternative sources or change the scope or pace of recovery plan implementation.

This funding level will support significant progress toward recovery based on local watershed scientific work and the TRT's regional recovery criteria. Based on the assumptions in the finance strategy, it will do so at a cost that can reasonably be borne by the governments and taxpayers of the region without tax increases. It does not, however, fund the entire suite of priorities on which the watersheds based their estimates.

The financing strategy's concepts, principles and approach were recently supported and affirmed by a Leadership Group composed of city and county elected officials from throughout the Puget Sound region, government agency representatives, tribes, conservation organizations, and private industry.

Who will make this plan a reality?

"...without everyone making a change we will not be successful."

Alison Studley,
Skagit Fisheries Enhancement Group

The contributors to this plan wish to create a future in which both people and salmon co-exist and thrive. They know that salmon recovery is a long-term prospect. Achieving recovery involves coordinating and integrating many parts such as harvest and hatchery management and habitat restoration and protection. It requires building community support and leadership commitments to implement plan actions.

Many people and organizations need to work together in a coordinated way over time to succeed. Meanwhile, scientists must continue to research and learn more about salmon and their needs and the ecosystems which they share with other species, including humans. In the future, new opportunities may open up for adding to recovery actions that may not be available or apparent today.

All this is to say that salmon recovery has to be viewed as a dynamic and evolving initiative.

All the people and groups who were involved in the development of the watershed chapters and regional strategies, and who are already working on salmon recovery, will also be called upon to help implement the plan. Many are already committed to do their part, and many others are expected to add their commitments in the next six months. Successful implementation will require leadership and action on the part of the following groups — they are being asked to:

- Farmers and forest land owners — Implement state and federal laws, increase conservation and salmon habitat restoration efforts through voluntary action and use of existing and improved incentive-based programs.
- State and tribal co-managers — Continue individual efforts related to harvest and hatchery management in concert with recovery goals, and increase assistance to watersheds to integrate hatchery, harvest and habitat actions.
- Tribes — Help implement local watershed plan actions and participate in local forums to continue to share information and problem solve as issues related to implementation and adaptive management arise.
- City and county governments — Enforce and update existing environmental laws using watershed information as Best Available Science; continue contributing funds for the implementation phase of recovery; and help broaden public and legislative awareness and support.
- State government — Implement programs in concert with plan goals and strategies such as for water quantity and quality, and forest management. Continue to fund capital improvements and support for watershed groups.
- Federal government — Continue supporting the Pacific Salmon Fund; provide visible leadership support for salmon recovery efforts; negotiate international fishing agreements; and address marine water issues consistent with the goals and strategies of this plan.
- Scientists — address technical uncertainties through the adaptive management and monitoring program at both local and regional scales.
- Conservation groups such as the Cascade Land Conservancy, The Nature Conservancy and the Trust for Public Land — Coordinate, land conservation and protection actions to complement other protection tools consistent with local salmon habitat protection priorities.
- Environmental organizations — Continue to support the best use of science in governmental programs and regulations while increasing support for incentives to landowners.
- Regional Fisheries Enhancement Groups and other voluntary, citizen-based salmon programs — Continue to galvanize citizen interest in voluntary programs, increase assistance in monitoring and measuring results.
- Citizens and private property owners — Continue stewarding property to protect financial investments and contribute to the public good; implement salmon-friendly practices; participate in the watershed processes to implement the local plans for both protecting property rights and public resources.
- Businesses — use salmon-friendly building and development practices; work with local communities to continue to seek solutions that meet both economic and environmental goals.

A Call to Action

"If humanity can tap its capacity for caring and creativity, if humanity taps a resolve equal to the salmon's drive to return to their native waters then the question can humans and salmon coexist can be answered."

Dan Kowalski,
Film Maker and Commercial Fisherman

The many people who put their hearts and souls into developing their local recovery chapters and the regional strategies in this plan hope that their efforts inspire dialogue and action around the following questions:

- What sort of neighbors will we be to salmon in the future?
- How can we have more people and more salmon in this region?
- What more is needed to increase people's confidence, commitment to and hope for the future of this region-one in which both people and salmon co-exist?
- What evidence do we need to see to know that we are succeeding?
- How can we focus people's energy on continuing to seek and find solutions?

"My tribe has not fished for Skagit Spring Chinook for over 30 years. I hope some Memorial Day in the future I can stop at my farmer friend Dave Hedlin's home, and trade stories about who caught the biggest fish for the family dinner."

Brian Cladoosby, Chairman, Swinomish Tribe.

Puget Sound Salmon Recovery Plan

Volume 1

Plan adopted by the National Marine Fisheries Service (NMFS)
January 19, 2007

Submitted by the Shared Strategy Development Committee

SHARED STRATEGY
FOR PUGET SOUND
working with communities to restore salmon

Shared Strategy for Puget Sound

1411 4th Avenue, Suite 1015 | Seattle, WA 98101

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Volume II includes electronic copies of the complete set of local watershed and regional nearshore chapters:

Nooksack
San Juan
Skagit
Stillaguamish
Island
Snohomish
Lake Washington / Cedar / Sammamish
Green / Duwamish
East Kitsap
Puyallup / White
Nisqually
South Sound
Hood Canal
Dungeness & Elwha
Regional Nearshore and Marine Aspects of Salmon Recovery in Puget Sound

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We would like to thank and acknowledge participants in the 14 watersheds and Puget Sound tribes, too numerous to list individually, but whose hard work is greatly appreciated. Without their tireless work, devotion to the Puget Sound region and willingness to find solutions to complex problems, this recovery plan would not be possible:

Watersheds

Nooksack
San Juan
Skagit
Stillaguamish
Island County
Snohomish
Lake Washington/Cedar/Sammamish
Green/Duwamish
East Kitsap
Puyallup/White
Nisqually
South Sound
Hood Canal
Dungeness & Elwha

Participating Puget Sound Tribes

Jamestown S'Klallam Tribe
Lower Elwha Klallam Tribe
Lummi Nation
Nisqually Indian Tribe
Nooksack Indian Tribe
Point No Point Treaty Council
Port Gamble S'Klallam Tribe
Puyallup Tribe of Indians
Sauk-Suiattle Tribe
Skokomish Tribe
Squaxin Island Tribe
Stillaguamish Tribe
Suquamish Tribe
Swinomish
Tulalip Tribes
Upper Skagit Tribe

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CHAPTER 1

One Strategy Shared by Many

Introduction

"These waters, which in 1899 produced nearly one-third of the salmon catch of the world, are generally known as Puget Sound."

Report of the U.S. Commissioner of Fish and Fisheries, 1902[j1]

Tribal ancestors of the Pacific Northwest believed that salmon were another tribe that had gone to live in the ocean. The returning runs of salmon each year were an annual gift from the ocean people to their terrestrial counterparts. The abundance of salmon runs in the 19th and 20th centuries has become legendary, and salmon formed the basis of tribal sustenance and economies. Early settlers to Puget Sound also depended on marine resources for their food source and livelihood. A letter in late 1854 from the first territorial governor, Isaac Stevens, indicated that, "The Indians on Puget Sound...catch most of our fish, supplying not only our people with clams and oysters, but salmon to those who cure and export it." Stevens was given the charge of negotiating treaties with Washington Indian tribes to arrange the transition to a new society, and open the way for farming, lumbering and other industries. Population growth in the Pacific Northwest exploded in the late 1800s following the completion of the transcontinental railway, and white settlers flocked to the territory to take advantage of opportunities based on fertile soils, vast stands of timber, and abundant fisheries. Even though 150 years have passed since Governor Stevens signed the treaties, salmon still represent an intrinsic part of the Pacific Northwest identity. Tourists and local residents sporting salmon t-shirts still enjoy watching the large fish get tossed over the counter at the Seattle Public Market, salmon banners and statues adorn community streets, and recreational fishing skills are passed from generation to generation when (increasingly rare) opportunities arise.

From the collection of the Washington State Archives.

Unfortunately, the condition of some Puget Sound salmon runs threatens the viability of this resource as a Pacific Northwest icon. Although salmon have always been subject to natural fluctuations across their range, scientists have warned of the degradation of salmon and

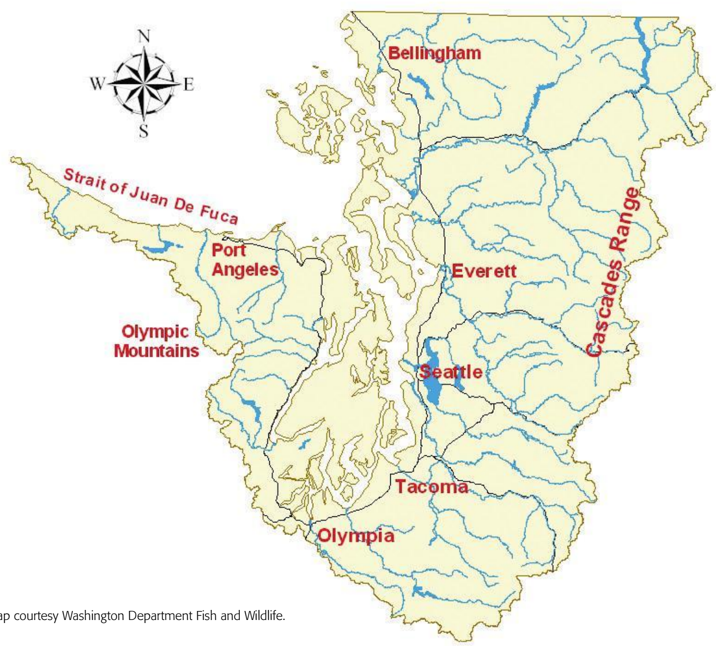
Figure 1.1

their ecosystems for several decades. Part of the concern stems from the evidence that salmon also serve as an indicator of the overall health of the regional ecosystem. They depend on clean, cool and abundant water, cover from their predators, and food sources throughout the rivers, estuaries and coastlines of Puget Sound and the Pacific Ocean. The compelling story of their return to their birthplace after a journey of thousands of miles at sea has been an inspiration to Puget Sound residents of all ages and occupations. The final return of the nutrients from their decomposing bodies completed the gift of the ocean tribe to the plants, animals and trees that dwell on the land.

The Puget Sound Region

Nestled between the Cascade and Olympic mountains in Northwest Washington State, the Puget Sound Basin is the second largest estuary in the United States and covers more than 16,000 square miles. Land constitutes 20 percent of the area, with the remainder consisting of freshwater,

Puget Sound Salmon Recovery Region



Map courtesy Washington Department Fish and Wildlife.

Figure 1.2

estuarine, and marine waters. Over 20 major river systems and their tributary creeks drain mountain elevations of 7,000 feet or more (with Mt. Rainier at twice that height) that drop to sea level within 50 to 70 miles. The upper portions of most Puget Sound rivers flow through natural preserves and working forest lands. As they descend, they meander through agricultural lands, small woodland lots, local parks and small towns, and in some cases, busy city suburbs and urban areas. Extensive glacial and tectonic activities have created a rich and diverse landscape that nurtures some of the most productive habitats in the world. Salmon and bull trout rivers were shaped when glaciers carved a myriad of streams, lakes and valleys, and serve as a bridge between the land and the ocean. Deposits of cobble, silt and volcanic ash provided the parent materials for the distinct structure of today's watersheds, marine shorelines, and protected embayments. From the forested slopes of the Olympic Mountain foothills, the fertile Skagit River floodplain, the rich tidal mudflats of the southern inlets to the rocky shores of the San Juan Islands, the health of Puget Sound depends on these diverse environments.

Although the Puget Sound basin is famous for its rain, two-thirds of the annual precipitation falls during November through March. Salmon and bull trout depend on rivers that are fed by glacial melt, snow and rainfall, and the region relies almost entirely on snowpack during the dry summer months. The Olympic Mountains form a natural barrier to storms coming off the Pacific, and cast a "rainshadow" of dryness in portions of Puget Sound. Annual precipitation in western Washington can vary from 17 to over 100 inches a year depending on location and topography.

Favorable natural features including lush timber resources, protected embayments, and soil-rich river deltas led to the development of agricultural and commercial centers throughout the Puget Sound region. Today, Puget Sound is home to 3.8 million people, two-thirds of the State's population. By 2020, another 1.4 million people are expected to settle around the Sound. Homes, roads, water supply, sewer systems, business, industries and recreational areas will accompany the growth which is fueled by an attractive quality of life and opportunities for employment in high-tech and other industries.

The location of major urban metropolitan areas which are centered around Seattle, Everett, Tacoma and Olympia, create unusual challenges to the protection and restoration of threatened populations of salmon and bull trout that still co-exist in these watersheds.

Puget Sound Salmon and Bull Trout at Risk

Dwindling runs of salmon and bull trout in several river systems in the Pacific Northwest prompted a number of organizations in the 1990s to evaluate the status of these fish throughout the region. Several petitions were filed to the National Marine

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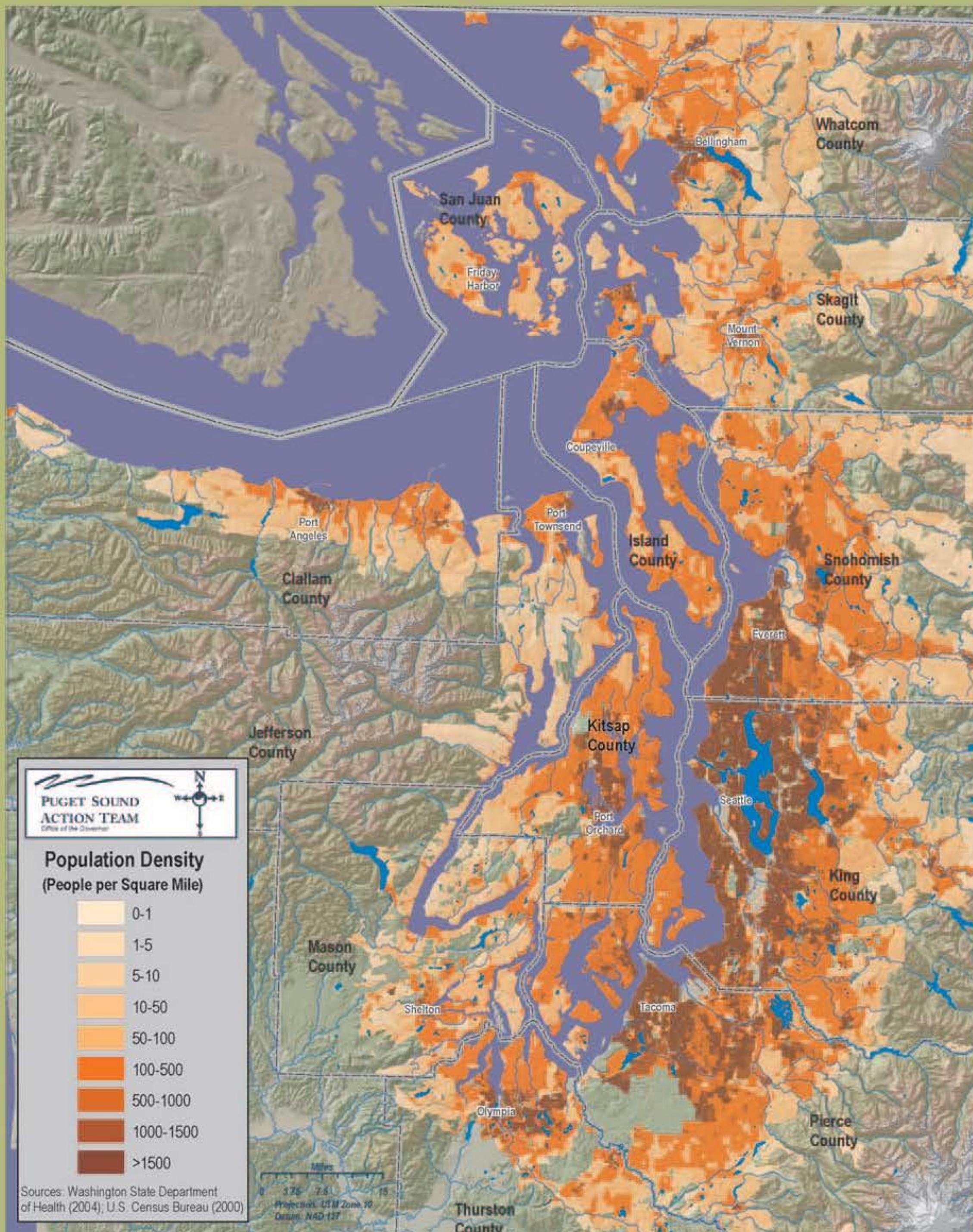
Puget Sound Population Density



Puget Sound Population Density Map courtesy the Puget Sound Action Team.

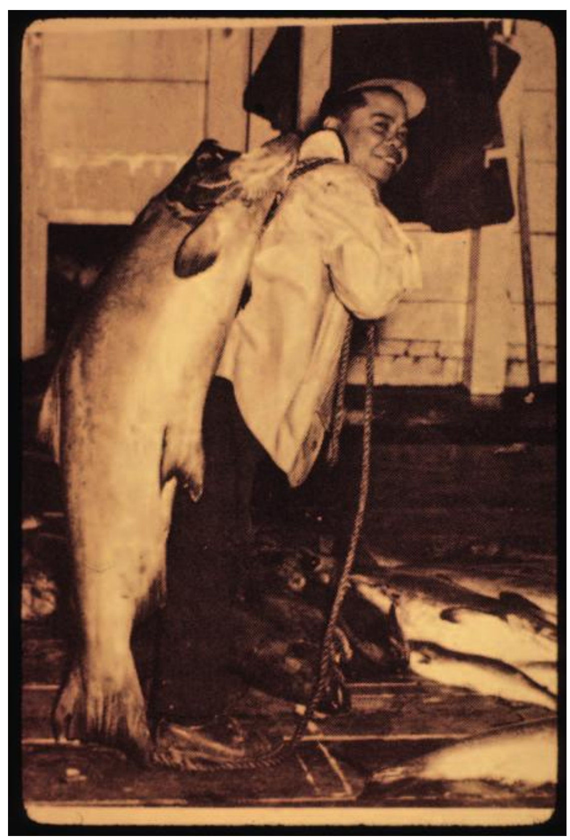
Figure 1.3

Fisheries Service and US Fish and Wildlife Service requesting protection for specific runs of salmon and bull trout under the Endangered Species Act. These petitions complemented the growing concern by the agencies about the overall health of West Coast stocks of Pacific salmon and bull trout. Following a comprehensive technical review, three species in the Puget Sound region were found to be at particular risk and merit additional study and protection under the Act: Puget Sound Chinook, the Hood Canal summer run of chum salmon and Coastal-Puget Sound bull trout.

Chinook Salmon (Oncorhynchus tshawytscha), commonly known as "Kings," were called the "Tyee" or chief by the Indians of the Pacific Northwest. These salmon are the largest of the Pacific salmon species, achieving sizes over 100 lbs in some river systems. The species historically ranged from the Ventura River in California to Point Hope, AK in North America, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia. Chinook salmon exhibit a complex life history as they develop from egg to juvenile and returning adult, which is intertwined with the streams, estuaries and ocean environments they inhabit.

The decline of Puget Sound Chinook salmon has occurred over the past 100 years, but has accelerated rapidly in the last two decades. Historical data indicate that the harvest of Puget Sound Chinook peaked in 1908, with a cannery pack of 95,210 cases of canned Chinook salmon. While the extrapolation of this number to fish population estimates should be viewed cautiously, it corresponds to a figure of 690,000 adult Chinook returning to Puget Sound that year. Naturally-spawning Chinook are well below peak historical levels, with a cumulative run size of 13,000 returning adult fish in North Puget Sound, and approximately 11,000 in South Sound tributaries in the mid-1990s. Most of the remaining natural production of Puget Sound Chinook is concentrated into just two watersheds (Skagit and Snohomish), making them vulnerable to catastrophic events, and many watersheds exhibit less than 100 returning adults. It is believed that 31 different populations of Puget Sound Chinook existed historically, and that nine of these populations have already become extinct (NMFS/BRT, 1997). Although many positive actions have been taken in the region to protect and restore the remaining 22 Chinook populations, the threats facing the Chinook at the various stages of their life cycle were not sufficiently reduced by the late 1990s to provide enough certainty for their long term survival. The National Marine Fisheries Service thus determined that protections and improvements beyond those already underway were needed for Puget Sound Chinook under the Endangered Species Act.

Chum Salmon (Oncorhynchus keta) are known for the striking body coloring and enormous canine-like fangs of spawning males, which led to their nickname as "Dogs." The species has the widest natural geographic and spawning distribution of any Pacific salmonid, primarily due to the extent of its range up along the shores of the Arctic Ocean.


Elwha man with chinook salmon. Photo courtesy Jamestown S'Klallam Tribe.

Chum salmon have been documented to spawn from Korea and Japan around the North Pacific rim as far south as Monterey Bay in California. Chum salmon may have been the most abundant of all salmon, and constituted almost 50 percent of the biomass of all salmonids in the Pacific Ocean prior to the 1940's. Migration to saltwater begins almost immediately after the young chum emerge from their gravel spawning beds, thus the survival and growth of juvenile chum depends highly on favorable estuarine conditions.

Biologists in both Asia and North America have used run-timing differences to divide the species into early (summer) and late (fall) runs. Chum salmon generally return to their natal spawning streams on both continents progressively later in southern areas. Within Hood Canal, sharp differences occur between the summer chum runs, which spawn from early September to late October, and the fall runs which spawn from early November to late December. Information as far back as 1913-14 from the Big Quilcene River in northern Hood Canal specified almost a month's separation between the two runs.

Of the16 historical summer chum populations in Hood Canal and the eastern Strait of Juan de Fuca identified by scientists, seven populations are presumed to be extinct, the status of one population is unknown, and eight streams still have existing runs. The remaining populations have run sizes ranging from less than 10 to 4,500 spawners, but the long term trend indicates that most populations are declining at a rate of six percent a year. State, tribal and volunteer efforts to rebuild summer chum runs appear to be having a positive short-term effect. Despite the strong returns to some streams however, Hood Canal summer chum salmon are still considered to be at risk of extinction, since their long term survival is dependent on changes to hatchery management, harvest management and habitat conditions.

Bull Trout (Salvelinus confluentus) are char native to the Pacific Northwest and western Canada. Although bull trout and Dolly Varden (Salvelinus malma) were once considered to be a single species, they have been formally recognized as separate species by the American Fisheries Society since 1980, based on evidence related to their

Photo courtesy Washington Department Fish & Wildlife.
Adult male chum spawner.

measurements, bone structure and distribution. Historically, bull trout ranged from the McCloud River in northern California and the Jarbidge River in Nevada, to the headwaters of the Yukon River in the Northwest Territories of Canada. They are also dispersed throughout the tributaries of the Columbia River Basin, including headwaters in Montana and Canada, and east of the Continental Divide in Alberta and British Columbia. Various populations of bull trout are observed to be "resident" in freshwater streams or migrate to larger rivers, lakes or saltwater for a portion of their life cycle. The Coastal-Puget Sound segment of bull trout in Washington State is considered to be significant to the species as a whole because it is thought to contain the only forms of bull trout in the coterminous United States that migrate to saltwater for a portion of their life cycle.

In their evaluation of bull trout throughout the Pacific Northwest, the US Fish and Wildlife Service concluded that many individual river basins within the Coastal-Puget Sound region have declining populations of bull trout and are subject to considerable fragmentation. Bull trout are isolated above dams or other diversion structures in seven basins in the Coastal-Puget Sound area. Although several populations of bull trout are largely within national park or wilderness areas, they are threatened by habitat degradation outside of the restricted boundaries, and have been impacted by the introduction of other competing species. The majority of Coastal-Puget Sound basins have an unknown status for bull trout, one population in the lower Skagit River is considered to be strong, and at least 10 core areas are considered to be depressed or at risk. The declining trend of Coastal-Puget Sound bull trout overall, the documented threats to habitat from low flows, migratory barriers, road density and other habitat loss, and the pressure from introduced, non-native species led the USFWS to list Coastal-Puget Sound bull trout as threatened on November 1, 1999.

Photo courtesy the US Fish & Wildlife Service

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Vision and Goals of the Puget Sound Community

"We have an opportunity to do something extraordinary-to save a species from expiring, not only on our watch, but on the watch of our great grandchildren."

King County Executive Ron Sims (Shared Strategy Summit 2005)

The Shared Vision

Across Puget Sound, leaders at all levels aspire to a future in which the Puget Sound region has demonstrated to the world that economic prosperity, more people and a healthy environment can co-exist. The many contributors to this plan hope that fifty years from now, their great-grandchildren will be able to say:

Our elders got it right. They listened to what the salmon were telling them. Anticipating the region's growth, the choices they made in the early 2000's and the hard work that followed, created the vibrant community we share today, where both people and nature thrive and the salmon are once again teeming in our rivers and streams.

Furthermore, the plan's contributors hope that by 2055:

- Puget Sound's fresh and marine waters are healthier for all species.
- Chinook abound in numbers that enable harvest by all and Tribes are once again able to meaningfully exercise the right to catch fish that they reserved in their treaties with the United States government two centuries ago.
- Hatcheries are used only were necessary to supplement and enhance wild fish consistent with best scientific knowledge.
- All the major rivers and many of the smaller streams in each watershed are places where people go to enjoy nature and watch salmon with their kids and grandkids. People stroll, kayak, canoe, boat; enjoying river deltas and estuaries, that have been restored and now burst with wildlife. Young salmon feed in these restored estuaries adjacent to marinas and ports as they prepare for their epic ocean journey. As the young salmon leave their rivers of birth they swim through the protected shallow waters adjacent to the land all the way to the sea.
- The region is friendlier to business than it was fifty years ago. Environmental laws are clear, predictable, effective and efficient. Small and large businesses are growing and easily find skilled workers from their local communities. The prosperity of the regional economy is enhanced by our commitment to a sustainable environment and marketing of eco-friendly products.
- Rural communities have prosperous farms that significantly contribute to the health of the land and water.

People throughout the region are excited and motivated to buy produce grown in harmony with ecosystem needs. Timberlands also are managed to provide renewable wood products and protect restored rivers and streams. There is strong public support to protect working landscapes (such as farms and timberlands) and the region is known internationally for its creative approaches to land stewardship.

- Propelled by the success of saving salmon, the region is addressing even tougher problems like water and alternative energy sources. All of these efforts are characterized by a true partnership between citizens, businesses and governments. As a whole, people take pride in the fact that our region is built on a sustainable economy and healthy natural environment. In short, the region has become a world model for how our ecosystem and economy can both flourish to the benefit of all who share it.

"My grandmother said that the Nisqually Indians taught the settlers to pull pitchforks of dead salmon from Chambers Creek to fertilize their gardens, and that there were so many dead salmon you could smell the creek from a long way away. We will know that we have recovered salmon when we can once again smell them from a mile away."

John Ladenburg,
Pierce County Executive Director

Aspirations for salmon can take a technical, societal, cultural, or even an olfactory form.

Treaty Indian tribes of western Washington have a unique cultural relationship with salmon, and seek to protect their treaty rights to harvest the celebrated fish. Scientists look to preserve the genetic diversity and the ability of salmon to sustain themselves in the long term, and offer technical parameters to assess whether recovery is being attained. Many landowners and businesses have stepped

Photo courtesy the King County Department of Natural Resources.

forward to work in concert with salmon recovery while retaining the economic viability of timber, fishing, recreation and agriculture. Many local governments and citizen groups have worked for many years to restore salmon habitat. All of these groups have been working together in partnership across the Sound to prepare this recovery plan.

One Strategy Shared by Many

The Shared Strategy for Puget Sound is a collaborative initiative built on the foundation of local efforts, supported by leaders from all levels of government and sectors of our communities, and guided by the Puget Sound Technical Recovery Team's regional recovery criteria. The collective, overarching goal of the Shared Strategy salmon recovery plan is:

To recover self-sustaining, harvestable salmon runs in a manner that contributes to the overall health of Puget Sound and its watersheds and allows us to enjoy and use this precious resource in concert with our region's economic vitality and prosperity.

Since many of the actions to recover Chinook are also expected to help bull trout, the Shared Strategy effort is also expected to support US Fish and Wildlife Service's stated goal for bull trout (USFWS, 2004):

To ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the Coastal-Puget Sound Distinct Population Segment, so that the species can be delisted.

Factors for Success

The Puget Sound community has a rich history of success in addressing natural resource challenges, and the people of the Puget Sound region are committed to protect and restore the land and waters that define their quality of life. This commitment will be tested as the region works to address the challenges facing salmon recovery efforts over the next several decades.

It is in part the history of success that helped build the confidence on which several key assumptions of this plan are based. To make the assumptions come true, the plan builds on the legacy of past leadership and relies upon this region's current and future leaders to step up as their predecessors did to make the tough decisions and search for innovative solutions.

The key assumptions are:

More People and More Salmon: Perhaps the most far-reaching assumption of this plan is that this region can accommodate human population growth and recover salmon runs at the same time. Over a million more people are projected to live in Puget Sound in the next 15 years. During this same period, the Recovery Plan aspires to add many more salmon, on the order of a twenty percent increase. Achieving the salmon goals will require protecting existing habitats and building more homes for salmon (habitat restoration) as we build more homes for people. This plan provides the blueprint for how we can accomplish such a Herculean task.

There Still Are Enough Fish and Habitats to Build on For Recovery: Another fundamental assumption of this plan is that the Puget Sound region still has sufficient Chinook populations left to achieve recovery in the long-term. The 22 populations left in Puget Sound represent significant reduction in diversity from the over 30 populations believed to have existed in the past. All remaining populations are important. Some are stable at low levels and others are still in decline. Scientists contributing to this plan believe we must act quickly to protect remaining populations and to restore the productivity of all Puget Sound watersheds and marine waters. While science doesn't have the answers to all the tough questions, there is enough information to act now. Delaying or weakly stepping into implementation will diminish our options and opportunities to achieve recovery.

Science Can Help Us Make Wise Policy Decisions: This plan was developed with a strong partnership between scientists and policy makers at local and regional levels. The intent behind such a partnership is to make the best decisions to achieve a future that supports people and the environment. This plan is based on years of scientific observation, testing of hypotheses, multiple lines of evidence, monitoring and learning. The policy and technical elements in this plan incorporate the best available science to date for salmon recovery. This plan relies upon the continuation of a strong interface between science and policy as new scientific information comes to bear on future policy decisions.

Inclusive, transparent collaborative processes create better and more sustainable results: At the start of the Shared Strategy salmon recovery initiative, participants agreed to a voluntary, collaborative process. They believe that issues as complex as salmon recovery that span urban and rural landscapes, multiple jurisdictions and involve actions affecting many sectors of a community cannot be satisfactorily solved by a single entity or point of view. Collaborative processes have their limitations too, sometimes justly criticized for taking too long and succumbing to the lowest common denominator. However, if done right, they still offer the best opportunity for finding creative solutions that address multiple interests. When people with a stake in the outcome have a say in the decisions, they are more likely to implement them.

"Citizens are turning to these collaborative processes with increased frequency in the West as they realize that in many cases they are the only path out of gridlock...the real virtue of democracy is that it is a school. In it we learn how to manage the public aspects of our lives, and thus, unlike other systems of government, it is progressive-we can actually get better at it as time goes on."

William D. Ruckelshaus
(from Restoring Trust in Government, or Get in the Boat and Row, 1-13-04)

The contributors to this plan believe that the Shared Strategy's collaborative approach and partnership with local communities created a better and more sustainable plan than might otherwise have occurred. The plan's contributors understand that this type of approach will need to continue during the implementation phase to build commitments to action and increase the likelihood of achieving the Puget Sound community's vision and goals

Local Communities are the Essence for Success: A fundamental assumption of this plan is that local watershed efforts are the engine that will lead the region to recovery. This is because many groups had already been working for years before the listing to improve conditions for salmon in their local river basins. Each local watershed area has unique assets in terms of technical ability, partnerships and regulatory frameworks; this plan tailors recovery strategies and actions to the political, cultural, economic, and ecosystem needs of individual watersheds across the Sound. These groups know the most about what is needed and what would work best both technically and politically in their local areas.

Restoration and protection actions will take place largely at the watershed level. Within Puget Sound, fifteen watershed planning areas plus a nearshore group have prepared detailed salmon recovery chapters that are a fundamental part of this plan. The chapters are Volume II of this plan and summary profiles of each can be found in Chapter 6 of this document. Commitments at the local watershed level to implement the steps necessary for recovery in both the short and long-term are essential for success. Although each watershed has its own unique set of circumstances, every watershed contains active and committed government and citizen groups contributing to the salmon recovery process.

This recovery plan provides a scientifically-based, practical and cost-effective guide for restoring and protecting salmon runs across Puget Sound. Through this plan, the people living and working in Puget Sound hope to secure a future with healthy watersheds, plentiful fish, strong communities and a viable economy.

The Shared Strategy Approach to Puget Sound Recovery Planning

"The most impressive thing to me in all this is the degree of cooperation everyone is showing...In the watersheds in Puget Sound where people are listening to one another, trying to understand what the world looks like to their neighbor, whether tribal member, farmer, forest owner, government official, fisherman or just someone concerned about the future of the place where they live and where people are working together to ensure a prosperous future-when all this is happening-it's like magic."

William Ruckelshaus

Existing Efforts to Protect and Restore Salmon and Bull Trout

Federal, tribal, state and local leaders are not new to the salmon crisis. In response to dwindling populations of salmon and a commitment to sustainable fisheries, treaty Indian tribes and Washington State fisheries managers have curtailed the harvest of Puget Sound salmon by as much as 90 percent in the last 20 years. Local governments have made strides to protect salmon through land use, stormwater and growth management authorities. Numerous individual watershed councils and regional fish enhancement groups already had undertaken scientific studies and restoration activities throughout the Sound well before listing occurred. State and tribal co-managers also began tailoring annual and long term harvest and hatchery management plans to be consistent with recovering declining salmon runs prior to listing. Businesses such as hydropower utilities and timber companies prepared licensing agreements and regulatory proposals directed toward improving their practices with respect to salmon.

Although the regulations to conserve a threatened species and prepare a recovery plan are federal responsibilities under the Endangered Species Act, the state of Washington determined the need to take a proactive direction for salmon recovery. In 1998 and 1999, the Washington State Legislature adopted the Salmon Recovery Planning Act, the Salmon Recovery Funding Act, and the Watershed Planning Act to involve local watershed groups in watershed management, and habitat protection and restoration. Governor Gary Locke adopted the 1999 "Statewide Strategy to Recover Salmon: Extinction is Not an Option" and formed the Governor's Salmon Recovery Office (per the Salmon Act) to coordinate and assist in the development of state and regional salmon recovery responses. The legislation also created the Salmon Recovery Funding Board to provide fiscal oversight of salmon recovery efforts in Washington State, and ensure that these actions are scientifically sound and supported by their communities. Despite all of these contributions to salmon recovery at the local and state level, the listing of Puget Sound Chinook and other species affirmed the need for more and better coordinated action to halt the decline and strive for recovery.

Formation of the Shared Strategy for Puget Sound

Puget Sound leaders recognized the need to link the widespread efforts for salmon recovery, and developed a coordinated regional approach. Shortly following the 1999 determination of Puget Sound Chinook as a threatened species, a group of over 150 representatives of federal, state, tribal and local governments and salmon recovery organizations came together at Port Ludlow to shape the "Shared Strategy" for salmon recovery.

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Headed by William Ruckelshaus, the first administrator of the Environmental Protection Agency under President Nixon, Northwest Indian Fisheries Commission Chairman Billy Frank, Jr., and former Washington Governor and U.S. Senator Daniel J. Evans, the Shared Strategy for Puget Sound was formed to, "develop a recovery plan for the Puget Sound region that meets the needs of fish and people."

Knowing that a recovery plan is mandated by the ESA listing, the Shared Strategy effort was motivated, in part, by the desire to have local and regional communities that have been involved in salmon protection and restoration, and that would be responsible for implementing the actions needed to achieve recovery goals, prepare the Puget Sound Salmon Recovery Plan.

More than that, people involved in salmon efforts across the Sound wanted the ability to tailor recovery strategies and actions to the political, cultural, economic and ecosystem needs of individual watersheds across the Sound. They wanted to ensure that the plan would provide for economically viable fisheries, forestry, and agricultural industries. Furthermore, they wanted to place salmon recovery in the context of contributing to overall ecological benefits for other species and the marine environment. Thus the Shared Strategy process was designed to meld ESA requirements with locally-driven recovery efforts and a vision for the future of the region.

The federal agencies responsible for administering the Endangered Species Act (NOAA and USFWS) agreed to support this effort and have been active participants in the Shared Strategy process from the beginning.

Watershed and Salmon Recovery Planning Areas

The Shared Strategy is based on the conviction that people in Puget Sound have the creativity, knowledge and resources to find lasting solutions to complex ecological, economic and community challenges. Watershed groups that represent diverse communities are considered to be essential to the success of salmon recovery.

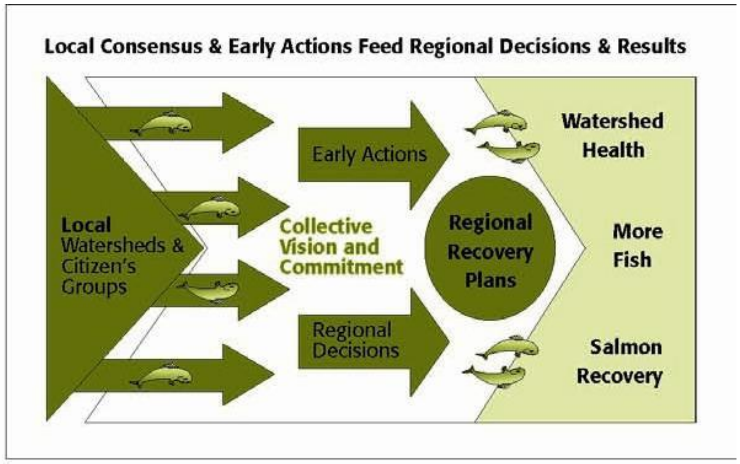

Figure 1.4

For administrative and water resource planning purposes, the Washington Department of Ecology has divided the State of Washington into a number of Water Resource Inventory Areas (WRIA's) based on watershed/topographic boundaries rather than political units. Most salmon recovery planning groups are roughly organized along these lines as well. Considerable variety exists among the fourteen watershed planning areas such as urban and rural differences, precipitation, water quality and quantity, shoreline development, and topographic characteristics, but each of the areas contains committed groups working on salmon recovery. It is the goal of participants in the Shared Strategy process to protect and restore these fourteen major watershed areas, and in combination with cross-watershed actions, have them cumulatively add up to regional recovery.

Functions of the Shared Strategy Organization

Shared Strategy leaders believe that effective stewardship occurs only when all levels of government coordinate their efforts in support of activities at the appropriate local or regional scale to protect and restore salmon runs. The preparation of the recovery plan has had the close involvement of federal, state, tribal and local governments along with watershed groups to develop technically sound solutions that communities can embrace. (See chart of roles and responsibilities below.) Three functions of the regional organization were identified for the Shared Strategy at the onset of the preparation of the recovery plan, and have helped to guide the recovery planning process throughout.

1. Link existing federal, state, and tribal programs at the regional level.

Preparation of a regional strategy and future implementation of the recovery plan depends on the integration of recovery efforts between governments throughout the Puget Sound region. The close communication of efforts such as hatchery reform, water quantity planning, growth management and salmon restoration has enabled the participants to take advantage of common data bases, assessment tools, and share strategic concepts, and is intended to avoid duplication of effort as the recovery plan is implemented.

2. Build the participation, capacity and commitment of watershed groups and local jurisdictions to plan and implement salmon recovery.

One of the primary assumptions of the Shared Strategy has been that the efforts of people in the watersheds across Puget Sound are the fundamental building blocks for a recovery plan and its successful implementation, and that participation from every watershed is necessary to achieve recovery. Watershed residents are most directly aware of the conditions in their river systems and shorelines, and are being asked for commitments to carry out the recovery actions.

3. Provide coordination to the regional effort to prepare and facilitate decisions to implement the plan.

The third function of the Shared Strategy organization has been to provide a forum for the region as it moves through plan preparation toward implementation, ensuring that appropriate scientific technical information is melded with community participation and policy judgments. Scientists from federal, state, tribal and local governments participated on a Technical Recovery Team appointed by NOAA, and met with regional policy-makers and community watershed groups throughout the planning process. Additionally, regional administrators from NOAA and representatives from the Governor's Salmon Recovery Office participated consistently at regional forums and provided outreach and assistance to community groups throughout plan development.

Steps in the Preparation of the Regional Plan

In 2002, the Shared Strategy Development Committee identified five main steps to build the information base and technical and policy decision making processes for preparing the Puget Sound Salmon Recovery Plan.

Step 1. Determine recovery plan content and assess current efforts.

Efforts to outline the essential elements of the plan occurred in consultation with the National Marine Fisheries Service, US Fish and Wildlife Service, State of Washington, Puget Sound tribes, local governments, watershed councils and marine resource groups. The Puget Sound Technical Recovery Team (PSTRT) prepared guidelines for watershed groups outlining the technical information they felt would be required to determine whether the salmon populations could achieve recovery (PSTRT, 2003). The Washington Department of Fish and Wildlife (WDFW) prepared a broader outline for a Salmon Recovery Plan which incorporated elements from state watershed planning legislation and the Northwest Power Planning Council guidelines.

While the WDFW originally intended the outline to meet the requirements of the regional recovery plan required under the ESA, it became clear early in the process that planning guidance was most needed at the watershed level. Accordingly, the final Salmon Recovery Plan Outline (WDFW, 2003) contained a detailed list of technical and policy questions for watershed groups to consider during plan preparation. The WDFW version of the plan outline was approved by the regional director of NMFS in a letter on January 22, 2004. The

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Shared Strategy for Puget Sound
Roles and Responsibilities During Recovery Plan Preparation

- **Watershed Groups/Local Governments:** Groups such as watershed councils, regional fish enhancement groups, lead entities for salmon recovery, watershed planning units and other community resource groups have been involved in preparing recovery plans for their watersheds. Local and tribal governments have helped coordinate these efforts and provided substantial technical assistance. Key functions have been to assess historic, current and potential future conditions of fish and watershed resources, identify and prioritize protection and restoration actions, and prepare timelines and cost estimates.

- **Puget Sound Technical Recovery Team (PSTRT):** Appointed by NOAA, this panel of 7 scientific experts from federal, state, local and tribal organizations has developed the scientific framework and ESU recovery criteria at the regional level; developed planning ranges for Chinook populations; and has provided technical guidance to watershed and regional groups in preparing watershed recovery chapters and regional elements of the plan.

- **State and Tribal Co-Managers:** Puget Sound tribes and the Washington Department of Fish and Wildlife have been actively involved in the preparation of comprehensive harvest management plans and hatchery genetic management plans for listed species across the region; worked toward the integration of habitat, harvest and hatchery considerations in the watershed and regional level chapters of the recovery plan; participated in habitat restoration activities, and developed recovery target numbers for Chinook salmon.

- **Shared Strategy Development Committee:** This successor group to the leaders who formed the Shared Strategy for Puget Sound in 1999 have provided overall direction for the Shared Strategy approach to recovery planning, resolved policy issues, and have served as ambassadors to constituent groups, local government, watershed groups, legislators and Congress. Comprised of community leaders and representatives from federal, state, tribal and local governments, as well as business, agricultural and environmental groups, these individuals bring different perspectives to the table for discussion in the recovery planning process.

- **Shared Strategy Work Group (agency policy staff) and regional staff:** Staff activities have focused on the organization's objectives to provide outreach and support to watershed groups, link various recovery activities, and provide the policy analysis, strategy advice and logistical support necessary for plan preparation.

collaborating agencies extended considerable support to the local watersheds during plan development.

Step 2. Determine regional recovery criteria and targets and ranges for each watershed.

The guidelines for recovery plans under the Endangered Species Act require the preparation of quantifiable recovery goals for the species listed, as a benchmark in measuring the progress toward recovery. Regional recovery guidelines and planning ranges for Puget Sound Chinook populations were developed by the Technical Recovery Team (PSTRT, 2002). Planning targets for Chinook were prepared by state and tribal co-managers using a variety of computer models. Watershed planning groups used this information to prepare their local recovery chapters. Goals for Hood Canal summer chum and bull trout have been developed by federal, state and tribal biologists working on these species.

Step 3. Develop local watershed recovery chapters.

At the start of the Shared Strategy initiative local watershed planning groups had the opportunity to voluntarily join the regional effort and have their local recovery plans incorporated into the Puget Sound-wide plan. In the end, all fourteen planning areas agreed to participate. To meet ESA recovery plan requirements, they were asked to prepare chapters to identify the threats to salmon survival and specify restoration and protection strategies and actions addressing the factors for decline. Following PSTRT guidance, the planners developed working scientific hypotheses to relate watershed conditions to their effects on the species, and prepared detailed action plans with timelines, costs and in some cases a beginning set of commitments for implementation. Local and regional agencies and state and tribal fisheries co-managers were also requested to integrate habitat, harvest and hatchery actions affecting listed species in each watershed area.

Individual draft watershed chapters were submitted to the PSTRT, the Shared Strategy Work Group and staff by watershed planning groups on June 30, 2004. An extensive technical and policy review process occurred from July 2004 to September 2004. Watershed planners revised their chapters according to the feedback received during the review to the extent possible given the various states of knowledge and political support in their respective areas. They submitted updated chapters for inclusion in the regional plan in April and May, 2005.

In May 2005, the PSTRT and an interagency policy committee facilitated by the Shared Strategy staff conducted another round of technical and policy reviews of watershed chapters. The PSTRT reviewed the plans from a technical perspective to determine the degree of certainty that they can achieve their stated recovery goals. Together the PSTRT and policy team looked at how well the plans met ESA recovery plan requirements. The analysis from the review was used to summarize strengths and significant proposals as well as decisions underway, possible gaps and recommend ways to close the gaps to increase the certainty of success and meet ESA plan requirements.

Individual watershed plans are summarized in profiles in Chapter 5. The results from the review are also included at the end of each watershed profile.

Step 4. Build regional strategies and commitments.

In addition to the individual watershed chapters (Volume II of this plan), Shared Strategy participants identified a number of cross-watershed issues that will need to be addressed at the regional, state and federal levels in addition to the individual watershed level. These include water resource issues (water quality and water quantity), forestry and agricultural programs, habitat protection measures and tools (voluntary and regulatory), nearshore-marine protection and restoration strategies, a financing strategy and implementation functions.

Initial ideas for how to approach these topics were presented at the 2005 Shared Strategy Summit attended by over five hundred people representing the diversity of interests related to salmon recovery. Summit participants provided input on how to advance these approaches. Following the Summit, groups with members having policy or scientific expertise and an interest in the topics further refined them.

The May 2005 review also assessed the degree of certainty that the combined local and regional elements in this plan can meet the PSTRT regional recovery criteria and meet ESA recovery plan requirements. Some of the same cross-watershed issues listed above emerged as needing more focus and attention to increase the certainty of achieving plan outcomes and contributing to overall ESU-scale recovery. (It is the Puget Sound Evolutionarily Significant Unit or ESU that is listed as threatened under the Endangered Species Act and not the individual Chinook populations.) The review conclusions and recommendations were used to complete the plan, including identifying strategies for closing identified gaps and ensuring that the plan meets ESA plan requirements under section 4(f).

Issues that are common to multiple watersheds as identified during the 2005 review by the Puget Sound Technical Recovery Team as well as those requiring attention and action by other levels of government are described in Chapter 6: Regional Strategies, in Chapter 7: Adaptive Management and Monitoring and in Chapter 9: Financing Strategy.

Step 5. Finalize and submit the regional plan.

The objective of Step 5 was to finalize recovery strategies and actions for Puget Sound that are consistent with the requirements of the Endangered Species Act, treaty rights, and the goals and objectives of state and local governments and watershed planning groups. The May 2005 review process "rolled up" the various watershed chapters and regional elements to assess how the combined parts of this plan add up to meet the PSTRT recovery criteria. These roll-up conclusions can be found in *Chapter 5: How Does It All Add Up Into One Plan? Regional Results.*

The Shared Strategy Development Committee received a briefing on the watershed and regional plan elements and the May 2005 review conclusions and recommendations. They proudly agreed to submit the Draft Puget Sound Salmon Recovery Plan to the federal agencies (NOAA and USFWS) on schedule on June 30, 2005. The attached transmittal letter describes the conditions of the submittal.

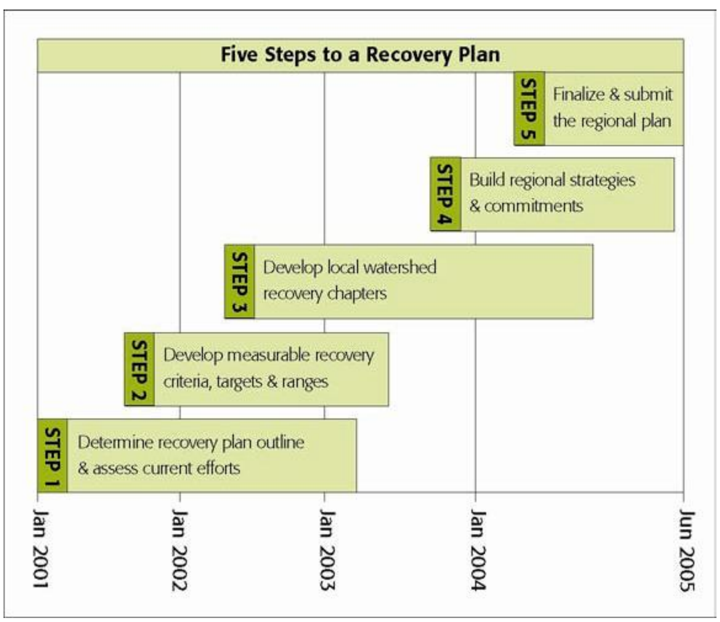

Figure 1.5

The Draft Puget Sound Salmon Recovery Plan

Under the Endangered Species Act (ESA), a recovery plan must have quantitative recovery criteria and goals, identify threats to survival, site specific management strategies and actions necessary to address the threats, cost estimates of the actions and a schedule for implementation. A monitoring and adaptive management program should also be included. The May 2005 review process concluded that this draft plan meets the ESA recovery plan requirements under section 4(f).

As the vision and goals section points out, Shared Strategy participants aspire to more than the minimum requirements of the ESA. They wish to create a future in which both people and salmon co-exist and thrive. They know that salmon recovery is a long-term prospect. Achieving recovery involves coordinating and integrating many parts such as harvest and hatchery management and habitat restoration and protection. Many people and organizations need to work together in a coordinated way over time to succeed. Meanwhile, scientists must continue to research and learn more about salmon and their needs and the ecosystems which they share with other species, including humans. In the future, new opportunities may open up for adding to recovery actions that may not be available or apparent today. All this is to say that salmon recovery has to be viewed as a dynamic and evolving initiative.

The plan lays out long-term recovery goals and strategies, but its primary focus is on the next ten years of actions to place this region on a path toward recovery. This is because its ultimate success depends upon the various authorities and responsible parties stepping up to commit to implement the strategies and actions described in the plan. A ten-year timeframe

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is a reasonable period of time to ask for commitments and begin to see progress and results. Shared Strategy leaders are committed to continue to build the needed commitments throughout the rest of 2005 and beyond to implement the first ten year's of actions. Shared Strategy participants hope that the first ten years will put the region on a solid recovery path and demonstrate to future leaders and decision-makers in years eleven and beyond that they should continue to support recovery activities.

This recovery plan recognizes the dynamic and evolving nature of salmon recovery. It should be read and understood as a living document. Strategies and actions in this plan will make significant progress in the next ten years to benefit all of the remaining 22 populations of Chinook. While this plan will improve conditions for the salmon and meets the ESA recovery plan requirements, it does not claim to have all the answers nor to solve all the chronic problems and threats affecting the species. It does however, identify the threats and issues needing to be addressed, identifies at least preliminary approaches for dealing with them and has a schedule for making progress on those issues for which there are no easy answers. It also lays out the framework for a monitoring and adaptive management program with details to be developed through the summer and fall of 2005 in time for the federal register notice and public review process.

Shared Strategy participants believe that this plan, if implemented, will put the region on a significant path toward recovery of the species in the next ten years. Through the on-going efforts described in the above paragraphs, Shared strategy participants also believe that these first ten years of actions will position the region to build long-term support for salmon recovery.

What happens next after submittal?

Following the submission of this document by the Shared Strategy to the National Marine Fisheries Service and the US Fish and Wildlife Service, the Services will conduct a review of the document and initiate a comprehensive public review process. Final adoption is expected in late December 2005.

Benefits of Salmon Recovery for Biodiversity and Ecosystem Health

Introduction

The Puget Sound ecosystem encompasses a wide range of freshwater, marine, and terrestrial environments that sustain a diverse array of species. The Shared Strategy process has resulted in a series of recommendations to help protect three of our region's species that are listed under the Endangered Species Act-the Puget Sound Chinook salmon, Hood Canal summer chum salmon, and bull trout. During this same period, The Nature Conservancy, the Washington Department of Fish and Wildlife, and others, completed an extensive eco-regional assessment for an area known as the Willamette Valley-Puget Trough-Georgia Basin (WPG) eco-region, which includes a portion of the Puget Sound ESU (Floberg et al., 2004). This mutual effort provides an opportunity to qualitatively assess the benefits of the Salmon Recovery Plan for overall biodiversity of the region.

The WPG Eco-regional Assessment is a comprehensive conservation analysis of the region's terrestrial, nearshore, marine, and freshwater biodiversity. Relying on the best available biological information as well as information on human impacts, the assessment quantifies the biodiversity of the region and identifies which geographic areas are most important for the conservation of existing biodiversity. As a result, in those areas where they overlap, the WPG assessment complements the recovery plan's salmon habitat assessments.


Photo by Dan Kowalski.

The eco-regional assessment found that relative to its size, the Willamette Valley-Puget Trough-Georgia Basin eco-region has a large number of species that are imperiled,

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declining, or of conservation concern. There are also a number of nearshore, terrestrial, and freshwater ecological systems that are at risk. In the Georgia Basin-Puget Trough portion of the eco-region, the assessment identified over 250 species targets that are imperiled, declining, or of conservation concern (Floberg et al., 2004). These findings point to some troubling trends in the overall health of this ecosystem.

The Puget Sound salmon recovery plan will be implemented within the context of this complex ecosystem. The plan proposes a wide range of recovery actions that will be implemented throughout the Puget Sound basin-from nearshore areas to the upper reaches of the watersheds. While the recovery plan is necessarily focused on listed salmon species, it is logical to also ask the question, "In what ways will the recovery plan benefit the overall health of the ecosystem and the breadth of biodiversity in the region?" This section of the plan explores that question and discusses ways in which recovery actions may benefit other species as well as the overall health of the Puget Sound ecosystem.


Photo courtesy the Dungeness River Management Team

Role of salmon in Puget Sound watershed ecosystems

Over the past few decades, there has been a growing consensus in the scientific community about the crucial role that salmon play in supporting and maintaining ecosystem health. It has become clear that many ecological processes of our watersheds (including those that shape the land, control water flow and content, and govern biological activity) have evolved with and depend on salmon.

Because of their important role in supporting the ecosystem, salmon have been identified as a "keystone species" (see Willson and Halupka, 1995). A keystone species is a species whose impact on a biological community or ecological system is disproportionately large compared with their abundance. Keystone species contribute to ecosystem function in a unique and significant manner through their regular activities. Removal (or decline) of these species can cause fundamental changes in the ecological system.

To illustrate the importance of salmon in Northwest ecosystems, it is useful to consider the role that salmon play in: 1) cycling of nutrients in watersheds; and 2) ecological/wildlife interactions.

Nutrient cycling

Research shows that salmon populations are critical in transferring energy and nutrients inland from the Pacific Ocean to aquatic and terrestrial ecosystems. Spawning salmon provide a source of carbon, nitrogen, and phosphorous that is essential to maintaining the production of juvenile salmon and other animals in the watershed's food web. Riparian forests, which are important habitat to many wildlife species, benefit directly from the nutrients that salmon provide (Mathewson et al., 2003).

Through this nutrient cycling function, anadromous salmon play a key role in maintaining an ecosystem's productivity (Cederholm et al., 2000). For example, introduction of salmon carcasses in

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Photo by Dan Kowalski.

a stream has been shown to increase the density of certain macroinvertebrates. Macroinvertebrates feed on adult salmon carcasses and then are in turn eaten by juvenile salmon, providing an important food source that supports the growth and survival of salmon in the early stages of their life cycle (Cederholm et al., 2000).

A recent study found, however, that due to declining salmon runs, the rivers of Puget Sound, the Washington coast, and the Columbia River are receiving only 3% of the marine-derived organic matter that was once delivered to those rivers by anadromous salmon (Gresh et al., 2000).

Ecological relationships-salmon/wildlife interactions

A growing body of research shows the important interplay between salmon and other wildlife populations. The various life stages of salmon (i.e., eggs, fry, smolts, adults, and carcasses) all provide direct or indirect foraging opportunities for a variety of terrestrial, freshwater, and marine wildlife (Cederholm et al., 2000).

Anadromous fish (including their eggs) are a major source of high-energy food that allows for successful reproduction and enhanced survival of adults and juveniles of many wildlife species. They also provide support for long-distance migrant birds (Cederholm et al., 2000). For example, the Skagit River system, which has the highest populations of all five salmon species in Puget Sound, is a critically important winter feeding area for migrating bald eagles. As many as 580 bald eagles have been observed in the Skagit River watershed in recent winters feeding on the carcasses of spawning chum, pink and other salmon species.

Johnson et al. (in prep.) examined the relationship between salmon and 605 species of wildlife in Oregon and Washington. The study found 137 species of birds, mammals, amphibians and reptiles that are predators or scavengers of salmon at one or more stages of the salmon life cycle. Of this total, nine species were found to have strong-consistent relationship with salmon. These include the bald eagle, American black bear, Caspian tern, common merganser, grizzly bear, harlequin duck, killer whale, osprey, and river otter. Fifty-eight species were found to have a recurrent relationship with salmon.

Johnson et al. (in prep.) also showed how these nine species with a strong-consistent relationship with salmon are found in many different habitat types. These nine species not only inhabit freshwater and marine habitats, but also occur across a range of inland forest, woodland, shrubland, and grassland habitats. In this way, salmon support ecological functions that extend beyond just salmon-inhabited aquatic systems.

Cederholm et al. (2000) concluded that the loss or severe depletion of anadromous fish stocks could have major effects on the population biology (i.e., age class, longevity, dispersal ability) of many species of wildlife, and thus on the overall health and functioning of natural communities over much of the region. Conversely, as the health of salmon populations improves, one would expect to see improvements in populations of many of the associated wildlife species as well.

How the recovery plan supports biodiversity and ecosystem health

Given the important role that salmon play, how will the recovery plan support the region's biodiversity and the overall health of the ecosystem?

Watershed-level analysis

First, it is important that the recovery plan is built around watershed-level analysis.

Watersheds are also an appropriate scale for evaluating freshwater ecosystem conservation needs, since freshwater organisms depend on the health and integrated processes of the contributing watershed. Around the world, freshwater-dependent animals, such as mussels, crayfishes, stoneflies, amphibians, and fish, are the species most vulnerable to extinction (Stein et al., 2000). It is estimated that the rate of extinction for freshwater species is five times greater than the rate for terrestrial species (Ricciardi and Rasmussen, 1999). As more and more public and private conservation efforts are focused on freshwater systems, it will be extremely helpful to make linkages between freshwater and salmon conservation planning efforts.

The Willamette Valley-Puget Trough-Georgia Basin Eco-regional Assessment, which did not explicitly analyze salmon habitat, identified a pressing need to integrate salmon-related data into its analysis in order to develop a more comprehensive and coordinated approach to identifying areas of significance for freshwater biodiversity. Subsequent freshwater assessments conducted by The Nature Conservancy have incorporated salmon and have been conducted in a watershed context. The recovery plan's watershed-level of analysis will help facilitate further linkages between salmon recovery planning and freshwater biodiversity planning.

Ecological functions and processes

The recommendations in the recovery plan, if carried out, offer another significant benefit to biological diversity: a focus on the need to maintain and restore ecological processes and services. Maintaining instream flows, restoring riparian habitat and estuarine habitat, removing fish passage barriers, opening up off-channel and floodplain habitat, reducing sediment loading-all of these actions will help restore ecological processes that are essential to freshwater, terrestrial, and marine species and systems.

One aspect of restoring natural processes to watersheds is allowing for some level of natural disturbance (i.e., flooding, landslides, etc). Recovery actions which allow for a greater degree of natural disturbance within watersheds should result in more diverse habitat types which, in turn, will help support a higher diversity of plant and animal species.

Recovery actions will also help restore biological integrity to Puget Sound watersheds. Watersheds with a high degree of biological integrity have the ability to support and maintain a balanced, integrated and adaptive assemblage of organisms

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having species composition, diversity, and functional organization comparable to that of natural habitat of the region (Karr and Dudley, 1981).

Habitat restoration

Salmon occupy a variety of habitats during their life cycle. The recovery plan addresses the limiting factors for salmon recovery for each of these life cycle stages and habitat types. Given the diversity of habitats that salmon require, recovery actions should benefit a broad array of species that rely on these diverse habitats.

Restoration actions in riparian areas will be especially helpful to other species. Research shows that 393 of 456 (86%) of the common terrestrial, and freshwater wildlife species in Oregon and Washington use riparian areas, wetlands, and streams during some season or part of their life cycle. Of these 393 species, 110 were found to be closely associated with riparian habitat types (Johnson et al., in prep.).

In particular, mainstem channels are essential components of biodiversity and have a high degree of species richness. Some listed species-Chinook salmon in particular-are mainstem dependent. Because the development footprint is most intense around mainstem rivers in Puget Sound, recovery actions that improve mainstem conditions will benefit many other species as well.

A number of the watershed plans have identified estuary protection and restoration as high priorities. Estuaries are highly productive nurseries, supporting juvenile fish, shellfish, and large numbers of migrating birds. The region has lost over 70% of its estuarine habitat to diking, filling, and dredging. Restoring estuarine habitats will result in significant benefits to a wide range of species. Many of the 40 Puget Sound species that are listed as threatened or endangered rely on nearshore and estuary habitat for at least part of their life cycle.

Nutrient dynamics

As recovery actions are implemented, there is a significant potential to enhance the flow of energy and nutrients into freshwater and estuarine food webs. If salmon populations are recovered to viable populations, one should expect a positive, and in some cases very significant, impact on nutrient dynamics in Puget Sound watersheds. Restoration of healthy nutrient dynamics will have ripple effects throughout the ecosystem, benefiting a variety of other species.

For example, Munn et al. (1999) considered changes in nutrient loading, cycling, and ecosystem productivity that could result from restoration of historic salmonid populations to the Elwha River system if the river's two dams are removed. The study indicates a potential 65-fold increase in nitrogen and phosphorous loadings from salmon returns. They concluded that restoration of the Elwha River system salmon runs would have a profound effect on the productivity of the ecosystem.

Wildlife interactions

Restoring viable populations of listed salmon stocks will result in additional fish spawning and rearing in the various watersheds. Additional numbers of fish will directly benefit the 67 wildlife species discussed above that have either strong-consistent or recurrent relationships to salmon (Johnson, in prep.).

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Conclusion

Local watersheds have identified a range of actions that will contribute to the recovery of listed salmon stocks. These actions will have a direct and demonstrable effect on salmon habitat, but they will also help restore and improve a range of habitats, species, and ecosystem processes. Although the recovery plan is salmon-focused, the proposed actions will benefit many native species and natural communities. Over time, these actions should improve the overall health of the Puget Sound ecosystem.

In order to maximize the salmon-biodiversity benefits described above, local watersheds should be encouraged to evaluate salmon recovery priorities along with the biodiversity conservation priorities identified in the Willamette Valley-Puget Trough-Georgia Basin (WPG) eco-regional assessment. This assessment provides useful information to determine how areas identified as priorities for salmon would contribute to the larger biodiversity of the region. In many cases, protection of top-priority biodiversity sites may also benefit salmon stocks. By integrating salmon conservation priorities with the multi-species assessment in the WPG report, it may be possible to leverage recovery actions to achieve even greater benefits for the biodiversity of the region.

Endangered Species Act Listing and Related Mandates

"The purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate...."

The Endangered Species Act of 1973

In 1994, following several petitions to list West Coast Salmon and Steelhead as threatened or endangered under the Endangered Species Act, the National Marine Fisheries Service (NMFS) convened Biological Review Teams to undertake comprehensive scientific reviews of Chinook, coho, chum, sockeye and pink salmon, as well as steelhead and cutthroat trout in Washington, Oregon, California and Idaho. These status reviews were used to identify "evolutionarily significant units" (ESUs) of salmon and steelhead, and to evaluate whether any of the identified ESUs should be listed as threatened or endangered (see definitions). Petitions to list bull trout as an endangered species were submitted to the U.S. Fish and Wildlife Service (USFWS) in 1992, including the "distinct population segment" of Coastal/Puget Sound bull trout.

In the Puget Sound region, the NMFS Biological Review Teams determined that two ESUs are sufficiently at risk to be classified as "threatened species", i.e. Puget Sound Chinook and the Hood Canal summer run of chum salmon. Coho salmon in the Puget Sound/ Strait of Georgia ESU were considered a "species of concern" but actual listing under the Act was not considered to be warranted at this time. In 1999, bull trout recovery teams convened by the USFWS determined that listing of bull trout as "threatened" throughout its range in the coterminous United Stated was needed.

Listing History for Puget Sound Chinook

West Coast Chinook salmon have been the subject of numerous Federal Endangered Species petitions for listing beginning with an action to list the Sacramento River winter-run Chinook, which was filed by the American Fisheries Society in 1985. Following several more actions and petitions related to the Sacramento River, Snake River and Columbia River, the National Marine Fisheries Service was petitioned by the Professional Resources Organization-Salmon (PRO-Salmon) on March 14, 1994 to list various populations of Chinook in Washington State. On September 12, 1994, NMFS indicated that the PRO-Salmon

Status Reviews under the Endangered Species Act

NMFS follows three steps in making listing determinations:

1. NMFS determines whether a population or group of populations constitutes an Evolutionarily Significant Unit; i.e. should be considered as a "species".
2. NMFS determines the biological status of the ESU and the factors that have led to its decline.
3. NMFS assesses efforts being made to protect the ESU and determines whether, in light of those efforts, the statutory listing criteria are satisfied.

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petition contained substantial information that action may be warranted, and announced that it would commence a coast-wide status review of all West Coast Chinook salmon.

A Biological Review Team (BRT) comprised of scientists from the NMFS Northwest, Southwest, and Auke Bay Fisheries Science Centers, and the National Biological Survey completed a coast-wide review in December, 1997, which was updated in 2003 (NMFS/BRT, 1997 and 2003). The Team concluded that West Coast Chinook salmon were grouped into 17 Evolutionarily Significant Units based on genetic data, differences in where the salmon migrate, age at which the Chinook mature, run timing, and geographic and environmental characteristics. Of these 17 Chinook salmon ESUs, eight did not warrant listing under the Endangered Species Act, seven were considered to be threatened (including the Puget Sound ESU) and two are listed as endangered.

A proposed rule for the listing of Puget Sound Chinook and three other Chinook ESUs as threatened was published in the Federal Register on March 9, 1998, and a Final Determination was issued on March 24, 1999. A chronology of the major listing notices and related actions is located at the end of this section. During the year between the proposed rule and the final determination, NMFS conducted 21 public hearings within the range of the proposed Chinook salmon ESUs in California, Oregon, Washington and Idaho. A summary of the comments on the proposed rule and the NMFS response is included in the Final Determination (Federal Register; March 24, 1999).

In the years following the 1998-1999 rule process, additional scientific information on the status of Chinook populations and legal proceedings related to the determination of hatchery-produced fish necessitated an update to the rules listing Puget Sound Chinook and other threatened ESUs. NMFS issued a proposed rule to list these ESUs on June 14, 2004.

Listing History for Hood Canal Summer Chum and the Chum Status Review

Listing for Hood Canal summer chum closely corresponded to the process for Puget Sound Chinook. The 1994 petition filed by PRO-Salmon included

Some Definitions Used under the Endangered Species Act

For purposes of the Endangered Species Act, a **"species"** is defined to include "any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."

Distinct Population Segment: A population is considered distinct (and hence a "species" for purposes of conservation under the Act) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species' range.

The National Marine Fisheries Service uses the term **"Evolutionarily Significant Unit" (ESU)** to describe a distinct population segment of Pacific salmon that:

1. is reproductively isolated and
2. represents an important component in the evolutionary legacy of the species.

To evaluate these criteria, scientists look at the following questions:

- Is the population genetically distinct?
- Does the population occupy unique habitat?
- Does the population show unique adaptation to its environment?
- If the population became extinct, would this event represent a significant loss to the ecological/genetic diversity of the species?

The term **"endangered species"** means any species or distinct population segment which is in danger of extinction throughout all or a significant portion of its range.

The term **"threatened species"** means any species or distinct population segment which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

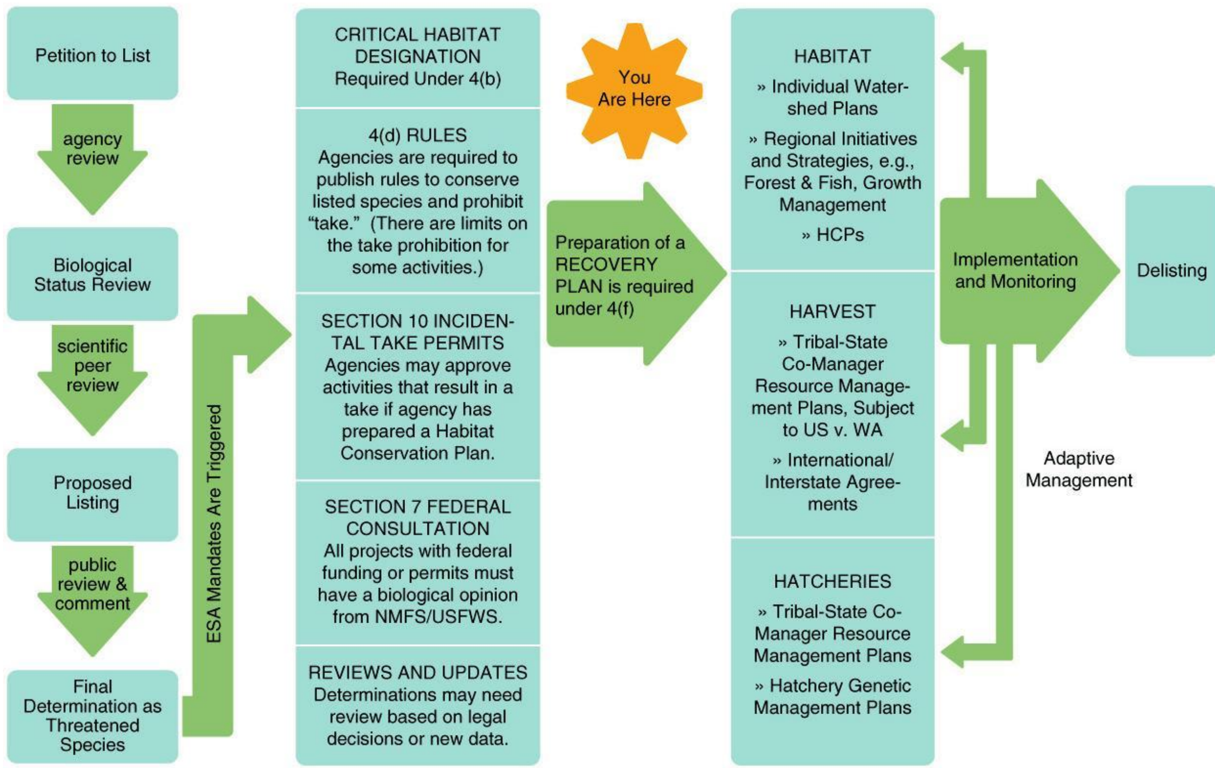

FIgure 1.6 A simplified overview of the ESA listing process for Puget Sound Chinook, and Coastal/Puget Sound Bull Trout.

Hood Canal summer chum, and a status review for all West Coast chum salmon was initiated September 12, 1994. A total of four evolutionarily significant units (ESUs) were identified by the Chum Biological Review Team in 1997, of which the Hood Canal summer chum and the Columbia River chum ESUs were considered to be at risk of becoming endangered. The declining trend of Hood Canal summer chum and extremely low run sizes in several streams were cited as reasons for the proposed listing, which was issued on March 10, 1998. A final determination to list Hood Canal summer chum as threatened was published in the Federal Register on March 25, 1999. Hood Canal summer chum were also included in the proposed rule to list several West Coast ESUs on June 14, 2004, which constituted an update of previous listings.

Listing for Coastal/Puget Sound Bull Trout

Bull trout fall under the jurisdiction of the U. S. Fish and Wildlife Service (USFWS), and have followed a slightly different pathway and timeline for the listing process. On October 30, 1992, the USFWS received a petition to list bull trout as an endangered species throughout its range from the Friends of the Wild Swan, Alliance for the Wild Rockies, and the Swan View Coalition. The USFWS published a determination in 1993 that the petitioners had provided substantial information indicating that listing may be warranted but that it was precluded by other higher priority work. A number of legal challenges to this finding ensued, and on December 4, 1997 the Oregon Federal District Court ordered the USFWS to determine whether listing of the Coastal-Puget Sound distinct population segment was warranted, among other actions. The Coastal-Puget Sound bull trout are one of the five distinct population segments which collectively encompass the entire range of the species in the coterminous United States. Bull trout recovery teams were convened by USFWS in early 1999, and a final rule was published on November 1,

Critical Habitat

"Critical Habitat" is defined in the Endangered Species Act as, "the specific areas within the geographical area occupied by the species… on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection." Essential features of critical habitat include adequate

- Substrate
- Water quality
- Water quantity
- Water temperature
- Water velocity
- Cover/shelter
- Food
- Riparian vegetation
- Space
- Safe passage conditions

Freshwater and estuarine habitat includes riparian areas that provide the following functions: shade, sediment transport, nutrient/chemical regulation, streambank stability, and input of large woody debris or organic matter.

1999 to list all bull trout in the coterminous United States as threatened. A draft recovery plan for the Coastal-Puget Sound Distinct Population Segment was issued by the USFWS in May, 2004.

ESA Mandated Actions Following Listing

The final determination of species as threatened initiates a number of procedures and requirements under the Endangered Species Act, including the designation of critical habitat, regulations governing take, Federal consultation on actions affecting the threatened species, preparation of a recovery plan, and monitoring.

Designation of Critical Habitat

The Endangered Species Act requires designation of critical habitat at the time a species is listed, unless the Secretary of Commerce/Interior determines that the designation would be detrimental to the species' continued existence or that the limits of critical habitat are not determinable. In designating critical habitat, agencies consider the species' requirements including space for individual and population growth; food, water, air, light, minerals or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction or rearing offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of the species.

Puget Sound Chinook

In the proposed Rule (March 9, 1998) to list the Puget Sound Chinook ESU as threatened, NMFS generally described the areas that constitute critical habitat to include all marine, estuarine and river reaches accessible to Chinook salmon in Puget Sound. A designation was published on February 16, 2000 which indicated that critical habitat encompassed dozens of major river basins and an array of essential habitat types, including juvenile rearing areas, juvenile migration corridors, areas for growth and development to adulthood, adult migration corridors and spawning areas. In April, 2002 NMFS withdrew the designation in order to incorporate an economic analysis of the designation and obtain additional public and technical input. A revised Critical Habitat Designation for Puget Sound Chinook was published in the Federal Register on December 14, 2004 and NMFS took public comment until March 14, 2005. A final rule is scheduled to be issued on or before August 15, 2005.

Coastal/Puget Sound Bull Trout

Following the 1999 listing of bull trout as a threatened species, the USFWS found that the designation of critical habitat for the Coastal-Puget Sound Population and other population segments was "not determinable." This was due to the lack of sufficient information about the biological requirements of bull trout that would be needed to identify areas as critical habitat. Additionally, the USFWS

Habitat Conservation Plans Approved or in Development in Puget Sound:

Plans Approved:

- City of Seattle (upper Cedar River Watershed) approved 4/21/00.
- City of Tacoma (upper Green River City Watershed) approved 7/9/01.
- WA Dept Natural Resources (forest mgmt activities on state-owned timberlands) approved 1/30/97.
- Green Diamond Timber (forest mgmt activities Shelton-area) approved 10/12/00.
- Plum Creek Timber (forest mgmt activities upper Green River and I-90 corridor) approved 6/27/96.

HCPs in Development (as of April, 2005; which may or may not proceed to a permit-issuance decision):

- Forest Practice HCP (forest activities on all commercial private forest lands under State regulations).
- WA Dept Natural Resources (various activities on state-controlled aquatic lands, freshwater and sub-tidal).
- King County Wastewater Treatment Division (operations of KCWTD within their service area).
- City of Kent (instream flows and City water operations on Rock Creek, trib to Cedar River).
- Sequim Dungeness Water Users Association (Dungeness River instream flows and water operations of the 7 local irrigation districts).
- Snohomish County Dept of Public Works (county road and stormwater mgmt in watersheds of 3 tribs to north Lake WA).
- City of Bellingham (water diversions in Nooksack River for City water supply).

lacked information about the number of individuals and the amount or locations of spawning areas within rivers and streams required for viable populations of bull trout.

A number of legal actions were filed against the USFWS regarding the failure to designate critical habitat for bull trout. On June 25, 2004, the USFWS published the proposed critical habitat designation for the Coastal-Puget Sound population of bull trout, which includes a total of 2,290 miles of streams in western Washington, along with 52,540 acres of lakes and reservoirs, and marine habitat paralleling 985 miles of shoreline. The proposal excludes properties where special management status for bull trout already exists, such as approved Habitat Conservation Plans and the Washington Forest Practice Regulations under the Forest and Fish Report. Hearings on the proposed critical habitat designation were held in July and August, 2004 and a final rule is anticipated by June, 2005.

Other Endangered Species Act Mandates and Related Actions

Publication of 4(d) Rules

Under section 4(d) of the Endangered Species Act, Federal agencies are, "required to adopt such regulations as are deemed necessary and advisable for the conservation of species listed as threatened." The National Marine Fisheries Service issued a proposed rule governing the take of salmon within seven salmon ESUs, including Puget Sound Chinook and Hood Canal Summer Chum, on January 3, 2000. A wide range of activities were prohibited in the proposed 4(d) rule that NMFS believes may injure listed salmonids, including water withdrawals, destruction of habitat (such as removal of large woody debris or dredging), land use activities adversely affecting habitat (such as logging, grazing, farming and urban development), pesticide and herbicide application, and introduction of non-native species. The final 4(d) rule for Puget Sound Chinook and Hood Canal summer chum was adopted in June, 2000.

Section 4(d) rules related to the taking of bull trout were generally included as part of the November 1, 1999 listing documents. The USFWS also filed a Notice of Intent to Prepare a Proposed Special Rule Pursuant to Section 4(d) to exempt additional habitat restoration activities and other land and water management activities from the take prohibitions of the Act when they are conducted in accordance with enforceable regulations that provide protection for bull trout.

Section 10 Permits: Section 10 of the Endangered Species Act provides another mechanism for NMFS and USFWS to permit the taking of a threatened species when it is the incidental result of carrying out an otherwise lawful activity. Applicants for an "Incidental Take Permit" must submit a "Habitat Conservation Plan" that identifies the impacts expected from any take associated with the proposed activities, and the steps that will be taken to monitor, minimize, and mitigate those impacts. A number of Habitat Conservation Plans have been approved or are in process.

Federal Consultation: Section 7 of the Act requires that Federal agencies consult with NMFS or the USFWS on activities they authorize, fund, or carry out to ensure they are not likely to jeopardize the continued existence of listed species or result in the destruction of modification of their critical habitat. This includes federally funded projects such as road construction, stormwater management, rural and urban development, and many other activities conducted, permitted, or funded by Federal agencies. NMFS and the USFWS have developed methods to determine whether proposed actions are likely to restore, maintain or degrade habitat (NMFS, 1996).

Role of Hatchery Salmon in Listing Determinations: Hatchery fish present potential benefits and risks to the biological status of salmon populations. In 1993, NMFS adopted an interim policy on how to consider artificially propagated fish in the listing and recovery of Pacific salmon and steelhead under the Endangered Species Act. In response to additional scientific research and legal actions, NMFS issued a revised policy in 2004, which is described further in Chapter 6, *Regional Hatchery Management Strategies*.

Relationship of the ESA and the Rights of American Indian Tribes: In recognition of the trust responsibility and treaty obligations of the United States toward Indian tribes and tribal members, the Secretaries of Interior and Commerce issued Secretarial Order #3206 on June 5, 1997 to clarify the responsibilities of the agencies while taking actions under the authority of the Endangered Species Act. The Order directed the departments to work directly with Indian tribes on a government-to-government basis to promote healthy ecosystems, recognized the unique legal status of Indian lands, and affirmed tribal management authorities and Federal consultation responsibilities in carrying out the conservation measures of the Act.

Section 4(f) of the Endangered Species Act requires the agencies to develop and implement plans for the conservation and survival of endangered species. Each plan is required to incorporate:

(i) " a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;

(ii) objective, measurable criteria which, when met, would result in a determination…. that the species be removed from the list; and

(iii) estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal…"

Recovery Plans

Many of the same factors have contributed to the decline and limit recovery of Chinook, Hood Canal summer chum, and Coastal-Puget Sound bull trout, and many of the recovery actions are likely to benefit all of the distinct population segments that are threatened. Although recovery plans have generally been prepared by the federal agency of jurisdiction, studies have indicated that the broad participation of diverse participants in the development of

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recovery plans increases the likelihood of successful plan implementation (Hatch et al. 2002). Accordingly, NMFS, USFWS, and state, tribal and local governments have determined the advisability of coordinating the regional recovery planning to meet the requirement of Section 4(f).

The USFWS has divided the Coastal/Puget Sound Bull Trout distinct population segment into two management units for recovery planning--Olympic Peninsula and Puget Sound. USFWS issued draft recovery plans for the two management units in May, 2004, which provides recovery targets (abundance, distribution, productivity, and diversity/connectivity) identified by bull trout technical recovery teams, and provides focus and guidance for key watersheds in their recovery planning efforts for bull trout. While the draft plan sets broad recovery goals and objectives for bull trout, the USFWS is using the Stared Strategy watershed recovery planning process to identify specific actions that can be taken to meet bull trout recovery targets, and to elicit commitments to implement bull trout recovery in concert with salmon recovery in Puget Sound.

Date	Action	Reference
October 30, 1992	US Fish and Wildlife Service (USFWS) receives a petition to list bull trout as an endangered species throughout its range from the Friends of the Wild Swan, Alliance for the Wild Rockies, and the Swan View Coalition.	
June 10, 1993	USFWS publishes finding determining that the petitioners had provided substantial information indicating that listing of bull trout may be warranted in coterminous US, but precluded by higher priority work.	
December 4, 1997	Oregon Federal District Court orders USFWS to reconsider several aspects of previous findings concerning listing of bull trout, including whether listing of the Coastal-Puget Sound distinct population segment is warranted.	
January 12-14, 1999	USFWS convenes bull trout recovery teams.	
November 1, 1999	USFWS publishes Determination of Threatened Status for Bull Trout in the Coterminous United States; Notice of Intent to Prepare a Special Rule Pursuant to Sections 4(d) for the Bull Trout.	64FR 58910 64FR 58934
	Legal actions and settlement agreements related to critical habitat designation	
June, 2004	Draft recovery plan for Coastal/Puget Sound DPS published.	
June 25, 2004	Proposed Critical Habitat Designation for Coastal / Puget Sound Bull Trout	

Figure 1.7 Chronology of Administrative Actions Relevant to the Listing of Coastal/Puget Sound Bull Trout to the US List of Threatened Species.

Date	Action	Reference
March 14, 1994	A group of professional fisheries biologists known as PRO-Salmon petitions NMFS to list several populations of Washington State salmon as threatened species.	
September 12, 1994	NMFS announces that petitions to list populations of Chinook, chum, and other salmonids on the West Coast USA may have scientific merit, and initiates status reviews.	59FR 46808
February 7, 1996	NMFS policy for defining Evolutionarily Significant Units of West Coast Pacific salmon	61FR4722
March 9, 1998	Proposed Rule: Threatened Status for Puget Sound Chinook ESU.	63FR 11482
March 10, 1998	Proposed Rule: Threatened Status for Hood Canal Summer Chum ESU.	63FR 11774
March 24, 1999	Final Rule: Threatened Status for Puget Sound Chinook ESU.	64FR 14308
March 25, 1999	Final Rule: Threatened Status for Hood Canal Summer Chum ESU.	64FR 14508
January 3, 2000	Proposed 4(d) Rule Governing Take for Puget Sound Chinook and Hood Canal Summer Chum	65FR 170
February 16, 2000	Final Rule Designating Critical Habitat: PS Chinook and HC Summer Chum.	65FR 7764
July 10, 2000	Final 4(d) Rule Governing Take for PS Chinook and HC Summer Chum	65FR 42422
June 3, 2004	Proposed Policy on the Consideration of Hatchery-Origin Fish in Endangered Species Act Listing Determinations for Pacific Salmon and Steelhead	69FR 31354
June 14, 2004	Proposed Rule to list PS Chinook and HC Summer Chum following an update to the status review and incorporating the proposed policy on hatchery-origin fish.	69FR33101
Dec.14, 2004	Proposed rule: Critical Habitat Designation of Puget Sound Chinook ESU.	69CFR 239
March 11, 2005	Final Determination: Implementation of harvest Resource Management Plan will not appreciably reduce likelihood of the survival and recovery of Puget Sound Chinook ESU	70CFR 47

Figure 1.8 Chronology of Key Administrative Actions Relevant to the Listing of Puget Sound Chinook and Hood Canal Summer Chum to the US List of Threatened Species.

References

Introduction

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-35, 443 p..

National Marine Fisheries Service; West Coast Chinook Salmon Biological Review Team, 2003. Updated status of federally listed ESUs of West Coast salmon and steelhead. Available from the NMFS Northwest Fisheries Science Center; Seattle, WA.

Schlosser, T.P. 1978. Washington's resistance to treaty Indian commercial fishing: The need for judicial apportionment. http://www.msaj.com/papers/commfish.htm#_ftn18 May 3, 2005.

U.S. Fish and Wildlife Service, 2004. Draft recovery plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (Salvelinus confluentus). Available from U.S. Fish and Wildlife Service Region 1; Portland, OR.

Washington Department of Ecology. 2005. Puget Sound Shorelines. http://sss.ecy.wa.gove/programs/sea/pugetsound/tour/people.html May 3, 2005.

The Shared Strategy Approach To Puget Sound Recovery Planning:

Puget Sound Technical Recovery Team. 2003. Integrated Recovery Planning for Listed Salmon: Technical Guidance for Watershed Groups in Puget Sound. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Puget Sound Technical Recovery Team, 2002. Planning Ranges and Preliminary Guidelines for the Delisting and Recovery of the Puget Sound Chinook Salmon Evolutionarily Significant Unit. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Washington Department of Fish and Wildlife, 2003. An Outline for Salmon Recovery Plans. Olympia, WA.

Washington State Governor's Joint Natural Resources Cabinet, 1999. Statewide Strategy to Recover Salmon: Extinction is not an option. Olympia, WA. Also available at www.governor.wa.gov/gsro/strategy/longversion.htm.

Benefits of Salmon Recovery for Biodiversity and Ecosystem Health

Cederholm, C.J., D.H. Johnson, R.E. Bilby, L.G. Dominguez, A.M. Garrett, W.H. Graeber, E.L. Greda, M.D. Kunz, B.G. Marcot, J.F. Pamisano, R.W. Plotnikoff, W.G. Pearcy, C.A. Simenstad, and P.C. Trotter. 2000. Pacific Salmon and Wildlife-Ecological Contexts, Relationships, and Implications for Management. Special Edition Technical Report, Prepared for D.H. Johnson and T.A. O'Neil, Wildlife-Habitat Relationships in Oregon and Washington. Washington Department of Fish and Wildlife, Olympia, WA.

Floberg, J., M. Goering, G. Wilhere, C. MacDonald, C. Chappell, C. Rumsey, Z. Ferdana, A. Holt, P. Skidmore, T. Horsman, E. Alverson, C. Tanner, M. Bryer, P. Iachetti, A. Harcombe, B. MacDonald, T. Cook, M. Summers, D. Rolph. 2004. Willamette Valley-Puget Trough-Georgia Basin Ecoregional Assessment, Volume One: Report Prepared by The Nature Conservancy with support from the Nature Conservancy of Canada, Washington Department of Fish and Wildlife, Washington Department of Natural Resources (Natural Heritage and Nearshore Habitat Programs), Oregon State Natural Heritage Information Center and the British Columbia Conservation Data Centre.

Gresh, T., J. Lichatowich, and P Schoonmaker. 2000. An estimation of historic and current levels of salmon production in the Northeast Pacific ecosystem: Evidence of nutrient deficit in the freshwater systems of the Pacific Northwest. Fisheries 25 (1): 15-21.

Johnson, D.H., M.M. Hoover, E.L. Greda, and C.J. Cederholm (in prep). Relationship betweeen Pacific Salmon and 605 species of birds, mammals, reptiles, and amphibians in Oregon and Washington.

Karr, J.R. and D.R. Dudley. 1981. Ecological perspective on water quality goals. Environmental Management, 5:55-68.

Mathewson, D.D., M.D. Hocking, and T.E., Reimchen (2003). Nitrogen uptake in riparian plan communities across a sharp ecological boundary of salmon density. BMC Ecology 3:4 (3 May 2003).

Munn, M.D., R.W. Black, A.L. Haglund, M.A. Hummling, and R.L. Huffman. 1999. An assessment of stream habitat and nutrients in the Elwha River Basin: Implications for Restoration. U.S. Geological Survey, Water Resources Investigations Report 98-4223. Prepared in cooperation with the Lower Elwha Tribe and the National Park Service.

Stein, B.A., L.S. Kutner, J.S. Adams. 2000. Precious Heritage: The Status of Biodiversity in the United States, The Nature Conservancy and the Association for Biodiversity Information.

Ricciardi, Anthony & Rasmussen, Joseph B. (1999) Extinction Rates of North American Freshwater Fauna. Conservation Biology 13 (5), 1220-1222.

Willson, M.F. & KC. Halupka. (1995) Anadromous Fish as Keystone Species in Vertebrate Communities. Conservation Biologic 9 (3), 489-497.

1 Strong, consistent relationship: This occurs when salmon play (or historically played) an important role in this species' distribution, viability, abundance, and/or population status. The ecology of this wildlife species is supported by salmon, especially at particular life stages or during specific seasons. The relationship to salmon is direct (e.g., feeds on salmon or salmon eggs) and routine.

2 Recurrent relationship: The relationship between salmon and this species is characterized as routine, albeit occasional, and often tends to be in localized areas.

CHAPTER 2

Status of Threatened Species

Life Cycle of the Pacific Salmon

"There is no ending here. The ending here is the cycle of the salmon and another cycle of the salmon and another cycle of the salmon which takes us into the future."

Billy Frank, Jr., Chairman, Northwest Indian Fisheries Commission

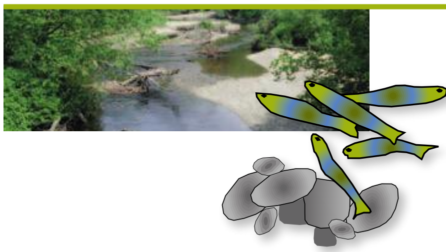
The Pacific Northwest is home to seven different species of Pacific salmonids: Chinook, coho, chum, sockeye, and pink salmon; and steelhead and cutthroat trout. The salmon life cycle occurs in a chain of connected environments as they journey through freshwater streams, estuaries, nearshore areas, and the ocean. Each of these habitats provides crucial elements for the salmon's survival as they cycle through their incubation, emergence, freshwater rearing, estuary transition, ocean residence, migration and spawning. The cycle from birth in freshwater streams to the ocean and back defines Pacific salmon as "anadromous." Most Pacific salmonids (though not bull trout) are also "semelparous," meaning that they die after spawning only once. Their total energies are devoted to producing the next generation, and their bodies help enrich the stream for that generation and other wildlife species.

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

Habitat Determines the Salmon's Survival at Each Stage of the Life Cycle.......

Eggs: Incubation requires clean water, free of contamination and siltation. Disturbance of a single "redd" (nest of eggs) will terminate the survival of thousands of salmon.

Alevins: During emergence, alevins remain nestled in gravel and feed from their attached yolk sacs. They are highly vulnerable to siltation and gravel scour.



Fry: Feeding is crucial during freshwater rearing. Riparian vegetation helps produce insects, provides cover from predators, and keeps water temperatures cool. Tree roots stabilize streambanks and create habitat structure. Decaying trees form log jams that provide cover and help create side channel refuges for the tiny salmon, away from high velocity flows. Pools and wetlands also provide shelter. Depending on the species, juvenile salmon remain in freshwater from a period of only weeks to over a year before heading to the estuary.

Outmigrants: Juvenile salmon undergo a physiological change known as "smoltification" that enables them to transition from freshwater to saltwater in the estuary. Smoltification can occur primarily within freshwater areas, or almost entirely in the nearshore environment depending on the species, thus they may reside in the estuary to feed and adjust for a period of only days to as much as a year before continuing on to the ocean. The protected waters of the nearshore help them during their migration to the sea. Shoreline logjams, brackish sloughs, marsh plants and eelgrass beds are essential features that provide forage and hiding places along the way.

Sub-Adults/Adults: Maturation occurs during ocean residency over a period from one to five years, leading up to the adult salmon's return to rivers and lakes of their birth. The ranges and patterns of migration vary greatly between the species and the region of origin for specific populations. Shifts in ocean conditions (such as El Nino and Pacific Decadal Oscillations) have been shown to affect food production, alter their typical migration patterns, and result in differences in ocean survival rates. As the adult salmon approach the stream of their origin, they once again undergo a physiological change from saltwater to freshwater, and depend on nearshore and estuary habitats during the transition.

Spawners: Once the adult spawners arrive at their home river mouth, they need adequate flows, cool water temperatures, deep pools and cover to rest and hide as they migrate upstream. Spawners seek clean, loose gravel of an appropriate size in highly oxygenated water for laying their eggs. The site must remain stable throughout incubation and emergence, and allow water to percolate through the gravel to supply oxygen to the developing embryo.

Puget Sound Chinook

"Although it is natural for salmon populations to fluctuate from year to year, the dramatic fall in populations over the past century places remaining salmon stocks in jeopardy. Their reduced abundances allow no room for further downward cycles."

Tim McNulty, Olympic Peninsula Naturalist and Author

Chinook Life History

Truly the "King" of Pacific salmon, Chinook are the largest species with adults often exceeding 40 pounds; reports of adults over 100 pounds are common. Chinook at sea look similar to coho salmon (blue-green back with silver flanks), but are distinguishable by their large size, small black spots on both lobes of the tail, and black pigment along the base of their teeth.

Spawning and Incubation

As they prepare to spawn, Chinook lose their silvery color and appear battered from their journey. Chinook salmon typically spawn in larger streams and higher velocity areas with larger gravels than those areas utilized by the other salmon species. Depending on their evolutionary history, Chinook salmon may select spawning areas close to or even within estuaries, but their size and strength enable them to travel for hundreds of miles upstream in some river systems. Once the adult fish have arrived at the spawning grounds and "ripened," a female Chinook will dig a redd (nest) with her tail and deposit her eggs into four or five nesting pockets. The number of eggs for each Chinook female can range from fewer than 2,000 eggs to more than 17,000 eggs, but in Puget Sound it is estimated that 2,000 to 5500 per female is typical. One or more males will fertilize the deposited eggs, and the female Chinook will guard the redd from 4 to 25 days before dying. Males may seek other spawning opportunities before they too, expire. Depending on the water temperature, Chinook eggs will hatch between 32 to 159 days after deposition. Alevins (newly hatched salmon with attached yolk sacs) will remain in the gravel for another 14 to 21 days before emerging. Water quality, depth, velocity and temperature are all critical for the survival of eggs. Shallow water may make eggs more vulnerable to predators and disturbance. High velocity can cause scouring of the stream bed, dislodging the eggs from their redd. Puget Sound Chinook tend to have relatively large eggs, greater than 8.0 mm in diameter on average. (Croot and Margolis, 1991) (63FR11482; 3/9/98).

Rearing and Outmigration

The patterns for rearing and outmigration within the life history cycle of Chinook salmon vary widely, and scientists have identified four patterns just for juvenile Chinook. (See the Nearshore Chapter for a full description.) Juvenile Chinook salmon may move out of the freshwater area from their river of birth within 1 to 10 days after emerging from the streambed gravel, and spend many months rearing in the estuary, or they may reside in freshwater for a full year, spending relatively little time in the estuary area before migrating to sea. The majority of Puget Sound Chinook leave the freshwater environment during their first year, making extensive use of the protected estuary and nearshore habitats.

Chinook Population	% Outmigration During First Year min-max
NF Nooksack early	52-79
SF Nooksack early	40-73
Upper Cascade (Skagit)	28-91
Upper Sauk (Skagit)	29-65
Suiattle (Skagit)	16-77
Skykomish (Snohomish)	50-78
Snoqualmie (Snohomish)	58-94
Dungeness	29-100
Elwha	41-83
All others*	min >75%

*No data available for Hood Canal populations.

Figure 2.1 Puget Sound Chinook juvenile outmigration; percent of population that leaves freshwater in their first year (PSTRT members, pers. comm.; 2005

Figure 2.1 shows the percentages of the Chinook populations in Puget Sound rivers that leave freshwater during their first year. However, it should be noted that each of the populations exhibits a great deal of variation in the pattern of outmigration by juveniles.

Nearshore ecosystems provide areas for the young Chinook to forage and hide from predators. Juvenile salmon experience the highest growth rates of their lives while in the highly productive estuaries and nearshore waters. These estuarine habitats are ideal for juvenile salmon to undergo the physiological transition to saltwater, and to readjust to freshwater when they return to spawn as adults. Nearshore areas serve as the migratory pathway to ocean feeding areas. The vegetation, shade and insect production along river mouth deltas and protected shorelines help to provide food, cover and the regulation of temperatures in shallow channels. Forage fish spawn in large aggregations along protected shorelines, thus generating a base of prey for the migrating salmon fry. Salmon often utilize "pocket estuaries"-small estuaries located at the mouths of streams and drainages, where freshwater input helps them to adjust to the change in salinity, insect production is high, and the shallow waters protect them from larger fish that may prey on them. As the juvenile salmon grow and adjust, they move out to more exposed shorelines such as eelgrass, kelp beds and rocky shorelines where they continue their migratory path to the ocean environment.

Given adequate habitat, juvenile salmon experience the highest growth rate of their lives in the nearshore environment.

Age at Maturation

Chinook salmon exhibit considerable variation in their size and age of maturity. Coast-wide, Chinook salmon remain at sea for one to six years (more commonly two to four years), with the exception of a small proportion of yearling males (called "jacks") which mature in freshwater or return after two or

River Deltas provide vegetation, shade and insect production for food.

The freshwater input of **pocket estuaries** helps the salmon adjust to changing salinity.

Forage fish, which serve as prey for salmon, spawn in large aggregations along **protected shorelines.**

Exposed shorelines such as eelgrass, kelp beds and rocky shorelines serve as the migratory pathway to the sea.

three months in salt water. As shown in figure 2.2, Puget Sound Chinook tend to mature at ages three and four.

Migration

Chinook salmon generally migrate great distances in the ocean and tend to migrate to the north into waters adjacent to Canada and Alaska. It is thought that the diversity of migratory routes in the ocean may be important to the success of the species as a whole. During this migration, salmon that originated in many different rivers are mixed together, and separate themselves as they return to the proximity of their natal stream.

Although some Puget Sound Chinook apparently spend their entire life within Puget Sound, most migrate to the ocean and north along the Canadian coast. The migratory pattern of Puget Sound origin Chinook along the coast, rather than the open ocean, makes them particularly vulnerable to recreational and commercial fishing. Fisheries catch data indicate that most Puget Sound Chinook are caught in the Strait of Juan de Fuca, Strait of Georgia, Puget Sound and off of the west coast of Vancouver Island. Less than one percent are caught to the south of Cape Flattery, off of the west coast of Washington and Oregon.

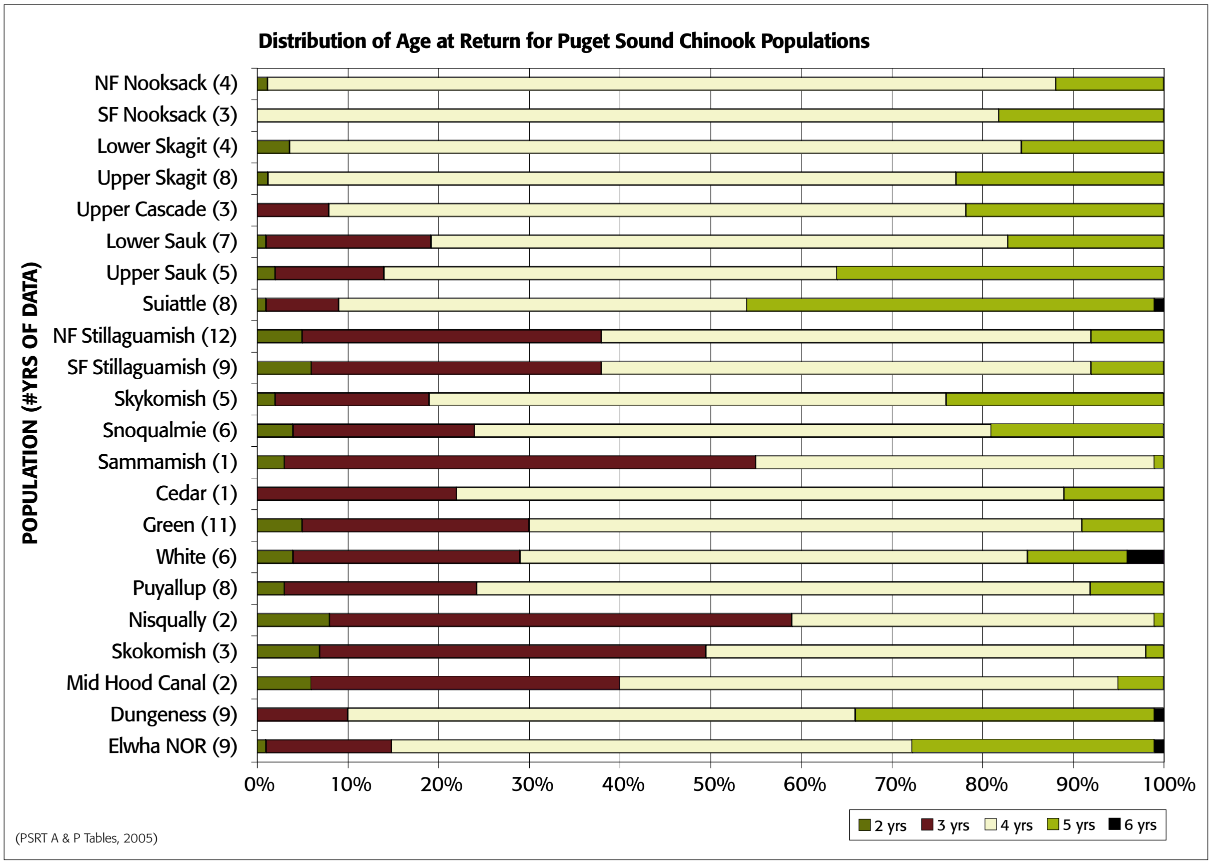
There appear to be substantial differences in migratory patterns between Chinook that originate from Puget Sound rivers and those from the Washington coast, with a higher proportion of coastal Washington Chinook migrating to Alaskan waters. While the Elwha River Chinook appear to be a transitional population between Puget Sound and coastal Washington stocks based on their genetic and life history characteristics, their migration patterns resemble Puget Sound Chinook more closely. Chinook from the northern rivers of Puget Sound, particularly the Nooksack, tend to utilize the Strait of Georgia more than other Puget Sound Chinook.

Puget Sound Chinook also vary in their return migratory routes from year to year, with different tendencies to migrate along the west coast of Vancouver Island or through Johnstone Strait and the Strait of Georgia. This may be a function of ocean temperature conditions and the effect of the large freshwater plume from the mouth of the Fraser River.

Timing of Returns and Spawning

Chinook salmon return to their streams of origin

Figure 2.2



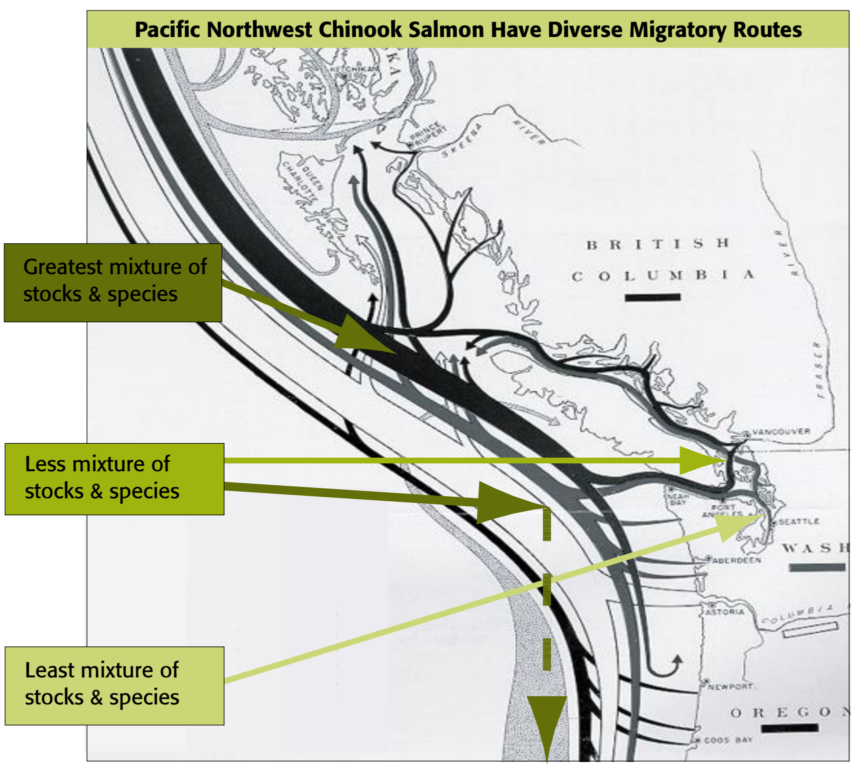


Figure 2.3 It is thought that the diversity of migratory routes in the ocean may be important to the success of the species as a whole. Image courtesy NWIFC.

with a high degree of fidelity. The "homing" characteristic is not perfect, and fish may stray to nearby streams with similar environmental characteristics, particularly when their home watershed has been disrupted. This trait may have helped spread their distribution across adequate incubation and rearing habitat, prevented catastrophic loss to the species based on a disturbance to one area or region, and provided a mechanism for local adaptation.

Although Chinook salmon may return to their natal river mouth almost any month of the year, peaks in run timing occur in the spring through late fall. The timing for Chinook re-entry to freshwater and spawning is believed to be related to local tempera-

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ture and water flow regimes. "Despite the wide variation in run timing within most rivers, spawning times tend to be similar among runs." (Croot and Margolis, 1991) Egg deposition must occur at a time to ensure that fry will emerge during the following spring when the conditions in the river or estuary will provide food and refuge sufficient for their survival and growth.

Early-timed Chinook salmon tend to enter freshwater as immature fish in the spring, migrate far upriver, and finally spawn in the late summer and early autumn. Late-timed Chinook enter freshwater in the fall at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Myers et al. 1998). All stocks utilize resting pools, which provide a retreat from high-energy flows, thermal protection from late summer temperatures, and a safe haven from potential predators.

The return of adult Chinook salmon to freshwater in the Puget Sound region occurs from late March to early December, and varies considerably across and within major river basins (Figure 2.4). Peak Chinook spawning occurs from mid to late August to mid October. Chinook runs which return in the summer and fall predominate in Puget Sound, and many of the early-timed runs have become extinct. (Myers et al. 1998)

Status of Puget Sound Chinook

Following the status review of Chinook salmon from Washington, Idaho, Oregon, and California in 1998, the National Marine Fisheries Service deter-

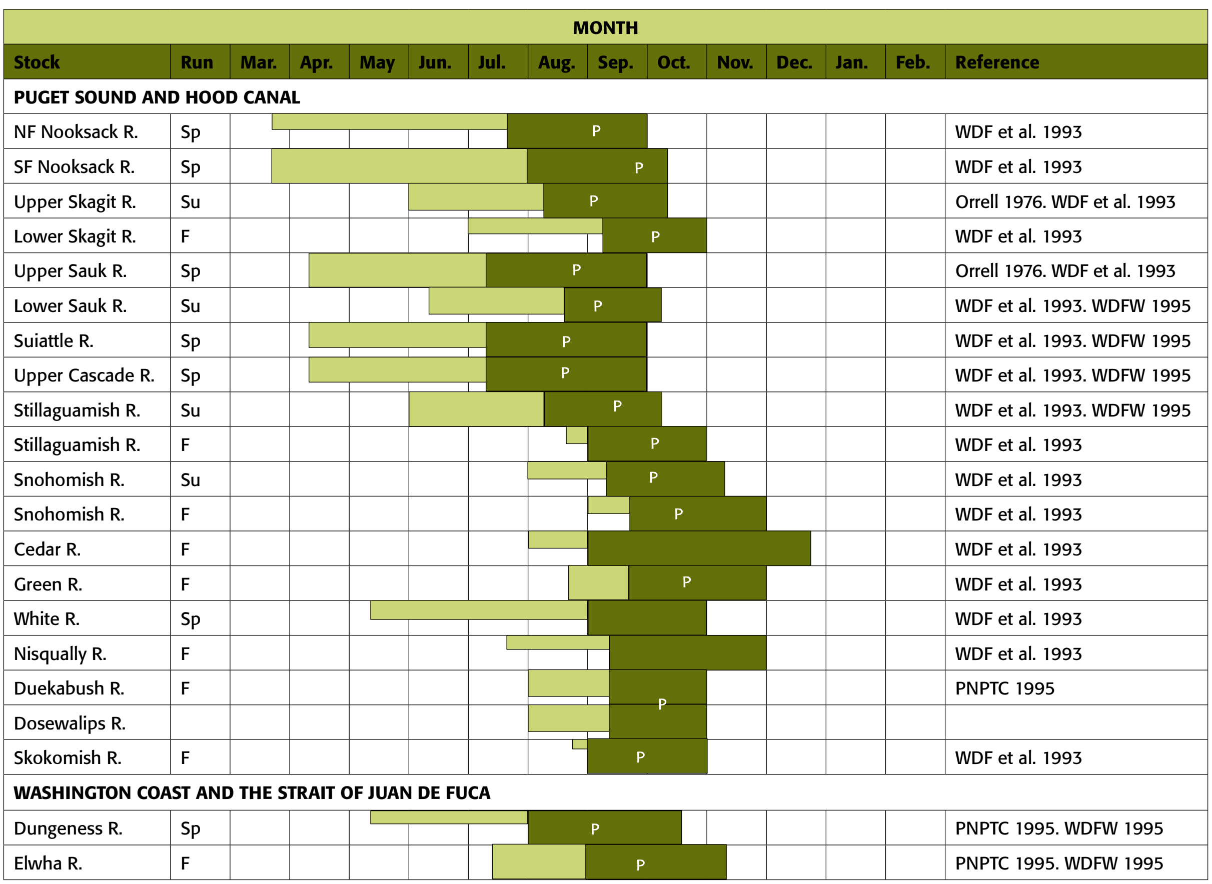

Figure 2.4 Freshwater migration and spawning timing for selected Chinook salmon from the Puget Sound. Run designations as characterized in the BRT Status Review, (Myers et al. 1998): Sp-spring; Su-summer; F-fall. Spring run designations for White and Dungeness Rivers stocks have been reclassified by local management agencies, but "Sp" labels have been retained for historical consistency. Due to variability in spawning times within a stock, some fish may still be entering freshwater during the spawning time intervals.

Freshwater Migration Timing
Spawning Timing

mined that Chinook salmon in the Puget Sound region constituted an evolutionarily significant unit and that the Puget Sound ESU is at risk of becoming endangered in the foreseeable future Myers et al. 1998). The Federal Register of March 9, 1998, which proposed the listing of Puget Sound Chinook as threatened under the Endangered Species Act, summarized the status of Puget Sound Chinook as follows:

"Overall abundance of Chinook salmon in the Puget Sound ESU has declined substantially from historical levels, and many populations are small enough that genetic and demographic risks are likely to be relatively high. Both long and short term trends in abundance are predominantly downward, and several populations are exhibiting severe short term declines. Spring Chinook salmon populations throughout this ESU are all depressed."

Populations, Metapopulations, Stocks and Runs

The dictionary definition of "population" is a broad term referring to a group of organisms that constitute a specific group and occur in a specified habitat. Ecology textbooks refer to populations as, "a group of organisms of the same species that occupy the same geographic area at the same time." Fisheries scientists have developed definitions for populations and related terms as follows:

- An **"independent population"** is defined as a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season.

- **"Metapopulations"** are the network of local populations or sub-populations that are genetically interrelated and in nearby geographic proximity. Their close relationships are thought to be the result of occasional straying by returning adult salmon to a neighboring patch of similar habitat within the same watershed or in a nearby watershed. The group of populations in an evolutionarily significant unit may be considered a metapopulation.

- In general, the term **"stock"** coincides with the definition of an independent population, referring to a local population of fish that originates from a specific watershed as juveniles and returns to the birth stream to spawn as adults. A stock is generally defined by its geographic spawning location, while a population takes into account genetic similarities as well.

- A **"run"** is generally the return of adult salmon in a given year for a particular species. A run may be further divided into timing segments such as an early run or a late run, and may refer to different geographic groupings, such as an individual river basin, or an entire region such as Puget Sound.

An evolutionarily significant unit (ESU) is defined by two criteria: 1) it must be substantially reproductively isolated, and 2) it must represent an important component of the evolutionary legacy of the species. The population definitions address the first of these criteria, but the evolutionary legacy component is based on additional considerations of genetics, geography and habitat adaptation.

(McElhany, et. al., 2000; PSTRT, 2005; National Research Council, 1996)

The Puget Sound Evolutionarily Significant Unit

The Puget Sound ESU is a composite of many individual populations of naturally spawning Chinook salmon, and a number of hatchery stocks (64FR 14308, 3/24/99). The delineation of the independent populations that make up an ESU is a major step in the development of a recovery plan, as the populations are the building blocks for persistence and recovery. The boundary of the Puget Sound Chinook salmon ESU extends from the Nooksack River in the north to southern Puget Sound, includes Hood Canal, and extends westerly out the Strait of Juan de Fuca to the Elwha River. The Skagit River and its tributaries constitute what was historically the predominant system in Puget Sound containing naturally spawning populations.

Independent Populations of Puget Sound Chinook

Recently the Puget Sound Technical Recovery Team (PSTRT) analyzed the Chinook populations of Puget Sound and identified 22 independent populations of Chinook salmon (figure 2.6). The population designations are preliminary, and may be revised based on additional information. The scientists looked at previous work in the Salmon and Steelhead Stock Inventory (WDFW et al., 1993) and other data to identify geographic boundaries of historical populations of Chinook. The PSTRT evaluated factors including the location of spawning habitat, the extent of straying by adult Chinook to spawning sites away from their natal stream or location, genetic attributes, patterns of life history, and other population and environmental characteristics. The report, Independent Populations of Chinook Salmon in Puget Sound (PSTRT, 2005), emphasized that the geographic boundaries of independent populations identified in the report do not include all of the habitats that may be important to population viability or recovery of the ESU.

Extinct and Extant Chinook Populations

Although 22 independent populations of Chinook salmon have been identified in Puget Sound, historically it is believed that there may have been 30-37 independent populations or spawning aggregations. Chinook populations that have been particularly affected

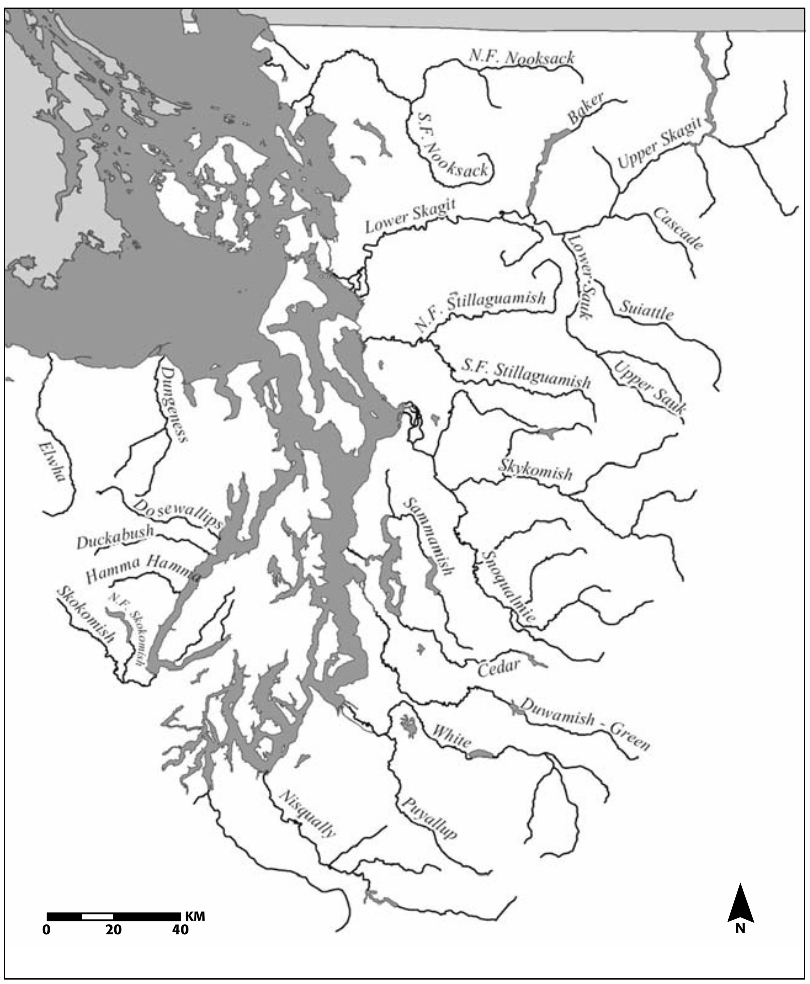

Figure 2.5 Major Chinook salmon spawning rivers and tributaries in the Puget Sound (PSTRT, 2005)

are the early returning life history types in the Puget Sound ESU. As noted by the West Coast Salmon Biological Review Team in their 2003 report, "The loss of early-run Chinook salmon stocks in Puget Sound represents an important loss of part of the evolutionary legacy of the historical ESU." (Myers et al. 1998)

The historical presence of early Chinook runs is supported by anthropological reports from the early 20th century, which noted that local tribes fished for salmon almost year-round, moving throughout Puget Sound to take advantage of the run timing on different river systems. As steelhead fishing wound down in the late winter, tribal fishers would look

Figure 2.6 Independent Populations of Puget Sound chinook (PSTRT, 2004)

forward to the early Chinook runs in the large rivers (Gunther, 1927).

Genetic Characteristics

An analysis of the genetic structure of groups of Chinook populations on the West Coast of the United States was conducted by the NMFS West Coast Chinook Biological Review Team during their 1997 status review. Puget Sound populations of Chinook salmon constituted a genetically distinct group from other chinook along the west coast of the United States and Canada. The Elwha River population was genetically intermediate between Puget Sound and Washington coastal populations. Populations from the Nooksack system were genetically very distinct, probably due to their location on the northern boundary of the Puget Sound eco-region, but were more closely allied with other Puget Sound samples than with populations from the Washington coast or Canada.

Further analysis of genetic differentiation among Puget Sound Chinook populations was conducted by the Puget Sound Technical Recovery Team (PSTRT, Technical Memo Draft, 2005). Six major genetic clusters of Chinook salmon in Puget Sound were identified, which were generally consistent with the geographic configuration of the river systems:

1. Strait of Juan de Fuca Chinook Salmon
2. Nooksack River early-returning Chinook salmon
3. Skagit and North Fork Stillaguamish Rivers Chinook salmon
4. Snohomish and South Fork Stillaguamish Rivers Chinook salmon
5. Center, southern Puget Sound and Hood Canal late-returning Chinook salmon
6. White River early-returning Chinook salmon

River Basin	Independent Populations	Putatatively Extinct Populations or Spawning Aggregations
Nooksack	North Fork Nooksack * South Fork Nooksack *	Late-run Nooksack
Skagit	Lower Skagit Upper Skagit Cascade* Lower Sauk* Upper Sauk* Suiattle*	Baker River
Stillaguamish	North Fork Stillaguamish South Fork Stillaguamish	Early-run Stillaguamish
Snohomish	Skykomish Snoqualmie	Early-run Snohomish
Lake WA	Sammamish Cedar	Late-run Sammamish
Duwamish/Green	Duwamish/Green	Early-run Duwamish/Green
Puyallup	White* Puyallup	Late-run White Late-run Puyallup Early-run Puyallup
Nisqually	Nisqually	Early-run Nisqually Late-run Nisqually
Skokomish	Skokomish	Early-run North Fork Skokomish Early-run South Fork Skokomish
Dosewallips, Duckabush, Hamma Hamma	Mid-Hood Canal	Early-run mid-Hood Canal
Dungeness	Dungeness	
Elwha	Elwha	Early-run Elwha
*indicates early-run timing		

Figure 2.7 List of extant independent populations of Puget Sound Chinook salmon and populations or spawning aggregations thought to be extinct. (PSTRT, 2005)

The genetic composition of Chinook in some Puget Sound systems, particularly in Lake Washington and the South Sound, has been extensively influenced by hatchery stocks. Evidence of historical variation has also been constrained by dams on some Puget Sound Rivers. The Elwha River, for example historically contained a population of the largest Chinook salmon in the Puget Sound area; it is not clear whether these fish have any remaining genetic legacy in the Elwha River population (PSTRT, 2001; 63FR11484, 3/9/98).

Viable Salmon Population Parameters

A **"Viable Salmon Population"** has been defined by NMFS as "an independent population of any Pacific salmonid that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame." (McElhany et al., 2000)

Four parameters have been identified to assess the viability of salmon populations: abundance, productivity, spatial structure and diversity. NMFS focuses on the four parameters for several reasons. They are reasonable predictors of extinction risk, they reflect general processes that are important to all populations of all species, and they are measurable. VSP parameters can be applied at the population and ESU level.

"Abundance" is simply the size of the population. NMFS considers abundance important because, "all else being equal, smaller populations are at greater risk of extinction than large populations."

"Productivity" refers to the population's growth rate and how well the population is performing, and is generally measured by the number of returning adults produced by a parent spawner. If the estimates of productivity indicate that a population is consistently failing to replace itself, it is an indicator of increased extinction risk.

"Spatial Structure" refers to the distribution of the fish in a population or group of populations in the habitat they use throughout their life cycle. A population that has a greater spatial distribution of individuals is more likely to persist than a population whose individuals are concentrated in a few locations. Spatial structure of fish populations goes with the habitat that supports them. Habitat patches are needed by salmonids at all life history stages in a distribution pattern that does not increase the risk of a catastrophic loss. The populations and their habitat must be close enough to allow individuals or populations to connect to each other or to re-colonize an area that has become extirpated.

"Diversity" indicates the differences within and among populations in genetic and behavioral traits, such as run timing, age structure, size, etc. Diversity allows a species to use a greater variety of habitats, and allows it to survive short and long term changes in the environment from natural or human-caused factors.

Although the VSP parameters have been specifically developed for salmon, a chicken farmer might think of them this way: 1) Is the flock abundant enough that it can withstand some loss from foxes and hailstorms, and prevent inbreeding? 2) Are the chickens producing enough eggs to replace themselves over the long term and provide a living for the farmer? 3) Are you keeping all your eggs in one basket? Do you have enough egg-laying boxes and roosting posts for the size of the flock? Do your chickens have enough room to avoid fighting and competing for territory? 4) Is your flock diverse enough in its different breeds and age groups that it is likely to persist for a long time, even if environmental conditions around the coop change?

Recent Population Abundance and Productivity

Several populations of Chinook salmon in the Puget Sound ESU have experienced critically low returns within the last 20 years. Chinook populations in the Nooksack, Lake Washington, mid-Hood Canal, Puyallup and Dungeness basins have had returns of less than 200 adult fish, placing these populations at substantial genetic and demographic risk. Only two populations, the Upper Skagit and Green/Duwamish have had average returns in excess of 10,000 adult Chinook for the most recent five year (2000-2004) period. Figure 2.8 displays geometric means for the abundance of naturally spawning Chinook populations for selected five year periods.

Figure 2.8 also contains information on the contribution of hatchery-origin fish to the natural spawning populations. Of the twelve populations with greater than 1,000 natural spawners for the most recent five year period, only the two Skagit populations are thought to have a low fraction of hatchery fish (<5%). (Note that fish which were incubated and released from a hatchery, referred to as "hatchery-origin" fish, may return to spawn naturally. Data which would help scientists differentiate between those fish which incubated naturally in streams, and those returning adults which were

	1986-1990			1994-1998			2000-2004	
Populations	Geometric Mean	% Hatchery Contribution	Productivity	Geometric Mean	% Hatchery Contribution	Productivity	Geometric Mean	% Hatchery Contribution
North + Middle Fork Nooksack	140	21%	1.29	263	67%	0.45	4,232	94%
South Fork Nooksack	243	7%	0.60	181	35%	1.20	303	46%
Lower Skagit	2,732	1%	0.59	974	1%	3.15	2,597	2%
Upper Skagit	8,020	2%	0.69	6,388	1%	1.60	12,116	4%
Upper Cascade	226	0%	0.88	241	0%	1.34	355	1%
Lower Sauk	888	0%	0.61	330	0%	2.35	825	0%
Upper Sauk	720	0%	0.57	245	0%	1.35	413	0%
Suiattle	687	0%	0.40	365	0%	1.20	409	0%
North Fork Stillaguamish	699	0%	0.92	862	35%	0.94	1,176	31%
South Fork Stillaguamish	257	0%	1.31	246	0%	1.22	205	0%
Skykomish	3,204	14%	0.52	3,172	52%	0.82	4,759	39%
Snoqualmie	907	12%	1.23	1,012	33%	1.68	2,446	14%
Sammamish	388	41%	0.28	145	74%	2.72	243	69%
Cedar	733	9%	0.51	391	17%	0.97	412	21%
Green/Duwamish	7,966	62%	0.50	7,060	71%	1.00	13,172	34%
White	73	56%	7.51	452	82%	1.49	1,417	28%
Puyallup	1,509	15%	1.86	1,657	40%	0.67	1,353	31%
Nisqually	602	3%	4.22	753	21%	1.38	1,295	25%
Skokomish	1,630	69%	0.48	866	69%	0.34	1,479	80%
Mid Hood Canal	87	26%	1.41	182	26%	1.31	202	46%
Dungeness	185	83%	0.12	101	83%	0.70	532	83%
Elwha Nat Spawners	2,055	34%	0.46	512	61%	1.03	847	54%
Elwha Nat+Hat Spawners	3,887	34%	0.67	1,679	61%	1.27	2,384	54%

Table Notes: Data from TRT A&P Tables 4/15/05.
No estimates of productivity are included for 2000-2004 period, since returns from those spawning (brood) years are not complete. The1986-1990 period represents the first 5 year period for which escapement data is available for all populations. The 1994-1998 period is the 5 years prior to listing (in March 1999). The 2000-2004 period is the last 5 years for which we have escapement data (most recent 5 years).

Figure 2.8 Geometric mean (5 yr periods) of natural spawning abundance, % hatchery contribution to natural spawners, and productivity (return spawners from parent spawners) for Puget Sound Chinook populations.

hatchery-origin fish that returned to spawn naturally, are unavailable in several river systems.)

The productivity estimates in figure 2.8 are the number of adult offspring that return and spawn successfully from a single parent spawner. A figure of 1.0 indicates that the population is replacing itself. Figures shown in red represent productivity values below the population replacement level. It should be noted that productivity is calculated on the basis of parent year to offspring returning over several years, and the trends of mean annual abundance may not be the same as those for productivity.

Although the status review of Puget Sound Chinook conducted in 1998 (Myers et al.) indicated that the long term productivity trend for naturally-spawning populations was declining by 1.1%, more recent information has shown some improvement. The updated trend calculated in 2003 was flat, suggesting that the populations are, on average, just replacing themselves (NMFS/BRT, 2003). Productivity in many populations has increased, although it may still be below the replacement value. However, it should be noted that it is difficult to determine these trends due to the presence of hatchery-origin fish in the naturally spawning populations.

In order to compare recent abundance figures with historical run sizes, scientists have used a number of methods to estimate the historical population levels. One method is the Ecosystem Diagnostic Treatment (EDT) computer model (Mobrand, Inc.) which allows biologists to input the size and quality of habitat capacity to estimate the number of salmon that the river system could support. EDT modeling results support other records and observations over the last century, and indicate that present Puget Sound Chinook populations are a small fraction of their historical levels.

Viability of Puget Sound Chinook Populations and the Puget Sound ESU

Based on the four Viable Salmon Population (VSP) parameters, few of the Chinook salmon populations in Puget Sound are considered to be viable. With the exception of the Skagit system, abundance levels in each of the populations are a small fraction of their historical estimates. Productivity in many cases has been declining, or remains below the population replacement value. Although the spatial distribution of naturally-spawning populations is difficult to determine due to hatchery influence, the remaining populations with significant numbers of natural-origin spawners are concentrated in the region containing the Skagit and Stillaguamish River basins. Diversity has been impacted

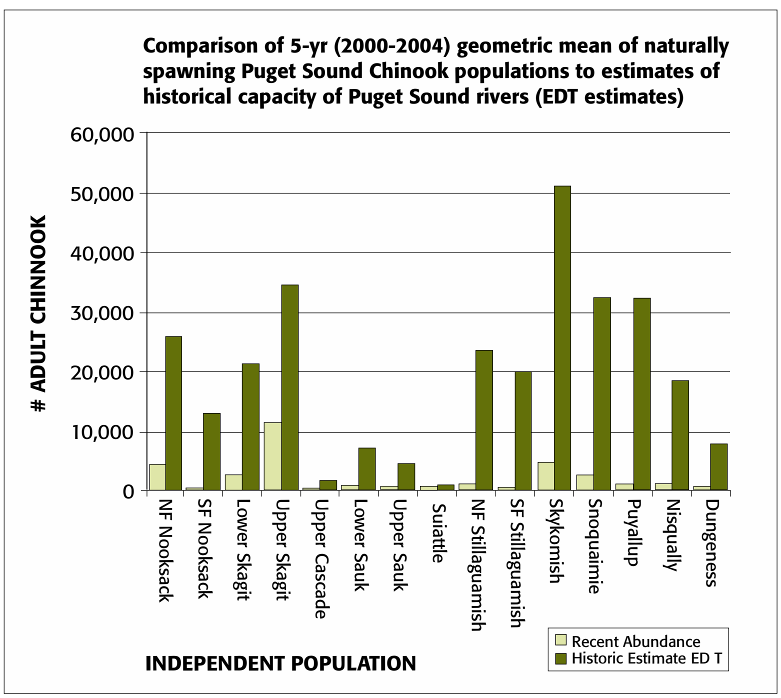

Figure 2.9 is a sampling of historical estimates for the 15 Puget Sound chinook populations for which EDT analysis was available.

Notes on graph: EDT estimates of historical capacity of Puget Sound streams are taken from the 2003 Status Report by the NMFS Biological Review Team, which was based on unpublished data from the Puget Sound TRT and Puget Sound co-managers.

Viability at the ESU Level

In considering the viability of an entire ESU, consideration must be given to additional factors such as catastrophic events that eliminate an entire population, long-term demographic processes that allow populations to colonize new or restored habitat areas, and long-term evolutionary potential. ESU viability guidelines include:

- ESU's should contain multiple populations.
- Some populations in an ESU should be geographically widespread.
- Some populations should be geographically close to each other.
- Populations should not all share common catastrophic risks.
- Populations that display diverse life histories and other attributes should be maintained.
- Some populations should exceed minimum VSP ranges.
- The level of uncertainty about ESU-level processes should be taken into account.

(McElhany, et al., 2000)

by the loss of many of the early-run Chinook populations, underscoring the importance of preserving the remaining early populations. (FIgure 2.7).

Section 4 of the Recovery Plan contains a discussion of the technical guidelines and planning ranges for abundance in determining whether an individual Chinook population can be considered to be viable, and thus at a low risk of extinction.

A viable ESU is similar to a viable population--it is naturally self-sustaining and has a negligible risk of extinction over a time period of more than a century. Guidelines for the ESU level are also similar to those for individual populations, and focus on the risk of catastrophes, maintenance of population processes, and preservation of diversity. These guidelines are described further in Section 4.

Hood Canal Summer Chum

"Ecologically, summer-run chum salmon populations from Washington must return to fresh water and spawn during periods of peak high water temperature, suggesting an adaptation to specialized environmental conditions that allow this life-history strategy to persist in an otherwise inhospitable environment." *FR63; March 10, 1998*

Chum Life History

In addition to the prominent fangs that have given them the nickname "dogs," chum salmon are known for the striking calico pattern of spawning males, which exhibit a bold, jagged reddish and black line along their flank. Chum salmon are second only to Chinook salmon in adult size, with individuals reported up to 43 inches in length and 46 pounds in weight. The average size for the species is around 8 to 15 lbs.

Chum salmon spend more of their life history in marine waters than any other Pacific salmonid species. Juvenile chum migrate to saltwater almost immediately after emerging from gravel, thus their continued survival depends substantially on estuarine conditions (unlike other salmonid species that depend extensively on freshwater habitat). Also unlike other salmon species, chum salmon form schools, a characteristic that is presumed to help them reduce predation.


Photo by Rene Neff

Spawning, Emergence, Estuarine Rearing and Migration

Chum salmon usually spawn in the lower reaches of rivers, probably due to their lack of persistence in overcoming blockages and falls. Although chum may migrate upstream for over 100 miles on some river systems, most of these rivers are low gradient and without substantial blockages. Redds are usually dug in the mainstem or in side channels of rivers beginning just above tidal influence. Some chum salmon even spawn in intertidal zones of streams at low tide, particularly where groundwater upwelling is present. Most chum salmon mature between three and five years of age, with 60 to 90 percent of the fish maturing at four years of age.

Some scientific observations of chum suggest that the returning adults have a greater tendency to stray to other river systems than other salmonids. This is thought to be due to a number of possible factors such as

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their spawning location near the mouths of rivers, which does not afford the juveniles the long downstream migration undertaken by other species during the process of imprinting. Additionally, chum enter streams when they are sexually mature and may not be able to endure a delay, leading them to spawn at the first available location. Additional studies on straying by chum have been inconclusive, and are affected by hatchery releases.

The timing of hatching and the young fry's emergence from gravel varies by stream temperature, dissolved oxygen level, gravel size, salinity and nutritional conditions. Summer chum eggs and alevins (juveniles with egg-sac attached) develop in the redds for approximately 18 - 20 weeks before emerging as fry between February and the last week of May. Outmigration to saltwater may take only hours or days where the spawning sites are close to the river mouth. Estuarine residency is the most critical phase in the life history of chum. They remain close to the surface, rearing in shallow eelgrass beds, tidal creeks, sloughs or other productive estuarine areas for several weeks between January and July.

Although migratory information on chum is limited, both Asian and North American chum are found in the North Pacific and Bering Sea. North American chum salmon are rarely found west of the mid-Pacific ocean, while Asian-origin chum have been shown to migrate eastward of that point. After two to four years in the northeast Pacific ocean, Puget Sound-origin chum reaching maturity follow a southerly migration path parallel to the coastline of southeast Alaska and British Columbia.

In Washington State, fall-timed runs of chum predominate, generally returning to their streams of origin from October to November. However, distinct summer runs of chum in Hood Canal and the eastern Strait of Juan de Fuca spawn from late August to mid-October.

Characteristics of Hood Canal Summer Chum

Data as far back as 1913 have shown a well-defined timing separation of summer and fall runs in Hood Canal, even within the same river system. Despite hatchery releases, a strong temporal separation remains. Hood Canal summer chum spawn soon after they enter freshwater in the lowest reaches of their natal streams. Ninety percent of summer chum in the Quilcene River spawn in the lowest mile. In Salmon Creek the summer chum also spawn within the lowest mile, and in Snow and Jimmycomelately Creeks they spawn in the lowest one-half mile.

Genetic data indicate a strong and long-standing reproductive isolation between Hood Canal summer chum and other chum populations in the United States and British Columbia. Summer chum populations are rare in the southern portion of the specie's range. The high water temperatures and low streamflows in the late summer and early fall are unfavorable for salmonids south of northern British Columbia. The ability of Hood Canal Summer Chum to persist in the face of such hostile conditions led the NMFS Biological Review Team to conclude that these populations contribute to the ecological and genetic diversity of the species as a whole. Although a few summer-run populations are also present in southern Puget Sound, the genetic data indicate that the summer-run populations of Hood Canal and the eastern Strait of Juan de Fuca are part of a much more ancient lineage.

"The Washington Harbor [Klallam] people fish for dog salmon in a creek near Blyn. The chief owns the trap at the mouth of the creek."

Gunther, 1927

Status of the Hood Canal Summer Chum Populations

"Hood Canal and Strait of Juan de Fuca summer chum experienced a severe drop in abundance in the 1980's, and returns decreased to all time lows in 1989 and 1990 with less than a thousand spawners each year," (WDFW/PNPTT, 2000). In response to this alarming decline, the state and tribal co-managers began to implement harvest management actions in 1992 to protect summer chum, and worked with the US Fish and Wildlife Service and citizen groups to initiate hatchery supplementation and re-introduction programs. These combined efforts, known as the "Summer Chum Salmon Conservation Initiative," appear to have contributed to substantial increases of returning summer chum to some streams in the late 1990's. Although the NMFS Biological Review Team acknowledged that the Initiative represented a positive step for the recovery of the ESU, they continue to consider the ESU as likely to become

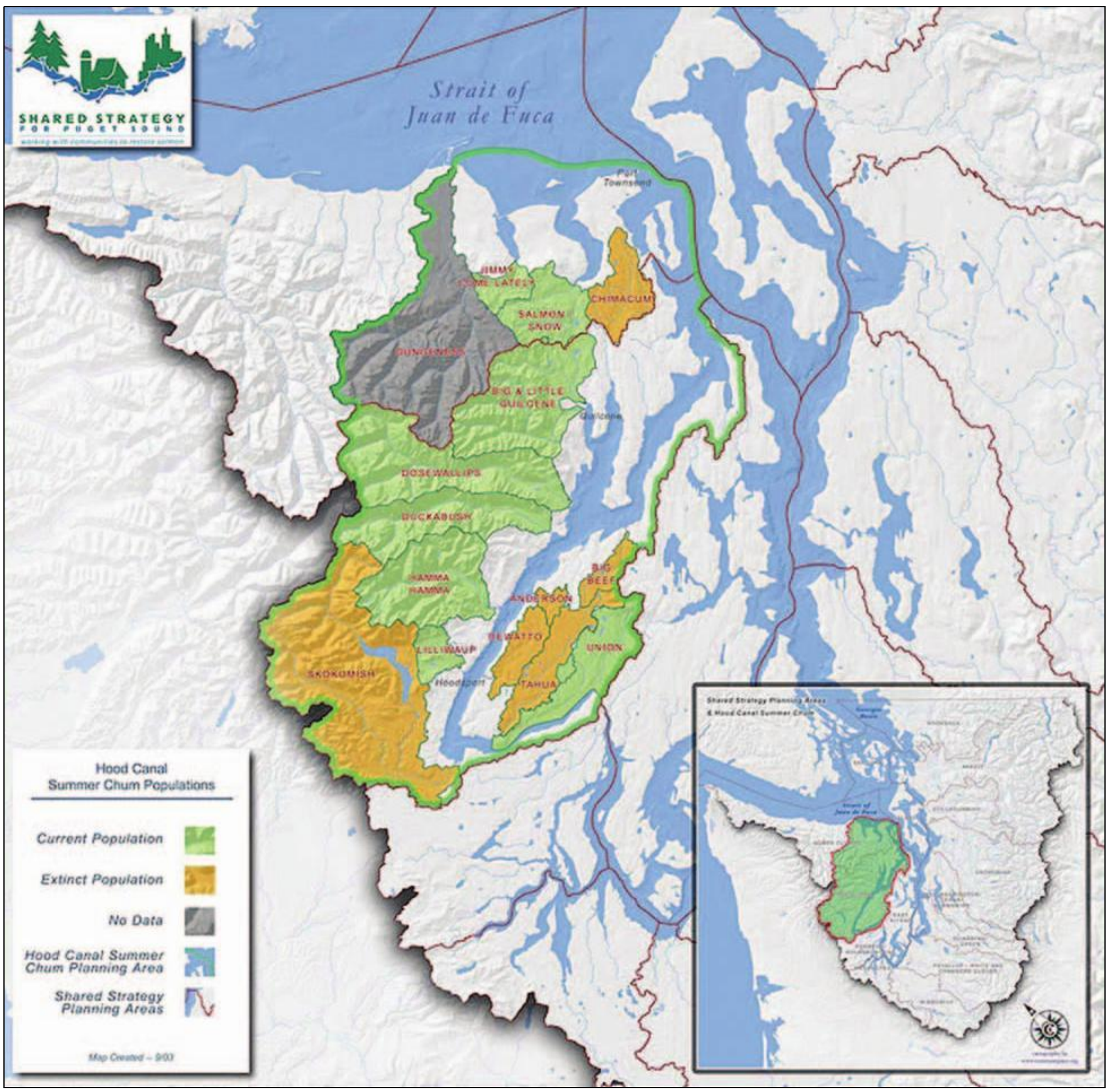

Figure 2.10 Hood Canal Summer Chum Populations and ESU

endangered due to the widespread loss of estuary and lower floodplain habitat, negative interactions with hatchery fish, and high predation by marine mammals.   (BRT 2003)

The Hood Canal Summer Chum Evolutionary Significant Unit

The Hood Canal summer chum salmon ESU includes all naturally spawned populations of summer-run chum salmon in tributaries to the Hood Canal, and in Discovery Bay, Sequim Bay, and the Dungeness River on the Strait of Juan de Fuca (See Figure 2.10).

Sixteen historic populations comprise the Hood Canal summer chum ESU, of which eight currently have existing runs, (see Figure 2.11). Most of the populations which have become extirpated occur on the eastern side of Hood Canal.

Six projects to supplement existing populations and two reintroduction projects are part of the Summer Chum Salmon Conservation Initiative, with the largest supplementation program at the Big Quilcene River fish hatchery. Reintroduction programs have been initiated in Big Beef and Chimacum creeks, where the historical populations are thought to be extinct.

Recent Population Abundance and Trends

The recent abundance of summer chum in Hood Canal and Strait of Juan de Fuca streams ranges from a geometric mean of 10 spawners in Jimmycomelately Creek to just over 4,500 in the Big/Little Quilcene (Figure 2.12). The analysis of long term population trends by the NMFS Biological Review Team indicated that only two naturally spawning populations (Quilcene and Union) are increasing, and the Quilcene's positive growth rate is almost surely due to active supplementation programs. The median long-term trend for the productivity of extant populations is 0.94 (a growth rate of 1.0 indicates that a population or group of populations is just replacing itself). Long term trends are generally computed based on data going back to the early 1970's.

In contrast to the declining long-term trends, most of the naturally spawning populations of Hood Canal summer chum have shown improving productivity in the recent short term. Seven of the eight extant populations in the ESU have been increasing from 1990-2002, reflecting supplementation programs and possible improvements in recent ocean conditions.

Spatial Distribution of Natural-Origin Spawners

Status Reviews of Hood Canal summer chum in 1997 and 2003 indicated concern that most of the historical summer chum stocks on the east side of Hood Canal have been extirpated. The increasing urbanization of Kitsap County was also cited as a threat to the potential to retain or reintroduce sum-

Population	Status	Supplementation/Reintroduction Program
Union River	Extant	Supplementation program began in 2000
Lilliwaup Creek	Extant	Supplementation program began in 1992
Hamma Hamma River	Extant	Supplementation program began in 1997
Duckabush River	Extant	---
Dosewallips River	Extant	---
Big/Little Quilcene River	Extant	Supplementation program began in 1992
Snow/Salmon Creeks	Extant	Supp. program began in 1992 in Salmon
Jimmycomelately Creek	Extant	Supplementation program began in 1999
Dungeness River	Unknown	---
Big Beef Creek	Extinct	Reintroduction program began in 1996
Anderson Creek	Extinct	---
Dewatto Creek	Extinct	Natural re-colonization occurring
Tahuya River	Extinct	---
Skokomish River	Extinct	---
Finch Creek	Extinct	---
Chimacum Creek	Extinct	Reintroduction program

Figure 2.11 Historical populations of summer chum in the Hood Canal ESU (BRT 2003)

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mer chum populations on the east side.

The Puget Sound Technical Recovery Team has preliminarily identified two aggregations of summer chum salmon in the ESU which may constitute independent populations. Stocks in the Hood Canal aggregation include the extant stocks originating in the Big/Little Quilcene, Dosewallips, Duckabush, Hamma Hamma, Lilliwaup and the Union watersheds, as well as those being supplemented in Big Beef Creek and the Tahuya River. The Strait of Juan de Fuca aggregation includes those extant stocks originating in Salmon/Snow Creeks, Jimmycomelately Creek, Chimacum Creek (supplemented stock), and any summer chum salmon that may be spawning in the Dungeness River.

Viability of the Hood Canal Summer Chum ESU

During the preparation of the 2003 update to the chum status review, members of the NMFS Biological Review Team were asked to rate each of the four VSP categories (abundance, productivity, spatial structure and diversity) with respect to the risk of extinction. Despite the recent gains in productivity due to supplementation programs, the Team voted overwhelmingly to retain the Hood Canal summer chum ESU in the "likely to become endangered" category.

Although a population viability analysis for summer chum salmon has not yet been completed, co-managers have continued to develop interim recovery goals with TRT participation. These goals are described further in the Hood Canal Summer Chum Recovery Plan being prepared by the Hood Canal Coordinating Council.

Population	Geometric mean escapement (1999-2002)	Long Term Trend (a value of 1.0 indicates that the population is replacing itself)	Short Term Trend
Union River	594	1.08	1.10
Lilliwaup Creek	13	0.88	1.00*
Hamma Hamma River	558	0.90	1.20
Duckabush River	382	0.91	1.14
Dosewallips River	919	0.96	1.25
Big/Little Quilcene River	4,512	1.05	1.62
Snow/Salmon Creeks	1,521	0.99	1.24
Jimmycomelately Creek	10	0.88	0.82*
* Supplementation programs at Jimmycomelately and Lilliwaup reduced the number of spawners released to achieve escapement naturally.			

Figure 2.12 Abundance and trends of growth/decline for extant populations of summer chum in the Hood Canal ESU (BRT 2003)

Coastal/Puget Sound Bull Trout

"The Coastal/Puget Sound bull trout distinct population segment is thought to contain the only anadromous form of bull trout in the coterminous United States."

FR64; November 1, 1999

Bull Trout Life History

Bull trout are members of the char group of the salmon family. They have light-colored spots on a darker background--the opposite pattern of trout and salmon. Bull trout have a large, flattened head and pale-yellow to crimson body spots on an olive green to brown background. They lack teeth in the roof of their mouth.

Bull trout have more specific habitat requirements than most other salmonid species. Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems and may use certain streams and rivers in the fall and winter when water temperatures have seasonally dropped. Because bull trout inhabit side channels and the margins of streams, they are highly sensitive to flow patterns and channel structure. They need complex forms of cover such as large woody debris, undercut banks, boulders, and pools to protect them from predators and to provide prey. Unlike chum and Chinook salmon, bull trout survive to spawn year after year. Since many populations of bull trout migrate from their natal tributary streams to larger water bodies such as rivers, lakes and saltwater, bull trout require two-way passage for repeat spawning as well as foraging.

Photo courtesy King County Department of Natural Resources & Parks.

Spawning, Emergence, Rearing and Migration

While some bull trout are migratory, spending portions of their life cycle in larger rivers, lakes or marine waters before returning to smaller streams to spawn, other bull trout reside in a particular stream where they complete their entire life cycle. Migratory bull trout spawn in cold upstream tributaries and rear there for one to four years before migrating to a river, lake or estuary/nearshore area. Resident bull trout are

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smaller than their migratory counterparts, with an average size of six to twelve inches. Migratory bull trout are typically 24 inches or more. The largest bull trout ever verified was 32 lbs., caught in Lake Pend Oreille, Idaho in 1949.

Spawning occurs in the late summer and early fall. Bull trout spawn in the low gradient sections of high gradient streams with clean, loose gravel and water temperatures of five to nine degrees Celsius (41-48 F). Bull trout can use habitat that is not available to Chinook because of their small size and their ability to inhabit colder water. Depending on water temperature, egg incubation is 100 to 145 days. The fry emerge from gravel in early April to May, depending on temperature and flow conditions. After one to three years in an upper watershed, migratory bull trout travel downstream, usually in the spring months, where they enter a larger body of water. Bull trout have a high degree of fidelity to their natal streams and straying is rare.

While all bull trout are opportunistic eaters, feeding on insects, macrozooplankton, and crayfish, migratory bull trout are primarily "piscivorous"--they prey mostly on juvenile trout, salmon and other species of fish. Like other salmonids, the availability of food sources for newly hatched bull trout is particularly important. An adequate food base is critical to sustaining migratory bull trout in freshwater systems as well as saltwater forage areas.

Bull trout are repeat spawners, and may live 12 years or more, spawning annually or bi-annually in headwater areas, and returning to larger rivers, lakes or estuaries to forage. Repeat spawners are extremely important to the long term persistence of bull trout populations; they typically have greater fecundity, and these survivors have multiple opportunities to contribute to the gene pool.

Migratory corridors which link the various habitats at different seasons for all of the life history stages are also essential to the persistence of bull trout populations. Bull trout are thought to have metapopulations, i.e. a network of local subpopulations with an interchange of migration and gene flow. The alteration of habitat, primarily through the construction of impoundments, dams and water diversions, has fragmented habitats, eliminated migratory corridors, and isolated bull trout local populations.

Characteristics of Coastal/Puget Sound Bull Trout

Although both resident and migratory forms of bull trout are present in the Coastal/ Puget Sound bull trout population segment, it is the only known segment of bull trout in the United States that includes the anadromous life history form (spawns in freshwater, migrates to saltwater and returns to freshwater to spawn). Technically, Coastal/Puget Sound bull trout are "amphidromus"--unlike strict anadromy, amphidromus individuals often return seasonally to freshwater as sub-adults, sometimes for several years, before returning to their natal tributary to spawn. These sub-adult bull trout move into marine waters and return to freshwater to take advantage of seasonal forage opportunities to feed on salmonid eggs, smolts or juveniles. Bull trout in the Coastal/Puget Sound population segment also move through the marine areas to gain access to independent streams to forage or take refuge from high flows.

Bull trout target a variety of estuarine and nearshore marine forage fish such as sandlance, surf smelt and herring, and depend on the persistence of productive forage fish spawning beaches and intertidal habitats such as eelgrass beds and large woody debris. These populations can migrate extensively while in the marine waters of Puget Sound, the Strait of Juan de Fuca and the Pacific Ocean; but there is currently no evidence that they make long off-shore migrations similar to other salmon.

Also unique to the Coastal/Puget Sound bull trout population segment is the overlap in distribution with Dolly Varden, another native char species. The two species are genetically distinct, but very difficult to differentiate visually. Within the Coastal/ Puget

Bull Trout Core Areas

A **"core area"** represents the closest approximation of a biologically functioning unit for bull trout. A core area is a combination of core habitat (i.e. habitat with all necessary components for spawning, rearing, foraging, migrating and overwintering) and a core population. The designation of core areas is an update from the classification of sub-populations that was used by the US Fish and Wildlife Service in the 1999 listing information (64FR 58910).

The term **"local population"** is similar to the definition used by NMFS as a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) that is reproductively isolated to a substantial degree. USFWS defines a **"potential local population"** as a local population that likely exists but has not been adequately documented, or that is likely to develop through re-colonization following habitat restoration.

Sound region, Dolly Varden tend to be isolated populations located in tributaries above natural barriers, while bull trout are found below the barriers.

Status of the Coastal/Puget Sound Bull Trout Distinct Population Segment

Although specific data on population abundance, trends and spatial distribution is scarce, ample information exists to indicate that the bull trout are threatened. Population abundance and distribution has declined within many individual river basins, and habitat is severely fragmented in many instances. Bull trout display a high degree of sensitivity to environmental disturbance and have been significantly impacted by habitat degradation similar to other listed and sensitive species. In addition to migratory barriers, such as dams or diversion structures which isolate populations, bull trout are threatened by poor water quality, sedimentation, harvest and the introduction of non-native species. Although several populations lie completely or partially within national parks or wilderness areas, these local populations are threatened by the presence of introduced brook trout or from habitat degradation outside of the park boundaries.

Based on biological and genetic information, the US Fish and Wildlife Service has delineated two management units in the Coastal/Puget Sound population segment. Olympic Peninsula bull trout populations are thought to differ from those in the Puget Sound management unit, which originate in watersheds on the western slopes of the Cascade Mountains. Although the two units are connected by marine waters, there is currently no evidence that bull trout from Puget Sound migrate to the Strait of Juan de Fuca or Hood Canal.

Olympic Peninsula Management Unit

The Olympic Peninsula Management unit includes all watersheds within the Olympic Peninsula and the nearshore marine waters of the Pacific Ocean, Strait of Juan de Fuca, and Hood Canal. Six core areas are contained within this management unit, with a total of 10 local populations and 2 potential local populations (Figure 2.14).

The six identified core areas all play a critical role in the recovery of bull trout in the Olympic Peninsula Management Unit, and are vital to maintaining the overall distribution of bull trout in the Coastal/Puget Sound region. The Skokomish core area is the only core area on the eastern portion of the Olympic Peninsula and the only core area draining into Hood Canal. Additionally, it is the only population with long term monitoring data on abundance trends and distribution within the Olympic Peninsula Management Unit. Due to the low abundance of local populations and the fragmentation of habitat from dams, the Skokomish core area is considered to be the most depressed core area within the Olympic Peninsula management unit. The Dungeness and Elwha are the only core areas connected to the Strait of Juan de Fuca. Little is known about

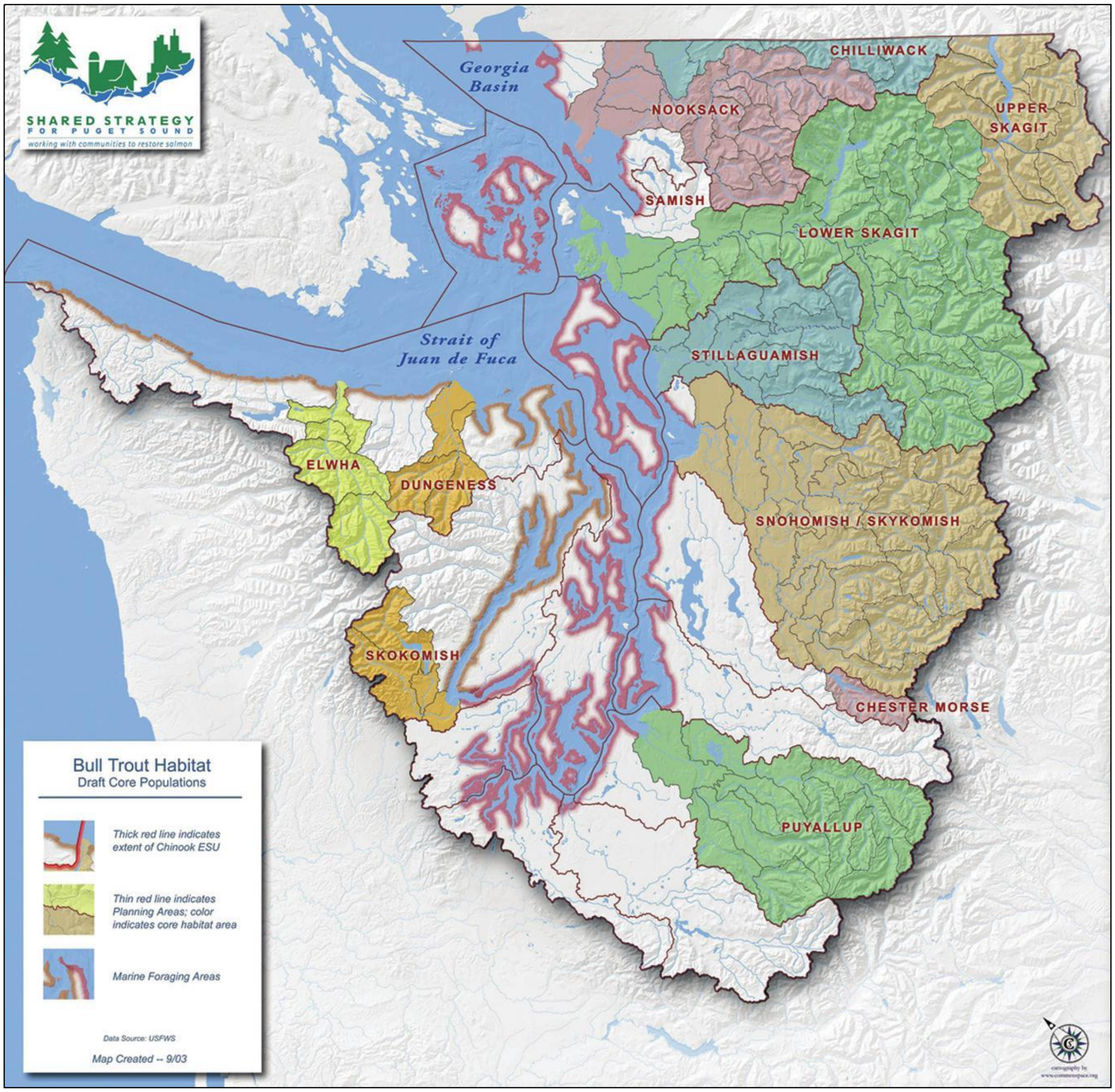

Figure 2.13 Indicates where bull trout core areas overlap with the Puget Sound Chinook ESU. Hoh, Quinault, and Queets core areas are located along the Pacific Coast of the Olympic Peninsula and are not included on this map.

spawning abundance or distribution within these systems, but it is believed that most of the spawning and rearing habitat for the Elwha core area is in the Olympic National Park. Of the Pacific coastal streams, the Hoh has had the highest number of observed redds, with 24 redds in 1998. This low abundance is fewer than what is believed to be necessary to reduce the risk from genetic inbreeding. Due to the lack of information on bull trout abundance and trends in all of the core areas other than the Skokomish, the status of these areas is classified as unknown.

Several independent tributaries (streams which empty directly to saltwater) on the Olympic Peninsula are used by bull trout for forage and refuge, but are not believed to support spawning populations. These tributaries include Bell, Morse, Ennis, and Siebert Creeks in the Strait of Juan de Fuca; Goodman, Cedar, Kalaloch, Steamboat, Mosquito, and Joe Creeks, and the Raft, Moclips, and Copalis Rivers on the coast; and Wishkah and Humptulips Rivers in Grays Harbor. Snorkeling surveys conducted as recently as the 1980's in independent tributaries to Hood Canal documented the pres-

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Core Areas	Local and Potential Local Populations	Information on Abundance, Trends and Distribution	Status
Skokomish	S. Fork Skokomish	S. Fork Skok: <60 documented adults. N. Fork Skok: Approx 100 documented adults; population declined 1993 to 2002 Cushman dam has isolated and fragmented populations.	Depressed
	N. Fork Skokomish		
	Brown Creek (potential)		
Dungeness	Middle Dungeness & tribs. to river mile 24	Multiple age classes have been documented in the middle Dungeness. Spawning has been documented in the Gray Wolf River.	Unknown
	Gray Wolf River		
Elwha	Elwha	Limited information on abundance or trends. Dams have isolated and fragmented Elwha population.	Unknown
	Little River (potential)		
Hoh	Upper Hoh	S. Fork Hoh had 236 adults in 2002. The Hoh River appears to have the highest number of redds of Pacific coastal streams.	Unknown
	S. Fork Hoh		
Quinault	N. Fork Quinault	The Quinault basin appears to support all life history forms of bull trout.	Unknown
	E. Fork Quinault		
Queets	Queets	Bull trout in the Queets River are considered to be healthy by WDFW.	Unknown

Figure 2.14 Olympic Peninsula Bull Trout Core Areas, Local Populations and Status

ence of bull trout in several rivers including the Quilcene, Dosewallips, Duckabush and Hamma Hamma; however recent surveys by Olympic National Park detected no bull trout in independent tributaries to Hood Canal. Anadromous bull trout usage of nearshore marine waters and estuaries for migration, overwintering and foraging has been confirmed throughout the Olympic Peninsula Management Unit.

Puget Sound Management Unit

The Puget Sound Management Unit encompasses all watersheds within the Puget Sound basin and the Chilliwack River watershed, a transboundary system flowing into British Columbia, Canada and discharging into the Fraser River. The management unit is bounded by the Cascade Mountain crest on the east, the Kitsap Peninsula on the west, and the Canadian border to the north. The US Fish and Wildlife Service has identified eight core areas with 57 local populations and five potential local populations (see Figure 2.15). In addition to the core areas, important forage, migration and overwintering habitat are found in the Samish River, Lake Washington system, Lower Green River, Lower Nisqually River; however, no spawning populations have currently been detected in these systems. These areas in addition to the marine areas of Puget Sound, are essential to the unique migratory requirements of anadromous bull trout.

Each of the eight core areas is vital to maintaining the overall distribution of bull trout within the management unit. However, the Lower Skagit is distinctive in its geographic size and population abundance, making it central to the maintenance of anadromous bull trout within the Puget Sound Management Unit. Additionally, the Nooksack, Stillaguamish, Snohomish-Skykomish, and Puyallup core areas are critical for maintaining the distribution of the anadromous life history form. The Puyallup core area is the only major watershed in south Puget Sound supporting a population.

Bull trout are present in nearly all of the watersheds in Puget Sound where they historically occurred, with the probable exception of the Nisqually River where few observations are reported in the recent past. Dolly Varden are confirmed only in the Upper Skagit and Nooksack core areas.

All life history forms are present within the Puget Sound unit. Two naturally-occurring adfluvial populations (migrate to lakes) are present--the Chester Morse Lake in the upper Cedar River, and Chilliwack Lake in upper Chilliwack. Prior to the modification of the Skagit system for hydroelectric production, adfluvial forms are unknown, but there are now adfluvial populations in Gorge, Diablo and Ross Lakes in the Upper Skagit.

Generally, bull trout distribution has contracted and abundance declined in the southern portion of the Puget Sound Management Unit. Data on abundance is limited throughout the unit. The US Fish and Wildlife Service has evaluated the level of risk from stochastic events for each of the core areas (risk to continued survival of the populations from floods, landslides and other events affecting the population and its habitat), and their findings are summarized in Figure 2.15.

Bull trout have declined due to many of the same threats facing other listed salmonid species, including habitat degradation and fragmentation, blockage of migratory corridors, poor water quality and past fisheries management. They are particularly vulnerable to activities that warm their spawning and rearing waters, and have been heavily impacted by the introduction of non-native species such as brown, lake and brook trout. Although bull trout occur over a large geographic area, many of the populations are small and isolated from each other, making them more susceptible to local extinctions. Threats for each core area are described in the draft Coastal/Puget Sound Bull Trout Recovery Plan (USFWS, 2004).

Evaluation of Risk to Bull Trout Populations in the Puget Sound Unit

In general, populations were considered to be at **"diminished risk of adverse effects"** by the USFWS where spawning populations are numerous and well distributed, abundance is high enough to avoid genetic drift, and a migratory life form was present and had connectivity with other local populations.

Populations at **"intermediate risk"** generally have low numbers of local populations, and spawning areas are few and not widespread. Another criterion was the presence of a migratory life form in at least some local populations with a partial ability to connect with other local populations.

Those populations with low levels of abundance, few known spawning areas, and/or where a migratory life form was absent from the local population, or was present and lacked connectivity, were considered to be at an **"increased level of risk."**

Core Areas	Local and Potential Local Populations	Information on Abundance, Trends and Distribution	Risk from Stochastic Events
Chilliwack	Little Chilliwack River Upper Chilliwack River Selesia Creek (British Columbia & US) Depot Creek (BC & US) Airplane Creek (BC) Borden Creek (BC) Centre Creek (BC) Foley Creek (BC) Nesakwatch Creek (BC) Paleface Creek (BC)	Chilliwack Lake is an important source of rearing and forage for most local populations.	Intermediate risk if only the US populations are considered. Diminished risk if both US and Canadian populations are considered.
Nooksack	Lower Canyon Creek Glacier Creek Lower Middle Fork Nooksack R Upper MF Nooksack River Lower North Fork Nooksack R Middle NF Nooksack River Upper NF Nooksack River Upper South Fork Nooksack R Lower SF Nooksack River Wanlick Creek	Spawning occurs in all three forks of the Nooksack River and its tributaries. Fewer than 1000 spawners; most local populations have less than 100 adults.	Intermediate Risk
Lower Skagit	Bacon Creek Baker Lake Buck Creek Cascade River South Fork Cascade River Downey Creek Goodell Creek Illabot Creek Lime Creek Milk Creek Newhalem Creek Forks of Sauk River Upper South Fork Sauk River Straight Creek Upper Suiattle River Sulphus Creek Tenas Creek Lower White Chuck River Upper White Chuck River Sulphur Creek -Lake Shannon (potential local population) Stetattle Creek-Gorge Lake (potential local population)	Bull trout are known to spawn and rear in at least 19 streams/ stream complexes. This core area supports a spawning population of migrating bull trout numbering in the thousands. Connectivity and diversity of habitats are excellent except portions modified by dams. High abundance of pink salmon for forage.	Diminished Risk
Upper Skagit	Big Beaver Creek Little Beaver Creek Lightning Creek Panther Creek Pierce Creek Ruby Creek Silver Creek Thunder Creek (Diablo Lake) Deer Creek (Diablo Lake) (potential local population) Skagit River (BC) East Fork Skagit River (BC) Klesilkwa River (BC) Nepopekum Creek (BC) Skaist River (BC) Sumallo River (BC)	Populations are well distributed. British Columbia portion presumed healthy; status is generally unknown. 2 areas of concern due to lack of connectivity: Diablo Lake and Gorge Lake.	Intermediate risk if only the US populations are considered. Diminished risk if both US and Canadian populations are considered.
Stillaguamish	Upper Deer Creek South Fork Canyon Creek North Fork Stillaguamish River South Fork Stillaguamish River	Few known spawning areas. Fewer than 1000 spawners; most local populations have less than 100 adults. Snorkel surveys have found greater than 100 adults in the North Fork Stillaguamish R.	Increased risk

Core Areas	Local and Potential Local Populations	Information on Abundance, Trends and Distribution	Risk from Stochastic Events
Snohomish-Skykomish	North Fork Skykomish River South Fork Skykomish River Salmon Creek Troublesome Creek (primarily a resident population)	Area has few known spawning areas and total number of adult spawners is 500-1000. System has no lakes. Large portion of migratory segment are anadromous. North Fork Sky considered healthy by WDFW with 470-650 individuals on average, based on redd counts. South Fork Sky considered healthy by WDFW due to increasing numbers, and recolonization is occurring.	Increased risk
Chester Morse Lake	Boulder Creek Upper Cedar River Rex River Rack Creek Shotgun Creek (potential local population)	Area has few known spawning areas. Surveys in 2000-2002 documented 236-504 redds, with estimated 500-1000 spawners. Upper Cedar River and Rex River are the primary local populations in this core area. Upper Cedar River is the only known self-sustaining population in the Lake WA basin.	Increased risk
Puyallup	Carbon River Greenwater River Upper Puyallup and Mowich Rivers Upper White River West Fork White River Clearwater River (potential local population)	Fewer than 1000 spawners; most local populations have less than 100 adults. Known spawning areas are few and not widespread. Area has a low number of local populations. Portions within the National Park and wilderness area provide pristine habitat.	Intermediate risk

Figure 2.15 Bull Trout Core Areas, Local Populations and Risk Levels for the Puget Sound Management Unit

References

Puget Sound Chinook

Croot, C. and L. Margolis, 1991. Pacific Salmon Life Histories. University of British Columbia Press. Vancouver, BC.

63 Federal Register 11484, 3/9/98. Proposed Rule: Threatened Status for Puget Sound Chinook ESU.

64 Federal Register 14308, 3/24/99. Final Rule: Threatened Status for Puget Sound Chinook ESU.

65 Federal Register 7764, 2/16/2000. Final Rule Designating Critical habitat for Puget Sound Chinook and Hood Canal Summer Chum.

Gunther, Erna; 1927. Klallam Ethnography

McElhany, P., M. Ruckelshaus, M.J. Ford, T. Wainwright and E. Bjorkstedt. 2000. Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units. U.S. Dept. Commerce, NOAA Tech. Memorandum NMFS-NWFWC-42, 156 pp.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

National Marine Fisheries Service, Northwest Region; Puget Sound Treaty Tribes and Washington Department of Fish and Wildlife, 2004. Puget Sound Chinook Harvest Resource Management Plan Draft Environmental Impact Statement." USDA/NOAA. Seattle, WA.

National Marine Fisheries Service; West Coast Chinook Salmon Biological Review Team, 2003. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. Available from the NMFS Northwest Fisheries Science Center; Seattle, WA.

National Research Council, 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academy Press. Washington, D.C.

Puget Sound Technical Recovery Team, 2002. Planning Ranges and Preliminary Guidelines for the Delisting and Recovery of the Puget Sound Chinook Salmon Evolutionarily Significant Unit. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington. [NOTE: THIS IS THE "BLUE PAPER"]

Puget Sound Technical Recovery Team. 2005. ESU Viability Criteria for the Puget Sound Chinook Evolutionarily Significant Unit. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Puget Sound Technical Recovery Team. 2005. Independent Populations of Chinook Salmon in Puget Sound. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Hood Canal Summer Chum

Chum Status Reviews 1997 and 2003 by the Biological Review Team Federal Register 63, 3/10/98

Draft HC/Eastern SJF Summer Chum Salmon Recovery Plan, June 21, 2004 Gunther, Erna; 1927. Klallam Ethnography

Summer Chum Salmon Conservation Initiative; April 2000. WDFW and PNP Treaty Tribes

Coastal/Puget Sound Bull Trout

64FR 58910 (November 1, 1999)

US Fish and Wildlife Service, June 22, 2004. News Release re: Critical Habitat Proposed for Washington's Coastal-Puget Sound Population of Bull Trout.

U.S. Fish and Wildlife Service, 2004. Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (Salvelinus confluentus). Available from U.S. Fish and Wildlife Service Region 1; Portland, OR.

U.S. Fish and Wildlife Service, 2/24/2004. Preliminary Technical Assistance for Bull Trout Recovery Planning Efforts (Puget Sound Management Unit and Olympic Peninsula Management Unit).). Available from U.S. Fish and Wildlife Service Region 1; Portland, OR.

CHAPTER 3

Factors Affecting Puget Sound Salmon and Bull Trout

Habitat Factors Affecting Puget Sound Chinook Salmon and Bull Trout

"Puget Sound is like a large water bucket, full of habitat and life. Habitat losses are the holes in the bucket, and many small holes can eventually drain it. Restoration is the process of plugging the holes while protection is to prevent new holes from being formed, allowing the bucket to fill once again through natural processes."

Jacques White, The Nature Conservancy

Puget Sound settlers and tribes in the 19th Century were so accustomed to the abundance of salmon that shortages were unthinkable. Salmon had been a constant and reliable part of the tribal diet for millennia, and were an important source of sustenance for pioneer families. In 1870, the human population of the entire state numbered less than 24,000, and hundreds of thousands of Chinook salmon returned to Puget Sound rivers. Today these numbers have dramatically reversed. In addition to salmon and other marine resources, early settlers found vast stands of virgin timber, fertile river deltas suitable for agriculture, and numerous bays ideally situated for shipping and commerce. As the face of the Puget Sound landscape changed, so too did the processes that formed and sustained the habitat for salmon.

Numerous reports document the decline of salmon abundance on the west coast of the United States as a result of loss, damage or change in their natural environment. Early logging practices removed the backbone of the watersheds that had been formed by old-growth riparian forests, stripping off shade, protective cover and food supplies for the salmon. Access to important spawning and rearing areas was eliminated as a result of dams, culverts and other barriers. Other important areas for incubation and forage have vanished due to the placement of dikes, fill or structures in riparian zones and estuaries. Patches of habitat have become so fragmented that they are no longer usable by salmon as they move through their life cycle in time and space.

Scientists distinguish between the outright loss of habitat quantity and the loss of ecosystem processes that once served to form and rebuild the variety of habitat structures salmon depend on. The amount of habitat that is usable by salmon is a fraction of what was once present in Puget Sound, and the ability of salmon to recover to sustainable and harvestable levels depends directly on an increase in the quantity of available habitat of sufficient quality. Additionally, effective recovery strategies must focus on restoring the ecosystem processes that build salmon-friendly rivers and estuaries so they will sustain salmon and other ecosystem functions in the long term. Although every restoration project helps, piecemeal actions that are largely "random acts of kindness" for salmon will not achieve long term recovery in the same way as the restoration of fundamental ecosystem functions in the watersheds and estuaries.

Habitat impairments affecting Chinook salmon and bull trout in Puget Sound have been described generically and locally in numerous scientific publications as well as the watershed chapters (see box on next page), thus an exhaustive list and description is not provided in this chapter. The first section provides an overview of the changes in the Puget Sound landscape over the last 100 years and a sample of the changes and impacts in specific watersheds around the region. The following section briefly discusses the relationship of land use activities to the habitat forming processes upon which salmon depend and describes the technical studies of habitat available for Puget Sound watersheds. The statutory framework and other conservation activities in Washington are discussed later.

Puget Sound Land Use History and Habitat Change

When Captain George Vancouver sailed into the soft grey fog of Puget Sound waters in 1792, an estimated 50,000 Indians lived in scattered villages near most of the river mouths. The Puget Sound tribes were experts at gathering food from the teeming waters of area rivers and bays, and traveled seasonally through well-defined local territories for fishing, hunting and gathering. Fur traders and missionaries soon followed Vancouver and other explorers, putting the region on a trajectory of increasing population growth and accelerated landscape change.

Timber Harvest

Coastal Indians utilized the forest to construct cedar plank longhouses, canoes, weapons, utensils, ceremonial objects and cedar bark clothing. The huge trees formed the structure for salmon and bull trout habitat in Puget Sound watersheds. Interlocking root systems stabilized streambanks and retained soil. As trees fell into the rivers, pools and logjams formed, creating cover and low velocity areas where salmon could rest. Massive logjams moderated water velocity and interrupted the transport of sediment, providing ample areas suitable for spawning. Temperatures were kept cool by the dense shade, and insect production was high, thus salmon emerging from their redds (nests) found plenty to eat. Salmon thrived on the slowly but constantly changing environment, where pools and spawning areas could shift and re-form as wood, water and soil moved downstream. The large trees and rootwads washing down from the upper watersheds continued to provide structure and cover along the saltwater shore zones of Puget

Key documents which describe the factors that have led to the decline of Chinook, bull trout and other species of salmon include:

General information on habitat impacts to salmon:

- "Upstream: Salmon and Society in the Pacific Northwest" (National Research Council, 1996)
- "An Ecosystem Approach to Salmon Conservation" by Management Technology. (Spence, et al., 1996)
- "Factors for Decline: A Supplement to the Notice of Determination for West Coast Steelhead" (NMFS, 1996)
- "Factors Contributing to the Decline of West Coast Chinook Salmon: An Addendum to the 1996 West Coast Steelhead Factors for Decline Report" (NMFS, 1998)

Information on habitat conditions specific to Puget Sound and local watershed areas:

- "Salmon and Steelhead Habitat Limiting Factors" reports for each Water Resource Inventory Area in Washington State (Washington State Conservation Commission, 1998-2004 depending on WRIA)
- "State of Our Watersheds Report: WRIAs 1-23 (Salmon and Steelhead Habitat Inventory and Assessment Program, Northwest Indian Fisheries Commission, 2004)
- "Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout—Olympic Peninsula and Puget Sound Management Units" (USFWS, 2004)
- "State of the Sound 2004" and previous reports of the Puget Sound Action Team
- See also, watershed chapters.


Photo courtesy the Washington State Salmon Recovery Funding Board.

Sound as well, protecting the migrating salmon as they moved through the saltwater.

"Perhaps no other structural component of the environment is as important to salmon habitat as is large woody debris, particularly in coastal watersheds."

(National Research Council, 1996)

The stands of ancient forest remained largely untouched until the 1840's when small mills were constructed to supply building materials for local settlers. The arrival of the trans-continental railroad in the 1870's also brought tough and energetic lumbermen, who greatly accelerated the harvest of trees, and marketed them to the growing population in the East. Enormous tracts of timberland were purchased from the railroad companies, and large mills were constructed throughout Puget Sound ports and railroad terminuses, dumping unprecedented amounts of concentrated nutrients into Puget Sound waters from the production of lumber, pulp and paper.

The most accessible timber was that located along the Puget Sound river systems, and riparian stands in lowland areas were soon liquidated and floated downstream, removing the shade, cover and food supply for salmon. A common practice was that of "splash-damming." On many rivers and streams, small temporary dams were built. Thousands of logs were stored behind these dams, and when the timing was right, the dam was destroyed with carefully placed dynamite charges, sending a wall of water and wood down the channel towards the waiting mills. Miles of salmon habitat were scoured to bedrock by these manmade floods. As Puget Sound residents started to experience the effects of erosion and flooding from poor early timber practices, the industry began to improve harvest methods and protect environmental functions. Many upland areas remained relatively unharmed or were allowed to re-grow and heal, but the long lasting effects from permanent removal of the forest canopy in some locations, loss of the structure provided by massive old-

Timber harvest impacts are not limited to private timberlands.

- 5,451 miles of road development occurs in the Olympic and Mt. Baker-Snoqualmie National Forest land surrounding Puget Sound
- A majority of stream crossings in the national forest road system in the Pacific Northwest cannot tolerate more than a 25-year flow event without the failure of culverts and other structures associated with the road system.

(Report from the Federal Ecosystem Management and Assessment Team; part of the Northwest Forest Plan.)

growth trees along rivers and shorelines, and the erosion from the construction and failure of logging roads continue to degrade aquatic habitat.

Agriculture

The broad, flat river deltas at the mouths of most large Puget Sound rivers attracted settlers anxious to secure a land base and supply farm products to the growing towns. By 1900 the basic farming patterns in western Washington had been established for the next century. Vegetables, bulbs, hops and berries were largely grown in the fertile river deltas, while dairy farming took hold in the foothills near large cities and towns. The expansion of farmland resulted in the removal of streamside vegetation and elevated water temperatures, which reached lethal levels for salmon in some tributaries. Salmon were further impacted by chemical and nutrient fertilizers and fine sediments from farm runoff.

Lowland deltas underwent further modification by agricultural workers who were able to expand their land base and improve crop growth by diking, draining and filling wetland areas and tidal marshes. The loss of these crucial estuarine sloughs and marsh areas for juvenile salmon, needed for their physiological adjustment to saltwater, had a profound effect on the survival of salmon. Recent studies of the Skagit River delta, for example, have estimated that 72% of intertidal and estuarine marsh habitat has been lost, coinciding with the modification of the basin for agriculture and other land uses. Skagit system studies further indicate that the quantity of certain types of delta habitat may have a major effect on juvenile Chinook productivity (Beamer, et al., 2004).

Low flows related to water withdrawals for agricultural irrigation have further stressed both adult and juvenile salmon. In some rivers, water rights were granted to remove instream flows as early as 1896. In the Dungeness watershed alone, over 100 miles of irrigation canals and ditches legally diverted the bulk of the river's flow in the late summer-the peak spawning season for Chinook salmon. Prior to the 1960's, the irrigation outtakes from the river were largely unscreened, and juvenile salmon were lost in the maze of ditches and laterals that wan-

Photo by Dan Kowalski.

dered through the fields. The irrigation system in the Dungeness is largely unique to western Washington, but water withdrawals from surface and groundwater sources are used to water crops in several major river basins of Puget Sound.

Water quality problems have been experienced in several watersheds with high proportions of agricultural land use. In the Nooksack basin, water temperatures reaching the threshold of mortality to salmon have been documented in several tributaries, along with high levels of nitrogen, phosphorous and fine sediments. Several Nooksack tributary streams are included on the list of impaired water bodies under Section 303(d) of the Clean Water Act for warm water temperatures, fine sediments, fecal coliform levels, chemical contamination and low instream flows (WCC, 2002). These problems are not the sole result of agricultural practices, as urban runoff, wastewater treatment and other inputs add to the mix.

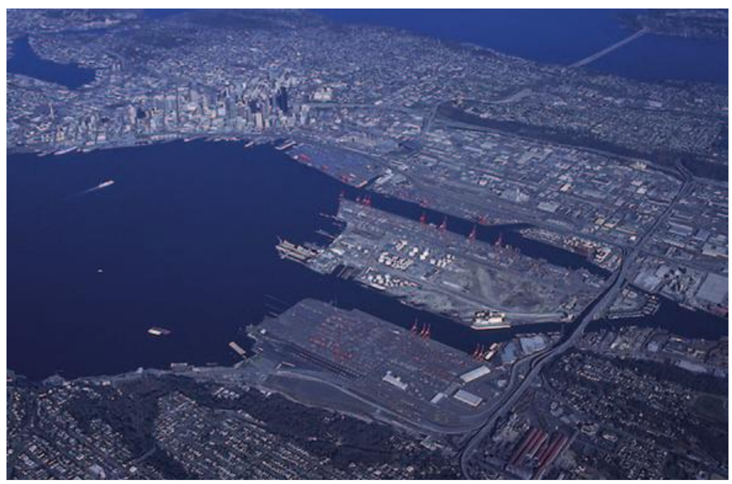
Farming practices in the second half of the 20th century incorporated lessons learned from the Great Depression and dust bowl years. National initiatives were implemented to form soil and water conservation districts, and similar efforts were organized in Puget Sound to help control erosion and chemical contamination from agriculture. "Best management practices" for farming were developed and are continually being refined, but the extent of implementation of these practices still varies widely around Puget Sound. Many individual farmers are avid fishermen themselves, and have worked toward the improvement of water quality and quantity in their farming practices, but the cost of these improvements often limits what they can do. Farmers presently struggle to retain economic viability in the face of competitive markets, escalating land values and urban/suburban development pressures. The greatest restoration potential for salmon habitat today probably occurs on these agricultural parcels of land, which still have no pavement or other extensive infrastructure which would be costly to modify or remove in order to restore habitat features.

"Farmers in Snohomish County look toward seven generations, but it's hard to see what will happen in the next seven years."

Aaron Reardon, Snohomish County Executive

Urbanization

Early explorers to Puget Sound immediately recognized the region's geographic potential for commerce and trade, and the ideal configuration of protected harbors with year-round access. Proximity to timber resources also promoted major shipbuilding centers, which occurred in Port Townsend, Tacoma, Everett, Bellingham, Olympia and Seattle. However it was the Alaska Gold Rush of 1897 to



1903 which made Seattle into the largest city and seaport in the Pacific Northwest. The miners used the port to purchase supplies and ship them north, and shipped the gold back to determine its value. Returning miners spent their millions in the Puget Sound economy and often settled in the Seattle area. Between 1900 and 1910 the population of Seattle grew from 81,000 to 237,000 (Lambert, 2001).

Although the urbanization of Puget Sound slowed somewhat during the Great Depression, the advent of World War II and the growth of the aviation industry once again caused the population to soar.

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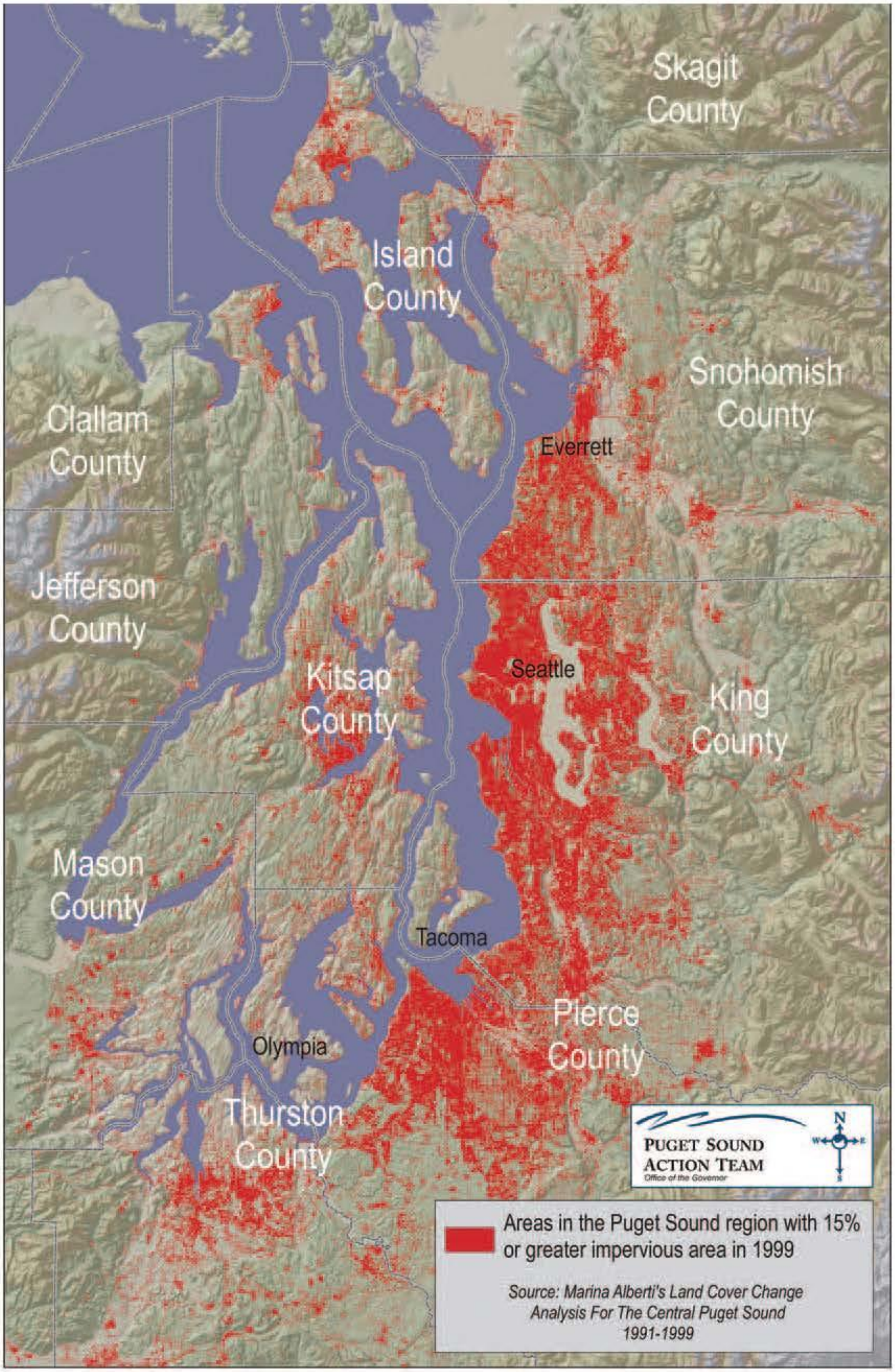


Figure 3.1 indicates the amount and location of impervious surface in the Puget Sound region. Map courtesy the Puget Sound Action Team

Today the cities of Seattle, Everett and Tacoma form a metropolitan area of over three million people along the Interstate 5 corridor. Suburbs and small cities have rapidly filled in the spaces in between, and a complex human-constructed network of roads, bridges, and utilities provide residents with transportation corridors, power, water supply and waste disposal. This system of urban infrastructure has largely displaced the natural network which once sustained salmon habitat throughout the freshwater and nearshore areas of Puget Sound.

Streams in heavily urbanized areas have lost much of their complexity and riparian vegetation. For example, Thornton Creek in the Seattle area lost all of its wetlands and 60% of its open channel network during 100 years of development. The remaining stream system is heavily armored with rock and concrete along its banks, has extensive culverts and pipes, and little native vegetation remains. Despite heavy outplants of salmon into the creek for many years, only a handful of returning adults have been observed in recent years.

When watersheds are urbanized, problems may result simply because structures are placed in the path of natural runoff processes. In almost every point that urbanization activity touches the watershed, sources of pollution occur. Water infiltration is reduced due to an increase in impervious surfaces. As a result, runoff from the watershed is flashier, with increased flood hazard. Flood control and land drainage schemes may concentrate runoff, resulting in increased bank erosion, eventually causing widening and downcutting of the stream channel. Sediments washed from the urban areas contain trace metals such as copper, cadmium, zinc, and lead. These together with pesticides, herbicides, fertilizers, gasoline and other petroleum products, contaminate drainage waters and harm aquatic life necessary for salmon survival (FR 62, 5/6/97).

Wastewater treatment plants contribute additional metals and contaminants such as ammonia, chloride, aluminum, boron, iron, manganese, oil/grease, PCBs and other toxic substances.

"As cities around the Sound grew and prospered, human activities left chemical contaminants buried in the sediments. Pulp mills, chemical factories, smelters, shipyards, oil refineries, and other industries dumped byproducts into the Sound for years before federal and state governments placed controls on such discharges. Most of the contaminated sediments of Puget Sound are found in the nearshore areas of urban bays near Seattle, Tacoma, Bremerton, Everett and other major cities." (Puget Sound Action Team, 2004).

A 1997 study by NOAA and the Washington Department of Ecology indicated that 400,000 acres of the areas tested for sediment in Puget Sound are clean. However, 5,700 acres are highly degraded, and sediments of intermediate quality cover 179,000 acres. This represents an improvement from the 1970's when contaminant levels peaked. The Puget Sound Action Team has indicated that much of the contamination still present in the mud came from historic activities that are now outlawed or controlled by state and federal laws.

Much of the urbanized area in Puget Sound is concentrated near the mouths of rivers and along estuarine shorelines, coinciding with important and sensitive habitat required by salmon. Urban leaders face challenges accommodating the anticipated growth of the region without exacerbating existing habitat deficiencies.

"Our watershed is keenly aware that we have the biggest population center, and the largest recovery challenge."

Jim Compton, Seattle City Councilman

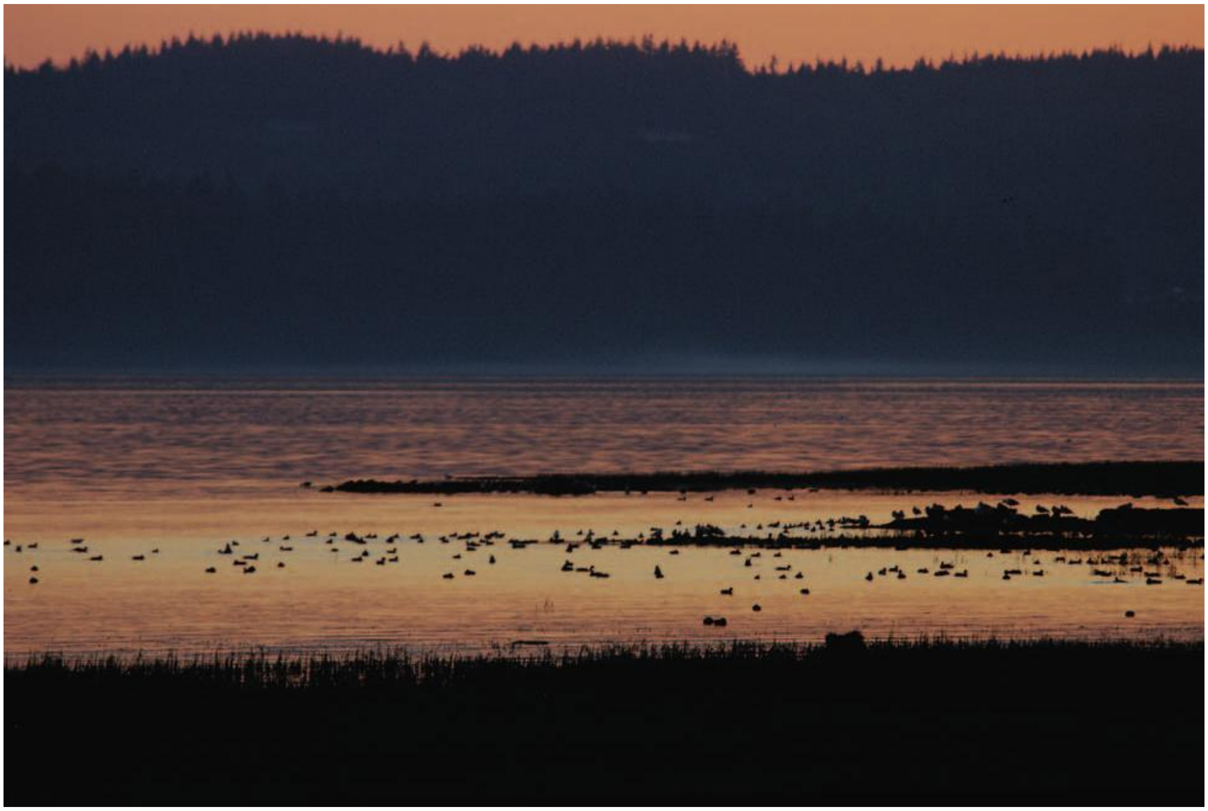


Photo by Dan Kowalski

Nearshore, Estuary and Marine Habitat Modification

An 1885 survey estimated that there were 267 square kilometers of tidal marsh and swamps bordering Puget Sound. Tidelands extended 20 km inland from the shoreline in the Skagit and Stillaguamish watersheds. Approximately 100 years later, only 54.6 km2 of intertidal marine or vegetated habitat is estimated to occur in the Puget Sound basin. This represents a decline of 80 percent across the region due to agricultural and urban modification of the lowland landscape (NMFS/Chum BRT, 1997). In heavily industrialized watersheds, such as the Duwamish, intertidal habitat has been eliminated by 98 percent, (Figure 3.2).

In addition to the high-intensity industrial and urban development at major river mouths in Puget Sound, intertidal and nearshore habitats throughout the Sound have been modified by shoreline armoring (e.g. construction of rock, concrete, and timber bulkheads or retaining walls). These modifications have a cumulative environmental impact that

Estuary	Area (ha)		Change (%)
	Pre-development	Amount in 1970's	
Nooksack	445	460	+3
Lummi	580	30	-95
Samish	190	40	-79
Skagit*	1600	1200	-25
Stillaguamish	300	360	+20
Snohomish	3900	1000	-74
Duwamish	260	4	-98
Puyallup	1000	50	-95
Nisqually	570	410	-28
Skokomish	210	140	-33
Dungeness	50	50	0

*More recent and more encompassing studies of the large scale habitat changes in the Skagit Delta indicate a loss of riverine tidal and estuarine habitat of 72% (Beamer et al., 2003).

Figure 3.2 Changes in Areas of Selected Puget Sound Estuaries from 1800s to 1970s. (from Simestad, et al. 1992 as cited in Upstream)

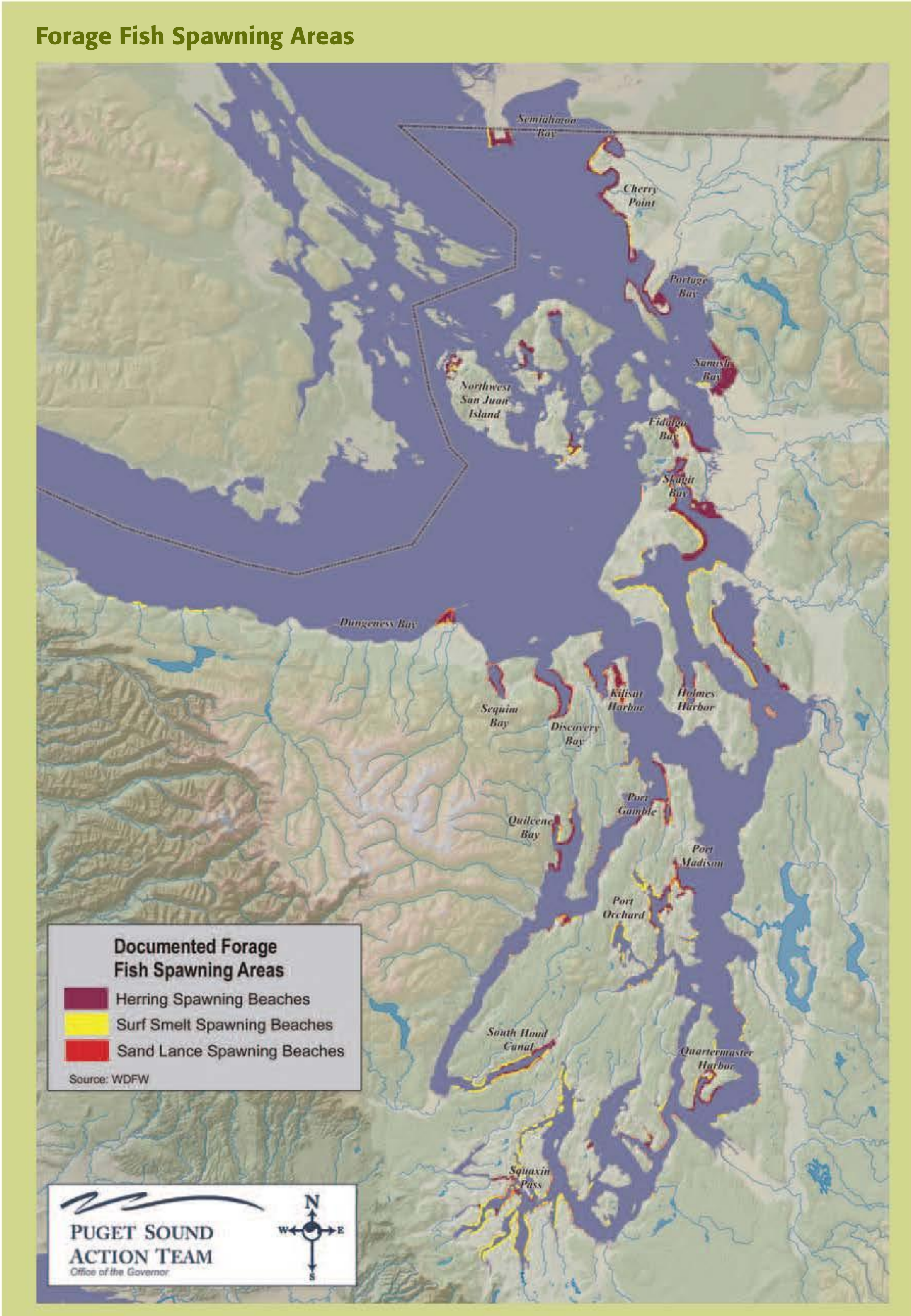


Figure 3.3 indicates Nearshore areas throughout the Puget Sound region that are known forage fish spawning beaches. Forage fish are an important food source for salmon. Map courtesy of the Puget Sound Action Team.

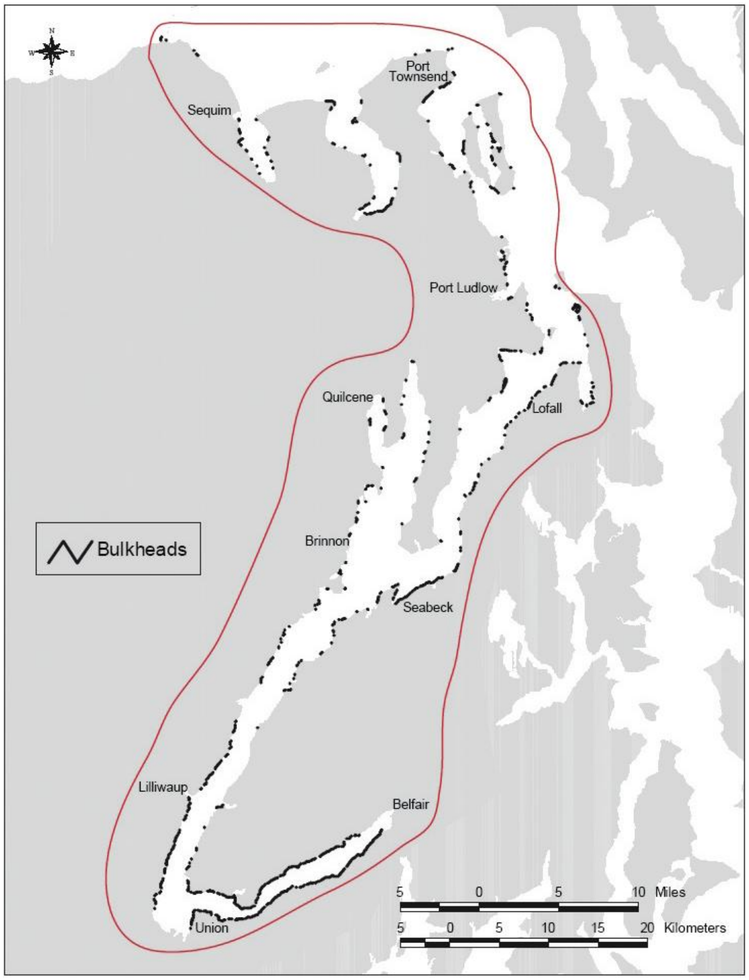


Figure 3.4 shows the distribution of bulkheads throughout the Hood Canal. Map courtesy the Northwest Indian Fisheries Commission, and the Salmon and Steelhead Habitat Inventory and Assessment Program, (SSHIAP).

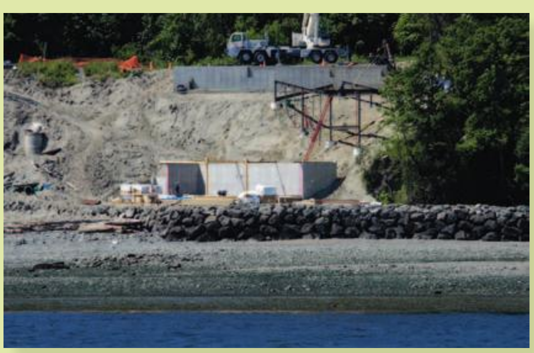
results in loss of riparian vegetation, obstruction of sediment movement along the shoreline, interference with wave action, and burial of upper beach areas. Although upper beach areas are not utilized directly by salmon, they are egg-laying grounds for species of smaller forage fish that salmon depend on. A 1994 inventory of armoring along Bainbridge Island indicated that between 42% and 67% of the entire shoreline had been armored (NMFS/Chum BRT, 1997). A recent inventory of bulkheads in Hood Canal conducted by the Point No Point Treaty Council demonstrated large clusters of bulkheads throughout the Canal (figure 3.4).

Diking and Floodplain Modification

Extensive dredging, diking and filling for flood control and development beginning in the early 1900s eliminated and degraded miles of salmon habitat. One area hard hit by major floodplain modification was in south Puget Sound where, "The Puyallup, White and Carbon Rivers are all contained within a revetment and levee system for their lower 26, 8 and 5 miles respectively. These channel containment structures have removed the natural sinuosity of the rivers and the spawning and rearing habitats that were once present." (South Sound Salmon Recovery Chapter). Dikes, levees, and channelization beginning in 1906 reduced the length of the Puyallup River from its mouth to the confluence with the White River by 1.84 miles, a loss of almost 15% of its channel length in that section alone. Levee structures eliminated connections with side-channel and off-channel habitat. Although juvenile Chinook fry would once have been present in high numbers in the lower river and its distributaries, the modifications of the floodplain have increased water velocities, making it difficult for juveniles to maintain their position or defend territories. Spawning activity throughout

Cherry Creek, King County. Dikes separate rivers from their historic side channels, wetlands, and floodplains. Photo courtesy the Washington State Salmon Recovery Funding Board.

Modifications and threats to the function of the Puget Sound nearshore and marine environments for salmon include:



33% of Puget Sound Shorelines have been modified with bulkheads or other armoring.

73% of the wetlands in major deltas of Puget Sound rivers have been lost in the last 100 years.

Number of piers and docks in Puget Sound: 3,500

Number of small boat slips: 29,000

Number of large ship slips: 700

Before 1900, 4,000 acres of tidal marshes and mudflats once existed where Harbor Island and the East and West Waterways now stand in Elliott Bay, Seattle.

290 "pocket estuaries" formed by small independent streams and drainages have been identified to occur throughout Puget Sound; of these 75 are stressed by urbanization.

40+ aquatic nuisance species currently infest Puget Sound. In 2003, Spartina species infested 770 solid acres of Puget Sound.

972 municipal and industrial wastewater discharges into the Puget Sound Basin are permitted by the Washington Department of Ecology. 180 permit holders had specific permission to discharge metals, including mercury and copper. Over 1 million pounds of chemicals were discharged to Puget Sound in 2000 by the 20 industrial facilities that reported their releases to the Environmental Protection Agency.

An estimated 500,000 on-site sewage systems are estimated to occur in the Puget Sound basin.

16 major (> 10,000 gallons) spills of oil and hazardous materials occurred in Puget Sound between 1985 and 2001. 191 smaller spills occurred from 1993 to 2001, releasing a total of more than 70,000 gallons.

More than 2,800 acres of Puget Sound's bottom sediments are contaminated to the extent that cleanup is warranted.

Sources for these figures, along with information on the relationship of these threats to salmon, are included in the Nearshore Chapter.

A sample of the changes to the Puget Sound nearshore and marine environment which have occurred over the past 100 years is contained in figure 3.5.

the diked portions of the river is limited, and water velocities scour pockets of eggs. The Puyallup basin represents one of the more extreme examples of floodplain modification in the region, but dikes, channelization and bank armoring are widespread throughout Puget Sound.

Water Diversions and Hydroelectric Development

The growth of towns and industries along Puget Sound created the need for water supply and power to municipal and industrial facilities. The steep drop from the Cascade and Olympic Mountains to sea level in the Puget Sound basin was ideal for the development of dams to impound water supplies and generate hydroelectric power.

Within the Puget Sound region, several major dams block access to historic Chinook salmon spawning and rearing habitat as follows:

- Elwha River:
  - Elwha and Glines Canyon Dams
- Green River:
  - Howard Hansen Dam
- Puyallup River:
  - Electron Dam
- White River:
  - Mud Mountain Dam
- Cedar River:
  - Cedar Falls Dam
- Skagit River:
  - Gorge Falls Dam
- Baker River:
  - Baker Dam
- North Fork Skokomish River:
  - Cushman Dam
- Nooksack River:
  - Middle Fork Diversion Dam

The construction of the Cushman Dam may have isolated a population of Chinook salmon in Lake Cushman, creating a resident population. Passage at Chittendon Locks (Lake Washington) also poses a barrier problem for downstream juvenile Chinook salmon migrants and bull trout.

In addition to the major dams, blockages for water diversion, hatchery water supply, and small hydro development occur on several tributary streams throughout the Sound. While many of these tributary barriers may not block access for Chinook spawning and rearing specifically, they still generate downstream impacts to mainstem river areas by interrupting flow and sediment transport, large woody debris recruitment and transport, nutrient supply, and elevating temperatures.

Physical barriers also alter streamflow which

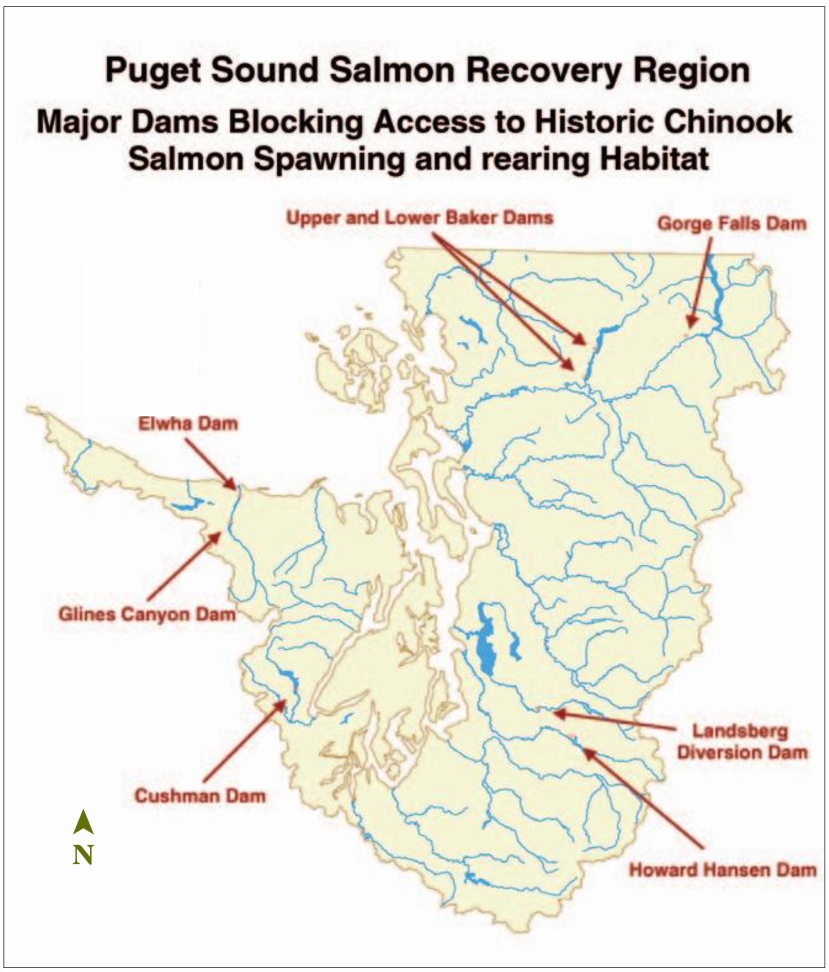


Figure 3.6 illustrates a partial list of the major, human-made chinook passage barriers in the Puget Sound. Map courtesy Washington Department of Fish and Wildlife.

increases salmon mortality in several ways — migration can be delayed by insufficient flows or habitat blockages; loss of usable habitat due to dewatering; stranding of fish resulting from rapid flow fluctuations; and juvenile fish becoming entrained from high velocity waters at poorly screened diversions. Reduced flows also diminish fish habitat by decreasing recruitment of new spawning gravels, and allowing the encroachment of non-native vegetation into spawning and rearing areas.

Dams have also been cited as a major factor affecting bull trout in the Olympic Peninsula and Puget Sound management units. In addition to downstream habitat damage, barriers limit the interaction of populations in core areas, reducing long term genetic viability and eliminating life history forms. Bull trout that migrate downstream of dams without return fish passage are unable to return and contribute to the upstream population. Dams in several locations have formed migratory barriers

The Story of the Elwha River

The Chinook salmon of the Elwha River were well known throughout the Northwest; the rugged canyons and wild waters rushing down from the Olympic Mountains had isolated a race of genetic giants among salmon, commonly weighing over 75-100 pounds. Early settlers envisioned the transformation of the river's energy into power for operating the mills in the nearby city of Port Angeles. Despite laws that prohibited the total blockage of the stream channel, a loophole in the law around 1915 allowed dams to be constructed without fishways, so long as hatcheries were built in lieu of fish ladders (Lichatowich, 1999). In the early years following the construction of the dam, thousands of Chinook returned from sea and beat themselves against the concrete wall in an effort to return to their natal spawning grounds. Descendants of the original population have continued to spawn in the few miles left to them, and have been used as hatchery broodstock. Plans to remove the two dams on the Elwha River and allow Chinook to return to pristine spawning grounds still remaining above the dams in Olympic National Park are well along, and removal is set to begin in 2008.

"A lot of our tribal elders have passed on that put up the fight to get the dams removed. It's going to be a very emotional time when they start taking them down."

Dennis Sullivan, Lower Elwha S'Klallam Tribal Chairman and isolated populations that were once connected, such as those in the Middle Fork Nooksack, upper and lower Skagit, Puyallup, Elwha, Skokomish and White Rivers. Although information on historic use of upper watersheds by bull trout is incomplete in many locations, it is thought that diversion dams, hydroelectric facilities and pipeline crossings have formed migratory barriers in the Nisqually and lower Green Rivers (USFWS, 2004).

> *"The Sound might have absorbed some environmental impact 100 years ago, but we have pushed our Puget Sound ecosystem to the limit."*
>
> *Christine Gregoire, Governor*

Habitat Factors Limiting Salmon Production

None of the pioneers and their followers who were drawn to Puget Sound to farm, produce lumber, or build communities and jobs came with the intent of destroying salmon, but incrementally and collectively these activities degraded the habitat and caused long term declines in fish abundance, productivity, spatial distribution and diversity. Some of the change was obvious to the naked eye, as trees were removed, dams built and areas paved. Other changes that affected stream temperatures, water chemistry and the food web for salmon were more insidious. Despite the change, salmon continued to return for generation after generation, but in the late 20th century the collective impacts exceeded their capacity to continually perpetuate themselves.

Loss of Habitat-Forming Processes

Salmon depend on habitat variety to find food and avoid predators – the suite of pools, riffles, boulders, logjams, side channels, wetlands and other features of their rivers; and the saltwater sloughs, marshes, eelgrass and kelp beds in the marine environment. The simplification of habitat features caused by vegetation removal and construction along streambanks and shorelines has had a pervasive and cumulative effect. The structural diversity that enabled salmon to thrive was built over centuries by the complex interaction of light, water, soil, vegetation and nutrient cycles. Salmon evolved to stream conditions that had cyclical disturbances varying by days, decades and centuries. Human activities modified these constant cycles of change by increasing the frequency of disturbance, altering the magnitude of disruption, and affecting the ability of the stream channel to respond.

Most devastating to the long term viability of salmon has been the modification of the fundamental natural processes which allowed habitat to form, and recover from disturbances such as floods, landslides, and droughts. So critical are these driving processes that Spence et al. (1996) state that " ...salmonid conservation can be achieved only by maintaining and restoring these processes and their natural rates." Among the physical and chemical processes basic to habitat formation and salmon persistence are floods and droughts, sediment transport, heat and light, nutrient cycling, water chemistry, woody debris recruitment and floodplain structure. Important biological processes that depend on habitat dynamics include migration, adaptation, the complex energy transfers of the food chain, and the metabolism of the fish.

Vegetation removal has also altered the hydrologic system in many watersheds, affecting the watershed's retention of moisture and increasing the magnitude and frequency of peak and low flows. Wetlands play an important role in hydrologic processes, as they store water which ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Forest wetlands are estimated to have diminished by one-third in Washington State. (Spence et al., 1996; FEMAT, 1993)

Despite the improvement in timber practices, many long lasting effects from timber harvest continue to degrade aquatic habitat. Surface erosion and slope failure from logging roads are an ongoing

Land Use Activity	Habitat-Forming Processes						
	Vegetation / Organic matter	Hydrology	Thermal Regime (temperature/ light)	Soils	Nutrients	Chemical Composition	Riparian Function and Floodplain Dynamics
Forestry	Timber harvest removes the forest canopy, changes the composition of tree species, and modifies the type and rate of input of leaves and other organic matter into streams, thereby affecting the food supply for salmon.	Vegetation removal alters the water storage capability of the watershed, changes the timing of runoff, and may increase the magnitude and frequency of peak flows and low flows. Peak flows may scour redds and cause mortality to juveniles. Low flows limit spawning and migration.	Summer stream temperatures are documented to increase by 3-8°C following clearcutting and up to 16°C in small watersheds, and may take many years to recover. High temperatures stress salmon and in extreme cases can cause mortality.	Mass failures may result from road construction or vegetation removal on unstable slopes. Surface erosion from bare soil also changes the rate of soil input to a river system. Soil compaction results from equipment use during harvest. Soil transfer alters availability of spawning gravel. Fine sediments can severely impact eggs and juveniles.	Vegetation removal leads to a loss or reduction of the nutrient supply and changes the normal rate of decomposition and input of nutrients.	Use of fertilizers herbicides, pesticides and other chemicals alters water chemistry and some substances are toxic to salmon, resulting in direct mortality, reducing resistance to disease, or ability to reproduce.	Timber harvest removes the large woody debris that provides structure for stream channel features such as pools and riffles.
Agriculture	Conversion of woodlands and wetlands removes riparian vegetation.	Forest clearing alters soil retention of water, which is further exacerbated by ditching and draining to create crop lands. Runoff timing and patterns are altered. Irrigation directly removes instream flows, affecting the availability of spawning and rearing habitat.	Loss of shade along riparian corridor increases stream temperatures as do return flows from irrigation. Low flows, sedimentation and nutrient input further exacerbate temperature problems.	Agricultural crop practices may increase surface erosion with substantial sediment input into streams.	Runoff from animal waste and other farm activities increases the nutrient load and depletes the oxygen available for salmon	Use of fertilizers, herbicides and pesticides alter the water chemistry and may result in direct mortalities or the alteration of physical condition of salmon.	To create and protect agric. lands, stream channels have been straightened and banks have been armored removing low velocity side channels. Diking of estuarine sloughs has removed the quantity and quality of lower river rearing habitat.
Urbanization	Severe, permanent alteration of vegetation.	Impermeable surfaces create permanent loss of water infiltration to soil and stormwater runoff is rapid and severe. Water withdrawals for urban and industrial supplies deplete instream flow.	Loss of shade increases summer maximum and may decrease winter minimum stream temperatures. Disruption of groundwater input will reduce its moderating effects on stream temperatures.	Construction activities create intensive short term sediment input.	Loss of leaf matter from vegetation is replaced with nutrient input from sewage, fertilizers and other sources.	Stormwater runoff includes oils, pesticides, metals and other toxic substances.	Permanent severe alteration of meandering stream channel and wetland structures. Bank hardening, fill and dikes remove other habitat features. Dikes isolate or fragment habitat and increase stream velocity.

Figure 3.7 Relationship of forestry, agricultural and urban land use activities to habitat processes affecting salmon.*

* A more complete discussion of these relationships including other land use activities is contained in "An Ecosystem Approach to Salmonid Conservation" also known as the "Man Tech" report by Spence, et al. 1996. Additional discussion of applying information on habitat characteristics to recovery planning is contained in, "Ecosystem Recovery Planning for Listed Salmon: An Integrated Assessment Approach for Salmon Habitat" by Beechie, et al., 2003.

Figure 3.7 outlines the ways that some of the major land use activities in the Pacific Northwest have modified the fundamental and interlinking processes that form salmon habitat. One of the major factors affecting habitat has been the temporary and permanent removal of vegetation. Vegetation is a key component of the light and temperature regimes in stream systems. The logging, farming and development activities described previously removed streamside vegetation, resulting in long term increases in water temperatures and drastically affecting the ability of bull trout and salmon to survive. Summer stream temperatures have been documented to increase by 3 to 8°C (5.4 -14.4°F) following clearcutting and up to 16oC (28.8°F) in small watersheds (Spence, et al., 1996). High temperatures may stress or kill salmon outright, or limit the production of organisms they need for food. Water temperatures above the tolerance threshold for Chinook migration, rearing or emergence have been found in the Nooksack, Dungeness, Elwha, Green/Duwamish, Skagit, Snohomish and Stillaguamish Rivers.

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Poor riparian conditions can result in higher water temperatures which may stress or kill salmon. Photo courtesy the Washington State Salmon Recovery Funding Board.

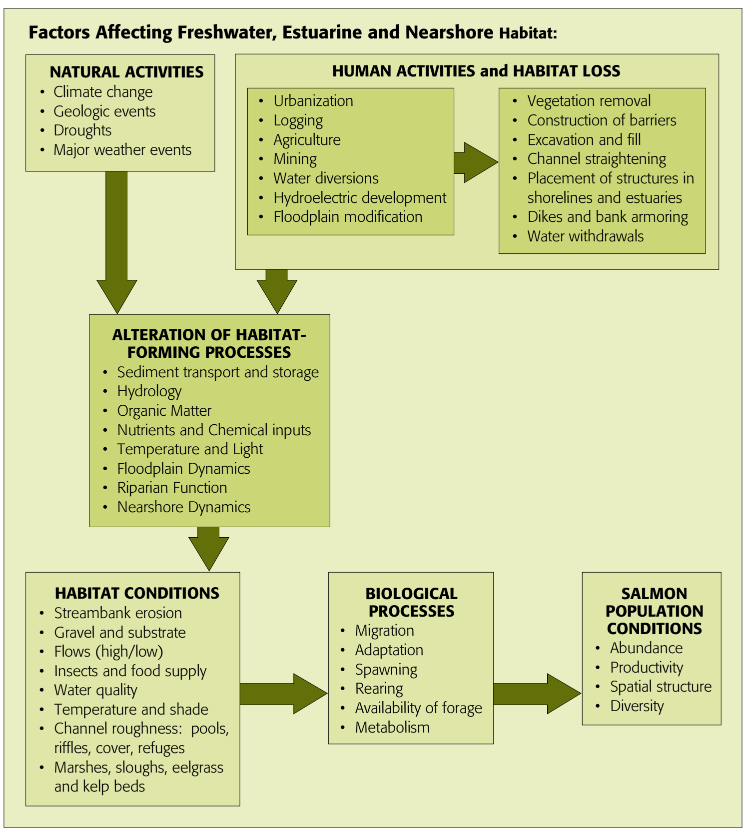


Figure 3.8

source of fine sediment and debris, with detrimental effects to salmon habitat. (Spence, et al., 1996; National Research Council, 1996) Sedimentation filled in many of the large deep pools in rivers and many river systems have been unable to recreate these essential habitat features for salmon, since the large wood that would serve as the structural raw material has been removed. Sediment input also results from urban construction and agricultural practices and the excessive input of fine sediments has been identified as a problem in every watershed into Puget Sound.

The toxic mix of oil, grease, pesticides and other pollutants carried by stormwater runoff alters the chemical processes of urban streams and creates dramatic shifts in their flow patterns. Recent studies by NMFS and the Seattle Public Utilities have also documented high rates of outright mortality to adult salmon still full of eggs and sperm, even in a creek where habitat had been restored. While the restoration of these urban creeks is essential to allowing greater numbers to spawn, the studies suggest that the control of polluted runoff from urban streets, lawns and parks and restoration of chemical balance is imperative to fish productivity (Scholtz, 2003).

Riparian function depends on vegetated banks, and the removal of large trees precludes the recruitment of large woody debris, essential to a varied channel structure. Dikes and levees generally have maintenance requirements that prohibit vegetation, largely eliminating the production of food for salmon and the recruitment of large woody debris for cover and diverse channel structure. Channelization and floodplain structures such as dikes reduce river sinuosity, increasing water velocity and reducing the volume of habitat. In many cases, floodplain structures eliminate the connection to side channels and wetland complexes where salmon once could rest and feed.

Guidelines for salmon recovery emphasize the need to address fundamental ecosystem processes by restoring vegetation, hydrology, channel structure and essential food supplies for salmon.

"Salmon are adapted to local environmental conditions....[that] vary in space and time due to landscape processes and land use. Because landscape processes (e.g., sediment supply, wood recruitment to streams) create and sustain habitats over time, an approach to habitat recovery that focuses on preserving or restoring ecosystem processes should provide good quality salmon habitat over the long term." (Beechie, et al.; 2003)

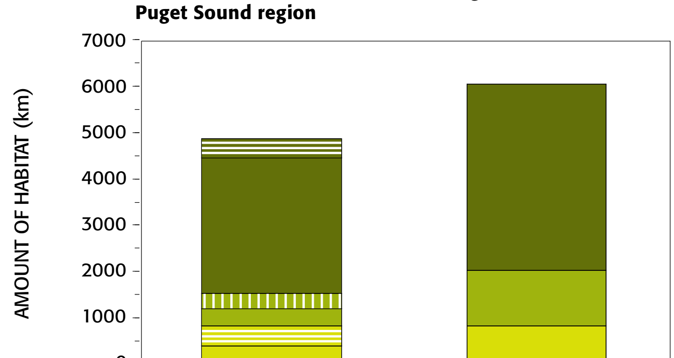
Technical Assessments of the Potential to Recover Chinook populations at the ESU Scale

Several "broad-brush" looks at habitat conditions in the entire Puget Sound ESU indicate that the potential capacity of watersheds to support Chinook spawning and rearing is still present in many watersheds. Coarse scale assessments of this nature are unable to factor in the varying levels of detail that have gone into habitat analysis in each watershed. Some watersheds have been able to assemble the resources to conduct studies of habitat factors in more depth than others. Additionally, the Sound-wide review has so far focused primarily on the quantity of potential habitat, and generally has yet to fully incorporate qualitative information. The individual watershed plans submitted in the Spring of 2005 contain a large amount of habitat information that will need to be assimilated into an ESU-wide assessment of habitat and its effect on VSP parameters.

Figure 3.9 contains a map depicting current and historical spawning capacity for Puget Sound Chinook populations, to display the varying levels throughout the Sound. Several watersheds still retain habitat with the potential to support spawning at historical capacity levels, although the quality may have been modified by flow diversions and other impairments. The Elwha River represents the opposite case, as it has lost approximately 85% of historical spawning capacity, but the quality of habitat above the dams has been fully retained since these areas are located in Olympic National Park. Dam removal, scheduled to begin in 2008, will restore access to these spawning areas.

In addition to spawning capacity, NOAA Scientists have begun to collectively estimate changes in the amount of freshwater, estuary and nearshore rearing habitat in the Puget Sound region. Through airphotos, map layers and historical reports covering wetlands, vegetation and stream channel locations, rough estimates can be made of the amount

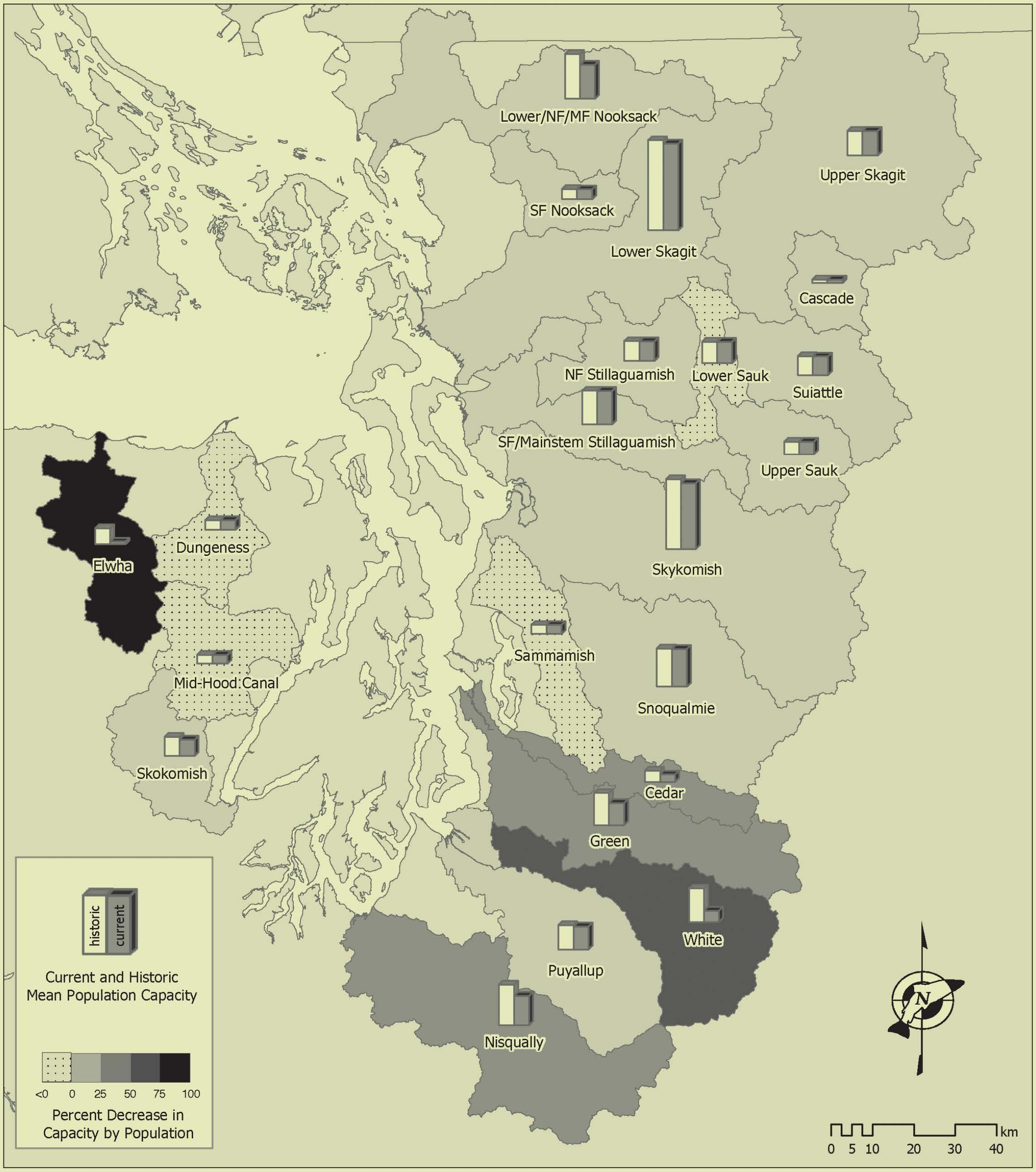
Estimated amount of Chinook rearing habitat in the Puget Sound region



	Current (km)	Historical (km)
Freshwater habitat - modified	406.89	0.00
Freshwater habitat	2924.79	4011.35
Estuary habitat - modified	333.69	0.00
Estuary habitat	361.09	1186.91
Nearshore habitat - modified	440.82	0.00
Nearshore habitat	396.90	837.71

Notes: This graph depicts current and historical estimates of juvenile rearing habitat in the Puget Sound Region. Rearing habitat is divided into three habitat types: freshwater, estuary and nearshore. Current habitat is further divided into modified and unmodified amounts.

Figure 3.10 Courtesy NOAA Fisheries, NW Fisheries Science Center; M. Ruckelshaus



Historical Population Capacity Changes of Adult Chinook in Puget Sound ESU

Chinook Potential Spawning Capacity Estimates and Percent Decrease by Population

Population	Mean Capacity Historic	Mean Capacity Current	% Decrease	Population	Mean Capacity Historic	Mean Capacity Current	% Decrease
Lower/NF/MF Nooksack	62,027	47,046	24.2	Snoqualmie	52,525	51,828	1.3
SF Nooksack	13,648	13,392	1.9	Sammamish	12,406	12,468	0
Lower Skagit	124,563	119,786	3.8	Cedar	15,086	10,076	33.2
Upper Skagit	33,684	33,286	1.2	Green	45,247	31,419	30.6
Lower Sauk	29,437	29,378	0.2	White	46,232	15,601	66.3
Cascade	4,030	3,961	1.7	Puyallup	33,900	31,745	6.4
Suiattle	25,958	25,672	1.1	Nisqually	56,500	40,898	27.6
Upper Sauk	17,512	17,340	1	Skokomish	26,008	22,546	13.3
NF Stillaguamish	27,195	26,821	1.4	Mid-Hood Canal	12,166	12,288	0
SF/Mainstem Stillaguamish	46,108	45,837	0.6	Dungeness	12,852	12,912	0
Skykomish	96,501	91,279	5.4	Elwha	21,617	3,318	84.7

Figure 3.9 Courtesy NOAA Fisheries, NW Fisheries Science Center; M. Ruckelshaus

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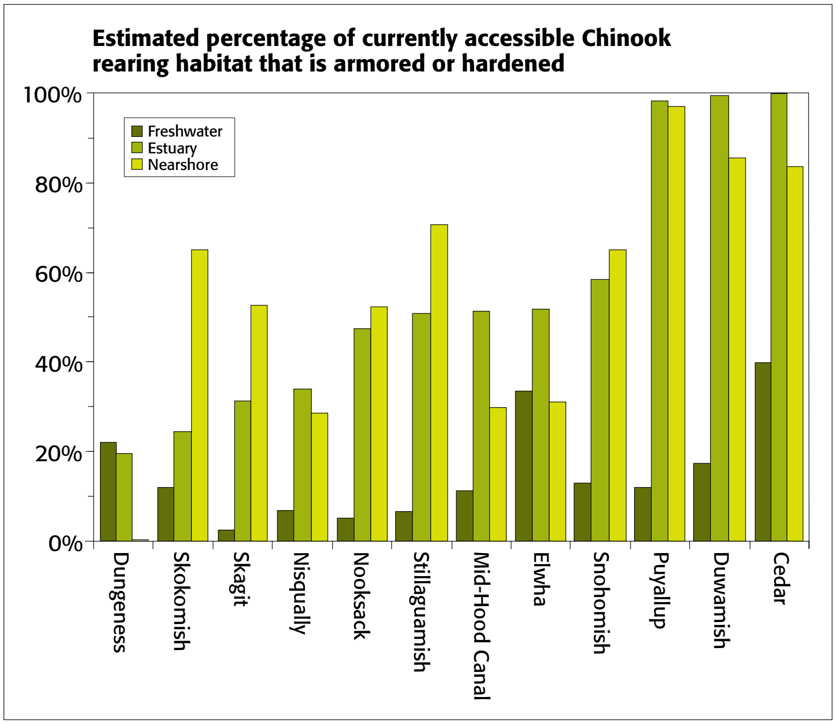


Figure 3.11 Courtesy NOAA Fisheries, NW Fisheries Science Center; M. Ruckelshaus

of Chinook rearing habitat in the region and the proportion that has been modified (figure 3.10). These estimates indicate that large quantities of juvenile rearing habitat remain relatively unmodified in portions of Puget Sound, and the connectivity and protection of these ecosystem features should be a focus for future study and action.

Additional analysis has been made of the percentage of bank armoring or hardening that has occurred in freshwater, estuary and nearshore environments. The extent of modification varies around the Sound, with extensive bank armoring or hardening in most of the river basins in South Puget Sound.

Studies such as these are assisting scientists with assessing the potential for improvements in VSP parameters at the scale of the entire Puget Sound Chinook ESU. This is particularly true for the spatial distribution and diversity parameters in the ESU since these will require a broader look than is possible watershed by watershed.

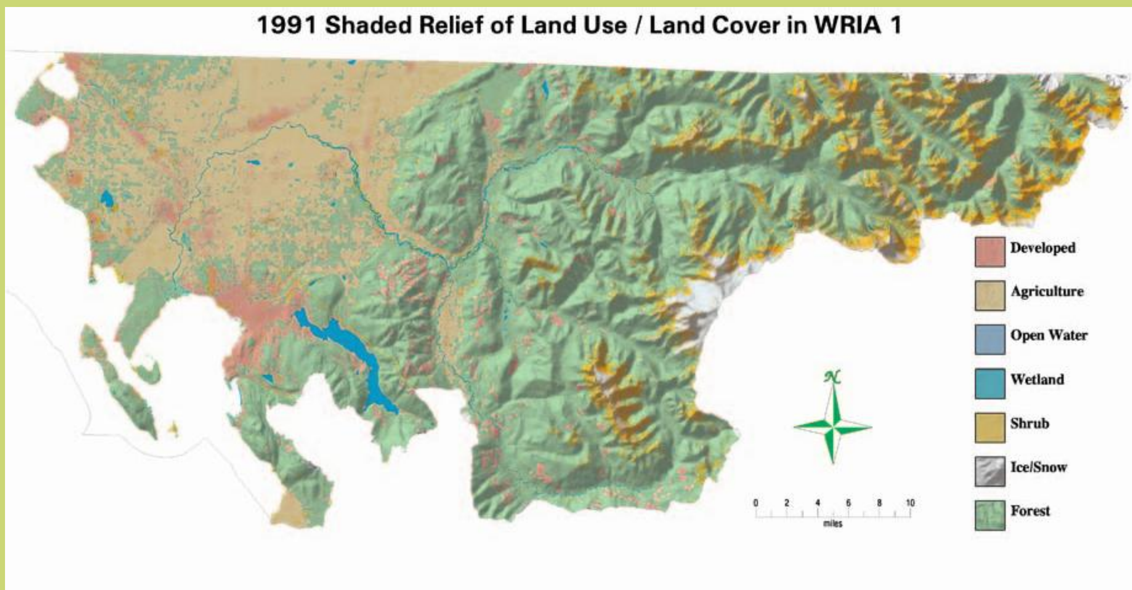
Technical Assessments of Habitat Factors at the Watershed Scale

Detailed technical analyses of the habitat factors affecting Puget Sound Chinook and other fish species are contained in the following reports and spatial information:

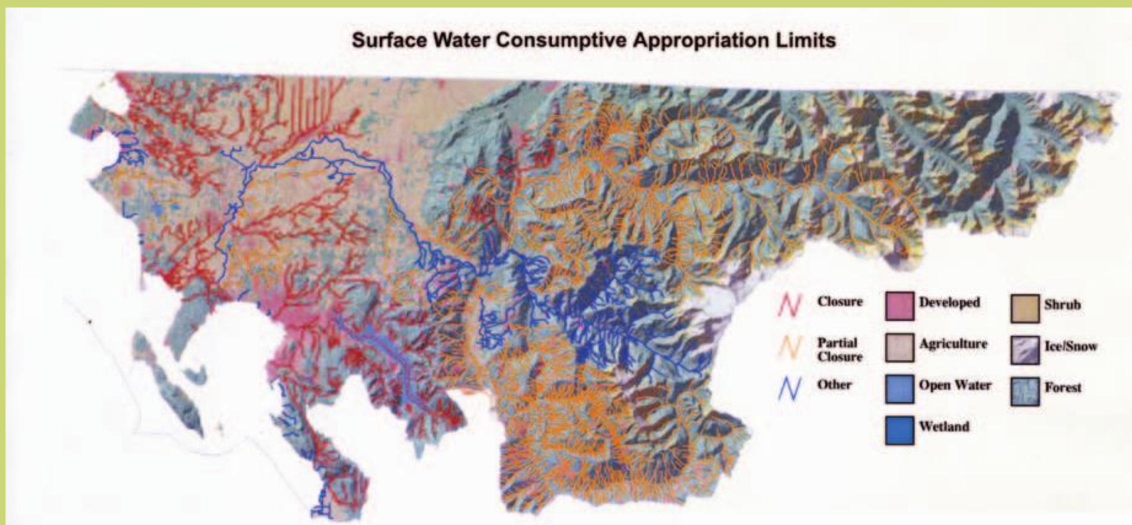
Salmon and Steelhead Habitat Inventory and Assessment Program: Since 1995, this cooperative project between the Northwest Indian Fisheries Commission and WDFW has characterized salmon habitat conditions and the distribution of salmonid stocks in Washington. The spatial data system is designed to utilize comprehensive, consistent data with sophisticated analytical tools to provide a variety of digital products and maps for regulatory and conservation efforts related to salmon in Washington. For each basin SSHIAP has information such as:

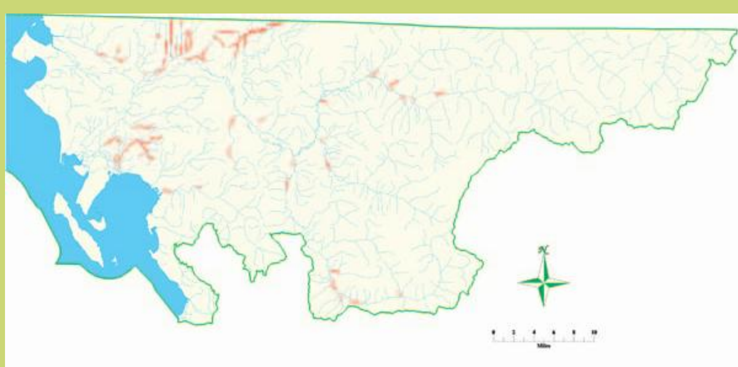
- Basin summary
- Land use relief map
- Escapement levels and stock status
- Limiting factors summary
- Map and list of impaired water bodies from the Clean Water Act 303(d)
- Surface water appropriation status
- Man-made blockages
- SRFB projects implemented

The SSHIAP program information is available on the website of the Northwest Indian Fisheries Commission [www.nwifc.org]. A sample of the products that are available through the SSHIAP program for the Nooksack basin are contained on the following pages.



Shows land use/land cover data from WRIA 1 Watershed Management Project, Stark & Gill, 2003. Map courtesy the NWIFC and Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP).





ABOVE: This map indicating Surface Water Consumptive Appropriation Limits does not include the status for the northward flowing Fraser Drainages (i.e. Sumas and Chilliwack Rivers). Map courtesy the NWIFC and Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP).

AT LEFT: Water courses shown in red denote streams identified in the WA Dept. of Ecology (DOE) 1998 303d listing. Water courses shown in blue are from WA DOE and are shown for locational purposes only. Map courtesy the NWIFC and Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP).

Figure 3.12 A sample of the products that are available through the SSHIAP program.

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Habitat Limiting Factors		
Sub-basin/Habitat Area	**Major Limiting Factors**	**Potential Causes**
South Fork	High temperatures; lack of lwd; high coarse and fine sediment load; channel instability; migration passage barriers; loss of wetlands and off channel habitat; loss of channel migration opportunities; low instream flow	Lack of riparian shade and lwd recruitment potential; elevated mass wasting rates; bank hardening; drained wetlands for agriculture; hydromodified channel; impassable culverts; over allocation of water rights; flood control
Middle Fork	Blocked access at rm 7.2; Channel instability; lack of lwd; high course and fine sediment load; high temperatures; lack of instream flow	Diversion dam; lack of riparian shade and lwd recruitment potential; elevated mass wasting rates; bank hardening; impassable culverts
North Fork	Channel instability; lack of lwd; high course and fine sediment load; lack of instream flow; loss of off-channel habitats in historic channel migration areas; high temperatures; blocked access; inadequate instream flow	Lack of riparian shade and lwd recruitment potential, elevated mass wasting; bank hardening including for sr 542 which is located in cmz; impassable culverts; over allocation of water rights
Mainstem Nooksack and Tributaries	Loss of channel migration and off-channel habitats in historic channel migration area; hydromodified channel; lack of lwd; high temperatures; blocking culverts; loss of historic wetlands; over-allocation of water rights; loss of former distributary habitats in estuary, tributary dredging for flood control	Levees and rip-rap and riparian maintenance for flood control; inadequate lwd recruitment potential and riparian shade along mainstem and tributaries, drainage of historic wetlands to promote agriculture; blocking culverts, over-allocation of water rights
Independent Drainages (Dakota, California, Terrell, Squalicum, Whatcom, Padden, Chuckanut, Olyster, and Colony)	Water quality; inadequate stream flows; peak flow impacts; migration passage barriers; high temperatures; loss of wetlands	Over allocation of water rights; increased impervious surface from development; urban storm water run-off; lack of shade and lwd recruitment in riparian zones; blocking tide-gates; flood control
Estuary and Nearshore	Loss of nearshore habitats; disrupted beach nourishment processes important for forage fish spawning; toxic contaminants; altered juvenile salmon migration paths; lost access in former distributaries and pocket estuaries	Filling to promote development; shoreline modifications including rip-rap bulkheads, jetties, railroad located in former nearshore area; industrial pollutants (Bellingham, Cherry Point, etc.); Overwater structures including docks, urban stormwater runoff, blocking culverts and tidegates
Sumas River and Tributaries	Blocked access, inadequate stream flow; high temperatures, inadequate lwd; agricultural runoff including siltation	Flood control along vedder canal and frasier river interrupts migration (Canada), inadequate riparian shade and lwd recruitment potential; drainage of historic wetlands to promote agriculture, dredging for flood control; over-allocation of water rights, blocking culverts

Figure 3.13 Habitat limiting factors for the Nooksack basin, available through the SSHIAP program

Limiting Factors Analyses: The Salmon Recovery Planning Act (ESHB 2496) was passed in 1998. Among other elements, the Act directed the Washington State Conservation Commission to prepare a Limiting Factors Analysis (LFA) for each Water Resource Inventory Area in Washington State. A technical advisory group was formed for each area consisting of state and tribal fisheries biologists and other local experts to evaluate habitat factors including barriers to migration, and the condition of estuarine areas, riparian corridors, stream channels and wetlands. The LFAs were intended as a basis for prioritizing recovery efforts and for measuring the results of future recovery actions.

The Limiting Factors reports provide considerable detail regarding the habitat factors limiting Puget Sound salmon and steelhead. For each major river and tributary, the reports describe the status of the habitat processes affecting salmon such as loss of access to spawning and rearing habitats, floodplain conditions, streambed sediment, riparian conditions, water quality and quantity problems, and estuarine and nearshore habitat. These reports may be accessed at the Washington Conservation Commission website [http://salmon.scc.wa.gov/].

Watershed Chapters: Shared Strategy watershed planning staff interviewed watershed participants in 2002-2003 to identify the major limiting factors in each watershed. A number of habitat factors were listed as common problems throughout almost all Puget Sound watersheds, such as altered hydrology and sediment transport, water quality degradation, loss of riparian vegetation, lack of large woody debris, and impaired floodplain processes. Additionally the loss of nearshore/estuarine habitat has been identified as a limiting factor throughout most of the Sound. More studies and information on the habitat conditions in each watershed planning area are located in the watershed chapters.

Ongoing Conservation Measures in the Puget Sound Region

State Statutory and Regulatory Framework

In 1997 a Joint Natural Resource Cabinet was brought together by Governor Gary Locke to coordinate salmon recovery efforts at the state level. The JNRC released the, "Statewide Strategy to Recover Salmon: Extinction is Not an Option" in 1999 which was designed as the state's long term guide for salmon recovery. As noted in the Strategy, many laws exist that directly or indirectly attempt to protect or restore salmon, but, "the troubling status of these fish is an indication that our existing regulatory framework and implementing agencies have been unable to protect salmon populations and their ecosystems." (JNRC, 1999). The regulatory framework includes laws dealing with land and water use and development, laws pertinent to fish and wildlife protection, and three new laws enacted in Washington State in 1998-9 which were specifically directed to bolster the statutory framework for salmon recovery.

Land and Water Use and Development: State laws include the State Environmental Policy Act, Shoreline Management Act, Growth Management Act, Floodplain Management Act, Forest Practices Act, Water Pollution Control Act, Hydraulic Project Approval, Aquatic Lands Act, and the Water Code and Water Resources Act.

Fish and Wildlife Protection: Of the state laws noted above, the State Environmental Policy Act,

Smolt trap on Stimson Creek, created by the Hood Canal Salmon Enhancement Group with funding from the Washington State Salmon Recovery Funding Board. Photo courtesy the Washington State Salmon Recovery Funding Board.

the Growth Management Act, and the Hydraulic Project Approval laws contain provisions relating directly to fish and wildlife protection.

Recent Legislation Directly Related to Salmon Recovery: Three laws were enacted in Washington State in 1998-1999 designed specifically to improve conditions for salmon. The acts recognized the need for comprehensive, coordinated solutions that would be locally based and implemented.

- Salmon Recovery Planning Act (ESHB 2496): This 1998 act provided the framework for developing salmon restoration projects. The Act required the preparation of a limiting factors analysis for habitat, and established the funding mechanism for local restoration projects. The Act also created the Governor's Salmon Recovery Office and an Independent Science Panel to work toward salmon recovery plans for the region.
- Watershed Planning Act (ESHB 2514): Also passed in 1998, this legislation encourages voluntary planning by local governments, citizens, and tribes for water supply and use, water quality, and habitat at the Water Resource Inventory Area level. The Act made available grants for assessments of water resources and preparation of water management plans.
- Salmon Recovery Funding Act (2E2SSB 5595): Adopted the following year, this legislation further developed concepts established in ESHB 2496. The Act created the Salmon Recovery Funding Board to coordinate the allocation of funding for restoration projects across the region, and clarified the content for the statewide strategy to recovery salmon.

Local involvement in identifying solutions for salmon recovery at the watershed level was a fundamental principle of all three laws. Water resource planning under ESHB 2514 identified "initiating governments" at the local level to direct watershed planning activities. The salmon recovery acts encouraged the formation of local "Lead Entity Groups" with citizen sub-committees and technical advisors to evaluate and prioritize restoration and protection projects for each watershed area. These locally-driven efforts were intended to allow local knowledge and relationships to assist planning and implementation, and to account for the differences between urban and rural communities and habitat conditions throughout the state.

As required by the Salmon Recovery Planning Act, the Governor's Salmon Recovery Office has issued a "State of the Salmon in Watersheds" report for 2004 providing an overview of the status of salmon in Washington State, and information on progress toward restoration and protection in the last few years.

Linkage to Federal Actions and Initiatives

Two federal services have direct responsibilities for recovery planning and enforcement of the Endangered Species Act. The National Marine Fisheries Service (NMFS) is charged with overseeing the preparation of recovery plans and rules for threatened and endangered species of West Coast salmon. The US Fish and Wildlife Service (USFWS) has recovery oversight for bull trout. Both agencies have worked closely with tribal, state and local governments and watershed groups in recovery planning for the Puget Sound region. Section 7 of the Endangered Species Act requires that federal agencies consult with NMFS or the USFWS on activities they authorize, fund, or carry out to ensure they are not likely to jeopardize the continued existence of listed species or result in the destruction or modification or their critical habitat.

Related Federal legislation includes the National Environmental Policy Act, Clean Water Act, Federal Reclamation Act, Coastal Zone Management Act, Rivers and Harbors Act, Wild and Scenic Rivers Act and more. Additionally, federal laws such as the Fish and Wildlife Coordination Act, Magnuson-Stevens Fishery Conservation Act, the Marine Mammal Protection Act, and the Pacific Salmon Treaty directly affect recovery processes.

Other major federal actions and initiatives that relate closely to Puget Sound salmon and bull trout recovery planning include the following:

- The Federal Forest Plan was issued by President Clinton and Vice-President Gore in 1993 to guide timber management in the National Forest System in the Pacific Northwest. The related report by the Federal Ecosystem Management and Assessment Team included an aquatic ecosystem assessment chapter identifying at-risk stocks of anadromous fish in the region, key watersheds in the protection of threatened species, and standards for riparian reserves and other forest management parameters. Additionally, the US Forest Service conducts ongoing aquatic habitat monitoring and fish surveys, and is closely involved in restoration of habitat for aquatic and upland species in the Puget Sound region. (FEMAT, 1993)
- The Puget Sound Nearshore Ecosystem Restoration Project began with a reconnaissance study in 2000 conducted by the US Army Corps of Engineers, which concluded that major human modifications along the Puget Sound shoreline have resulted in a significant loss of estuarine and nearshore habitats (USACOE and WDFW, 2001). The study identified a number of actions to restore nearshore habitats to a more natural state. The Puget Sound Nearshore Ecosystem Restoration Project has been undergoing feasibility and study since 2001, and project engineering and design is projected to begin by 2006, with construction targeted for 2009. A companion Corps of Engineers construction authority, the Puget Sound and Adjacent Waters Initiative, was authorized in 2003 for construction of early action restoration projects.
- Several Federal agencies including the Environmental Protection Agency and the US Army Corps of Engineers are closely involved in the cleanup of toxic contamination in Com-

Since 2000, the Salmon Recovery Funding Board has awarded $195.4 million in grants for 592 projects in 30 of the 39 counties in Washington State.

Projects funded by the board include:

• Fixed or removed 132 barriers to fish migration, opening up an estimated 456 miles of stream for salmon habitat.

• Planted trees and shrubs along 96 miles of streams to cool the water and provide sources of wood that can fall into the stream and improve channel structure for salmon habitat.

• Abandoned or fixed 222 miles of road to reduce the amount of soil washing into streams.

• Changed river flows in 85 acres to slow the rivers and create places for salmon to spawn and grow.

• Worked with willing landowners statewide to protect habitat through conservation easements and property acquisitions.

• Removed 19 dikes and tide gates in estuaries to allow freshwater and saltwater to mix, opening an estimated 6 miles of transition areas for salmon headed to and from the sea.

Additional activities funded by the board include:

• Assessments such as an inventory of barriers to fish passage.

• Operation of local salmon recovery boards for recovery planning.

• Support of state agency efforts to improve instream flows and enforce provisions of the "Forest and Fish Agreement"

• Provide technical assistance to family forest landowners.

(SRFB website-home page)

Brian Cladoosby, Chair of the Swinomish Tribe, speaks to a group of tribal members and farmers at a Skagit Tribal/Agricultural Alliance picnic in the summer of 2004.

mencement, Elliott, and Bellingham Bays which include designated superfund sites.

- A number of Puget Sound rivers and tributaries are included on the Environmental Protection Agency's list of impaired water bodies under Section 303(d) of the Clean Water Act for temperature, flows, fecal coliform and other pollutants. The authority for the development of water quality cleanup plans and coastal zone management activities has generally been delegated to the Washington Department of Ecology. The full list is located on the Washington Department of Ecology website.

Transition to Conservation and Restoration by the Local Community

In each of the case studies described in section 4.1.1, local and regional community members have stepped forward within the last two decades to initiate projects and reforms that have slowed the momentum of degradation and placed Puget Sound watersheds on a path toward recovery. After considerable conflict, forest industry representatives and fisheries interests forged a "Forest and Fish Agreement" and prepared a package of regulations for forest practices that provide more protections for aquatic organisms. Farmers in the Dungeness have won state and national awards for their voluntary water conservation efforts that have greatly improved instream flows in the late summer. Similarly, Nooksack basin farmers have instituted many improvements to their farm practices to remediate the water quality and temperature problems documented in the river and tributaries. Recently, farmers in the Skagit Valley met with Swinomish and Sauk-Suiattle tribal leaders to work toward solutions on the complex drainage and estuarine loss problems in the lower watershed. Urban volunteers have contributed thousands of hours to repair neighborhood tributary streams. State agencies and Puyallup residents have seized opportunities to set back dikes and replace critical ecosystem functions wherever feasible. Marine Resource Committees and other local citizens groups are using volunteers to remove derelict fishing gear, inventory important spawning grounds for forage fish, and other activities to improve conditions in the nearshore. Each of these efforts demonstrates the commitment of the Puget Sound community to protecting and restoring salmon, and ensuring that these Northwest icons remain part of the landscape.

Detailed descriptions of the accomplishments toward salmon recovery goals at the watershed levels are contained within the watershed chapters.

"Our efforts to protect habitat stretch out over the next 10 years, but really we're talking about forever."

Sarah Spade, Jefferson Land Trust

Harvest Factors Affecting Puget Sound Salmon and Bull Trout

"The parties hereto, all Puget Sound treaty tribes and the Washington Department of Fisheries… agree to a philosophy of cooperation in implementing management programs to maintain, perpetuate and enhance the salmonid resources."

Puget Sound Salmon Management Plan, 1985

Harvest is important to the Puget Sound region culturally and economically. The salmon themselves are inherently productive; and when populations are healthy, they can sustain harvest without jeopardizing their ability to sustain themselves. Scientists have determined that the mortality to salmon caused by habitat loss and natural factors exceeds the numbers of salmon taken by fishing. However, because harvest occurs late in the life cycle of the salmon, the risk of overfishing has a direct and potentially substantial effect on the population that is left to return home and reproduce (NRC, 1996).

Fisheries for Puget Sound Chinook and other species are structured around the cultural and legal history of the region, national and international laws and management forums, and the biological characteristics of the salmon themselves. Fishing occurs in waters off of the coast of Alaska and Canada, ocean environments along the Washington coast, and in the marine waters and rivers of Puget Sound. Each of these fisheries harvests a portion of the returning runs of Puget Sound Chinook and Hood Canal summer chum salmon. Although fisheries have not been targeted on the harvest of bull trout, these fish are also captured incidentally during the harvest of other species.

Today's harvest management objectives emphasize the survival and recovery of the wild salmon populations. The management of harvest is a complicated process that crosses traditional tribal geographic boundaries, state jurisdictions and international law. Salmon fishers in Washington include Indians and non-Indians who fish for commercial, recreational, ceremonial and subsistence purposes. Intertribal, tribal-state, interstate and international negotiations must balance the interests of the various fishers with the capacity and conservation needs of the fish, utilizing an extensive array of technical methods to estimate population sizes and run timing. The complex fisheries management structure for this process has evolved during more than 150 years of change to the human and salmon populations of Puget Sound.

History of Puget Sound Fishing

Tribal Fisheries and the Stevens Treaties

Evidence of fishing activity and trade by Puget Sound Indians is obvious in every coastal archaeological dig in the region, dating back thousands of years. Salmon were key elements in the diet, religious practices and trade customs of tribal ancestors, covering a wide geographic area in the Pacific Northwest. Tribes often moved from place to place to take advantage of the different timing of various salmon species, with each tribal band developing a traditional geographic pattern of fishing sites. These "usual and accustomed fishing grounds and stations" were located throughout tribal territorial areas in marine waters, embayments, and up and down rivers and tributaries. Many fishing stations were located at the mouths of rivers, capturing adult salmon as they returned to their "terminal" areas to complete their life cycle. Although tribes managed their fisheries to allow sufficient numbers of salmon to reach their spawning grounds, extensive regulation was unnecessary due to the abundance of fish and the small human population.

In the mid-1850's, Isaac Stevens, the first Governor of Washington Territory, was sent by President Franklin Pierce to negotiate with the many tribal communities in order to avoid conflict and secure clear title to the land for the coming influx of white settlers. The "Stevens Treaties" with western Washington and Columbia River tribes contained essentially the same language, by which the tribes ceded their ownership of millions of acres of land, reserved parcels of land for their exclusive use (reservations), and retained some of their rights for fishing, hunting and gathering throughout their former territory. The treaties were not a grant of rights to the Indians, but were rather a grant of rights from them, reserving those rights which they had not signed over to the Federal government (Cohen, 1986; Madsen, 1988).

"The right of taking fish, at all usual and accustomed grounds and stations, is further secured to said Indians in common with the citizens of the territory..."

Treaty of Medicine Creek, 1854

Expansion of Non-Indian Fisheries in the 19th and 20th Centuries

The arrival of the salmon canning industry in Puget Sound in the 1870's led to an explosion in the non-Indian commercial fishing industry, with a peak cannery pack of 95,210 cases of Chinook in 1908. As catch rates grew, fishers expanded their harvest to more species and moved further out toward the ocean to avoid conservation closures of river fisheries, already needed by about 1915.

Photo Courtesy NWIFC

Reenactment of the Point No Point treaty.

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The First Salmon Ceremony

Early anthropologists in the Pacific Northwest documented the practice of First Salmon Ceremonies, a ritual of giving thanks that is still held by many tribal communities. First salmon ceremonies are generally conducted in the spring, coinciding with the arrival of the first salmon runs, to welcome the return of the salmon and to thank tribal relatives in the oceanic world for allowing themselves to be killed and provide food. Although each tribe has their own traditions, generally a salmon is specially prepared and shared, and songs are sung to welcome the salmon as an honored guest. The community celebrates the cycle of the salmon to ensure that the runs will return, and often include prayers for the safety of the fishermen. The remains of the honored salmon are usually wrapped and returned to the water, so that the salmon can tell its people that it was treated well.

Photo courtesy NWIFC

2002 Swinomish First Salmon Ceremony

Washington harvest rates declined somewhat between World Wars I and II due to the Great Depression as well as surplus catches from Alaska, and expanded again after World War II, particularly in ocean fisheries. High seas fishing by Japan and other nations also became increasingly contentious. The 1976 Magnuson Fishery Conservation and Management Act asserted a 200-mile exclusive fishery management zone off of the coast of the

From the collections of the Washington State Archives

United States. This act along with other international agreements substantially reduced the interception of North American salmon on the high seas. (NRC, 1996)

Recreational hook-and-line fisheries became important following World War II and presently comprise the bulk of Chinook harvest by non-Indian fishers in Puget Sound marine waters. By 1957 the Puget Sound recreational Chinook harvest had reached 238,000 fish before size and bag limits were reduced in 1958. Prior to 1958, the daily limit was 6 fish greater than 12 inches, only 3 greater than 24 inches. From 1958 through 1970 the catches ranged between 100,000 and 160,000 Chinook. Recreational catches rose again in the early 1970s, possibly due to hatchery supplementation programs, and have dropped to levels less than 45,000 Chinook since 1998 (WDFW, 2005).

The Boldt Decision

"The expansion of ocean fisheries placed the burden of responsibility for conservation on fishers closer to the spawning grounds, including the American Indians" (NRC, 1996). The fishing pattern of non-Indian harvest in open waters of the Pacific Ocean and Puget Sound left few, if any, fish that could be harvested in many traditional terminal areas by the river mouths or in streams. By 1960, the Indian harvest in Puget Sound and coastal waters was 5 percent of the total catch; Indian fishers began harvesting in open defiance of state regulations, and were frequently jailed.

The 1974 "Boldt Decision" in U.S. v. Washington

(384 F.Supp.312) and related legal opinions interpreted the treaty language to mean that tribes had reserved the right to take 50% of the harvestable fish. The United States Supreme Court affirmed the decision and recognized the inextricable cultural relationship between Pacific Northwest tribes and salmon, indicating that, "Fishing is not much less necessary to the existence of tribes than the atmosphere they breathe." The decisions provided direction for the conservation of fisheries resources, established treaty tribes and the states as co-managers, and set out principles to distribute the burden of conservation fairly. It should be noted that the provisions of U.S. v. Washington did not extend to tribes that did not have treaty fishing rights. Thus the terms "treaty" and "non-treaty" are now used to describe the respective fishers from each of the co-management entities.

Photo courtesy Northwest Indian Fisheries Commission.

Allison Gottfriedson under arrest.

Despite the early strife and sporadic ongoing disputes, the State of Washington and treaty Indian tribes developed a cooperative management structure in the ensuing decades. The "philosophy of cooperation" expressed in the 1985 Puget Sound Salmon Management Plan and other key management agreements has enabled the co-managers to coordinate their response to salmon recovery through harvest management forums, as well as habitat restoration and hatchery operations.

Fishing no longer provides the level of sustenance and livelihood that it once did for either the treaty or non-treaty fishers of Washington. The number of participants in ocean troll (hook and line) fisheries has substantially declined, and the average landings by weight in the 1990's were only 43% of those in the 1980's (NRC, 1996). Within Puget Sound fisheries, the Chinook catch by non-treaty commercial net fishers declined by 93% from 1975 to 2003 and marine recreational fisheries (non-treaty) declined by 91% during the same period (WDFW, 2005). The commercial net catch of Chinook for treaty fishers in Puget Sound declined by 23% during the same period, despite the proportional increase in allocation resulting from US v. Washington. Conservation principles are embedded in the legal structure that governs management under U.S. v. Washington, and the curtailment of fisheries to protect rapidly declining runs was instituted by the co-managers well in advance of the listing under the Endangered Species Act.

Salmon Harvest Management Forums

Today a complex array of agencies and governments manage the fisheries on salmon as they migrate through Alaskan, Canadian, Washington and Oregon waters. State and tribal fisheries harvest managers in Washington must consider the effects of Washington fishing regulations on Columbia River and Canadian salmon populations, and in turn, the effects of fishing outside of Washington on Puget Sound salmon. The complex political and legal structures that frame harvest management of Puget Sound salmon are largely concentrated in three major forums: 1) the Pacific Salmon Commission, established by a treaty between the United States and Canada, oversees fishing on salmon traversing US and Canadian waters; 2) the Pacific Fisheries Management Council provides the forum for the negotiation and regulation of ocean fisheries along the US West Coast; and 3) U.S. v. Washington proceedings provide the structure for harvest management in the Strait of Juan de Fuca and Puget Sound waters (Figure 3.13 Ocean and Coastal Fisheries Management Forums).

Pacific Salmon Treaty

The Pacific Salmon Treaty between the United States and Canada was finalized on March 17, 1985 to address the management of salmon stocks that originate in one country and are intercepted by the other. The countries are committed to equitable sharing of the harvest and to constrain harvest on both sides of the border to rebuild depressed salmon stocks. The Pacific Salmon Commission oversees the implementation of the Treaty and the specific management provisions known as "annexes" which are subject to periodic revision. The most recent update to the annexes was agreed to in 1999 and is applicable through 2008.

Pacific Fisheries Management Council and the North of Falcon Process

"The Pacific Fisheries Management Council (PFMC) was created by the Magnuson Fishery Management and Conservation Act in 1977, and re-authorized by passage of the Sustainable Fisheries (Magnuson-Stevens) Act by the United States Congress in 1997. The Council coordinates and oversees the ocean fishery management objectives among the three state jurisdictions (Washington, Oregon and California) by mandating regulations that prevent overfishing and maintain sustainable harvest. The function of the Council is to assure that the co-managers' conservation objectives are achieved for all Chinook and coho salmon stocks, and that harvest is equitably shared among the various user groups." (NMFS, 2004) Washington fisheries managers are particularly involved with the North of Cape Falcon process, governing the harvest regime between Cape Falcon, Oregon (just south of the Columbia River) and the U.S.-Canadian border. Since the ocean fisheries forums set the context for all fishing that follows in the Strait of Juan de Fuca and Puget Sound, annual fishing regimes for most Puget Sound salmon populations are negotiated within this forum. The annual series

Major Harvest Management Forums Affecting Puget Sound Salmon

Pacific Salmon Commission

(Established through the U.S.-Canada Salmon Interception Treaty of 1985)

- **U.S. Commission Members:** U.S. State Dept., Washington Dept. of Fish & Wildlife, Oregon Dept. of Fish & Wildlife, Tribal Representative
- **Joint Advisory Committees:** Northern Panel, Southern Panel, Fraser River Panel

Pacific Fisheries Management Council

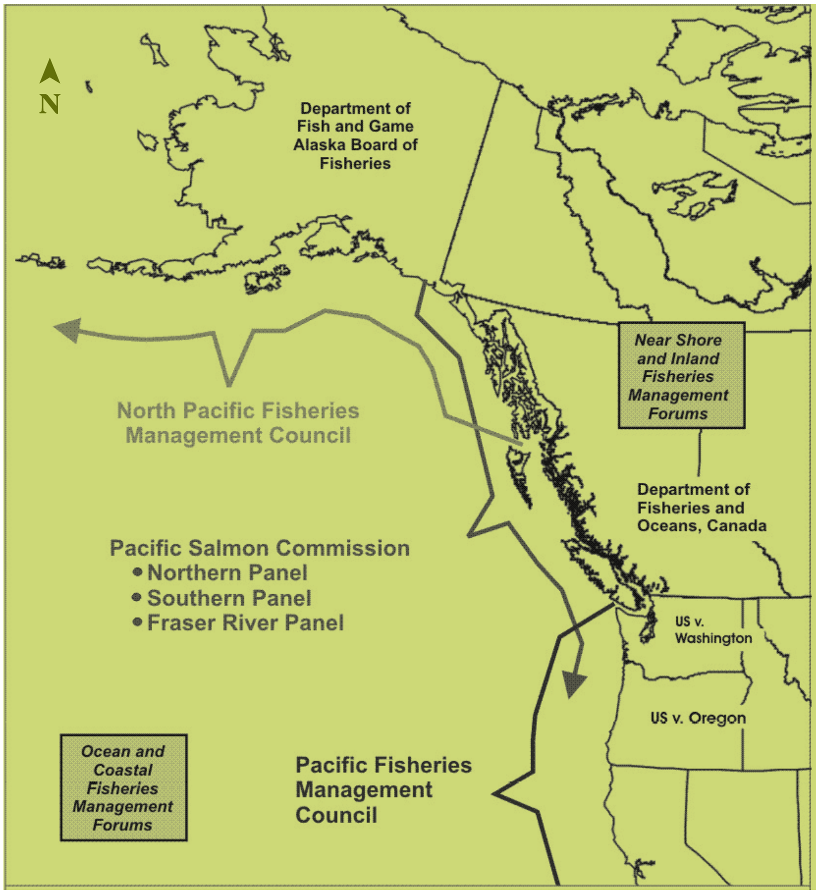
(Established under the Magnuson Fisheries Conservation and Management Act of 1976)

- Voting Members: NMFS, WDFW, ODFW, Idaho Dept. of Fish & Wildlife, California Dept. of Fish & Wildlife, 8 citizens.
- Standing Committees: Salmon Advisory Subpanel, Scientific and Statistical Committee, Salmon Technical Team

US v. Washington

- Washington Department of Fish and Wildlife
- Washington Treaty Indian Tribes

Figure 3.13 Ocean and Coastal Harvest Management Forums



National Marine Fisheries Service, Northwest Region (2003)

Figure 3.14 Ocean and Coastal Fisheries Management Forums (NMFS, 2004)

of PFMC and North of Falcon meetings receive active participation from state and tribal co-managers as well as individual commercial and sport fishing groups, and charter operators. Representatives from environmental organizations and others involved in salmon recovery are also encouraged to participate.

US v. Washington

The Federal court proceedings of US v. Washington are the legal framework for the joint management of salmon fisheries within Puget Sound and the Strait of Juan de Fuca. Treaty tribes that are parties to US v. Washington and the State of Washington Department of Fish and Wildlife are the co-managers of the salmon and steelhead resources returning to western Washington. Seventeen of the treaty tribes are based in Puget Sound, and their locations are shown in Figure 3.15.

Puget Sound Salmon Management Plan:

Harvest under U.S. v. Washington is largely guided by the 1985 Puget Sound Salmon Management Plan (US v. Washington, F. Supp. 1606:1405). The plan remains the framework for negotiating annual harvest regimes, implementing management objectives, and the allocation of harvest between the State of Washington and treaty tribes and between the tribes themselves. Management strategies are designed to provide opportunity for all parties while sharing the burden of conservation. Several principles for the management of fisheries in Washington were reinforced by the plan, including the need to allow an adequate proportion of returning runs of salmon to "escape" from fisheries to maintain both natural and artificial production. The PSSMP also emphasized the need to base allocation and management on the region of origin of returning salmon populations, and to protect weak stocks of salmon when setting up harvest shares, areas and time. Procedures for negotiation and the timely exchange of information were also established, along with principles for sharing and contingencies.

Comprehensive Management Plan for Puget Sound Chinook

The Puget Sound Chinook Harvest Resource Management Plan was jointly developed in 2004 by the Washington Department of Fish and Wildlife and the Puget Sound treaty tribes under Limit 6

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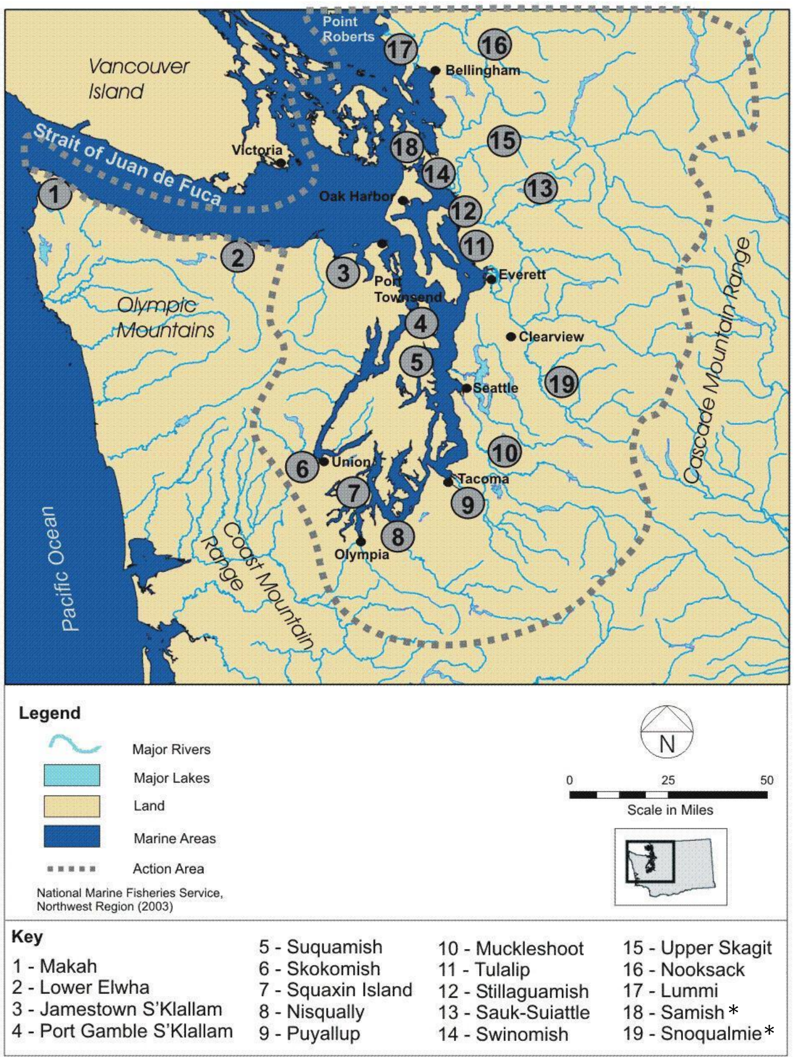
of the Endangered Species Act 4(d) Rule for the 2004-2009 fishing years. The Resource Management Plan regulates commercial, recreational, ceremonial, and subsistence salmon fisheries taking place within Puget Sound and the Strait of Juan de Fuca and potentially affecting Puget Sound Chinook Salmon. The co-managers' plan establishes "Rebuilding Exploitation Rates" for most Chinook populations in Puget Sound, which are intended to be conservative rates of harvest that should contribute to the recovery of threatened populations. Additionally, all Puget Sound Chinook populations have "Low Abundance Thresholds" that trigger additional conservation measures in United States fisheries when pre-season forecasts fall below certain levels or when US fisheries alone cannot achieve the harvest objectives. More information on the Comprehensive Chinook Resource Management Plan is described further in the section on regional recovery strategies contained in this recovery planning document.

Seasonal Harvest Management

Within the major harvest management forums, fisheries managers go through a number of steps to establish an annual harvest schedule incorporating an assessment of the effect of proposed harvest regimes on threatened populations of Chinook and summer chum.

Pre-season Planning:

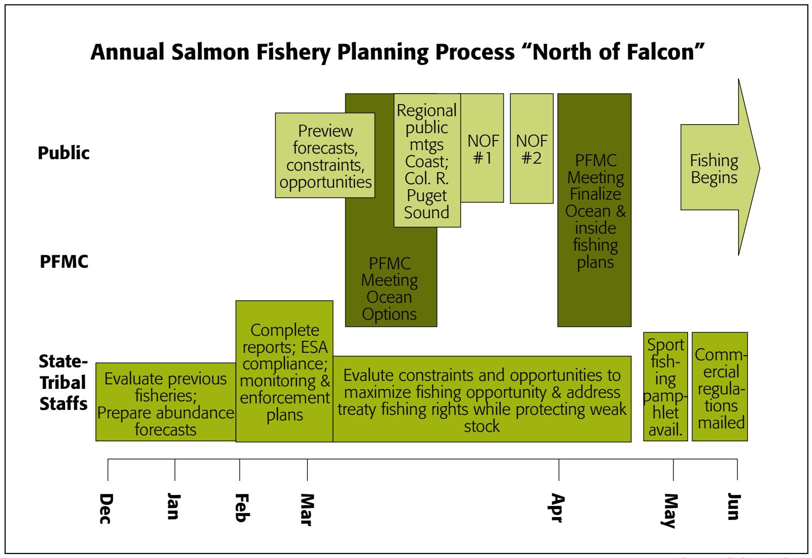
- Pre-season planning generally begins in December, with the preparation of data from previous run sizes and harvest levels. A preliminary forecast of the expected returns to Puget Sound fishing areas is made in January, and plugged into a simulation model that allows fisheries managers to estimate the impact of alternative fishing regimes on harvest and escapement
- Harvest limits for natural-origin Puget Sound Chinook are determined by the co-managers' plan (PSIT & WDFW, 2004) and provisions of the Pacific Salmon Treaty or other criteria. Harvest limits for hatchery-origin Puget Sound Chinook and other salmon species are determined by the Puget Sound Salmon Management Plan and other harvest management plans adopted under its auspices as well as provisions of the Pacific Salmon Treaty, where applicable.
- The annexes of the Pacific Salmon Treaty between the US and Canada



* A federally recognized tribe that does not hold tribal treaty fishing rights.

Figure 3.15 Federally recognized tribes.

operate on a parallel track for early pre-season planning. Each year, details of abundance forecasts, fisheries assessments, monitoring and fishing proposals are reviewed and decisions on fisheries implementation and management are made. Of primary importance to Washington State Chinook fisheries planning is the annual forecast of Canadian interceptions of US Chinook that is authorized by the Pacific Salmon Treaty and predicted to occur. This forecast is an essential input for the simulation modeling. The PSC process begins in January and intersects with the PFMC / North of Falcon process in March.



Source: T. Scott, WDFW

Figure 3.16

- As the PFMC / North of Falcon planning proceeds, information is updated, and model simulations are generated, looking for the appropriate fishing levels and balances to protect Chinook stocks based on their status. This process involves considering management controls such as the timing and locations of the various fisheries from the ocean to the terminal areas. The model results are used to ensure that the harvest rates are not exceeded for each individual stock as well as the cumulative harvest rates for a group of populations, such as Puget Sound Chinook.
- Once the proposed fisheries regimes have been reviewed, a decision is made by the PFMC on ocean fisheries and the Washington State co-managers (WDFW and the tribes) agree on an annual plan for the Strait of Juan de Fuca and Puget Sound fisheries. This fisheries plan includes the specific times, locations and other provisions (e.g., Chinook release requirement, size limit) of all the inside fisheries to occur that year. These decisions are generally reached in April of each year, but may extend into the summer and fall fishing season.

In-Season and Post-Season Management:

Fisheries schedules and regulations are often adjusted during the fishing season as better information becomes available on the abundance of various Puget Sound salmon populations. Managers must ensure that quotas are not exceeded. Commercial fisheries may be adjusted up or down based on updated information on the abundance of incoming runs. In each case, particular attention is paid to the impact to critical populations from potential changes to the harvest regime. Following the end of the season, fisheries managers collect monitoring data, evaluate the results and incorporate them into planning for future seasons.

Enforcement:

WDFW enforces commercial and recreational fishery regulations for the fishers under state jurisdiction. As of 2004, the WDFW Enforcement Program employed 150-170 personnel, of which 95% are fully commissioned Fish and Wildlife officers. Tribal fishery regulations are enforced by the individual tribe promulgating the regulation, both on and off the reservation, and enforcement officers generally attend the Federal law enforce-

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Common Harvest Management Terms:

Terminal Fishery refers to fishing at a location (terminal area) which represents the endpoint of the geographic migration cycle for a run of salmon--usually a river or embayment at the mouth of a river. Terminal fisheries capture returning adult salmon that are generally part of the same population heading for their spawning grounds, which have sorted themselves from salmon originating in other river systems. However, multiple species can be mixed together in terminal areas.

Directed Fisheries are those fisheries that are regulated to target on a particular species or population by restricting fishing areas, gear type and timing.

Incidental Catch is often used synonymously with "bycatch" and refers to fish that are caught incidentally while fishing for a different species, or populations of the same species, in a directed fishery.

Escapement is the number of adult fish that survive harvest or natural mortality and return to spawn to a particular geographic area.

Exploitation Rates are calculated as the percentage of the **total return** that is caught in fisheries. The total return is the catch + broodstock take for hatcheries or other supplementation programs + escapement to spawn naturally.

Pre-terminal or Mixed Stock Fishing Areas are the marine areas in the Pacific Ocean, Strait of Juan de Fuca and Puget Sound through which salmon originating from different river systems migrate on their way to their natal stream. Many species and populations may be mixed together in these areas.

Treaty and Non-Treaty Fisheries refers to the harvest by fishers with tribal treaty-reserved fishing rights exercised under the terms of US v. Washington, and harvest that falls under the jurisdiction by the State, respectively.

Commercial fisheries refers to fishing that is conducted to sell all or a portion of the catch, as opposed to **subsistence, take home, and sport or recreational fisheries** in which the fisher keeps the harvested fish for their personal consumption. Sport/recreational fishing is generally associated with catch by non-treaty fishers, while the term **subsistence fisheries** refers to catch obtained or retained for personal use by treaty tribal fishers.

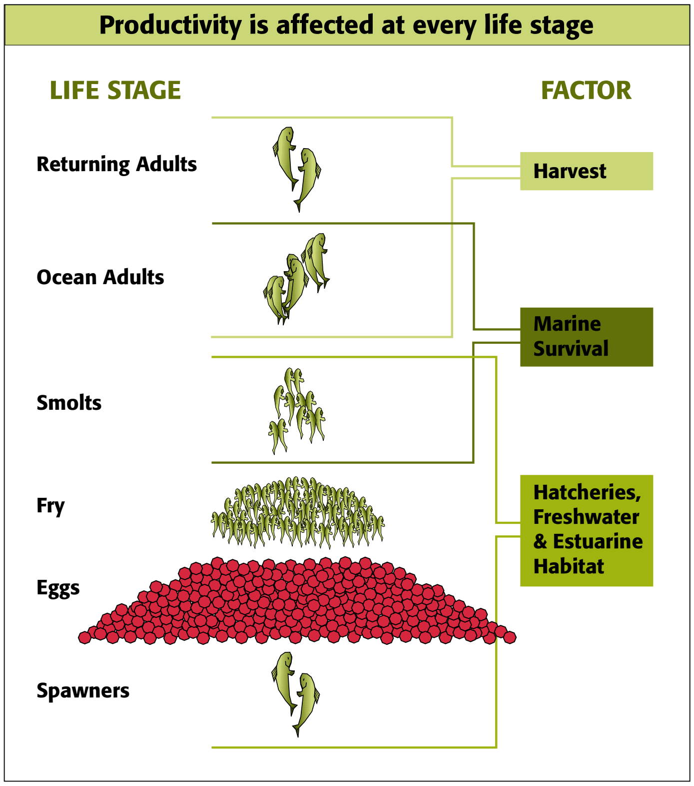
Ceremonial fisheries are conducted by treaty tribes to provide fish for funerals, tribal gatherings and other ceremonies involving the larger tribal community.

Troll fisheries are operated with hook and line equipment for either commercial or recreational purposes, as distinguished from **net fisheries** which utilize gill net, beach seine or purse seine equipment and are used in commercial fisheries. Both gear types have been used for ceremonial and subsistence fisheries .

ment academy for training. Several tribes operate enforcement consortia or utilize cross-deputization agreements where tribes fish in common areas. Violations are prosecuted in the respective state or tribal court systems. State and tribal law enforcement agencies cooperate with the US Fish and Wildlife Service, NMFS enforcement branch and the U.S. Coast Guard in the course of their enforcement duties.

Harvest Management and Salmon Abundance/ Productivity

Freshwater conditions, marine survival and harvest all affect the productivity of a salmon population, i.e. the number of returning adult progeny per spawner. Freshwater and marine habitat conditions can affect the rate by which eggs hatch, juvenile salmon survive and transition to seawater



(Source, WDFW & NWIFC)

Figure 3.17 Salmon productivity is affected at every life stage.

(smoltify), and migrate to ocean environments where they mature. Ocean conditions, predation and harvest directly affect the proportion of the adults that return to spawn (Figure 3.17).

Productivity and Harvest

When a salmon population is merely replacing itself, the relationship between the parent salmon and their returning offspring is a 1-to-1 ratio. The productivity of some Puget Sound Chinook populations is presently less than the level of replacement. One of the characteristics of viable, healthy populations is to have a level of productivity that is greater than the 1-to-1 replacement rate. These populations may have what is known as a "harvestable surplus", i.e. a portion of the population that can be harvested without affecting the population's ability to replace itself (see figure 3.18).

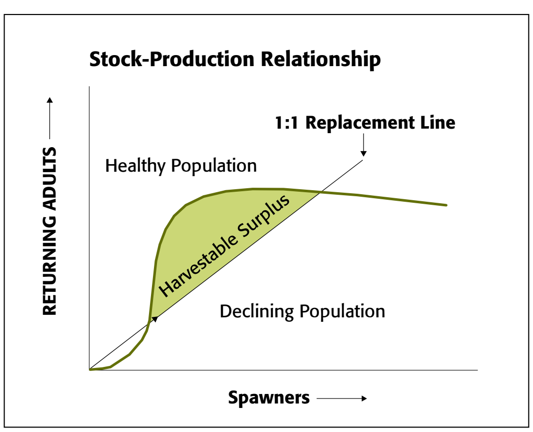


Figure 3.18 Productivity affects the ability of populations to replace themselves and provide a harvestable surplus.

Fisheries managers set the rates of harvest so as to allow adequate "escapement" from the fisheries that intercept adult salmon as they migrate. Estimating the number of fish that will return in advance and setting rates that will not impinge on the ability of a population to replace itself is a difficult task. The level of abundance of salmon populations varies from year to year, and different populations may require additional conservation measures in certain return years. In cases where the population levels are already very low, fisheries managers must ensure that harvest does not impede the ability of the populations to rebuild.

Reduction of Exploitation Rate in Puget Sound Chinook Fisheries

The objective of the current harvest management plan (PSIT and WDFW 2004) is to ensure that harvest will not significantly impede progress towards population recovery by keeping the rate of harvest low. Fisheries managers use the term "exploitation rate" to refer to the percentage of a total return of salmon that is taken in fisheries. The exploitation rates for Puget Sound Chinook populations of concern have declined by 44 to 64% between the periods 1983-1987 and 1998-2000, and have been held to this low level for the last few years (PSIT & WDFW, 2004). (See Figure 3.19 for an example for Snohomish Chinook.)

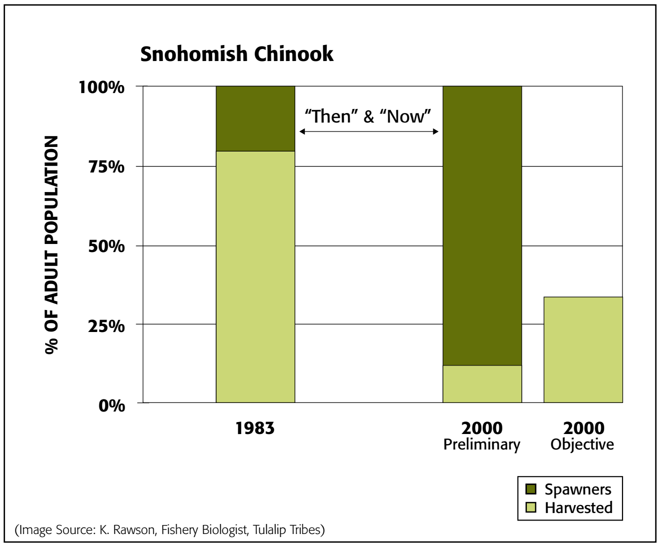


Figure 3.19 Comparison of the % of adult Snohomish Chinook harvested in 1983 and 2000.

Despite the low harvest levels of recent years, several populations have not been able to rebuild. Fisheries managers have concluded in many cases that further reduction in fishing is not feasible (due to habitat impairment and limited jurisdiction over certain fisheries), nor is it likely to contribute to rebuilding wild populations of salmon. Data comparing hatchery-origin fish to naturally-spawned fish have indicated that reduced exploitation rates (along with more favorable ocean conditions) are increasing the number of hatchery-origin fish that return to spawn. Unfortunately this is not the case for natural-origin Chinook returns which, though stabilized, have not increased. This information points to the condition of freshwater habitat as the factor constraining natural salmon production, indicating that the conservative levels of harvest now being implemented do not impede recovery (PSIT & WDFW, 2004).

Snohomish Chinook provide an example of the apparent disconnection between spawner numbers and productivity in some Puget Sound Chinook populations (figure 3.20). Harvest has been reduced to very low levels resulting in a relatively constant number of spawners. Despite the maintenance of a constant number of spawners, the total abundance continues to decline. Fisheries managers attribute this situation to factors affecting the survival of offspring to adulthood, such as habitat conditions (WDFW, 2005).

Directed Fisheries and Incidental Catch

Fisheries managers distinguish between "directed" fisheries which target a particular species for harvest, and the "incidental" catches of other species which occur because the various species are mixed in Pacific Ocean and Puget Sound marine areas. Directed fisheries can also target a particular population, such as a hatchery-origin stock, and may result in the incidental take of wild fish from the same species. Where threatened or weak populations of fish may be at risk of incidental catch, the managers shape "selective" fishing regulations in an attempt to avoid harvest of the weak stocks. This can be accomplished by limiting harvest to specific areas, and timing openings to avoid the peak of a weak salmon run. Regulations can specify types of gear, and require the release of all live Chinook that are harvested during

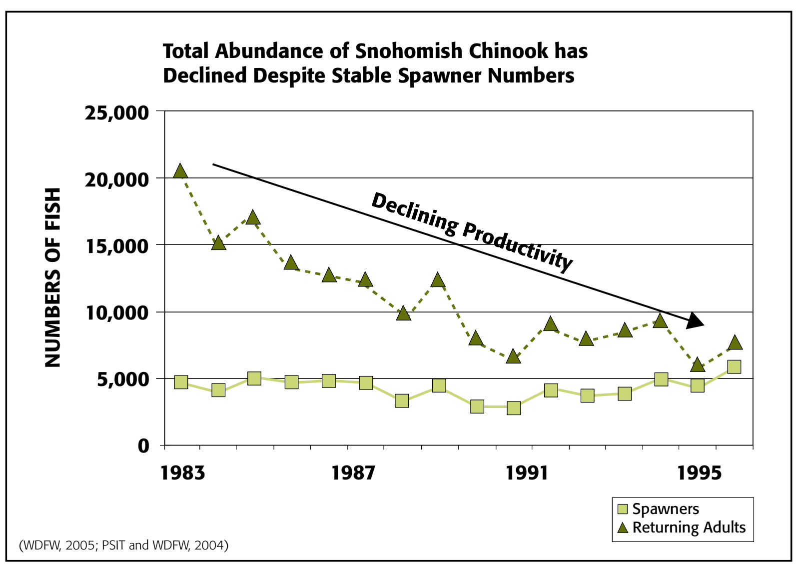


Figure 3.20 Number of Snohomish Chinook spawners and returning adults 1983-1998

an opening. Both directed fisheries and incidental catch are evaluated in establishing exploitation rates for Puget Sound salmon fisheries.

Additional Mortalities Related to Harvest

Commercial and recreational fisheries also result in "non-landed mortality" on Chinook and other species which varies by the type of gear. Even fisheries designed to be selective either for species or to harvest specially marked hatchery fish will have some mortality associated with the hooking and handling of the released fish. These include fish that are brought to the boat but are released because they are too small (may die from hooking trauma), fish that are hooked but drop off before they are brought to the boat, and fish that die from entanglement in gillnet or purse seine gear and drop out before being landed. For each type of fishery (commercial troll, recreational, net, etc.), harvest managers add between 5 and 50% percent to the total catch to account for fish deaths due to release, drop-off and other harvest related impacts (PSIT & WDFW, 2004).

Marine mammals are opportunistic feeders that take advantage of the chance to eat fish from lines or nets before they can be brought to the boat. Marine mammal predation is a substantial source of salmon mortality in many areas of Puget Sound but their effect varies widely from year to year and area to area. In the 1994 Amendments to the Marine Mammal Protection Act (MMPA), Congress directed that a scientific investigation be conducted to "determine whether California sea lions and Pacific harbor seals a) are having a significant negative impact on the recovery of salmonid fishery stocks which have been listed as endangered species or threatened species under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), or which the Secretary finds are approaching such endangered species or threatened species status; or b) are having broader impacts on the coastal ecosystems of Washington, Oregon, and California." A working group was established by NMFS and reported that sea lion and harbor seal populations have been increasing, and that the interaction of these marine mammals with commercial and recreational fisheries on the West Coast are on the rise. However, the working group indicated that there was insufficient information to determine ecosystem level impacts and a number of research efforts were recommended (NMFS, 1997).

Puget Sound Chinook Catch

Puget Sound Chinook salmon are captured in fisheries that occur in Alaskan and Canadian waters, ocean fisheries off of the West Coast of the contiguous United States, and within the marine waters and freshwater tributaries of the Strait of Juan de Fuca and Puget Sound. These fisheries are conducted for commercial purposes, for sport/recreational catch, or for tribal ceremonial and subsistence objectives. Puget Sound Chinook are captured through fisheries that are directed at the harvest of Chinook but are intended to catch populations that are not threatened, such as hatchery-origin fish; or they may be harvested as incidental catch during fisheries for coho and other species of salmon. Chinook are captured using "troll" gear (hook and line) or they may be taken in a variety of net gear types. The impact of these fisheries varies area by area, season by season and differs for individual populations of Chinook.

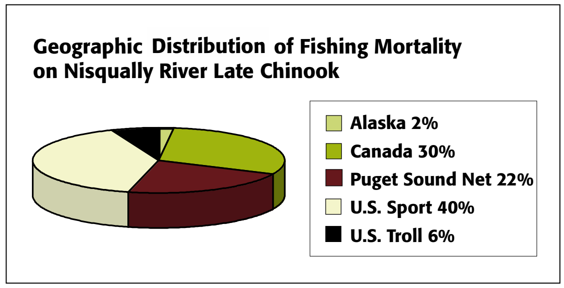
Alaskan and Canadian Interceptions of Puget Sound-Origin Chinook

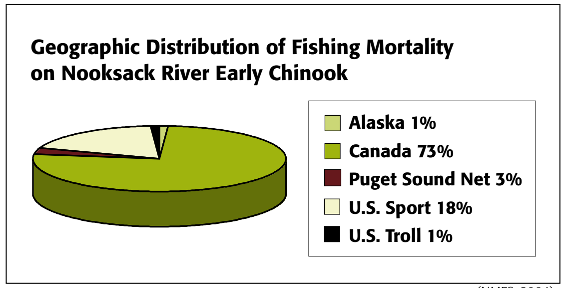
Chinook salmon originating in Puget Sound rivers are harvested in Alaska and Canada. Harvest in Alaskan and Canadian waters falls largely under the management of the Pacific Salmon Commission. For many Puget Sound Chinook populations, the majority of the total harvest occurs in these fisheries. Data which indicate the proportion of the catch taken by any given fishery (e.g. Canada, Alaska) is generally derived from coded wire tags that are inserted into juvenile salmon from hatcheries before their release.

Alaskan interceptions are relatively small; generally 5% or less of any given Puget Sound Chinook run is harvested in Alaska. The Elwha Chinook population and some Skagit Chinook are exceptions, since Alaskan catch accounts for a little less than 10% of the total run of Elwha Chinook which were released as fingerlings, and 12-13% of Skagit summer fingerlings (PSC, 2004).

A number of troll and net fisheries operate in Canadian waters off of the West Coast of Vancouver Island, Georgia Strait, northern British Columbia, Strait of Juan de Fuca, and marine waters between Vancouver Island and the British Columbia mainland. Canadian fisheries managers implement constraints on their fisheries similar to their US counterparts, with area closures, timing, and size restrictions to conserve weak Canadian and US Chinook and coho stocks. Due to the abundance of other Chinook populations in northern British Columbia waters, Puget Sound Chinook make up a small portion of the catch there. However, these fisheries can account for a large portion of the mortality of Puget Sound Chinook populations originating from the north Olympic Peninsula and northern Puget Sound.

The impact of Canadian harvest on Puget Sound Chinook populations varies significantly for each river system. Georgia Strait fisheries have heavy impacts on North Sound and Hood Canal stocks. West Coast Vancouver Island fisheries have a major impact on all Puget Sound early and late-timed populations of Chinook (PSIT & WDFW, 2004). Canadian harvests generally have a higher proportional impact on populations originating from areas closer to Canada, i.e. in the Strait of Juan de Fuca and northern Puget Sound, than on southern Puget Sound populations. For example, figure 3.21 shows that 73 percent of the Nooksack River early-timed Chinook that are caught in various fisheries are harvested in Canada, while the Canadian portion of the harvest of late-timed Nisqually River Chinook is estimated to be 30 percent . A river-by-river summary of the geographic distribution of fishing mortality, such as those shown in figure 3.21,





(NMFS, 2004)

Figure 3.21 Comparison of the Geographic Distribution of Fishing Mortality on Nisqually River Late-timed Chinook and Nooksack River Early Chinook. Distribution of fishing mortality based on coded-wire tags recoveries of Puget Sound Chinook.

is contained in the Draft Environmental Impact Statement for the Puget Sound Chinook Harvest Resource Management Plan (NMFS, 2004).

Because Puget Sound Chinook were listed as threatened under the Endangered Species Act, the US federal government was required under section 7 of the Act to conduct a consultation that considered the impacts of Chinook harvest management under the Treaty. The consultation was completed and the National Marine Fisheries Service issued a Biological Opinion in November 1999 (NMFS 1999). In that Opinion, NMFS stated that:

"[Reductions pursuant to the Treaty] in combination with other reductions that may occasionally be necessary in southern U.S. fisheries, will be sufficient to meet rebuilding exploitation rate (RER) targets for the larger, more productive stocks in Puget Sound like Upper Skagit summer Chinook. However, the analysis suggests that the exploitation rate reductions secured by the agreement will not be sufficient to meet RERs for smaller, less productive stocks that may already be close to critical threshold levels....However, ... it is highly unlikely that rejection of this agreement

would lead to a better or more restrictive management regime in the foreseeable future." ...

"Although the exploitation rate savings secured by the agreement for some components of Puget Sound Chinook may not be fully sufficient, they are very significant for many Puget Sound stocks and for other ESUs.....NMFS concludes that the alternative which carries the greatest benefit for the listed Puget Sound Chinook is the entry into force of the agreement and to employ the mechanisms in the agreement itself to address, more surgically, the deficiencies that are apparent with respect to several of the individual stocks of PS Chinook where warranted."
(NMFS 1999)

Tribal and state co-managers of Puget Sound Chinook remain concerned about the increased risk of under-escapement for some depressed Puget Sound Chinook under current levels of Canadian and Alaskan impacts and the additional constraints on Washington fisheries required to protect Chinook. The topic will be discussed during the development of a new Chinook regime for fisheries after 2008. In the interim, the tribal, state and federal managers have indicated their intent to continue to work with Canadian managers both to employ the mechanisms of the agreement and to find opportunities for reductions beyond those provided in the agreement that may be needed to address critical conservation concerns and that would provide additional benefits for Puget Sound Chinook populations.

Ocean Fisheries along the Washington Coast

Because most Puget Sound Chinook migrate north to Canadian and Alaskan waters, Puget Sound Chinook populations comprise less than 10 percent of the Washington coastal troll and sport catch overall. The contribution of Puget Sound populations to the catch is generally higher in the northern coastal areas and the mouth of the Strait of Juan de Fuca. Less than one percent of most of the individual Puget Sound Chinook populations is estimated to be harvested along the Washington coast. However, the rates vary annually depending on the abundance of Columbia River and British Columbia Chinook, which are co-mingled with Puget Sound stocks, as well as Chinook from local coastal rivers (PSIT and WDFW, 2004) and (NMFS, 2004).

Commercial Fisheries off the Washington Coast:

A Chinook troll fishery occurs 10 to 40 miles offshore and targets the harvest of Chinook in May and June, and coho in July through mid-September. Quotas (catch ceilings) are developed during preseason harvest planning and are modified annually due to the variation in abundance of the species. From 1998 to 2004, commercial troll catch along the Washington coast has ranged from approximately 18,000 to 94,000 (Figure 3.22).
Recent ocean fishing opportunities and catches have increased as ocean survival conditions became more favorable in the early 2000s, yielding higher abundances for most salmon stocks.

Year	Treaty Troll	Non-Treaty Troll	Recreational	Total
1998	14,859	5,929	2,187	22,975
1999	27,664	17,456	9,887	55,007
2000	7,770	10,269	8,478	26,517
2001	28,100	21,229	22,974	72,303
2002	39,184	53,819	57,821	150,824
2003	34,629	56,202	34,183	125,014
2004	49,175	35,372	24,910	109,457

Table 3.22 Commercial troll and recreational landed catch of Chinook in ocean fisheries along the Washington coast (Areas 1-4), 1998-2004. Note that Puget Sound Chinook populations comprise less than 10% of the catch in these fisheries. (PSIT and WDFW, 2004; PFMC 2005)

Recreational Fisheries along the Washington Coast:

Recreational fisheries in Washington ocean areas are also conducted under specific quotas and allocations, and are monitored by WDFW at each port to keep within the quotas. From 1998 to 2004, the recreational Chinook catch ranged from 2,200 to 58,000.

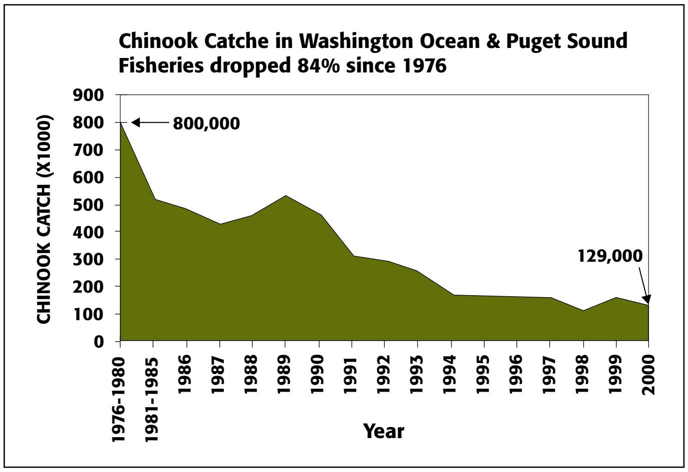


Figure 3.23 Total Chinook Catch in Washington Ocean and Puget Sound Fisheries, 1976 - 2000

Puget Sound and Strait of Juan de Fuca Fisheries

Commercial Chinook Harvest in Puget Sound and the Strait of Juan de Fuca:

> *"Total commercial net and troll harvest of Chinook salmon [in Puget Sound] has fallen from levels in excess of 200,000 in the 1980's to an average of 64,000 Chinook salmon for the period 1997 through 2001." (NMFS, 2004)*

Commercial fisheries for Chinook in the Puget Sound region consist of small-scale directed fisheries targeting hatchery populations, commercial troll fisheries in the western Strait of Juan de Fuca, and the incidental catch of Chinook during fisheries on other species. These fisheries are subject to seasonal and area closures to protect threatened populations.

Commercial directed:

- A few commercial fisheries that are generally directed at abundant hatchery Chinook production occur in terminal areas such as Bellingham/Samish Bay and the Nooksack River; Tulalip Bay; Elliott Bay and the Duwamish River; Lake Washington; the Puyallup River; the Nisqually River; Budd Inlet; Chambers Bay; Sinclair Inlet; southern Hood Canal; and the Skokomish River.
- Commercial troll fisheries directed at Chinook occur in the western Strait of Juan de Fuca in the winter and early spring, but are closed in mid-April to mid-June to protect maturing early-timed Chinook. Portions of the western Strait fishery are managed under ocean troll regulations, and schedules and quotas differ in these areas. The annual harvest of the directed troll fishery in the western Strait of Juan de Fuca generally ranged from 1,000 to 3,000 from 1997 to 2003 (PSIT & WDFW, 2004; WDFW, 2005). A harvest of 20,197 Chinook occurred in the 2004 - 2005 treaty troll fishery in the western Strait of Juan de Fuca. Pre-season projected total catch for the Strait troll fishery was 2,650 Chinook. The fishery was closed on February 3, 2005 in order to limit catch to near 20,000 (Makah Tribe & NWIFC, via WDFW, 2005).

Incidental Catch: Most of the commercial harvest of Chinook in Puget Sound waters consists of

Photo by Dan Kowalski

Year	Catch (thousands of fish)				
	Chinook	Coho	Pink [a]	Sockeye	Chum
1971-1975	165.1	748.4	2,055.4	2,192.0	408.4
1976-1980	239.5	901.1	3,091.1	1,365.4	699.4
1981-1985	228.9	950.8	3,303.5	1,833.5	750.3
1986	222.8	1,342.1	.1	2,735.6	1,147.1
1987	212.1	1,769.6	2,063.0	1,938.3	1,282.0
1988	230.6	1,228.4	.1	838.1	1,552.1
1989	250.4	958.7	3,419.7	2,237.4	877.1
1990	247.9	1,058.4	.3	2,151.9	1,092.4
1991	140.8	591.4	3,284.8	1,814.2	1,012.9
1992	111.7	394.2	.2	605.9	1,363.7
1993	81.1	184.5	2,090.0	2,690.2	1,114.4
1994	84.6	452.5	.2	1,837.7	1,350.8
1995	78.4	296.4	2,701.9	406.1	740.2
1996	76.5	161.7	.1	317.9	779.6
1997	77.4	145.0	1,876.5	1,362.7	416.6
1998	54.0	155.1	.9	537.1	816.9
1999	92.6	108.0	51.8	20.5	248.9
2000	80.2	404.5	.4	547.9	294.8
2001	132.2	392.1	780.8	255.4	1,572.9
2002	113.9	298.3	.3	476.0	1,951.5
2003	92.1	252.2	1,234.7	273.4	1,542.1
2004	101.2	572.1	.7	218.7	1,919.1

Table 3.24 Total Salmon Catch by Year and Species in Puget Sound and the Strait of Juan de Fuca (Treaty and Non-treaty commercial, take-home, C & S; freshwater and marine areas 4B-13) Source: WDFW, 2005 fish ticket data.

incidental catch that is permissible in order to provide the fishers with the opportunity to fish for abundant runs from other species. Recent regulations designed to reduce the incidental catch and mortality of Puget Sound Chinook have reduced the incidental contribution to less than one percent of the total catch of all other species in Puget Sound fisheries (Figure 3.24) (CWDFW, 2005 fish ticket data).

Puget Sound Recreational Harvest

Within Puget Sound, recreational fisheries occur in both marine and freshwater areas. "Since the mid-1980's, the total annual marine harvest of Chinook salmon has steadily declined to levels of less than 50,000 Chinook salmon in recent years." (NMFS, 2004) (See figure 3.25.) These fisheries occur during the summer months

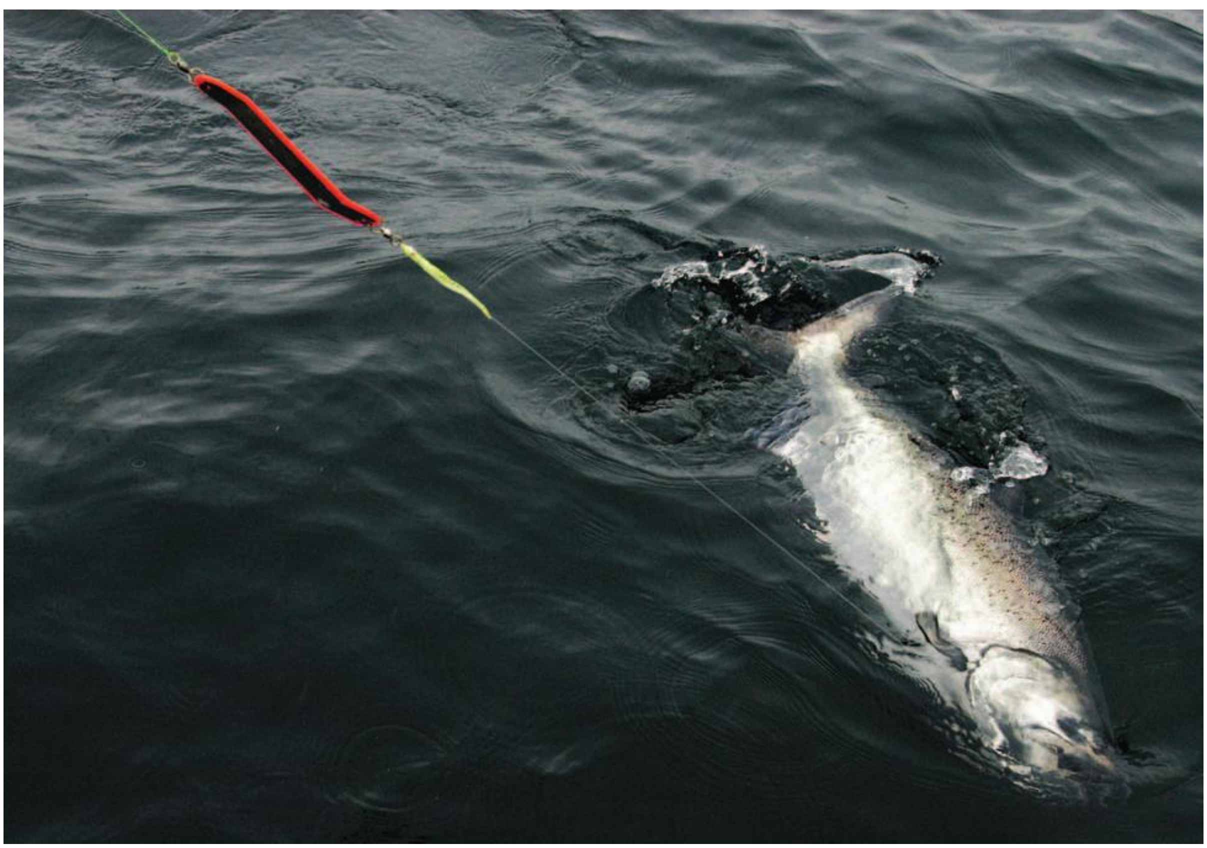


Photo by Dan Kowalski.

Chinook salmon caught by recreational angler.

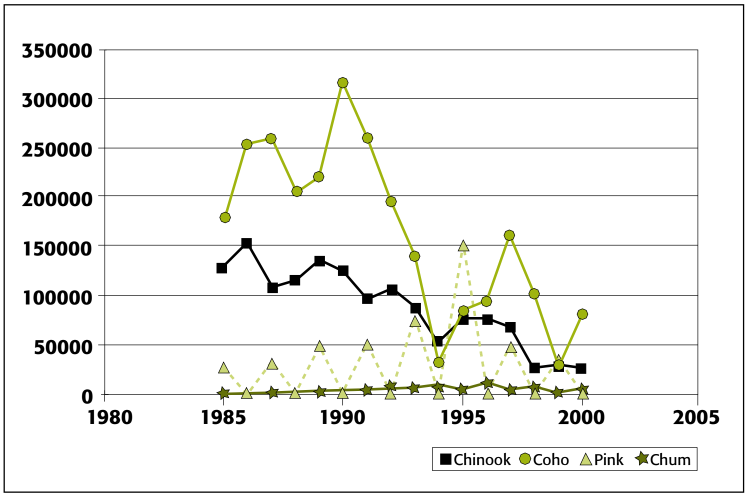


Figure 3.25 Number of Chinook salmon caught in Puget Sound marine recreational fisheries from 1985 to 2000 (NMFS, 2004).

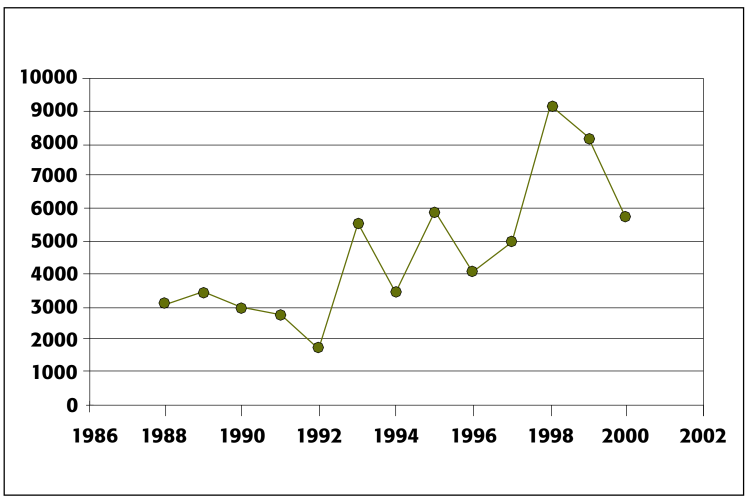


Figure 3.26 Number of Chinook salmon harvested in Puget Sound freshwater recreational fisheries from 1988 to 2000 (NMFS, 2004).

targeted primarily on coho and Chinook salmon, and continue during the fall and winter to target immature Chinook salmon called "Blackmouth."

The recreational catches of Chinook in Puget Sound marine waters have been constrained in a similar manner to commercial fisheries in an effort to protect weak Chinook populations. As a response to increasingly restricted bag limits and shorter fishing seasons in open marine waters to preserve commingled weaker populations, the recreational harvest of Chinook in freshwater areas has shown an increase since the early 1990s (figure 3.26). Since these fisheries occur within the terminal areas of the various salmon runs, it is easier to target a directed harvest on stronger salmon populations than is possible in pre-terminal areas.

Ceremonial and Subsistence Fisheries

The treaty Indian tribes of western Washington also schedule "ceremonial and subsistence" fisheries for Chinook salmon and other species. Subsistence fishing provides tribal members with basic nutritional benefits from eating salmon, and the economic and personal reward derived from catching one's own food. At many tribes, subsistence fishing is regulated on a structure parallel to the Washington State recreational fisheries, with punch cards or forms to report catches and similar seasonal and area openings. Some tribes utilize standard fish reporting tickets to report ceremonial and subsistence catch. Ceremonial fisheries occur in response to the cultural and traditional needs of the tribes, and are generally scheduled as needed for funerals, first salmon ceremonies, annual gatherings and other tribal ceremonies involving the full tribal community. Ceremonial and subsistence harvests are small in proportion to commercial and recreational catches, with annual harvest of a few hundred Chinook or less. Such fisheries typically open for a few hours or days, with participation limited to one or few boats.

AR057043

Traditional tribal method of cooking salmon on stakes, Lummi Tribe.

Photo by Dan Kowalski.

of decline for the Hood Canal summer chum in its 1998 status review (NMFS/BRT, 1998). Prior to 1974, commercial salmon fishing was prohibited in Hood Canal, with the exception of the Skokomish Indian Reservation. Following the opening of commercial fishing in the Canal in 1974, incidental harvest rates of summer chum climbed rapidly, reaching 50-80 percent in most of the Canal, and exceeding 90 percent in some areas in the 1980s. During the high harvest years, harvest rates on individual summer chum populations averaged 20 percent (NMFS/BRT, 2003).

Summer chum salmon are also harvested incidentally in British Columbia in pink and sockeye fisheries in the Strait of Juan de Fuca, Johnstone and Georgia Straits; and in troll fisheries off the west coast of Vancouver Island (63 FR, 11774-11795). Canadian harvest declined in the 1990s due to significant reductions in coho and sockeye fishing. Chum salmon are regulated in the same major harvest management forums as Chinook.

In 1991, coho salmon fishing in the main part of Hood Canal was closed by the co-managers to

"When times were tough, I remember my dad bringing home salmon to feed us and he'd bring some for the neighbors too. It isn't just enough for us to protect the salmon; It is part of our culture to consume them as well."

Terry Williams, Tulalip Tribes

Harvest Effects on Hood Canal Summer Chum

Although fisheries are not directed on Hood Canal summer chum a sizeable number of Hood Canal summer chum have been harvested incidentally during fisheries directed at Chinook and coho, which have overlapping run timing. Substantial incidental catches in Strait of Juan de Fuca and Hood Canal fisheries in the 1980s prompted the NMFS Biological Review Team to consider past harvest levels to be a factor

Population	1974 – 1979 mean exploitation rate (%)	1980 – 1991 mean exploitation rate (%)	2000 – 2004 mean exploitation rate (%)
Combined Quilcene	29.6	90.4	14.1
Dosewallips	24.4	47.9	1.5
Duckabush	24.4	47.9	1.5
Hamma Hamma	24.4	47.9	1.5
Jimmycomelately	9.4	21.2	0.4
Lilliwaup	24.4	47.9	1.5
Salmon	11.9	21.2	0.5
Snow	11.9	21.2	0.5
Union	57.6	54.9	1.5

Figure 3.27 Estimated exploitation rates on populations of Hood Canal summer chum salmon from 1974 to 2004. (S. Bishop, pers. comm., NMFS)

protect natural coho runs, and modifications were made to the remaining coho and Chinook fisheries throughout Puget Sound to protect summer chum. As a result of these efforts, exploitation rates on summer chum in Hood Canal have declined greatly, and have dropped to a cumulative average (including Canadian fisheries) of five percent or less in recent years.

Additional information on the effects of harvest management on Hood Canal Summer Chum is contained in the Summer Chum Conservation Initiative (WDFW & PNPTT, 2000) and the Hood Canal/ Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan (in progress) by the Hood Canal Coordinating Council.

Harvest Effects on Coastal/Puget Sound Bull Trout

Core bull trout areas in the Olympic Peninsula and Puget Sound Management Units have experienced current and historical impacts to bull trout from fisheries management. Incidental mortality to bull trout during recreational fisheries and the commercial harvest of other salmonid species is considered to be a major factor leading to the decline in bull trout abundance. As a predatory species, bull trout have also suffered from the decline of local populations of salmon.

Although char have not historically been the target of recreational anglers in the Coastal/Puget Sound region, it is believed that the incidental catches of bull trout during fisheries for steelhead, trout and salmon exceeded the population's productivity. As bull trout mature slowly, harvest that occurs prior to full maturity and reproduction has a significant impact on their viability. The migratory nature of bull trout between freshwater and saltwater causes them to pass through various harvest locations repeatedly during their life cycle. Bull trout are also highly susceptible to hooking mortality during other targeted recreational fisheries.

Unlike some Chinook salmon populations, bull trout in some core areas appear to have responded to restrictions on harvest. For example, prior to 1994, bull trout/Dolly Varden were allowed to be kept as part of the general trout bag limit in the North Fork of the Skykomish River. In 1994, WDFW enacted a conservation measure that disallowed retention of bull trout in key bull trout areas. A three-fold increase in bull trout redds in the North Fork Skykomish followed (figure 3.28; WDFW, 2005).

In addition to recreational fisheries, the illegal harvest of bull trout persists in some core areas within Puget Sound and may have significant localized impacts. These activities are difficult to enforce due to the remote nature of bull trout spawning areas. The tendency of bull trout to aggregate prior to spawning also makes them vulnerable to illegal harvest. The USFWS identified a number of illegal harvest hot spots in the Puget Sound region, which are primarily located adjacent to upper river campgrounds.

Commercial gill net fisheries that target steelhead and salmon near the mouths of Olympic Peninsula rivers are also associated with bull trout mortalities. Additional information on the relationship between fisheries management and bull trout related to seasons, bag limits, and fishing locations is contained in the Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (USFWS, 2004).

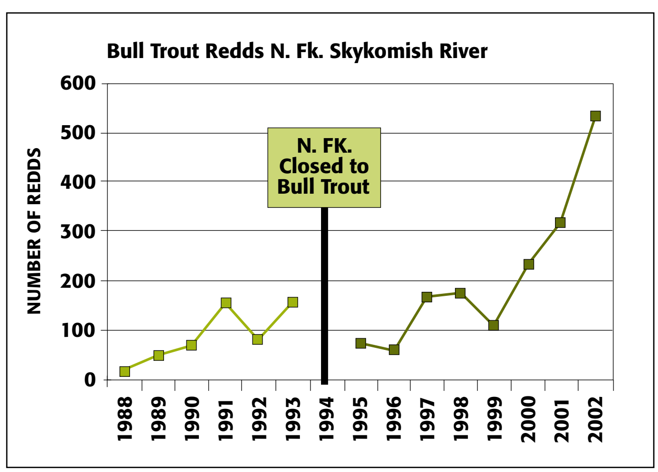


Figure 3.28 Number of Bull Trout Redds in the North Fork Skykomish River (WDFW, 2005)

AR057045

The Effect of Hatcheries on Puget Sound Chinook, Hood Canal Summer Chum, and Coastal/Puget Sound Bull Trout

"Hatcheries of the future must be different from those of the past. There is both need and opportunity to make them better by ensuring that they are more consistent with ecological and genetic/evolutionary principles."

Conclusions of the Hatchery Scientific Review Group, 2004

The artificial propagation of salmon in Puget Sound began with a hatchery on the Baker River in 1896. Hatcheries were traditionally operated for two main purposes-to mitigate for the reduction of salmon runs due to the construction of dams and other habitat loss, and to increase the number of fish available for harvest.
The science and practice of hatchery operation has advanced significantly over the past 100 years, but hatchery intervention into salmon runs has created long term genetic and evolutionary consequences that may never be fully mended. Hatchery management today still seeks to provide opportunity for fishers where the negative consequences of artificial propagation can be minimized and isolated. Additionally, many hatchery programs are now utilized as tools to salvage the remaining salmon populations and help maintain them as they rebuild to self-sustaining and harvestable levels. Hatcheries alone cannot achieve this goal, and it is widely recognized that they must operate hand-in-hand with habitat restoration if future salmon are to find a home.

History of Hatchery Production in Puget Sound

Washington hatcheries are one of the largest producers of Chinook salmon in North America. The earliest hatcheries were not built specifically for Chinook propagation, but hatchery managers soon focused on that species. Early propagation entailed the collection of eggs, often by installing a weir in the river to impede upstream migration by adult Chinook, and releasing the hatched fry with little or no rearing. Hatchery managers rapidly learned that survival would increase by feeding and rearing the fry to a larger size for at least a few months. Experimentation with the release of larger juvenile salmon as sub-yearlings or yearling smolts led to the use of these long term rearing methods as the predominant strategy for Chinook hatchery production.

Puget Sound Hatchery Production

Hatchery releases in most Puget Sound rivers began near the turn of the 19th-20th centuries. Since 1935, WDFW and the tribes have released approximately 2.5 billion Chinook salmon into Puget Sound regional waters from hatchery programs (WDFW&PSTT, 2004). The juveniles released ranged from a month to over a year old.

Egg Transfers and the Development of Broodstocks

As hatchery production increased, hatchery managers began to utilize the "broodstock" from a few abundant watersheds to provide the eggs for an entire region. Between 1913 and 1927, Puget Sound hatcheries imported large numbers of Chinook salmon eggs from the lower Columbia River Basin. However the majority of Chinook salmon eggs for hatchery fall Chinook production in Puget Sound came from the Green River Hatchery. "From 1904-1913 and 1927-1957, releases from the Green river Hatchery averaged 69.9% and 67.7%, respectively, of all Chinook salmon releases" (WDFW & PSTT, 2004). Hatchery managers assumed that fish of the same species were interchangeable, and fish were transferred to watersheds without awareness of the impacts to genetic diversity and fish health. The portion of Chinook produced by the Green River Hatchery diminished after the 1950's, but transfers of Green River eggs to numerous Puget Sound rivers continued until

WRIA - Drainage	Years Planted with Chinook	Total Number Released (1950-1997)	Chinook released from WDFW Hatcheries, (1998-2003)	Chinook released from tribal Hatcheries (1998-2003)
WRIA 1 -				
Nooksack R.	1899-1929, 1952-present	161,197,000	10,042,451	10,663,202
Samish R.	(1899) 1914-present	198,347,000	25,127,782	–
WRIA 3 and 4 -				
Skagit R.	1906-present	88,368,000	4,023,433	–
WRIA 5 -				
Stillaguamish R.	1905-15, 54, 57-present	16,861,000	1,069,135	299,686
WRIA 7 -				
Snohomish R.	1900-66, 89-93	2,729,000	–	–
Snoqualmie R.	1904-60, 63-75, 77	74,077,000	–	–
Skykomish R.	1904-51, 53-present	1,457,000	7,629,732	–
WRIA 8 -				
Lake Washington	1920-present	126,880,000	12,715,542	–
WRIA 9 –				
Duwamish/Green R.	1909-present	206,446,000	27,951,428	3,558,280
WRIA 10 -				
Puyallup R.	1917-present	2,480,000	10,021,800	2,600,586
White R.	1901-08, 1990-present	87,477,000	–	5,314,045
WRIA 11 -				
Nisqually R.	(1899-) 1937-present	63,179,000	–	27,158,288
WRIA 16 -				
Skokomish R.	1899-1922, 1957(?) -present	5,734,000	22,996,303	1,421,655
Hamma Hamma R.	1971-92	4,175,000	375,400	–
Dosewallips R.	1959-92	117,730,000	–	–
Duckabush R.	1959-92	3,745,000	–	–
WRIA 17 -				
Big Quilcene R.	1900-96	27,733,000	–	–
WRIA 18 -				
Dungeness R.	1902-82, 1996-present	48,768,000	9,293,796	–
Elwha R.	1914 -?; 1953-present	17,416,000	18,514,493	–

Figure 3.29 Releases of Chinook salmon in watersheds with historical natural production in the Puget Sound. (WDFW & PSTT, 2004) Watersheds are identified by water resource inventory area (WRIA). Data are from WDFW annual reports (1902-1970), liberation summaries in Myers et al., 1998, personal communication from Kent Dimmit, WDFW, and Ken Currens, NWIFC.

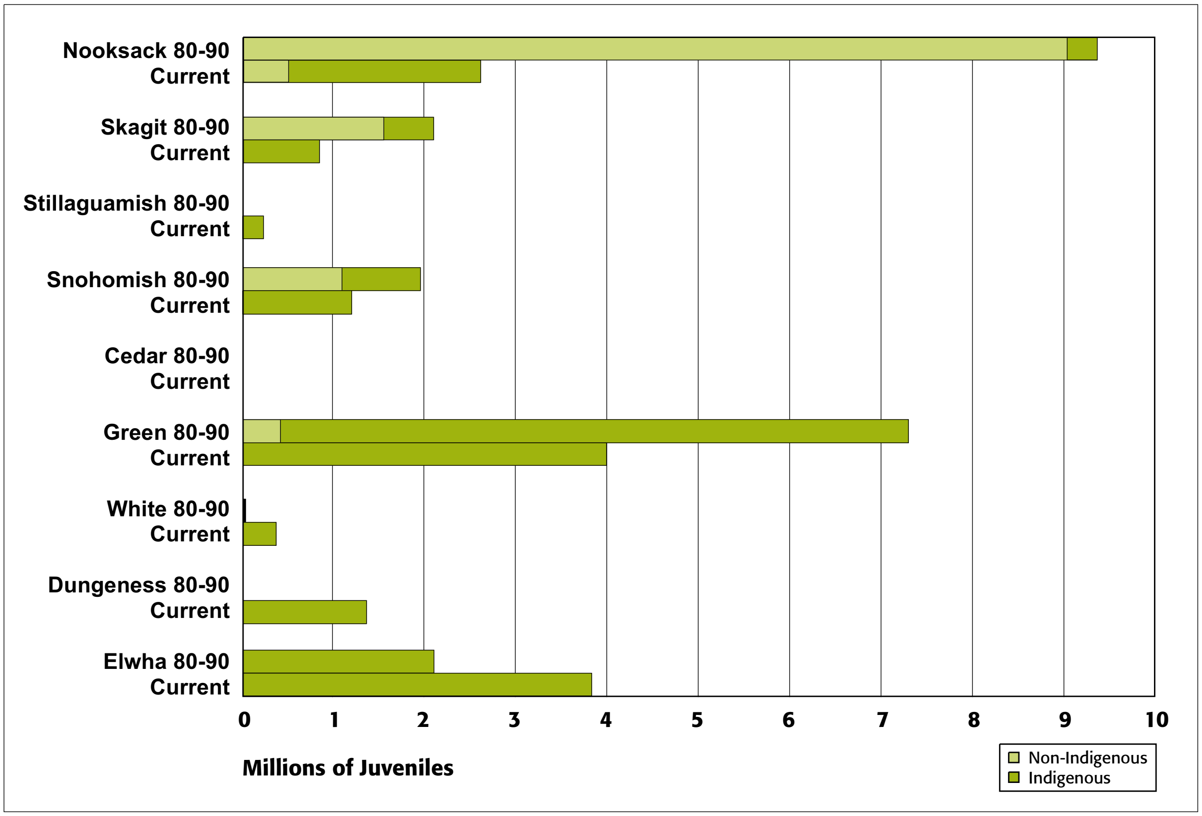


Figure 3.30 Current annual releases, and average annual releases, from 1980-1990 of non-indigenous and indigenous brood stocks in river systems with indigenous populations in the Puget Sound by WDFW and the tribes. Some river systems contain more than one indigenous population. Indigenous hatchery stocks in the Elwha, Dungeness, White, Stillaguamish, and Nooksack Rivers were identified by NMFS as essential for recovery.

the early 1990's. Two fundamental changes led to reforms in the late 1980s. As a result of the Puget Sound Salmon Management Plan, the co-managers developed the Co-managers' Salmon Disease Control Policy, which limited transfers of eggs to prevent spread of fish diseases, and in 1991 the co-managers developed the Wild Stock Restoration Initiative, which gave new emphasis to indigenous stocks. In recent years, indigenous stocks are being utilized as the broodstock for their home watersheds unless the local population is extinct.

U.S. v. Washington and the Puget Sound Salmon Management Plan

The affirmation of treaty Indian fishing rights in Washington added support to the concept of basing hatchery management on the production of fish from river-specific stocks. Tribes were legally bound to fish in designated "usual and accustomed fishing areas," thus they sought to build hatcheries and improve production where it would increase fishing opportunity in traditional fishing areas. Many of these areas had long been closed to fishing due to declining runs and interceptions by fisheries in the ocean and Puget Sound.

During legal arguments over the allocation of fish produced from hatcheries in the 1980's, the

Photo by K. Rawson.

The Bernie Kai-Kai Gobin Hatchery on the Tulalip Reservation.

AR057048

court recognized the role of hatcheries in providing harvest opportunity:

The hatchery programs have served a mitigating function since their inception in 1895. (506 Supp. At 198.) They are designed essentially to replace natural fish lost to non-Indian degradation of the habitat and commercialization of the fishing industry. Id. Under these circumstances, it is only just to consider such replacement fish as subject to allocation. For the tribes to bear the full burden of the decline caused by the non-Indian neighbors without sharing the replacement achieved through the hatcheries, would be an inequity and inconsistent with the Treaty.

United States v. Washington,
759 f.2d 1353m 1360 (9th Cir) (en banc), cer.
Denied, 474 U.S. 994 (1985)

United States v. Washington provides the legal structure for hatchery management in western Washington. The Puget Sound Salmon Management Plan (PSSMP) was entered as a court-ordered agreement in 1985 between state and tribal co-managers to provide the framework for

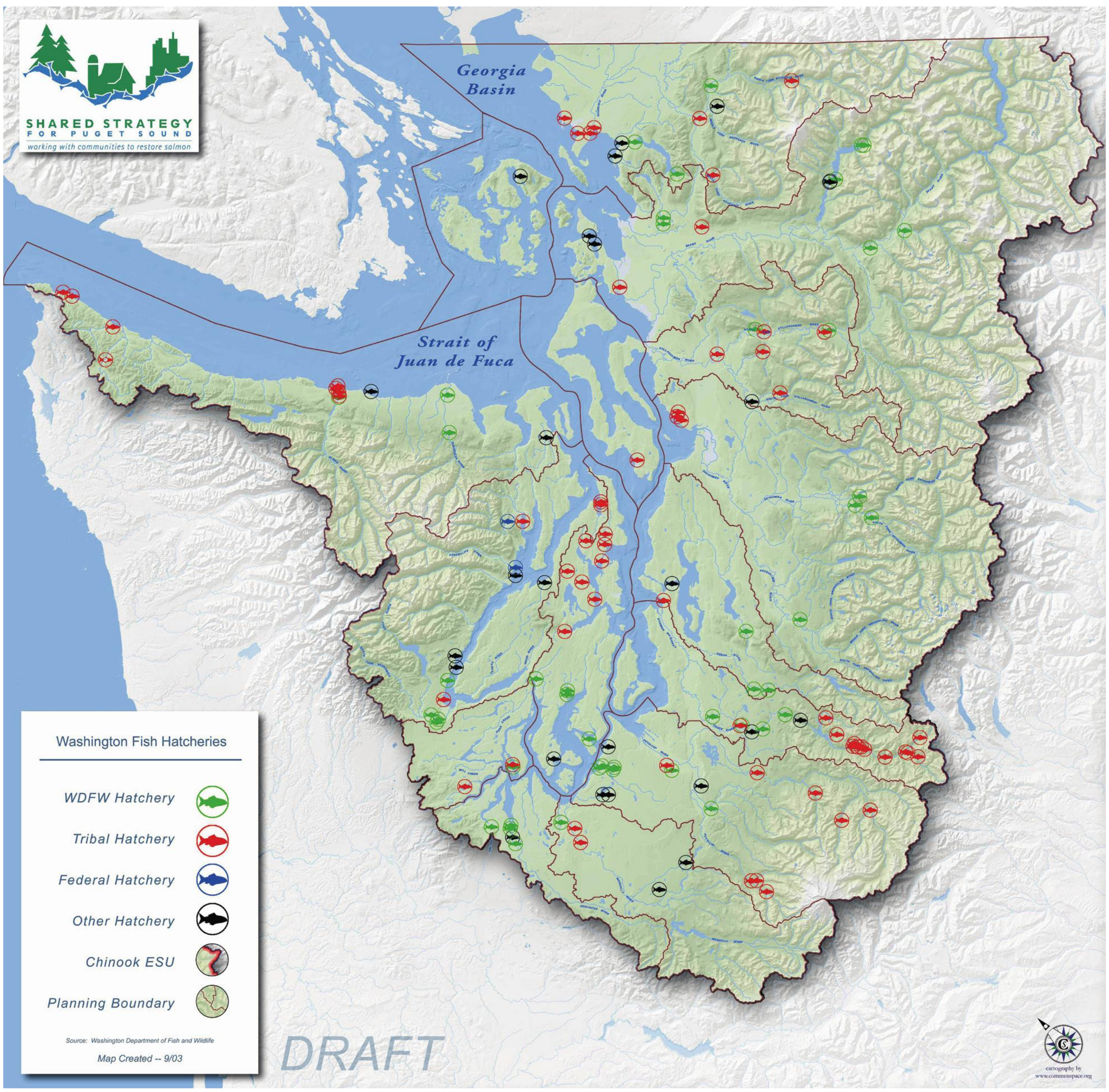


Figure 3.31 Hatchery locations in the Shared Strategy Planning Area.

the operation of hatchery programs and harvest opportunities. The PSSMP defines harvest management procedures and the basis for artificial production objectives and levels of production. Within the framework of the PSSMP, co-managers have prepared documents to describe facilities; species cultured; the source of broodstock; hatchery practices including transfers, rearing, and release; production goals and contingency plans. An annual forum is held to discuss and coordinate proposed program changes between the co-managers and other affected parties. Production changes or closures due to budget constraints may have disproportionate effects on various fisheries harvest opportunities, and continue to be the subject of discussion between the co-management entities.

Negotiations to prepare plans designating annual production levels, locations and broodstock use have continued to be based on the Puget Sound Salmon Management Plan since the 1980s. Co-managers have coordinated the implementation of the PSSMP with the recent review of hatchery operations in Washington by the Hatchery Scientific Review Group and with recovery planning under the Endangered Species Act

The Use of Hatcheries for Conservation and Recovery

Hatchery programs initiated to help wild stocks recover are managed to minimize adverse genetic and fish health effects which can be associated with long-term hatchery programs. Most conservation programs are considered to be drastic temporary measures, implemented as genetic life-support systems until habitat can be recovered sufficiently to support the indigenous population without intervention.

Photo by Scott Chitwood, courtesy of the Jamestown S'Klallam Tribe.

WDFW Dungeness hatchery staff working with Chinook for the captive broodstock program.

In the late 1970s and 1980s, the decline of several important wild stocks of Chinook salmon was so apparent that fisheries managers proposed using hatcheries to prevent their extinction.

"In the White River, for example, annual returns of 5,000 spring Chinook salmon had declined into the teens. In 1977, WDFW began an intensive captive/gene banking hatchery program to maintain these fish before they became extinct. Programs for other populations soon followed for Chinook salmon in the Nooksack, Elwha, Stillaguamish and Dungeness Rivers. Currently, approximately one-third of hatchery programs statewide focus on maintaining and rebuilding wild salmon runs." (WDFW & PSTT, 2004)

Due to the critical status of Hood Canal summer chum salmon populations, supplementation programs were implemented by WDFW, Puget Sound tribes, volunteer groups and USFWS in several eastern Strait of Juan de Fuca and Hood Canal rivers. The use of hatchery supplementation programs is an integral part of the Summer Chum Salmon Conservation Initiative (WDFW, Point No Point Treaty Tribes, 2000).

"With the loss of so many populations prior to our knowledge of stock structure, the historic richness of the salmon and steelhead resource of the West Coast will never be known. However, it is clear that what has survived is a small proportion of what once existed, and what remains is substantially at risk."

Williams, Nehlson et al.
as quoted by NRC, 1996

Hatchery Hazards and Risks

Concerns over the artificial propagation of salmon date back at least 150 years to the early days of salmon culture, when a Scottish critic calling himself "Salmo" harangued hatchery proponents as, "men of tanks and incubators... and feeble drivellers who have voted [the salmon] incompetent to discharge the functions which constitute the chief end and object of her existence." (Lichatowich, 1999) The advocates of hatcheries in the Pacific Northwest in the late 19th century were highly optimistic about the potential contribution hatcheries could make to Northwest rivers, but recognized that the successful transplant of salmon to other streams would require similar river conditions and careful management.

Although hatcheries have significant roles in recovering species and providing harvest opportunity, unless they are carefully managed a number of potential hazards stem from their operation (Busack and Currens, 1995):

- Long lasting changes to the genetic composition of salmon populations may occur due to the large numbers of hatchery fish that are released, altering the proportion and flow of genes among wild populations.
- Hatchery programs may lead to domestication by unintentionally or intentionally selecting for physical traits and behaviors that improve the chance of fish surviving in the hatchery environment. These characteristics have the potential to lower the fitness of salmon populations to survive and reproduce successfully in the wild.
- The physical layout and management of hatchery facilities themselves may create adverse effects through the removal of stream flow, placement of structures in the flood plain and the emission of effluent.
- Ecological effects occur when hatchery fish compete with naturally-spawned populations for territory and food, or when other hatchery-produced species prey upon threatened populations.
- The risk of disease is elevated in the highly dense hatchery environment, and can spread to wild populations.
- Hatchery production may increase the risk of overharvest of wild fish if harvest regimes target areas where the threatened populations are mixed in with hatchery runs, unless these fisheries are carefully managed for the needs of wild fish.

Loss of Population Identity

Natural populations of salmon are negatively affected by "gene flow," the transfer of genes from hatchery populations to natural ones. Recent studies have indicated that the greater the amount of gene flow and the dissimilarity between the hatchery and wild fish populations in a given watershed, the greater the negative genetic effects. Gene flow can cause a loss in unique identity and traits among natural populations of salmon, and within individual populations that receive hatchery fish.

The reduction in diversity among natural populations can result where a single hatchery stock is propagated over a wide area, such as the common practice of using Green River Chinook eggs for many decades in Puget Sound.

"Mass transfers of salmon between rivers disrupted thousands of years of reproductive isolation and destroyed the adaptive relationship between the salmon and their home stream. The newly hatched fry, deposited in rivers distant from their natal stream, had to face a new set of survival challenges that were not part of their evolutionary legacy. The advantages of local adaptation were lost..." (Lichatowich, 1999)

Similarly, changes in diversity can occur within individual populations receiving hatchery fish. "A reduction in diversity and the effective size of the wild population can result from 'genetic swamping,' where a large number of hatchery fish from relatively few parents interbreed with wild fish," (HSRG, 2004).

The loss of genetic diversity may result in a decrease of the viability of a local salmon population in two ways: 1) Loss of adaptation may occur when genes that evolved in a non-local environment replace those that were locally adapted; and 2) hybridization results in recombinations of sets of genes that were favorable to a local population, leading to loss of individual performance and population productivity that may not show up for a generation or more.

Loss of Fitness

Loss of fitness can occur because of domestication, which is the change in the genetic composition of a population as a result of selection for an artificial, captive environment (Busack and Currens, 1995). Fish rearing in a hatchery for all or a portion of their life experience very different environments than fish living in the wild. Fish with genetic traits that allow them to perform well in the wild may not survive as well in hatchery environments. Conversely, fish with genetic traits that allow them to survive better in the hatchery environments often perform more poorly in the wild. Hatchery environments tend to select for fish that do well in the hatchery environment.

Because hatcheries can successfully produce large numbers of fish, this can change the overall genetic composition of the population. Over time, if fish adapted to the hatchery return to spawn in the wild or natural-origin fish are used to produce fish in the hatchery, the population is forced to adapt to two different environments, which lowers the overall performance or fitness of the population.

Effects of Hatchery Facilities

Most hatcheries withdraw water from segments of a stream as the water passes through the hatchery facilities and is then returned further downstream. In some cases, diminished flow can be severe enough to affect migration and spawning behavior. Injuries and mortalities can occur at the screens where water is withdrawn. Hatchery effluent can change water temperatures as well as other chemical and nutrient levels.

Hatcheries that are utilized to incubate or rear threatened populations also present special risks, as the concentration of a large number of these precious eggs in a single "basket" raises the possibility of a catastrophic loss if equipment breaks down or water lines freeze. Restoration hatchery programs also run the risk of "mining" the broodstock population if they are unable to produce as many successful returning spawners as the remaining wild component of the population. Recent plans and reform initiatives have identified a number of potentially adverse impacts at Puget Sound hatcheries. Specific recommendations and actions to upgrade hatchery facilities and operations to reduce the risk to threatened populations have been incorporated into Hatchery Genetic Management Plans and local watershed plans, and implementation has commenced in many locations.

Ecological Effects

Ecological effects of hatchery fish include predation and competition for food and space. Hatchery-origin fish may prey upon juvenile wild Chinook in freshwater and estuarine areas, or compete for limited food supplies and territory. A large mass of migrating hatchery fish may also attract concentrations of birds, fish and seals, which contribute to predation on wild populations as well. A number of procedural changes have been incorporated by the co-managers in the operation of hatchery programs to minimize the risks to threatened populations, including alterations in the number, timing and location of releases of hatchery-produced fish.

Potential threats to Hood Canal summer chum salmon from negative interactions with hatchery fish (late-timed Chinook, coho, pink, and fall chum salmon) through predation, competition, behavior modification or disease transfer were identified by the NMFS Chum Biological Review Team (2003). However, NMFS indicated that specific mitigation measures for hatchery programs which presented a risk to summer chum had been identified and largely implemented by 2000. Continued evaluation and reporting on hatchery threats to summer chum is conducted by WDFW and the Point No Point Treaty Tribes through the Summer Chum Conservation Initiative (WDFW, PNPTT; 2000 and updates).

Disease Transfer

Although the pathogens responsible for fish diseases are present in both hatchery and natural populations, hatchery-origin fish may have an increased risk of carrying fish disease pathogens because the higher densities of rearing in the hatchery may stress fish and lower immune responses. A salmonid disease control policy was adopted by Puget Sound co-managers in 1998 to specify minimum fish health standards and conditions and procedures for egg and fish transfers, health inspection and communication (NWIFC & WDFW, 1998). The disease control policy emphasizes the importance of assessing the pathogen history of the fish, water supply and watershed prior to release or transfers.

Hatchery Production and Harvest Management

The presence of large numbers of hatchery-produced fish in ocean and Puget Sound fisheries

Tribal and WDFW staff check carcasses for coded-wire tags at the Samish Hatchery. Photo by S. Young

is thought to have exacerbated the risk to threatened populations in the past, due to the harvest of mixed populations of wild and hatchery fish. Naturally-spawning populations, many of which are low in abundance and productivity, are mixed in with populations from other river systems and with hatchery fish, and may be overfished where harvest rates were set high enough to take advantage of the hatchery production. However, current harvest management plans carefully control these mixed stock fisheries for the needs of wild fish. Additionally, managers use tools, such as time-and-area management and mark-selective fisheries to concentrate harvest on fish produced by hatcheries without exceeding allowable harvest rates for wild fish. As a result, some recreational and net fisheries have been maintained while harvest rates on most wild Chinook stock have been greatly reduced over the past 10 years (see Figure 3.32).

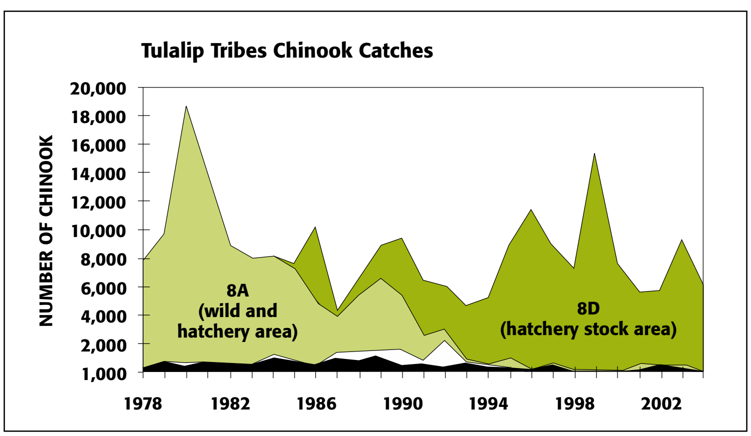


Figure 3.32 Graph showing the shift in the Tulalip Tribes chinook harvest from a mixed-stock area to a smaller area dominated by hatchery fish. By moving the fishery to a smaller area, the fishery has maintained overall harvest levels while reducing the rate of harvest on wild fish from approximately 50% to 5% (Source: Tulalip Tribes).

Until the development of "coded-wire-tags" in the 1970's, fisheries managers lacked tools to assess the fate of fish once they left the hatchery. The coded tags, 1 mm in length, are inserted into the nose of juvenile salmon prior to release. Tags are recovered from fish harvested in commercial and sport fisheries as well as the carcasses of adults that have spawned in natural areas or at hatcheries. The tags help managers obtain data on specific populations, providing clues to the proportional relationship between hatchery and natural origin fish and where, when and how the fish are caught.

Hatchery Threats to Bull Trout

Bull trout have not been extensively cultured in any part of the species' range, thus limiting the potential genetic and biological risks associated with hatcheries. Extensive supplementation programs are not considered to be necessary, and the potential use of hatcheries has generally been limited to genetic reserves and restoration restocking in watersheds where a population has been extirpated. The operation of hatchery facilities such as weirs and water intakes may have some impacts to bull trout, and correction of these threats is intended to be integrated with other hatchery reform efforts (USFWS, 2004). Although the interaction of hatchery species of salmon, steelhead or cutthroat trout with bull trout are cited as a potential threat, it is unclear whether these species serve primarily as prey for the bull trout, or whether they increase competitive pressure.

Hatchery Reform

Although fish rearing practices have continually improved in hatcheries over the last 100 years because of advancements in science, the development of the Puget Sound Salmon Management Plan in 1985 provided support to fundamentally change the direction of hatchery operations in Washington State. Tribal and state co-managers developed and implemented several important production guidelines and policies, including guidelines for fish transfers and spawning operations to minimize genetic loss, a salmonid disease control policy which limited the exchange of fish among watersheds to help prevent the spread of fish pathogens, and broodstock spawning protocols. Hatchery managers in the 1990s were also required to prepare detailed operations plans and complete permit requirements under the National Pollution Discharge Elimination System for producing healthy hatchery salmon populations and minimizing their effects on wild salmon. The Wild Stock Restoration Initiative began in 1991 with a comprehensive assessment of the status of local salmon and steelhead stocks by the co-managers, known as the Salmon and Steelhead Stock Inventory (WDF et al., 1993) which continues to be updated on a regular basis. Further efforts by the co-managers have included an assessment of management practices and proposed changes, and the development of the Wild Salmonid Policy (WDFW, 1997).

More recently, efforts toward hatchery reform related to threatened species have occurred on two interrelated tracks. The Hatchery Scientific Review Group, an independent panel of scientists, was convened by the US Congress to evaluate Puget Sound hatcheries; and the State of Washington and Puget Sound Treaty Tribes have prepared comprehensive Chinook resource management plans for harvest and hatchery management in response to the status of the Chinook populations and the requirements of the Endangered Species Act.

Hatchery Scientific Review Group

In 1999 the US Congress convened an independent panel of scientists called the Hatchery Scientific Review Group (HSRG) to evaluate Puget Sound hatcheries and provide recommendations for how hatcheries can accomplish two objectives:

1) Conserve naturally spawning salmon and steelhead populations; and
2) Support sustainable fisheries.

The evaluation process occurred from 2000 to 2003 and a written report, *Hatchery Reform: Principles and Recommendations*, was issued by the HSRG in 2004. In addition to the two primary objectives, the hatchery reform project was required to consider the relationship of artificial production programs to several legal mandates, including:

- Treaty fishing rights and co-management status of Puget Sound Indian tribes;
- The US/Canada Salmon Treaty;
- Applicable laws and responsibilities of the State of Washington; and
- The US Endangered Species Act.

The Hatchery Scientific Review Group issued a number of system-wide recommendations for hatchery reform, along with approximately 1,000 program-specific recommendations across the region. These conclusions and recommendations may be viewed at www.hatcheryreform.org. The HSRG also noted that a number of successful hatchery programs are already operational, which are helping to recover and conserve naturally spawning populations, supporting sustainable fisheries, and/or providing other benefits such as education.

In addition to the scientific evaluation process, the US Congress appropriated funding for related research grants, implementation of early action reform projects, and designated Long Live the Kings (a private, non-profit organization) as the facilitation and communications team for the project. The HSRG and regional co-managers are continuing to work on monitoring and evaluation programs.

Comprehensive Chinook Salmon Resource Management Plan: Hatchery Component

The draft hatchery component of the Puget Sound Comprehensive Chinook Salmon Resource Management Plan was jointly developed by the Washington Department of Fish and Wildlife and the Puget Sound treaty tribes as part of the Wild Stock Restoration Initiative and completed in 2004. In response to ESA, it expands the biological assessment of tribal hatchery programs submitted by the Bureau of Indian Affairs as a requirement of Section 7 of the Endangered Species Act to all state and tribal hatcheries. It also incorporates management alternatives developed by the tribes and the National Marine Fisheries Service, and draws from the recommendations of the Hatchery Scientific Review Group.

Several general principles guide the plan, including the following:

- Hatchery programs need to assess and manage the ecological and genetic risks to natural populations.
- Hatchery programs need to coordinate with fishery management programs to maximize benefits and minimize biological risks so that they do not compromise overall plans to conserve populations.
- Hatchery programs need protocols to manage risks associated with fish health, broodstock collection, spawning, rearing, and release of juveniles; disposition of adults; and catastrophes within the hatchery.

Benefits and risks from each artificial production program for Chinook salmon in Puget Sound were evaluated in multiple ways, resulting in a number of improvements and commitments to Chinook salmon programs in the region. The plan emphasizes the use of indigenous broodstock, the reduction of egg and juvenile transfers between watersheds, the timing and location of hatchery releases to avoid competition and predation, and a process of adaptive management. The plan also calls for a number of net pen and other production programs to be terminated or reduced. State-of-the-art fish health monitoring, facility disinfecting and disease management procedures are established for the operation of Puget Sound hatcheries. Specific facilities upgrades for screening, rearing or incubation are identified in some cases. The plan also calls for a number of research, monitoring and evaluation programs to mark fish and to determine the effects of competition and predation between hatchery and natural fish.

The specific details for each hatchery program are contained in 42 Hatchery Genetic and Management Plans developed by state and tribal fisheries managers. A Draft Environmental Impact Statement for the implementation of the hatchery component of the Comprehensive Puget Sound Chinook Management Plan is presently in process and is expected to be released in the summer of 2005.

NMFS Policy on the Consideration of Hatchery-Origin Fish in ESA Listing Determinations of Pacific Salmon

On June 3, 2004, the National Marine Fisheries Service issued a proposed policy to address the role of hatchery produced Pacific salmon in listing determinations under the Endangered Species Act (ESA) (69 FR 31354-31359). This policy superseded an interim policy on the artificial propagation of salmon under the ESA that was issued in 1993. In the past, NMFS had focused on whether the naturally spawned fish are, by themselves, self-sustaining in their natural ecosystems when making listing determinations. Generally NMFS did not explicitly consider the contribution of hatchery fish to the viability of threatened populations of salmon, and the potential that the hatchery fish could reduce the risk of extinction. A 2001 decision by the U.S. District Court in Alsea Valley Alliance v. Evans, 161 F. Supp. 2ad 1154 (D. Or. 2001) led to changes in how NMFS considered hatchery fish in population viability and extinction risk assessments. In that ruling, U.S. District Judge Michael Hogan found that the ESA listing for the Oregon Coastal coho salmon Evolutionarily Significant Unit (ESU) was invalid because the federal government did not take into account genetically similar hatchery fish with wild coastal coho in determining listing status. Judge Hogan did not determine how hatchery fish should be taken into consideration, but he did hold that they must be considered.

Following a review of other artificial propagation policies under the Endangered Species Act, NMFS agreed that artificial propagation may play a supportive role in the conservation and recovery of listed species. However, they also indicated that artificial propagation is not a substitute for addressing factors responsible for a species' decline, and the recovery of wild populations in their natural habitat is their first priority. Additionally, they highlighted the genetic and ecological risks that may be associated with artificial propagation, and which must be considered in recovery planning.

In response to the Alsea Valley Alliance v. Evans decision, and consistent with the conservation requirements of the Endangered Species Act, NMFS completed a proposed "Hatchery Listing Policy" describing how the agency will consider hatchery fish in all future ESA listing determinations for Pacific salmon. The policy was subsequently applied in 2004 in an updated species status review process for all listed salmon evolutionarily significant units in the Pacific Northwest and California. The proposed policy contains five points:

- NMFS recognized that genetic resources that represent the ecological and genetic diversity of a salmon species can be found in hatchery fish as well as fish spawned in the wild.
- NMFS delineated a process for determining which populations are included in an Evolutionarily Significant Unit. Additionally they defined the standards for determining how closely natural and hatchery populations are genetically related, to serve as a threshold in deciding whether or not the hatchery stocks should be considered as part of the Evolutionarily Significant Unit.
- NMFS stated that determinations for Pacific salmon ESUs will be based on the entire ESU (including natural, and where appropriate hatchery-origin salmon) but recognized the necessity of conserving natural populations and their habitat.
- A process for making status determinations was described based on the concept of viable salmon population parameters.
- The policy recognized the role of hatcheries in fulfilling trust and treaty obligations with respect to salmon harvest.

Additional Factors Affecting the Species

"Pacific Northwest salmon are subject to a world of multiple stresses, including human impacts on streamflows and salmon habitat. Climate change adds another dimension to, and in many cases exacerbates, these stresses."

The Climate Impacts Group at the University of Washington (2004)

In addition to the "H factors" of habitat, harvest and hatcheries, Puget Sound Chinook and Coastal-Puget Sound bull trout are affected by regional and global factors such as climate change and fluctuating ocean conditions. Although it is clear that these factors directly affect salmon and bull trout, scientists are only beginning to unravel the secrets of how these processes impact the food chain, precipitation and snowpack, and other habitat features. Temperature conditions and ocean cycles affect migration and the abundance of predators, and are essential in the production of the minute organisms that provide the food supply for salmon and bull trout to grow and flourish.

At the other end of the food chain, salmon and bull trout are part of the food supply for several species of marine mammals. The population size and feeding habits of these opportunistic predators may also have a substantial effect on salmon and bull trout populations, particularly where human modifications and structures make it easy for them to target specific salmon runs. However, specific information about the extent of predation by marine mammals on particular species or populations of salmon is largely unknown.

These three factors - climate change, ocean conditions, and marine mammal interactions are the focus of considerable research related to their effects on salmon and other species of fish. A lengthy discussion of these factors is not possible in the Puget Sound Chinook recovery plan, thus these factors are described here in terms of a brief description of research findings and sources of additional information. Although the residents of Puget Sound may not have direct influence over climate change, ocean conditions or marine mammal populations, several of the adaptive strategies suggested by the scientific community stress the need to ensure that local habitat conditions are protected and restored as a buffer against the coming changes, and that harvest and hatchery management consider these long term factors in their decision-making.

Climate Change in the Pacific Northwest

Data collected during the 20th century revealed widespread increases in average annual temperature and precipitation, and decreases in the April 1 snow water equivalent. Snow water equivalent is a common measurement for the amount of water contained in snowpack and is an important indicator for forecasting summer water supplies. 1990-2000 was the warmest decade on record, and was warmer than any other decade by 0.9°F (CIG, 2004).

Long term models for climate change in the 21st century show evidence of trends including, "region-wide warming, increased precipitation, declining snowpack, earlier spring runoff, and declining trends in summer

Indicator	Observed 20th century changes	Projected mid 21st century changes
Temperature	Region-wide warming of about 1.5°F (1920-2000)	• 2020s: average increase of 2.7°F • 2040s: average increase of 4.1°F
Precipitation	Region-wide increase in precipitation since 1920	Uncertain, although most models project wetter winters and drier summers.
April 1 snowpack	Substantial declines (>30%) at most monitoring stations below 6,000 feet	Continued decrease in April 1 snowpack in mid and low elevation basins. Projected decrease in April 1 snowpack for the Cascades Mountains in Washington and Oregon relative to 20th century climate: • -44% by the decade of the 2020s (based on +3°F avg. temp change) • -58% by the decade of the 2040s (based on +4.5°F avg temp change)
Timing of peak spring runoff	Advanced 10-30 days earlier into the spring season during the last 50 years, with greatest trends in the PNW	Earlier peak spring runoff expected on the order of 4-6 weeks
Summer streamflow	Declining in sensitive PNW basins. Example: May-Sept inflows into Chester Morse Lake in the Cedar River watershed (WA) as a fraction of annual flows have decreased 34% since 1946.	Continued and more wide-spread declines. Example: April-Sept natural streamflow in the Cedar River (WA) projected to decrease 35% by the 2040s (based on a 2.5°F increase in average temperature.

Figure 3.33 Observed and Projected Impacts of Climate Change in Major Climate/Hydrologic Indicators (Sources: Mote et al. 1999; Miles et al. 2000; Mote 2003; Snover et al. 2003; Steward et al. 2004; Wiley 2004 as cited in CIG, 2004)

streamflow." (CIG, 2004) Most of the models predict warmer, wetter winters and warmer, drier summers for the Pacific Northwest. Figure 3.33 contains a summary of the observed and projected impacts of climate change relevant to salmon and bull trout populations.

Salmon and bull trout have lived in the Pacific Northwest for millions of years. As different species and populations of salmon have developed over time, they have acquired specific behaviors for their migration, rearing and spawning life cycles that are attuned to temperature and streamflow. This complex life cycle makes it difficult to predict how they will react to climate changes, and their response will also vary depending on the habitat conditions in a particular river system and estuary. Changes in temperatures away from optimal conditions can influence salmon and bull trout in each of their life stages. Even a small increase in temperature can change migration timing, reduce growth, reduce the supply of available oxygen in the water, and increase the susceptibility of fish to toxins, parasites and disease. The increase in stream temperatures can also contribute to a reduction in the preferred species of insects that are used for food (NWF, 2005). Earlier spring runoff and lower summer flows may make it difficult for returning adult salmon to negotiate obstacles. Excessively high levels of winter flooding can scour eggs from their nests in the streambeds and increase mortalities among overwintering juvenile salmon and bull trout.

Adaptive strategies to cope with the projected changes largely focus on the need to maintain salmon and bull trout populations through conservation and restoration of freshwater and estuarine habitat. Additionally, it has been recommended that harvest and hatchery managers pay particular attention to the time lag associated with impacts of natural variability in one season on the viability of populations in successive seasons. For example, productivity may decline following drought conditions and should be factored into hatchery production targets and harvest regimes; similar issues are already being considered during technical planning forums for harvest.

The predicted increased winter flooding, decreased summer and fall streamflows, and elevated warm season temperatures in the streams and estuaries are likely to further degrade conditions for salmon that are already stressed from habitat degradation. Although the impacts of global climate change are less clear in the ocean environment, early modeling efforts suggest that, "warmer temperatures are likely to increase ocean stratification, which in the past has coincided with relatively poor ocean habitat for most Pacific Northwest salmon, herring, anchovies, and smelt populations." (CIG, 2004)

Ocean Conditions

Ocean conditions influence Chinook population abundance, distribution and survival in the marine environment. A number of studies have indicated that salmon survival during the first few months at sea is linked to ocean conditions such as sea surface temperature and salinity. This critical period of climatic influence on their survival occurs largely in coastal and estuarine environments. (Francis and Mantua, 1996; NMFS, 1998) Large-scale weather patterns affect food supplies, predator distribution and abundance, and migratory patterns for Chinook salmon. Climatic conditions can change the prevailing currents and the associated ocean productivity from nutrient-rich cold waters. The shifting currents, named either "El Nino" or "La Nina," can produce widely varied cycles of productivity. (NMFS, 1998)

Scientists utilize several indices to look at the changes in ocean conditions, particularly with respect to temperatures and wind patterns. The Pacific Decadal Oscillation (PDO) and the El Nino/Southern Oscillation (ENSO) are cycles that appear to have significant influence on salmon survival and migratory patterns. During El Nino and/or warm phase PDO cycles, higher Pacific Ocean temperatures and changes in wind patterns may reduce the upwelling of nutrients from the ocean floor, thereby affecting the entire food web in the Pacific. Wind-driven mixing replenishes nutrients to rich surface waters where phytoplankton occur, thereby promoting biological productivity at the base of the food chain and working its way up to salmon and other species of fish (NWF, 2005).

Comparisons of climate patterns with the levels of fisheries harvest in the northeast Pacific appear to show a relationship between these large scale changes and several salmon populations (Francis and Mantua, 1996; NMFS, 1998). As scientific understanding of these processes has improved, fisheries managers have started to utilize information on favorable or unfavorable ocean conditions in their harvest planning forums (NWF, 2005).

"Anadromous salmonids have managed to persist in the face of numerous climatic events and changes. The long term persistence of Chinook salmon populations depends on their ability to withstand fluctuations in environmental conditions. It is apparent that the combination of tremendous freshwater habitat loss, and extremely small anadromous salmonid populations has caused these fish to be more vulnerable to extirpation arising from natural events. Until salmonid populations reached their recent critical levels, these environmental conditions largely went unnoticed. Therefore, it would seem that environmental events and their impacts on remaining salmonid populations may become a more significant factor for decline as unstable Chinook salmon populations reach particularly low levels." (NMFS, 1998)

Marine Mammal Interactions

Several species of marine mammals prey on salmonid populations in the Pacific Northwest including California sea lions (Zalophus californianus), Pacific harbor seals (Phoca vitulina) and killer whales (Orcinus orca). Due to the depressed status of many salmon populations, the presence of marine mammals concurrent with salmon migration has been identified as a concern, but the limitations in available data make it difficult to determine the extent of impact.

California Sea Lions and Pacific Harbor Seals

In the 1994 Amendments to the Marine Mammal Protection Act, Congress directed that a scientific study be conducted to determine whether California sea lions and Pacific harbor seals are having an impact on threatened and endangered populations of salmon on the West Coast of the United States. A working group was formed by NMFS and submitted a report to Congress in 1997, entitled, "Impacts of California Sea Lions and Pacific Harbor Seals on Salmonids and on the Coastal Ecosystems of Washington, Oregon and California."

The report indicated that sea lion and harbor seal populations are increasing and interactions with West Coast fisheries are on the rise. The working group could not determine if these species were having a significant negative impact on any specific wild salmonid population, with the exception of documented impacts to the winter steelhead population that migrates through the Ballard Locks in Seattle. The study identified the geographic areas of greatest concern in each state, along with the elements of a research program to assess impacts (NMFS, 1997).

The population of California sea lions has been increasing at an annual rate of about 5% per year since the mid-1970s and their numbers were estimated to be more than 161,000 off of Washington, Oregon and California in 1994. Although they breed and pup in southern California, male sea lions migrate northerly along the West Coast from September to May, coinciding with the migration of several depressed runs of salmon. Pacific harbor seals in the three states have been increasing at a rate of about 5-7% annually since the mid-1970s and the population in Washington State was estimated to be 34,134 in 1993-1995.

Harbor seals are present year round in western Washington, and California sea lions are present in the fall, winter and spring. The geographic areas of concern for interaction between California sea lions and Pacific harbor seals with threatened salmonid populations identified by the NMFS Working Group included the following:

- **Strait of Juan de Fuca/San Juan Island:** The Working Group expressed concern for predation on juvenile and adult Chinook salmon and summer chum salmon in this area, particularly in Discovery and Sequim Bays.
- **Hood Canal:** The Working Group indicated that juvenile migration patterns in this region make them less vulnerable to predation. However, predation on adult salmon, particularly summer chum, was flagged as a concern.
- **Northeastern Puget Sound Bays (Bellingham Bay, Skagit Bay):** Harbor seals are present year round and juvenile salmon are vulnerable to predation during outmigration. During April-to-June, both juvenile and adult salmon from threatened populations are present and subject to predation. California sea lions are not considered to be a threat due to their low abundance in these areas.
- **Puget Sound:** Harbor seals are present year-round and California sea lions are present in the fall, winter and spring. Both species have been observed upriver for several miles in many rivers draining into Puget Sound. "More than 1,000 California sea lions, which occur seasonally near the mouth of the Snohomish River, have been observed 8-10 miles upriver and prey on free-swimming salmonids in the estuary. As many as 300 harbor seals haul-out on log booms near the mouth of the Snohomish River in fall and winter and have been reported 15-20 miles upriver....In the Nisqually, both seals and sea lions are common at the mouth; sea lions have been observed preying on free-swimming salmonids and have been observed as far as 40 miles upriver." (NMFS, 1997) The Working Group also reported observed predation in the Green River, Ballard Locks, Lake Washington and the White River. Overall concern was expressed for predation on adult and juvenile Chinook and other salmonid species.

Despite these observations, the Working Group noted that not all of the observed marine mammals near an active salmon run are actively feeding on salmonids. Several studies in the U.S. and Canada indicate that most predation was attributable to a small percentage of the observed population of marine mammals, suggesting that removal would not be an effective solution in many areas. The Working Group described several measures of harassment to deter marine mammals from fish predation and fishing gear.

The complexity of ecosystem level impacts and the limited amount of information has made it difficult to accurately estimate the amount of biomass consumed by California sea lions and harbor seals. Overall, the Working Group estimated total consumption of about 217,400 metric tons by sea lions and seals in Washington, Oregon and California and found that it was almost half of what had been cumulatively harvested in multi-species commercial fisheries. Estimates of the proportion of that consumption on individual species could not be made. Limited studies in Everett, WA demonstrated that the most frequent prey were Pacific whiting and Pacific herring. Based on scat samples, salmonid remains were found in 2% of the harbor seal samples and 15% of those of the sea lions.

Killer Whales

NMFS has prepared a preliminary draft Conservation Plan for Southern Resident Killer Whales (NMFS, 2005) describing characteristics of the three pods that reside for part of the year in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca and Puget Sound, primarily during the spring summer and fall. In the description of the diet and forage behavior of the whales, NMFS has indicated that killer whales forage on a variety of marine species ranging from squid, sea turtles, marine mammals, penguins and other seabirds, to several species of fish including herring, tuna, rays, sharks, bottom fish and salmon. Fish are the major dietary component of resident killer whales in the northeastern Pacific. Most of the information about killer whale consumption comes from the analysis of stomach contents from whales that were stranded or those killed during commercial whaling operations. A few studies utilizing direct observations of feeding behavior have added new data in recent years. Preliminary data, primarily from a single study in British Columbia with several data limitations, indicated that salmon were found to represent 96% of the prey during the spring, summer and fall.

"Chinook salmon were selected over other species, comprising 65% of the salmonids taken. This preference occurred despite the much lower numerical abundance of Chinook in the study area in comparison to other salmonids, and is probably related to the species' large size, high fat and energy content, ... and year-round occurrence in the area." (NMFS, 2005)

Based on estimates of food requirements and average size values for combined species of salmon, it is thought that adult killer whales may consume about 28-34 adult salmon daily and that younger whales (<13 years of age) need 15-17 salmon daily to maintain their energy requirements. Although these numbers cumulatively add up to substantial quantities, the impact of killer whale consumption to any particular species is generally unknown, let alone the impact to specific populations of Chinook in Puget Sound.

The relationship of salmon to large-scale factors in the larger ecosystem is the subject for further study, and points to the need to retain viable populations that fulfill existing and future ecosystem functions.

"Long ago my wife and I made a personal commitment to accept salmon as a teacher. It's taken us to a lot of places... Salmon can teach us where in the world we belong and what our responsibilities are."

Tom Jay, Chimacum Creek volunteer and artist

References

Section 1: Habitat Factors

Federal Register 62; May 6, 1997. Endangered and Threatened Species; Threatened Status for Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon.

Federal Register 63; March 9, 1998. Proposed Rule on the Threatened Status for the Puget Sound Chinook ESU.

Forest Ecosystem Management and Assessment Team, 1993. Forest Ecosystem Management: An Ecological, Economic and Social Assessment. USDA Forest Service.

Governor's Salmon Recovery Office, 2004. 2004 State of Salmon in Watersheds Report. Olympia, WA.

Beamer, E., C. Greene, A. McBride, C. Rice and K. Larsen. 2004. Recovery Planning for Ocean Type Chinook Salmon in the Skagit River: Results of a Decade of Field Studies. Skagit System Cooperative. La Conner, WA. http://www.skagitcoop.org/EB_SkagitChinookStudy-10yearSummary.pdf

Beechie, T.J., E.A. Steel, P. Roni, and E. Quimby (editors). 2003. Ecosystem recovery planning for listed salmon: an integrated assessment approach for salmon habitat. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-58, 183 p.

Greene, C., T. Beechie and E. Beamer, 2003. Linking Habitat-related and Density-dependent Population Responses in Chinook Salmon. Proceedings of the 2003 Georgia Basin/Puget Sound Research Conference. http://www.psat.wa.gov/Publications/03_proceedings/PAPERS/ORAL/5c_green.pdf

Lambert, D., 2001. Washington: A State of Contrasts. Directed Media, Inc. East Wenatchee, WA.

Lichatowich, J.A., 1999. Salmon Without Rivers: A History of the Pacific Salmon Crisis. Island Press. Washington, D.C.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

National Marine Fisheries Service, 1996. Factors for Decline: A Supplement to the Notice of Determination for West Coast Steelhead. NMFS Protected Species Branch; Portland, OR

National Marine Fisheries Service, 1998. Factors Contributing to the Decline of West Coast Chinook salmon: An Addendum to the 1996 West Coast Steelhead Factors for Decline Report. NMFS Protected Species Branch; Portland, OR

National Marine Fisheries Service; West Coast Chinook Salmon Biological Review Team, 2003. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. Available from the NMFS Northwest Fisheries Science Center; Seattle, WA.

National Marine Fisheries Service; West Coast Chum Biological Review Team,1997. Status Review of Chum Salmon from Washington, Oregon, and California. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-NWFSC-32.

National Research Council, 1996. Upstream: Salmon and Society in the Pacific Northwest.

Northwest Indian Fisheries Commission, 2004. State of Our Watersheds Report: WRIAs 1-23 (Salmon and Steelhead Habitat Inventory and Assessment Program). www.nwifc.org

Puget Sound Action Team, 2004. State of the Sound 2004. Olympia, WA.

Scholtz, N. 2003. Personal communication with staff at NMFS, Northwest Fisheries Science Center.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An Ecosystem Approach to Salmonid Conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp. Corvallis, OR.

State of Washington Governor's Salmon Recovery Office, 2004. 2004 State of Salmon in Watersheds Report. Olympia, WA.

U.S. Army Corps of Engineers and Washington Department of Fish and Wildlife, 2001. Draft Feasibility Cost Sharing Agreement Appendix A - Project Management Plan, Puget Sound Nearshore Ecosystem Restoration Study.

U.S. Fish and Wildlife Service, 2004. Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (Salvelinus confluentus). Available from U.S. Fish and Wildlife Service Region 1; Portland, OR.

Washington Department of Ecology, 2004. Washington State's Water Quality Assessment Report [303(d) & 305(b)]. http://www.ecy.wa.gov/programs/wq/303d/ 2002/2004_documents/wq_assessment_cats2004.html

Washington State Conservation Commission, 1998 - 2004 (depending on WRIA). Salmon and Steelhead Limiting Factors; reports for each Water Resource Inventory Area in Washington State. Olympia, WA. http://salmon.scc.wa.gov/

Washington State Governor's Joint Natural Resources Cabinet, 1999. Statewide Strategy to Recover Salmon: Extinction is not an option. www.governor.wa.gov/gsro/strategy/longversion.htm

Section 2: Harvest

Cohen, F.G., 1986. Treaties on Trial: The Continuing Controversy over Northwest Indian Fishing Rights. A Report Prepared for the American Friends Service Committee. University of Washington Press. Seattle, WA.

Federal Register/ Vol. 63, No. 46/ Tuesday, March 10, 1998. Endangered and Threatened Species: Proposed Threatened Status and Designated Critical Habitat for Hood Canal Summer-Run Chum Salmon and Columbia River Chum Salmon; Proposed Rule

Madson, P.K. and Koss, W.,1988. Washington Salmon: Understanding Allocation. Washington State House of Representatives, Office of Program Research. Olympia, WA.

National Marine Fisheries Service,1997. Investigation of Scientific Information on the Impacts of California Sea Lions and Pacific Harbor Seals on Salmonids and on the Coastal Ecosystems of Washington, Oregon, and California. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-NWFSC-28, 172 p.

National Marine Fisheries Service; West Coast Chum Biological Review Team,1997. Status Review of Chum Salmon from Washington, Oregon, and California. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-NWFSC-32.

National Marine Fisheries Service, West Coast Biological Review Team; 2003. Preliminary Conclusions Regarding the Updated Status of Listed ESUs of West Coast Salmon and Steelhead.

National Marine Fisheries Service, 2004. Puget Sound Chinook Harvest Resource Management Plan Draft Environmental Impact Statement. USDA/NOAA, Northwest Office. Seattle, WA.

National Research Council, 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academy Press. Washington, D.C.

Pacific Fishery Management Council (PFMC). 2005. Review of 2004 Ocean Salmon Fisheries. Pacific Fishery Management Council. Portland, OR

Pacific Salmon Commission, 2004. Joint Chinook Technical Committee 2003 Report: Catch and Escapement of Chinook salmon under Pacific Salmon Commission Jurisdiction. (available at http://www.psc.org/pubs/TCCHINOOK02-3.pdf)

Puget Sound Indian Tribes and the Washington Department of Fish and Wildlife, 2004. Comprehensive Resource Management Plan for Puget Sound Chinook: Harvest Management Component.

Puget Sound Indian Tribes and the Washington Department of Fisheries, 1985. Puget Sound Salmon Management Plan. Filed with U.S. District Court, Western Washington, October 17, 1985 in relation to U.S. v. Washington, F. Supp. 1606:1405

U.S. Fish and Wildlife Service; May, 2004. Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout. USFWS Region 1; Portland, OR.

Washington Department of Fish and Wildlife, 2005. Fish ticket data and personal communication courtesy of T. Scott.

Washington Department of Fish and Wildlife and the Point No Point Treaty Tribes, 2000. Summer Chum Salmon Conservation Initiative.

Section 3: Effect of Hatcheries

Alaska Department of Fish and Game, 2005. Coded Wire Tag Fact Sheet. http://tagotoweb.adfg.state.ak.us/CWT/

Busack, C. A., and K. P. Currens. 1995. Genetic Risks and Hazards in Hatchery Operations: Fundamental Concepts and Issues. Pages 71-80 in H. L. J. Schramm, and R. G. Piper, editors. Uses and effects of cultured fish in aquatic ecosystems, volume 15. American Fisheries Society, Bethesda, MD.

Federal Register; June 3, 2004. Endangered and Threatened Species: Proposed Policy on the Consideration of Hatchery-Origin Fish in Endangered Species Act Listing Determinations for Pacific Salmon and Steelhead. 69 FR 31354-31359.

Hatchery Scientific Review Group (HSRG)-Lars Mobrand (chair), John Barr, Lee Blankenship, Don Campton, Trevor Evelyn, Tom Flagg, Conrad Mahnken, Robert Piper, Paul Seidel, Lisa Seeb and Bill Smoker. April 2004. Hatchery Reform: Principles and Recommendations of the HSRG. Long Live the Kings, 1305 Fourth Avenue, Suite 810, Seattle, WA 98101 (available from www.hatcheryreform.org).

Lichatowich, J.A., 1999. Salmon Without Rivers: A History of the Pacific Salmon Crisis. Island Press.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

National Marine Fisheries Service Chum Biological Review Team, 2003. Preliminary Conclusions Regarding the Updated Status of Listed ESUs of West Coast Salmon and Steelhead. NMFS Northwest Fisheries Science Center; Seattle, WA.

National Research Council, 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academy Press. Washington, D.C.

Northwest Indian Fisheries Commission and Washington Department of Fish and Wildlife, 1998. Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State. www.nwifc.gov/pdf_public/Disease_Policy_1998.pdf

Washington Department of Fish and Wildlife, 1997. Policy of WDFW and Western Washington Treaty Tribes Concerning Wild Salmon. www.wdfw.wa.gov/fish/wsp/joint/final/fwsptoc.htm

Washington Department of Fish and Wildlife and the Point No Point Treaty Tribes, 2000. Summer Chum Salmon Conservation Initiative.

Washington Department of Fish and Wildlife and the Puget Sound Treaty Tribes, 2004. Puget Sound Chinook Salmon Hatcheries, a component of the Comprehensive Chinook Salmon Resource Management Plan, draft.

Washington Department of Fisheries, Washington Department of Wildlife, and Western Washington Treaty Tribes, 1993. 1991 Washington State Salmon and Steelhead Stock Inventory. Washington Department of Fish and Wildlife; Olympia, WA.

Section 4: Additional Factors

Climate Impacts Group (CIG), 2004. Overview of Climate Change Impacts in the U.S. Pacific Northwest. University of Washington. Seattle, WA www.cses.washington/edu/cig. [Numerous additional publication abstracts and sources are available on this website.]

Francis, R.C. and N.J. Mantua, 1996. "Climatic Influence on Salmon Populations in the Northeast Pacific." From McCall, A.D. and T.C. Wainwright, editors; 2003. Assessing Extinction Risk for West Coast Salmon: Proceedings of the Workshop November 13-15, 1996; Seattle, Washington. NOAA Tech. Memo. NMFS-NWFSC-56. (Available from http:www.nwfsc.noaa.gov).

Miles, E.L., A.K. Snover, A.F. Hamlet, B.M. Callahan, and D.L. Fluharty, 2000. "Pacific Northwest Regional Assessment: The Impacts of Climate Variability and Climate Change on the Water Resources of the Columbia River Basin." Journal of the American Water Resources Association 36(2):399-420.

Mote, P.W., D.J. Canning, D.L. Fluharty, R.C. Francis, J.F. Franklin, A.F. Hamlet, M. Hershman, M. Holmberg, K.N. Ideker, W.S. Keeton, D.P. Lettenmaier, L.R. Leung, N.J. Mantua, E.L. Miles, B. Noble, H. Parandvash, D. W. Peterson, A.K. Snover, and S.R. Willard, 1999. Impacts of Climate Variability and Change, Pacific Northwest. NOAA Office of Global Programs, and JISAO/SMA Climate Impacts Group, Seattle, WA. 110 p.

Mote, P.W., E.A. Parson, A.F. Hamlet, K.N. Ideker, W.S. Keeton, D.P. Lettenmaier, N.J. Manua, E.L. Miles, D.W. Peterson, D.L. Peterson, R. Slaughter, and A.K. Snover. 2003. "Preparing for Climate Change: The Water, Salmon, and Forests of the Pacific Northwest." Climatic Change 61:45-88.

National Marine Fisheries Service, 1996. Factors for Decline: A Supplement to the Notice of Determination for West Coast Steelhead. NMFS Protected Species Branch; Portland, OR

AR057064

National Marine Fisheries Service, 1997. Investigation of Scientific Information on the Impacts of California Sea Lions and Pacific Harbor Seals on Salmonids and on the Coastal Ecosystems of Washington, Oregon, and California. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-NWFSC-28, 172 p.

National Marine Fisheries Service, 1998. Factors Contributing to the Decline of West Coast Chinook salmon: An Addendum to the 1996 West Coast Steelhead Factors for Decline Report. NMFS Protected Species Branch; Portland, OR

National Marine Fisheries Service, 2005. Preliminary Draft; Conservation Plan for Southern Resident Killer Whales (Orcinus orca). NMFS Protected Resources Division, Seattle, WA. http://www.nwr.noaa.gov/mmammals/whales/ preliminkwconsplan.pdf

National Wildlife Federation, 2005. Fish Out of Water: A Guide to Global Warming and Pacific Northwest Rivers. National Wildlife Federation, Western Natural Resource Center. Seattle, WA

Snover, A.K., A.F. Hamlet, and D.P. Lettenmaier, 2003. "Climate Change Scenarios for Water Planning Studies: Pilot Applications in the Pacific Northwest." Bulletin of the American Meteorological Society 84(11):1513-1518.

Steward, I.T., D.R. Cayan, and M.D. Dettinger, 2004. "Changes in Snowmelt Runoff Timing in Western North America under a 'Business as Usual' Climate Change Scenario. Climatic Change 62:217-232.

Wiley, M.W., 2004. Analysis Techniques to Incorporate Climate Change Information into Seattle's Long Range Water Supply Planning. Master's Thesis, Department of Civil and Environmental Engineering, University of Washington; Seattle, WA

CHAPTER 4

Technical Recovery Criteria and Goals for Puget Sound Chinook Salmon and Bull Trout

Technical Recovery Criteria and Goals for Puget Sound Chinook Salmon

"I think science is important to this process because it helps describe the vision for what a recovered group of salmon in Puget Sound would look like, and it helps people decide how best to get there through their actions."

Mary Ruckelshaus, Chair; Puget Sound Technical Recovery Team

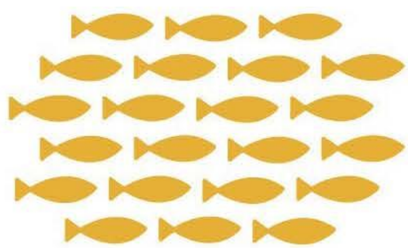
Introduction

Recovery plans prepared in response to a listing under the Endangered Species Act (ESA) are required to include, "objective, measurable criteria which, when met, would result in a determination.... that the species be removed from the list." It is the Puget Sound Chinook Evolutionarily Significant Unit (ESU), not the individual Chinook populations, that constitutes the listed entity under the Endangered Species Act. A viable ESU is similar to a viable population — it is naturally self-sustaining and has a low risk of extinction. The time frame over which scientists evaluate the risk of extinction at the ESU level is a minimum of 100 years. In order to recover the region as a whole and meet criteria for de-listing, Puget Sound salmon recovery efforts must focus on the four viable salmon population parameters (abundance, productivity, spatial distribution and diversity) at both the population and ESU levels.

- Population Viability and Watershed Goals: The Puget Sound TRT (TRT) has used historical information and technical models to determine planning ranges for abundance and productivity that describe low risk (or viable) characteristics for each of the 22 independent Chinook populations in Puget Sound. The TRT also provided general guidelines for identifying spatial structure and diversity characteristics in low-risk populations. State and tribal co-managers concurrently developed a set of recovery targets for the abundance and productivity of individual populations. Utilizing this information, several watershed-based groups involved in salmon recovery planning have adopted measurable goals for the populations that spawn in their river systems. Some of the watershed groups have also developed methods to assess the spatial distribution and life history diversity of the populations within their local area.
- Viability at the ESU level: To ensure that the Puget Sound Chinook ESU will avoid extinction and persist past the next century, the region must reduce the risk that a catastrophic event such as a massive landslide, volcanic eruption or toxic spill will be devastating to Puget Sound Chinook, or will eliminate more of their unique genetic and life history traits. In other words, the ESU must be resilient to the potential effects of such an event. To accomplish this objective, five bio-geographical regions have been identified within the Puget Sound Chinook ESU. The recovery strategy is to ensure that there are multiple viable populations in each of the five regions to mitigate against catastrophic loss. Additionally, within each region, diverse life history characteristics of the different Chinook populations, such as run timing, rearing strategies, and size

Rebuilding a Viable ESU for Puget Sound Chinook Salmon
Technical Recovery Guidelines and Watershed Goals

22 Independent Chinook Populations



Planning ranges and targets for abundance and productivity associated with low-risk status were established for each of the populations. Watershed groups adopted measurable goals for the salmon populations in their watershed.

Each watershed area should strive for habitat of sufficient quality, quantity and connectivity to support salmon populations, and to provide opportunities for future habitat needs.

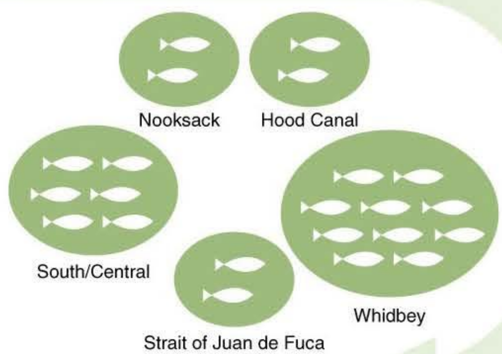
Each watershed should support some of the spatial distribution and diversity of life history traits that were historically present in their salmon population(s). The closer spatial distribution and diversity are to historical conditions, the lower the population risk.

5 Bio-Geographical Regions

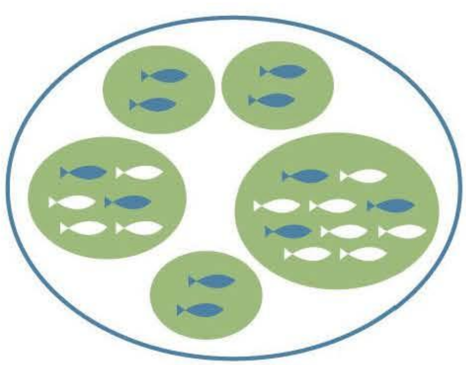
Reduce the risk of further losses to Puget Sound Chinook by ensuring that some populations are thriving throughout the Sound.

5 bio-geographical regions were identified within Puget Sound based on similarities in environmental and biological conditions in marine, freshwater and terrestrial landscapes, and where there are common risks of catastrophe.

Genetic and life-history characteristics of salmon should reflect historical patterns across the region.



1 Viable Evolutionarily Significant Unit



Puget Sound Chinook Salmon ESU

None of the remaining populations at a high risk of extinction.

At least 2-4 populations in each of the 5 regions achieve viable levels (low risk of extinction).

The five regions each have viable populations with life history traits that reflect historical patterns.

Habitat and population conditions across the region support future options for Chinook to rebuild.

Harvest, hatchery and habitat activities are consistent with ESU-wide recovery.

and age at return should be represented in each of the regions in a manner as similar to the historical structure as possible.

The achievement of viability for the entire Puget Sound Chinook ESU is the sum of these population and regional objectives, along with the preservation of future options for the Chinook in all salmon habitat types. The TRT has developed qualitative and quantitative guidelines for recovery and delisting of Puget Sound Chinook (PSTRT, 2002) that are described further in this section. Some of the key findings and recommendations include:

- To lower the risk of extinction of the Puget Sound Chinook ESU, all existing independent populations of Chinook salmon must show improvement from their current conditions, and some will need to attain a low risk status.
- To minimize the risk of a catastrophic loss, viable populations of Chinook salmon must be spread throughout the region. At least two to four populations in each of the 5 bio-geographical regions of Puget Sound must attain a low risk status.
- To minimize the further loss of genetic diversity and life history characteristics of Puget Sound Chinook, there should be at least one viable population from each major genetic and life history group in each of the 5 regions, based on the historical patterns present within that region.

The TRT recommendations also emphasize the need to maintain regional options for Chinook in the future. Habitat areas that are potentially used by Chinook but not presently used must be protected. Patches of habitat of an appropriate type and quality must be close enough together to provide "bridging points" to allow Chinook to colonize new areas and develop new traits over time. Populations that are not considered to be viable must not be allowed to go extinct.

Population Viability and Watershed Goals

Viable salmonid populations (VSP) and their habitat are the basic building blocks of a recovery plan. The TRT has identified four parameters to describe viability at the population level:

- Abundance: the size of the population (number of naturally spawning fish needed to ensure that the population persists over time)
- Productivity: how many fish are produced per adult spawner, or the overall population growth rate (how well the population replaces itself)
- Diversity: the variation in genetic, physiological, morphological and behavioral attributes (provide the fish with flexibility to adjust to changing environments)
- Spatial structure: the geographic distribution of fish at all life stages; needed to protect against a catastrophic loss in one location. This is important at both a river basin or population scale as well as a regional scale.

These four parameters are closely interrelated and together provide flexibility and buffer the risk of extinction in re-building and sustaining salmon populations. More information on VSP parameters is located in Chapter 2 of this plan.

Chinook Planning Ranges for Abundance and Productivity

The technical underpinnings of the recovery guidelines for the 22 independent Chinook salmon populations in Puget Sound are summarized in the 2002 report, "Planning Ranges and Preliminary Guidelines for the Delisting and Recovery of the Puget Sound Chinook Salmon Evolutionarily Significant Unit" by the TRT. Technical details of the population viability analysis and the development of the planning ranges are in process by the TRT as of this writing (spring 2005).

The TRT integrated the results from four different types of analysis to develop planning ranges

Applying VSP Parameters in Determining Population Viability

NMFS has developed guidelines to use in applying the four VSP parameters to salmonid populations for determining whether a population is viable. A complete description of these guidelines is included in "Viable Salmon Populations and the Recovery of Evolutionarily Significant Units" (McElhany et al, 2000); the following excerpts are included as examples. Uncertainty in data estimates for all four parameters must be taken into account.

Abundance:

- A population should be large enough to survive, and be resilient to, environmental variations and catastrophes such as fluctuations in ocean conditions, local contaminant spills or landslides.
- Population size must be sufficient to maintain genetic diversity.

Productivity:

- Natural productivity should be sufficient to reproduce the population at a level of abundance that is viable.
- A viable salmon population should not exhibit sustained declines that span multiple generations.
- A viable salmon population that includes naturally spawning hatchery-origin fish should exhibit sufficient productivity from spawners of natural origin to maintain the population without hatchery subsidy.
- Productivity should be sufficient throughout freshwater, estuarine and nearshore life stages to maintain viable abundance levels, even during poor ocean conditions.

Spatial Structure:

- Habitat patches should not be destroyed faster than they are naturally created.
- Human actions should not increase or decrease natural rates of straying among salmon sub-populations. Habitat patches should be close enough to allow the appropriate exchange of spawners and the expansion of a population into underused patches.
- Some habitat patches may operate as highly productive sources for population production and should be maintained.
- Due to the time lag between the appearance of empty habitat and its colonization by fish, some habitat patches should be maintained that appear to be suitable or marginally suitable, even if they currently contain no fish.

Diversity:

- Human-caused factors such as habitat changes, harvest pressures, artificial propagation and exotic species introduction should not substantially alter variation in traits such as run timing, age structure, size, fecundity (birth rate), morphology, behavior, and genetic characteristics.
- The rate of gene flow among populations should not be altered by human-caused factors.
- Natural processes that cause ecological variation should be maintained.

for abundance and growth rates of viable salmon populations in Puget Sound. Fishery records and biological data were utilized to estimate the historical sizes of salmon populations and the variability in the number of returning fish produced per spawner. Other analyses looked at the amount and condition of habitat in each watershed and its potential to support juvenile and adult Chinook. The TRT conducted population viability analyses using simple demographic models that predict the abundance and productivity needed for population persistence, given the natural variability in numbers over time. The TRT also included analyses conducted by the co-managers that used the Ecosystem Diagnosis and Treatment (EDT) model (Mobrand, Inc.) to predict fish abundance, productivity and diversity under different habitat conditions in each watershed. The EDT analyses utilized the concept of Properly Functioning Conditions (PFC) in evaluating the potential for habitat to support salmon abundance, productivity and diversity. PFC refers to the habitat conditions essential for conservation of the species, whether important for spawning, breeding, rearing, feeding, migration, sheltering, or other functions. These are described in the NMFS 4(d) rule (65 FR 170) and the "Matrix of Pathways and Indicators" (NMFS, 1996). Generally, properly functioning conditions are based on indicators such as water temperature, streambed sediment, hydrology, large woody debris, and chemical contaminants.

The TRT presented viable abundance and productivity estimates as a planning range - a broad estimate encompassing results from the different analyses that describes the abundance and productivity needed for a population to be viable over time. The ranges are large because of inherent variation in salmon populations, uncertainty in historical information, the fact that the required abundance depends upon the population's productivity, and differences among the analyses and models. A summary of the Puget Sound Chinook planning ranges for abundance and productivity is contained in Figure 4.1.

Chinook Planning Targets for Abundance / Productivity

State and Tribal fisheries co-managers also participated in the development of a set of planning targets to ensure that population viability was considered in evaluating harvest, hatchery and habitat measures. The targets are based on estimates of what salmon abundance can be supported by healthy salmon habitat at low productivity and high productivity. Figure 4.1 displays the planning ranges developed by the TRT, as well as the planning targets at low productivity and at the maximum productivity thought to be sustainable, given the habitat conditions assumed to be possible in each watershed. It is important to remember that the numbers represent different points along a population's performance curve, and that the planning targets seek to achieve the curve as average population performance over time. Population abundance and productivity will vary from year to year due to fluctuating environmental conditions.

The Shared Strategy approach relies on the work of individual watershed planning areas toward achieving independent population goals for their areas. Although the planning ranges and targets presented here are guidelines, several watershed groups have adopted measurable goals for the populations in their planning areas. (See watershed chapters.)

Spatial Structure at the Population Level

Spatial structure describes the geographic distribution of salmon within a population and, more broadly, across the habitat throughout the Puget Sound region. Spatial structure for a particular population generally refers to the distribution of individual fish in the habitats they use throughout their life cycle. The changing nature of habitat continuously affects the pattern of occupancy of salmon, but historically the structure of habitat provided essential features that enabled the salmon to disperse and adjust to habitat availability.

Populations	Mean spawner abundance for 1996 -2000	Low Productivity Planning Range for Abundance	Low Productivity[1] Planning Target for Abundance (productivity in parentheses)	High productivity[2] Planning Target for Abundance (productivity in parentheses)
NF Nooksack	120	16,000 – 26,000 (1.0)	16,000 (1.0)	3,800 (3.4)
SF Nooksack	200	9,100 – 13,000 (1.0)	9,100 (1.0)	2,000 (3.6)
Lower Skagit	2,300	16,000 – 22,000 (1.0)	16,000 (1.0)	3,900 (3.0)
Upper Skagit	8,920	17,000 – 35,000 (1.0)	26,000 (1.0)	5,380 (3.8)
Upper Cascade	330	1,200 – 1,700 (1.0)	1,200 (1.0)	290 (3.0)
Lower Sauk	660	5,600 – 7,800 (1.0)	5,600 (1.0)	1,400 (3.0)
Upper Sauk	370	3,000 – 4,200 (1.0)	3,030 (1.0)	750 (3.0)
Suiattle	420	600 – 800 (1.0)	610 (1.0)	160 (2.8)
NF Stillaguamish	660	18,000 – 24,000 (1.0)	18,000 (1.0)	4,000 (3.4)
SF Stillaguamish	240	15,000 – 20,000 (1.0)	15,000 (1.0)	3,600 (3.3)
Skykomish	1,700	17,000 – 51,000 (1.0)	39,000 (1.0)	8,700 (3.4)
Snoqualmie	1,200	17,000 – 33,000 (1.0)	25,000 (1.0)	5,500 (3.6)
N Lake WA/Sammamish	194*	4,000 – 6,500 (1.0)	4,000 (1.0)	1,000 (3.0)
Cedar	398*	8,200 – 13,000 (1.0)	8,200 (1.0)	2,000 (3.1)
Green	7,191*	17,000 – 37,700 (1.0)	27,000 (1.0)	Unknown
White	329*	Unknown	Unknown	Unknown
Puyallup	2,400	17,000 – 33,000 (1.0)	18,000 (1.0)	5,300 (2.3)
Nisqually	890	13,000 – 17,000 (1.0)	13,000 (1.0)	3,400 (3.0)
Skokomish	1,500*	Unknown	Unknown	Unknown
Mid-Hood Canal	389	5,200 – 8,300 (1.0)	5,200 (1.0)	1,300 (3.0)
Dungeness	123*	4,700 – 8,100 (1.0)	4,700 (1.0)	1,200 (3.0)
Elwha	1,319*	17,000 – 33,000 (1.0)	17,000 (1.0)	6,900 (4.6)
*Represents spawner escapement 1987 – 2001				

[1] The low productivity number in both the range and target represents one adult fish returning from the sea for each spawner, also called the equilibrium point (1:1)

[2] The high productivity number represents the number of spawners at the point where the population provides the highest sustainable yield for every spawner. The productivity ratio is in parentheses for each population and represents the relationship of fish returning from the sea for each spawner, (e.g. 3.4:1 for NF Nooksack)

Figure 4.1 Chinook Spawner Abundance Planning Targets & Ranges for Puget Sound Region. The numbers are presented for the populations for which analysis was available.

In assessing spatial structure within a population, the TRT recommended that human activities should not change the spatial structure in a way that significantly deviates from the historical pattern. The spatial distribution of habitat within a watershed must maintain enough quality, quantity and connectivity of habitat patches to support spawning, rearing, and upstream and downstream migration.

"The spatial and temporal distribution, quantity, and quality of habitat (landscape structure) dictate how effectively juvenile and adult salmon can bridge freshwater, estuarine, nearshore and marine habitat patches during their life cycle." (PSTRT, 2002)

Salmon transit a number of different habitats during their life cycle. Although a great deal of focus has been placed on restoring and protecting areas where they presently spawn, all of the freshwater, estuarine, nearshore and marine habitats that they utilize throughout their life are critical for survival and recovery.

Additionally, habitat options must be preserved for the future. Over time, salmon may re-colonize new areas due to increases in population abundance, their ability to once again access areas where habitat was formerly blocked or degraded, or because their present habitat areas are suffering a decline in quality from human or natural causes. The risk of extinction for Puget Sound salmon populations is thus affected by the quality, quantity and geographic structure of habitat now, and in the future. Some habitats not used today may be very important tomorrow and thus must be preserved. Spatial structure also can be threatened by excessive predation, competition, harvest, or hatchery practices in key rearing or spawning habitats.

Areas used by salmon that affect their viability and risk of extinction include:

- Presently delineated spawning habitat for the 22 independent populations of Chinook salmon in the Puget Sound ESU;
- Freshwater spawning habitat in other watersheds of Puget Sound;
- Freshwater habitats supporting juvenile rearing and the downstream and upstream migration pathways; and
- Estuarine and nearshore habitat supporting forage production, rearing and migration of juveniles and adults.

Smaller, independent tributaries, estuaries and nearshore habitats must support functions and conditions that do not impede ESU viability. For example, runoff from freshwater tributaries affects nearshore habitats, smaller freshwater tributaries are occasionally used by adults, and both juveniles and adults rear in and migrate through estuarine and nearshore habitats.

Diversity at the Population Level

"Diversity is important to population viability since more diverse populations are better buffered against changes in environmental conditions" (PSTRT, 2002).

The differences in genetic structure within and between populations, the range of adult size and appearance, the variability and spread in the time that fish return to the river to spawn, the range in age at return, the variety of behaviors and other traits are all important aspects of diversity. Salmon populations exhibit this variation today, and this diversity helps them "hedge their bets" against uncertain and variable environmental conditions. The TRT has emphasized the importance of retaining or restoring the historic pattern of diversity within populations to reduce extinction risk.

Metrics for Spatial Structure and Diversity at the Population Level

Quantitative viability criteria for spatial structure and diversity are largely unavailable at the population level. As discussed in the previous section, the TRT provided watersheds with general guidance for the importance of spatial structure and diversity, and gave examples of different ways to indicate these population attributes using existing data. Some watersheds such as the Snohomish have applied some of the TRT examples of "metrics" for evaluating these parameters to their populations. By mapping the current and historical use of subwatersheds for adult spawning and juvenile rearing, they have been able to look at the separation of habitat types and the types of habitats the fish can access under different watershed conditions (figure 4.2). This information can be used to compare the effect of alternative land use proposals on habitat diversity and the spatial structure of the local salmon population. The EDT model, used in many watersheds to estimate population abundance and productivity, can also summarize changes in life history diversity relative to the historical condition.

ESU-Wide Delisting and Recovery Criteria

Scientists from the TRT and elsewhere believe that Puget Sound was once home to more populations of Chinook with greater diversity than what presently remains. It is estimated that at least 11 to 15 populations of Chinook salmon in Puget Sound have already been extirpated, and most of them were from early timed runs (NMFS/BRT, 1997; PSTRT, 2005). The disproportionate loss of early-run life history diversity is a major loss to the genetic and evolutionary legacy of the ESU, and

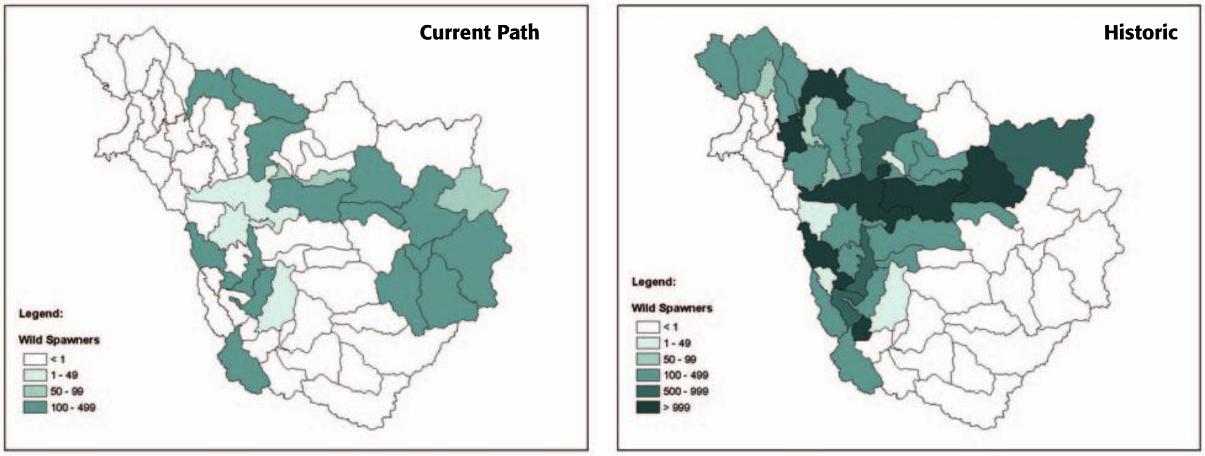


Figure 4.2 Map depicting the change in number of wild spawners in the Snoqualmie and Skykomish populations in the Snohomish River basin. Results are from SHIRAZ modeling. Maps created by K. Bartz, NOAA Fisheries' NWFSC.

recovery guidelines strive to reduce the risk that the region will have further loss.

Recovery criteria for Puget Sound Chinook are described in "Planning Ranges and Preliminary Guidelines for the Delisting and Recovery of the Puget Sound Chinook Salmon Evolutionarily Significant Unit" (PSTRT, 2002). ESU level viability guidelines consider the risk of catastrophes and the preservation of historical genetic, life history and geographic diversity across the ESU.

Summary of ESU Recovery Criteria and Technical Guidance

The ESU-wide delisting and recovery criteria (PSTRT, 2002) provide flexibility in meeting the requirements of the Endangered Species Act, and preserve options for Puget Sound Chinook in the future. The recommendations by the TRT describe the biological characteristics that would constitute a viable ESU for Puget Sound Chinook. The ESU would have a high likelihood of persistence if:

1. All populations improve in status and at least some achieve a low risk status.
2. At least 2-4 viable Chinook populations are present in each of the 5 regions.
3. Each region has one or more viable populations from each major diversity group that was historically present within that region.
4. Freshwater tributary habitats in Puget Sound are providing sufficient function for ESU persistence. Ecological functioning occurs even in those habitats that do not currently support any of the 22 identified Chinook populations, since they affect nearshore processes and may provide future habitat options.
5. The production of Chinook salmon in Puget Sound tributaries is consistent with ESU recovery objectives, and contributes to the health of the overall ecosystem in the region.
6. None of the 22 remaining Chinook populations go extinct, and the direct and indirect effects of habitat, harvest and hatchery management actions are consistent with ESU recovery.

Population Abundance Risk Levels

The planning ranges for the independent Chinook populations cumulatively affect the level of the risk of extinction for the ESU as a whole. In attaining viability at the ESU scale, it is expected that the individual populations will show different levels of risk, but they must be considered in the aggregate. Although some of the Puget Sound Chinook populations have shown substantial progress in recent years, none of the 22 populations are presently close to meeting the minimum value of the viable planning range for abundance and productivity, all are considered to be at high risk, and the condition of all of the populations needs to improve.

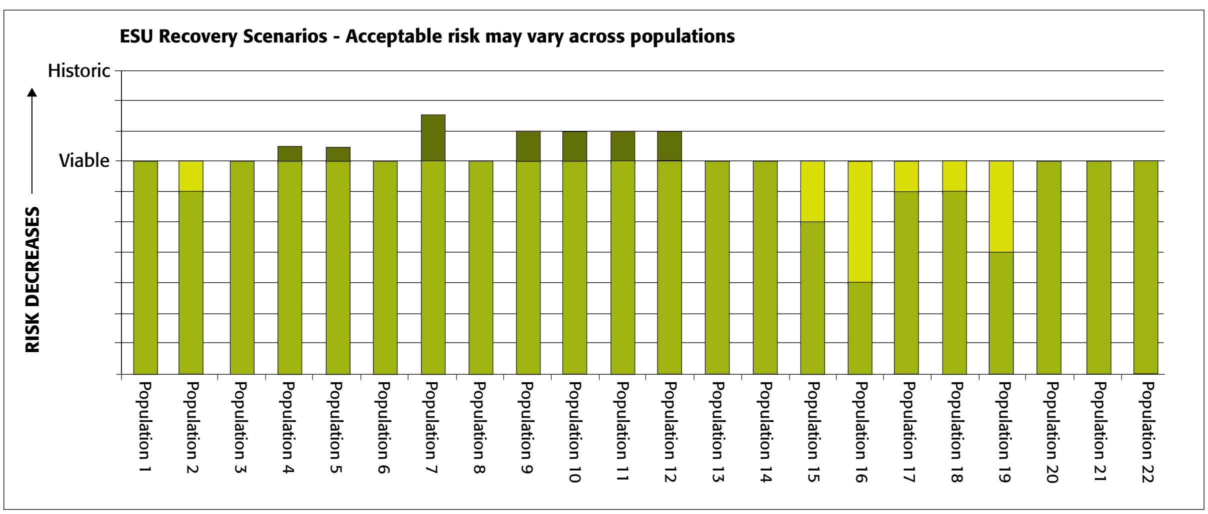
The TRT has indicated that it is not necessary for every single one of the individual populations to attain a low risk of extinction (i.e. fall within the planning range for both abundance and productivity) to achieve ESU-wide viability. However, at least some of the populations must recover well above the minimum threshold of the viable planning range since, "an ESU-wide scenario with all populations at the lower end of the planning range for viability is unlikely to assure persistence and delisting of the ESU." (PSTRT, 2002)

Figure 4.3 shows a conceptual diagram illustrating how the level of risk may vary across the aggregate of salmon populations. Risk considerations include the biological characteristics of the individual population as well as the habitat status of each watershed, the ability to exercise treaty fishing rights, comprehensive re-building programs using artificial propagation, and other considerations.

Populations that do not meet the low-risk criteria for abundance, productivity, and other VSP parameters must be sustained to preserve options for future recovery at the ESU scale. Additionally, habitat, harvest and hatchery management must pay particular attention to the effect of their actions on individual populations which remain at moderate or high risk of extinction.

Geographic Distribution of Risk

The threat that a catastrophic event will wipe out a large group of salmon and the need to preserve diversity throughout the ESU must also be considered when evaluating the risk of extinction at the ESU level. To incorporate these concerns, the TRT identified five bio-geographical regions within Puget Sound based on similarities in physical and habitat features, and where groups of Chinook have evolved in common. (Figure 4.4 and 4.5) Physical factors included topography (upland and marine bathymetry), major mountain ranges or other geologic features, ecological variation, of vegetation and biotic communities. The regions also correspond to locations where groups of populations would be at common risk from a potential disaster such as a volcanic eruption, toxic contamination, or an oil spill. Similarities and differences between the genetic and life-history composition of the salmon populations in the ESU were also evaluated.



Notes: Risk considerations include:
• Biological characteristics of population
• Treaty fishing rights, habitat status of watershed

Figure 4.3 Conceptual diagram that illustrates the level of risk may vary across the aggregate of salmon populations. Source: PSTRT & Mary Ruckelshaus.

Figure 4.4 Independent populations of Chinook salmon in the Puget Sound grouped according to geographic regions of diversity and risk. Map courtesy the PSTRT & Mary Ruckelshaus.

Geographic Region	Populations Remaining
Strait of Georgia This area includes the Nooksack River and the San Juan Islands. It is an area greatly influenced by the Fraser River and is utilized extensively for forage and migration by many Puget Sound populations.	North Fork Nooksack South Fork Nooksack
Strait of Juan de Fuca This region includes the rivers draining the north slopes of the Olympic mountains, and draining into the eastern Strait of Juan de Fuca. Nearshore areas along the Strait are considered to be a major migratory corridor.	Elwha Dungeness
Hood Canal The east face of the Olympic mountain range and small streams along the western Kitsap Peninsula drain into this distinct estuary.	Skokomish Mid Hood Canal (incl. Dosewallips, Duckabush and Hamma Hamma)
Whidbey Basin The Whidbey basin is the main estuarine area for the major Chinook-producing rivers in Puget Sound, and the migratory crossroads for most Puget Sound populations.	Skykomish Snoqualmie North and South Fork Stillaguamish Upper and Lower Skagit Upper and Lower Sauk Suiattle Cascade
Central/South Basin These basins were combined into a single geographic unit largely to reflect correlated risks from volcanic activity and urban-related effects.	Cedar River North Lake Washington Green/Duwamish Puyallup White Nisqually

Figure 4.5

Within each of the five bio-geographical regions, the TRT has recommended that:

"An ESU-wide recovery scenario should include at least 2-4 viable Chinook salmon populations in each of 5 geographic regions within Puget Sound, depending on the historical biological characteristics and acceptable risk levels for populations within each region." (PSTRT, 2002)

Geographic Distribution of Diversity

The loss of any additional genetic and life history characteristics from the Puget Sound ESU will affect the ability of the Chinook salmon to persist in the future. The guidelines for recovery at the ESU level thus include a recommendation to achieve a low risk of extinction for populations that represent the scope of genetic and life history types in all five regions.

"An ESU-wide recovery scenario should include within each geographic region one or more viable population from each major genetic and life history group historically present within that geographic region." (PSTRT, 2002)

Figure 4.6 illustrates the major diversity types of Chinook in Puget Sound based on suites of interrelated life history traits (e.g., run-timing, age-at-outmigration, length-at-age). Early-run Chinook generally enter the river system in April and May and spawn in late August and September, while late-run Chinook enter their natal stream in the late summer months and spawn in the fall. Several stocks of early-run Chinook have already become extinct in the Puget Sound region. The recovery guidelines from the TRT thus emphasize the preservation of the life-history types still remaining in the bio-geographical regions.

Although the TRT has been developing separate criteria for each of the four VSP parameters, it is important to recognize that all four are closely interrelated, and short term improvements to one factor may positively or negatively impact the others. For example, opening additional habitat areas is likely to benefit both abundance and spatial structure. However, in some river systems it may be necessary to provide opportunities for Chinook to occupy habitats that are not as productive in order to meet spatial and diversity criteria in the long term. TRT guidelines are primarily directed at reducing the risk of extinction and preserving options for the future of the Puget Sound Chinook ESU.

Major diversity types in extant and extirpated populations of Chinook in Puget Sound

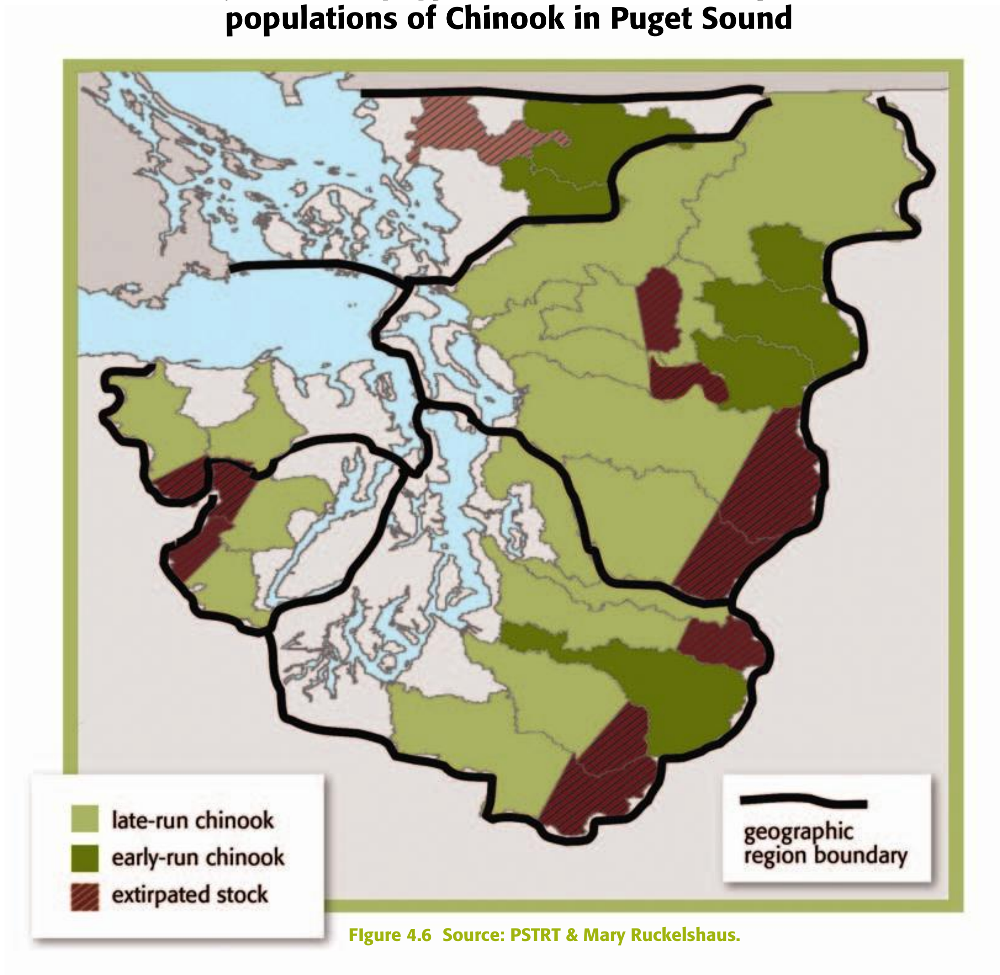


Figure 4.6 Source: PSTRT & Mary Ruckelshaus.

Technical Recovery Criteria and Goals for the Coastal/ Puget Sound Bull Trout Distinct Population Segment

"In keeping with the goal of fostering effective management and recovery of bull trout at the local level, we have developed ... specific recovery targets for each management unit that will be used to guide bull trout recovery... as a whole."

U.S. Fish and Wildlife Service, 2004

Introduction

Bull trout were listed as a threatened species in 1999 throughout their range in the coterminous United States. Because listing occurred at that level, currently delisting can only occur at the coterminous level as well. However, if additional information and rules determine that the Coastal-Puget Sound Distinct Population Segment of bull trout may be considered separately, delisting may be considered once the DPS has achieved a recovered state.

USFWS has stated the goal of their recovery plan is, *"to ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the Coastal-Puget Sound Distinct Population Segment, so that the species can be delisted." (USFWS, 2004)*

Recovery criteria and targets for the Coastal-Puget Sound Distinct Population Segment are structured around the parameters of abundance, productivity, distribution and connectivity of bull trout, including the potential for the full expression of life history traits.

Recovery Criteria

Essential to the recovery of bull trout are complex interacting groups - multiple local populations within a geographic area that have suitable opportunities and conditions to move freely upstream and downstream to interact with one another. Criteria for recovery of bull trout in the Coastal-Puget Sound DPS include the following conditions:

1. Biological and ecological function of the 14 identified core areas (6 in the Olympic Peninsula Management Unit and 8 in the Puget Sound Management Unit). Components of fully functioning core areas include:

    - Habitat that provides for the persistence of broadly distributed local populations supporting the migratory life history form within each area.
    - Adult bull trout are sufficiently abundant to provide for persistence and viability. This level of abundance is estimated to be 16,500 adult bull trout across all core areas in the Coastal-Puget Sound DPS.

- Measures of bull trout abundance within all core areas show stable or increasing trends, based on 10 to 15 years of monitoring data (represents at least 2 bull trout generations).
- Habitat within and between core areas is connected sufficiently to provide for the full expression of migratory behavior, re-colonization of areas that were previously extirpated, and provide for potential genetic exchange between populations.

2. A monitoring plan has been developed and is ready for implementation, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions. The plan must cover a minimum of 5 years post-delisting.

Recovery Targets

The Recovery Plan for the Coastal/Puget Sound bull trout DPS (USFWS, 2004) outlines the following recovery targets.

Distribution

Maintain or expand the current distribution of bull trout in identified core areas (within United States waters).

Puget Sound Management Unit: This unit contains 8 identified core areas with 57 identified local populations which will be used as a measure of broadly distributed spawning and rearing habitat within these core areas. The distribution within the five additional potential populations that have been identified should also be confirmed or restored.

Olympic Peninsula Management Unit: This unit contains 6 core areas with 10 currently identified local populations. These populations will be used as a measure of broadly distributed spawning and rearing habitat within these core areas. Spawning distribution in the two potential local populations that are essential to recovery should be restored or confirmed.

Abundance

Recovery targets are based on the abundance needed to reduce the likelihood of genetic drift and consideration of surveyed fish densities, habitats, and potential fish production after threats have been addressed.

Puget Sound Management Unit: Achieve minimum estimated abundance of at least 10,800 adult bull trout spawners among all core areas in the Puget Sound Management Unit. Recovered abundance targets are as follows:

Core Area	Recovered Abundance Target
Chilliwack	600
Nooksack	2,000
Lower Skagit	3,800
Upper Skagit	1,400
Stillaguamish	1,000
Snohomish-Skykomish	500
Chester-Morse Lake	500
Puyallup	1,000

Olympic Peninsula Management Unit: Achieve minimum estimated abundance of at least 5,700 adult bull trout spawners, including at least 1,000 spawning adults in each of the Dungeness, Elwha, Hoh, Queets, and Quinault core areas and at least 700 spawning adults in the Skokomish core area.

Productivity

Restore adult bull trout to exhibit stable or increasing trends in abundance at or above the recovered abundance target level based on 10 to 15 years of monitoring data (representing at least 2 bull trout generations).

Connectivity

Restore connectivity by identifying and addressing specific existing and potential barriers to bull trout movement. Connectivity criteria will be met when intact migratory corridors are present among

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all local populations within each core area, thus providing opportunity for genetic exchange and life history diversity. The achievement of distribution, abundance and productivity targets is expected to depend on providing passage at barriers throughout all of the core areas in the Coastal/Puget Sound distinct population segment of bull trout.

More information on the proposed recovery actions, research needs, timelines and costs of recovery are contained in the Draft Recovery Plan for the coastal-Puget Sound Distinct Population Segment of Bull Trout (USFWS, 2004).

References:

Section 1:

Federal Register; January 3, 2000. Proposed 4(d) Rule Governing Take for Puget Sound Chinook and Hood Canal Summer Chum. 65 FR 170.

McElhany, P., M. Ruckelshaus, M.J. Ford, T. Wainwright and E. Bjorkstedt. 2000. Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units. U.S. Dept. Commerce, NOAA Tech. Memorandum NMFS-NWFWC-42, 156 pp.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

National Marine Fisheries Service (NMFS). 1996. Making ESA Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. Environmental and Technical Services Division, Habitat Conservation Branch. Portland, Oregon.

National Marine Fisheries Service; West Coast Chinook Salmon Biological Review Team, 2003. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. Available from the NMFS Northwest Fisheries Science Center; Seattle, WA.

Puget Sound Technical Recovery Team, 2002. Planning Ranges and Preliminary Guidelines for the Delisting and Recovery of the Puget Sound Chinook Salmon Evolutionarily Significant Unit. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington. [NOTE: THIS IS THE "BLUE PAPER"]

Puget Sound Technical Recovery Team. 2003. Integrated Recovery Planning for Listed Salmon: Technical Guidance for Watershed Groups in Puget Sound. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Puget Sound Technical Recovery Team. February 17, 2004. Combining Demographic and Habitat-based Approaches to Triangulate on Viability Criteria for Puget Sound Chinook salmon Populations... Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Puget Sound Technical Recovery Team. June 21, 2004. ESU Viability Criteria for the Puget Sound Chinook Evolutionarily Significant Unit. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Puget Sound Technical Recovery Team, 2005. Independent Populations of Chinook Salmon in Puget Sound. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Section 2:

U.S. Fish and Wildlife Service, 2004. Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (Salvelinus confluentus). Available from U.S. Fish and Wildlife Service Region 1; Portland, OR.

CHAPTER 5

Local Watershed Profiles

Context for Profiles

The Puget Sound Salmon Recovery Plan is built on the tireless work of watershed recovery planning groups across the Puget Sound, made up of creative, knowledgeable people motivated to find lasting solutions to the complex challenges posed by salmon recovery. In total, fifteen watershed recovery plans were created and submitted for this plan. These efforts, as they occur in tandem across the Puget Sound in combination with regional efforts, will help put the region on a recovery path. This section provides an opportunity to lean about the work occurring at the watershed level.

Each watershed is unique--not only do salmon use each watershed differently – but each watershed is faced with different challenges, levels of collaboration, and has different goals and starting places on the road to recovery. Not surprisingly, the individual recovery plans vary in terms of their level of detail, how they address issues of habitat, harvest and hatcheries, and how they are organized. Because of these differences, profiles for all Puget Sound watersheds were written in a consistent format to concisely capture the essence of the watershed plans to make it easier to see how the ESA requirements have been met. The set of individual watershed recovery plans as submitted to the Shared Strategy are available electronically in Volume II of this plan.

The following profiles have three components. The first section, The Place and The People, is intended to create an understanding of the context within which the planning effort is occurring; the second and largest component summarizes the content of the watershed chapter; and the third, the Results section, describes the May 2005 Review conclusions by the Technical Recovery Team (TRT) and the Shared Strategy Interagency Work Group.

The TRT and Work Group assumed implementation – they did not evaluate the likelihood that strategies, actions or adaptive management would be implemented. Based on this assumption they focused on the degree of certainty that each watershed plan can achieve its goals, identified issues that need to be dealt with in order to increase certainty, developed recommendations for how to address those issues, and assessed how the combined local and regional elements meet the Endangered Species Act recovery plan requirements.

This Chapter concludes with a section that describes how the individual watershed efforts roll up into one comprehensive plan that meets the TRT's regional recovery criteria and Endangered Species Act recovery plan requirements.

Watershed Profile:

Nooksack

The Place and the People

The Nooksack watershed is located in northwestern Washington, encompassing most of northern and western Whatcom County, part of Skagit County, and reaching northward into British Columbia. The watershed is large, covering over 830 square miles and has more than 1,400 stream and river miles, with elevations ranging from sea level to the summit of Mt. Baker at 10,778 feet. The Nooksack's headwaters originate within National Park and National Forest boundaries, with Mt. Shuksan, the most photographed peak in the United States, jutting out from North Cascades National Park. Surrounding the Nooksack watershed are the smaller watersheds that drain directly into Puget Sound from the Canadian border south to Colony Creek in Skagit County. To the northeast of the Nooksack watershed are portions of the Chilliwack and Sumas Rivers in the U.S., which drain to the Fraser River. These areas combined are referred to as Watershed Resource Inventory Area 1 (WRIA 1), and total 1,400 square miles.

Mount Baker, Mount Shuksan and the Twin Sisters Mountain characterize the upper reaches of the Nooksack River's three forks: the North, Middle, and South. All three forks are fed by run-off from rainfall and snowmelt, groundwater, and, in the case of the North and Middle forks, glacial melt. In sections of the upper reaches of the forks, rapids tumble down steep gorges with huge boulders. On a clear day, the rugged, snow-capped peaks frame these cascading streams, making them a popular choice for white-water rafting, hiking and just enjoying the scenery.

Photo courtesy the Washington State Salmon Recovery Funding Board

Downstream the forks widen to broad valleys. While most of the upper watershed is in Federal ownership, much of this middle watershed is privately owned commercial forest lands, small landowner forestry lands, or State lands managed by the Washington Department of Natural Resources. Further downriver, the valleys transition to farms, particularly in the lower South Fork, and, largely out of the floodplain, include new homes for the growing human population. The flat lowlands down-river from the forks are more intensely developed with roads, homes and businesses that support the majority of the 50,200 people living in the Nooksack watershed. The lower mainstem Nooksack River area remains fairly rural, and includes substantial agricultural lands. Ultimately, the river drains to Bellingham Bay across a delta that is virtually unmanaged, recovering habitat diversity, and one of the higher quality estuaries in Puget Sound. The nearshore areas are rich in marine habitat and wildlife, including Drayton Harbor and Birch, Lummi, Portage, Chuckanut and northern Samish Bays. These areas are utilized by salmon for feeding and growing as a part of their epic ocean migrations, and used by people for fishing, crabbing, clamming, boating and living.

The sediment-rich waters of the Nooksack River create unique challenges for people and fish. The geology and landscape in the steep upper watershed are naturally prone to landslides. While naturally unstable, land management activities have increased landslide rates, often routing sediment to salmon and trout streams and the river. The increased sediment, along with the loss and removal of instream wood and lack of mature streamside vegetation to provide new wood, have resulted in more frequent and dramatic shifts of river channels during winter floods. In some areas, the channel migrates so frequently now that salmon eggs deposited in the fall are dewatered or washed away before they can emerge in the spring. The loss of in-stream wood also affected rearing habitat, with reduced habitat diversity like deep pools, and hiding cover for fish.

When the forks enter the gentler reaches they drop some of the sediment from the upper river. The fine sediments deposited in the floodplain over time in the lower valleys have created very fertile farmlands. But when sands and silt clogs spawning gravels, less of the eggs survive to emerge as young fish. Coarser sediment like gravel and boulders can fill pools important for adult and juvenile salmon, and sometimes make the river wider and shallower. The South Fork, although it is not glacier fed, now carries substantial suspended sediment that clouds the water long after the rains have passed. Because it is non-glacial, it also can have less flow that the other forks during summer and fall. Due to lower water flow, more mixed land use and the geographical setting and orientation compared to the other forks, the South Fork experiences high temperatures during the rearing, spawning, migration and holding periods that approach lethal levels for Chinook.

The original people of the watershed, the Native Americans, developed cultures in an environment rich with fish and wildlife that they managed for thousands of years. The two tribes, Lummi Nation and Nooksack Tribe thrived in the mild environment abundant with fish and wildlife. People of the Lummi Nation living on the marine shoreline utilized these resources and today are the largest fishing tribe in Puget Sound. The Nooksack people

Key Facts

The Whatcom County land designations in the WRIA 1 watersheds are 36% federal forest lands, 9.5% state forest lands, 30% private forests, 11% agriculture, 10% rural and 3% urban. Of the 8% of land designations outside Whatcom, 5% is rural residential (Canada) and 3% is forested (Canada and Skagit County).

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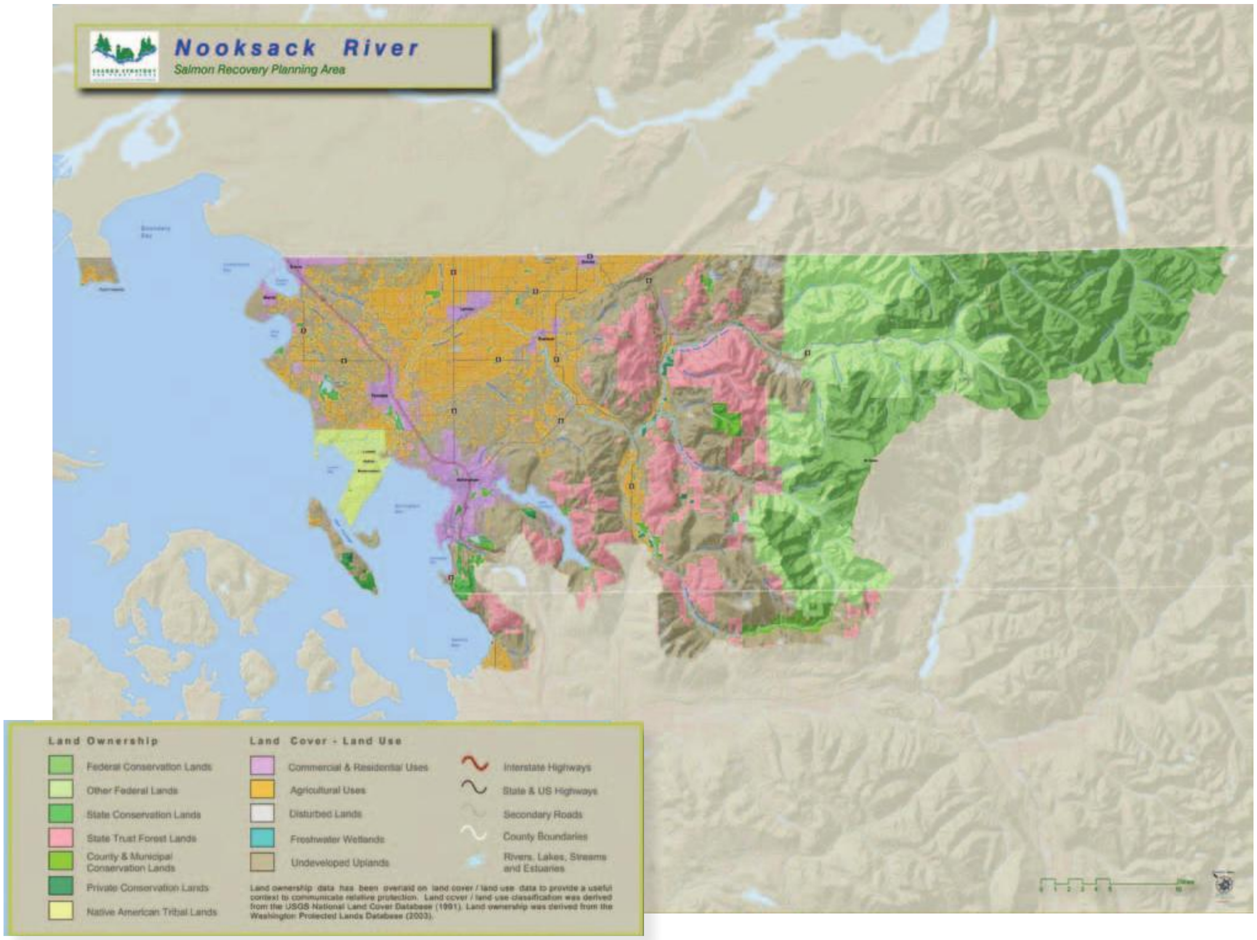
Population growth in WRIA 1 is projected to grow by 2022 to 261,084 an increase of 50.5%.



living upriver fished in the river valleys. Today these tribes still maintain many of their traditions and depend upon the salmon for their cultural, economic and social well-being. Less than two centuries ago, the area attracted European settlers, drawn by the mining, fishing, timber, and potential to farm. The settlers logged, mined and cleared most of the lowland acres for farms, making the county a productive agricultural center, home to many dairies and berry farms. Salmon canning was also important, with some of the largest canneries in the state located in Whatcom County.

In recent years the physical beauty and close proximity to the San Juan Islands, Vancouver, B.C., the Nooksack River and the North Cascade Mountains, has made the watershed an alluring draw for people who want to live close to the outdoors. Many people of the watershed care deeply for their environment. For several decades, their governments- tribal, County, cities and towns- have taken actions to minimize new impacts, and to restore past damages to the river and salmon as well as to protect the environment for people and wildlife. They continue to adopt and implement growth management regulations to encourage development into existing urban areas and protect important areas for fish and wildlife. They have recently adopted a watershed management plan to guide more efficient water management in the watershed, including ensuring enough remains for fish. In the last year, the governments in partnership with the State of Washington formed the WRIA 1 Salmonid Recovery Board to develop and implement a protection and restoration plan for the depressed salmonid populations and their habitats.

In the past decade, the City of Bellingham and the Port of Bellingham, in partnership with many others, developed a plan for cleaning up toxic chemicals in eastern Bellingham Bay sediment and are creating a new vision for the waterfront. The governments are not alone in their efforts to steward the natural resources of Whatcom County. An expanding number of citizen volunteers stewarded by the Nooksack Salmon Enhancement Association, the Whatcom Conservation District, Whatcom Land Trust, Tribes, and the County and others have completed over 600 projects; removing barriers to the fish and planting native trees on over 1,200 acres of land adjacent to the rivers and streams of the Nooksack River and adjacent local watersheds. The farmers too have pitched in to improve and expand their conservation practices as demonstrated by their high level of enrollment in the Conservation Reserve Enhancement Program.

The people of the Nooksack watershed recognize the magnitude of work ahead as well as the rewards to be gained from it. They are poised to tackle the task of protecting and restoring their watershed.

The Nooksack Salmon

Nooksack Chinook, including North/Middle Fork and South Fork native spring Chinook populations along with Nooksack and Chilliwack bull trout populations are listed as part of the Puget Sound evolutionarily significant unit (ESU) as threatened under the Endangered Species Act. The two Chinook populations are genetically unique, and together make up one of five genetic diversity units in Puget Sound, and are the only two populations in the Strait of Georgia Region of Puget Sound. These populations are considered by the TRT to be essential to recovering the Puget Sound Chinook ESU.

The two Chinook populations return from the ocean and swim up the river beginning as early as late winter and peaking late spring, and spawn late July through September. In addition, there is a Chinook run (a mixture of hatchery and natural fish that are considered reintroduced from Green River stock) that returns to the river in late summer and fall and spawns in the Nooksack from late-September through November. These late-returning Chinook predominantly use habitats lower in the river system than the North/Middle and South Fork fish, although there is significant overlap in timing and spawning with the South Fork fish.

Bull trout spawn and have early rearing in all or parts of three forks of the Nooksack, and also outmigrate to forage in productive nearshore areas prior to returning to freshwater. They require high quality, cold water for spawning and rearing with clean gravel, cover from predators and a good supply of oxygen. They migrate a lot, and are repeat spawners. Because of this, cool temperatures and complex habitat are important in foraging and migration corridors including the lower mainstem. They re-enter freshwater in summer and fall, migrating back to the forks and their tributaries to spawn in fall as water temperatures drop. Chilliwack River bull trout spawn and rear in the U.S., then forage and grow in the river and Chilliwack Lake. They may also be anadromous.

Key Facts

The Nooksack is home to nine species of native salmonids: Chinook, coho, sockeye, chum and pink salmon, bull trout, resident Dolly Varden, summer and winter steelhead, and coastal cutthroat trout. Chinook and bull trout are components of regional units listed as threatened under the Endangered Species Act.

Recovery Goals

The WRIA 1 Salmonid Recovery Board's goal is to recover self-sustaining salmon runs to harvestable levels that will support fisheries. Achieving this goal requires protecting existing good habitat and natural stream processes and restoring the ecosystem processes that create and maintain critical salmo-

Fish Population Goals (potentially 100 years)						
Population	Current Return Adults (2003)	Long-term Goals for Adult Return	Adult Spawners (natural origin)	Productivity	Diversity[1]	Spatial Structure[2]
North/ Middle Fork	210	10,552	3,442	3.1	97%	To be determined
South Fork	204	7,608	2,294	3.3	98%	To be determined

[1]Diversity is a theoretical estimate of the percentage of historical life history strategies that existed in the population. Life history strategies in this context are modeled based on the availability of a variety of pathways fish can use to diversify their presence across the landscape. [2]Spatial structure is the extent to which fish can occupy a broad range and variety of habitats to minimize their exposure to risk.

Bull Trout Goals				
Core Area	Abundance	Distribution	Trend	Connectivity
Nooksack	2,000	Maintain or expand the current distribution	Stable or increasing trend in abundance based on the 10-15 year timeframe.	Restore connectivity by identifying and addressing specific existing and potential barriers to bull trout movement
Chilliwack	600	Maintain or expand the current distribution		

nid habitat. This goal also requires careful use of hatcheries, responsible harvest, and thoughtful land use actions with the active participation and support of local landowners, businesses, and the larger community. To achieve the support of landowners and other affected parties, salmon recovery must be accomplished in a manner that complements fish friendly farming and forestry, urban development and other needs of the human population. The long-term objective requires increased productivity of both North/Middle and South Fork Chinook populations from their habitat.

Whether any native late returning Chinook still exist is unclear. The objective to expand opportunities for life history diversity in the watershed is consistent with the associated goal of preserving opportunities for a locally adapted late-timed run.

What is the current status of the Threatened Salmon populations?

Chinook

The North/Middle Fork and South Fork Chinook populations are at high risk due to their low numbers and the low productivity of the freshwater habitat. Estimates of historic Chinook abundances are an average of 26,000 and 13,000 respectively for the North Fork and the South Fork populations. Now, natural-origin Chinook return in the low hundreds, averaging 170 (North/Middle Fork) and 210 (South Fork) fish in recent years.

Both populations are essential to recovery of Puget Sound Chinook not only because they are the only two independent populations left in the northern sub-region of Puget Sound, but also

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because they are two of only six Chinook runs left in Puget Sound that return to their rivers in the spring. Despite their close geographic proximity, the genetic difference separating North/Middle fork fish from South Fork fish is the second largest in the Puget Sound region. Both populations contain wild fish but the North/Middle Fork spawning population contains thousands of hatchery produced recruits which are designed to conserve the genetic composition of the stock while the habitat is restored. The South Fork Chinook supplementation program was terminated in the early 1990's

The North/Middle Fork population spawns in both forks with most fish spawning in the North Fork and its tributaries up to Nooksack Falls, as well as the lower reaches and tributaries of the Middle Fork up to the diversion dam. A small percentage of North Fork fish from the hatchery supplementation program spawn in the South Fork. In recent years approximately ninety percent of the spawners in this population have been returns from the Kendall Hatchery re-building program.

The South Fork population spawns primarily in the mainstem South Fork and its larger tributaries including Hutchinson, Skookum, Deer and Plumbago Creeks. There are concerns that strays from the North Fork hatchery program and late run Chinook production pose a risk to the genetic makeup of the South Fork Chinook. Because the South Fork population is so small, even low stray rates pose a concern. The North Fork supplementation program was modified to reduce straying to the South Fork and the initial results are encouraging. The numbers of late run Chinook in the South Fork have been appreciable in some recent years. The current estimated adult capacity for each population is currently less than 10% of historic levels and returning fish number around 1% of historic levels. The reintroduced fall Chinook run continues to exist in the Nooksack watershed, suggesting that the basin continues to have the capacity to support this life history diversity.

Photo courtesy the Washington State Salmon Recovery Funding Board

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What are the key factors contributing to the current status of the populations?

The Nooksack watershed has a lot of beneficial attributes to support salmon. It is largely a rural watershed with most of the upper portions in national park, national forest or state and private timberland. The middle reaches of the river are predominately rural or in agriculture and the urban portion is a small percentage of the total area, mostly in the lower watershed. The City of Bellingham, developed on the eastern shoreline of Bellingham Bay, but much of the estuary is in comparably good condition.

Despite the relatively low percentage of land that has been urbanized, there have been significant changes. During the early decades of Euro-American settlement, the lowland forests were logged, and wetlands drained for conversion to agriculture. Subsequently, the river and streams were cleared of logs, first for navigation, then to transport wood, and as a result, today we have much less wood. The river was straightened and its banks armored with rock to more efficiently convey floods and control flood damage to property in the floodplain. The diversion dam was built on the Middle Fork to provide water to the City of Bellingham. The Lummi distributary was cut off over a century ago, and the Nooksack delta grew rapidly into northern Bellingham Bay while eastern Bellingham Bay was filled for industrial development. These changes to the land and water processes have significantly diminished the capacity of the watershed to support salmon including Chinook and bull trout in their historic numbers.

The decline of the fish in the Nooksack watershed may also have been affected by past harvest and hatchery practices. Harvest, hatchery and habitat factors all are possibly contributing to current low abundances of Chinook. All of these factors are being addressed to recover the salmon. Habitat degradation from human actions is considered the leading cause for the decline of North and South Fork Chinook.

Both early Chinook populations have similar rearing and spawning habits. Before going out to sea, two-thirds of the early Chinook fish move downstream as sub-yearlings to the estuary and marine environments while the other one-third rear in the river or streams and migrate to sea as yearlings. Their migration patterns make them susceptible to ocean harvest. Upon returning from the ocean, the fish can spend as many as 2-4 months holding in freshwater during the summer months before spawning. Scientists are concerned about negative impacts on fish holding in freshwater prior to spawning because of high water temperatures particularly in the South Fork. Hardening of the riverbanks and the loss of trees along the river edges and on mid-channel islands has caused the channel to change the way it responds to flood events. In some reaches, changes in the channel are thought to increase channel migration rates and bed scour. This disrupts the ability of eggs into the gravel to survive. Stable wood that historically would have been in the river to provide stable islands, maintain deep pools, and protect eggs during flood events is greatly diminished. Recovery is hampered by the limited availability of high quality habitat in the mainstem and forks to support the various salmon life-history stages.

There are seven significant habitat factors limiting the Chinook:

1. Instability of channel in the upper and middle portions the Forks,
2. Increased sediment coming from natural and human causes, and changes in how that sediment is transported through the system,
3. Loss of logs and other structures in the Forks and their tributaries that create pools and rearing places for the fish,
4. Levees and dikes mostly in the South Fork and mainstem that constrain the river and eliminate side channels where fish rear and could seek refuge during floods,
5. Obstructions that block fish from key habitats,

6. Changes in the river flow and temperature. The temperature and low summer/fall flows in the South Fork are viewed as a significant challenge to the long term survival of that population.
7. Changes along marine shorelines in Bellingham Bay and in nearshore areas have affected Nooksack and other Puget Sound populations that use these waters.

The low productivity of the freshwater and estuarine habitats created by these factors makes the fish susceptible to changes in ocean conditions, and the populations more vulnerable to harvest and hatchery practices. The very small South Fork population size and hatchery strays to that fork pose additional threat to the wild run. Also, fishing has the potential to significantly impact, if not wipe out the run if extreme care is not taken.

The most serious threat to bull trout in addition to those listed for Chinook is loss of access to former habitat. Habitat actions targeting recovery of Chinook should also benefit Nooksack bull trout, and the Chilliwack population essentially has pristine habitat in the U.S.

Future Threats

One of the biggest threats to recovery is projected future human population growth and its associated impacts on watershed processes and resources. By 2022, Whatcom County is expected to grow to 261,084 people or 50.5% potentially putting further pressure on the existing habitat. The intent is to direct growth to areas where environmental impacts can be minimized or avoided so that habitat decline does not occur. However, if not properly managed, growth and development will degrade current environmental conditions and offset restoration improvements.

Overall Approach to Recovery

To address the factors affecting the fish, the participating governments of the WRIA 1 Salmonid Recovery Board are building on the knowledge of local scientists and information from past studies to design and implement strategies and actions for the near-term (10 years) and long-term (50 years). Their objectives are to recover the North and South Fork populations to 80 percent of historic numbers and preserve opportunities for a naturally adapted late run population. They believe the actions taken for Chinook recovery will significantly improve conditions for bull trout with the exception of barriers identified in the watershed beyond the extent of the area used by Chinook.

In the short term, increasing the number of fish and their productivity will buffer against extinction. The government leaders are focused on how to improve conditions to support the whole life cycle of the fish as they move out to sea and back into the river system. This approach is guided by scientific assessments of the conditions in each portion of the river from headwaters to Puget Sound. These geographic assessments help determine the relative importance of each area for habitat protection and restoration, and help inform actions that are most urgent for the two populations.

Even though actions are tailored to each geographic area, the two overriding strategies for the short-term are to increase productivity of the two populations by protecting existing areas used by the fish, restoring damaged habitats and habitat forming processes and to immediately increase their numbers through hatchery supplementation. The overall strategy also provides for harvest on late-timed hatchery production and a harvest of up to 10-30 Natural Origin Recruits for ceremonial and subsistence use by the two tribes.

To address the threat of projected human population growth, local governments are committed to implement their growth management programs as required by the State of Washington. Specifically, they will guide the majority of growth into designated urban areas and manage rural development so there are minimal impacts to current habitat conditions.


Photo courtesy the Washington State Salmon Recovery Funding Board

The WRIA 1 Salmonid Recovery Board structured their overall approach into seven key habitat strategies and supporting actions for hatcheries and harvest. The seven habitat strategies described below are solidly built on existing programs. The Board anticipates that focusing efforts in the first ten years on strategies and actions that demonstrate measurable and tangible results will provide a strong foundation on which to build support for the next phase of implementation.

Key Strategies and Actions Supporting the Overall Approach to Recovery

Habitat

1. Remove Significant Barriers to High Quality Habitats:

One of the main habitat strategies for the North/ Middle Fork population removes or addresses barriers, allowing fish use of more high quality habitat. Two significant areas currently cannot be reached. The City of Bellingham diversion dam blocks access to the middle and upper reaches of the Middle Fork Nooksack and Canyon Creek has a recent barrier that has formed near the mouth of the creek after channel modifications to the lower reaches undertaken after the 1989 and 1990 floods. Both of these barriers can be addressed in the next few years. Removal of the Middle Fork dam alone is estimated to contribute to a thirty percent increase in the number of fish, 12% increase in productivity and a 47% increase in the diversity index. The project will also restore use by anadromous bull trout as well as connectivity and gene flow. Improving passage to Canyon Creek will add four miles of important Chinook and bull trout tributary habitat.

2. Restore Habitat in the Forks, Mainstem and Major Tributaries

In the next ten years, the most important and ambitious strategy for both Chinook populations is to restore habitats and habitat-forming processes in the mainstem and three forks. The most dominant factors limiting the populations in these parts of the watershed are: increased sediment from erosion and mass wasting, levees and dikes in the mainstem that constrain the river from creating habitat, channel instability of the Forks, loss of large trees along the rivers and tributaries subsequently limiting shade and wood in the channels that would provide channel stability and complexity for fish.

If the fish are going to recover, more natural conditions are needed in 115 miles of the Nooksack River mainstem and its forks as well as in 90 miles of tributaries and streams. Because the natural processes in the surrounding landscape have been dramatically altered, it will take time before the watershed forest cover and hydrology can be restored and support a functioning system for salmon.

A twofold approach is being pursued. The first part is to ensure fish-friendly timber practices occur on the lands draining to the forks to ensure that the areas influencing salmon and trout recover from past tree cutting and road building. This part of the strategy relies heavily on successful implementation of the Forests and Fish Agreement, the existing federal forest plan, the habitat conservation plan for State timber lands, and efforts by owners of less than 500 acres that are not covered by road maintenance plans under the Forests and Fish Agreement. The approach identifies specific gaps in forest practice rules that are of concern with a commitment to work with the various stakeholders to find solutions that support recovery.

The second part of the strategy is to implement a combination of projects in the river and along the river's edge that provide more immediate benefit to the fish until habitat processes are restored. During the next 10 years, numerous instream logjam structures will be placed in the forks and mainstem to help stabilize the channels, increase pool frequencies and improve adult holding habitat, and to provide immediate improvements to rearing habitat. In addition to the engineered structures, projects will also include riparian tree planting along the banks, removing and setting back levees that constrain the river, and acquisition of key property with unprotected functioning habitats necessary to protect it from development or preserve options for restoration.

Because of the extensive work necessary to stabilize the forks and mainstem, more detailed planning is necessary to increase the certainty of success and to limit any potential short-term detrimental impacts to fish or people. Detailed assessments and plans will be developed starting with the South Fork. By late 2006, a comprehensive plan for the South Fork will be complete. Development of the plan for the South Fork has started and will detail project needs, priorities, sequencing and funding. Assessment is underway for the North Fork, and a similar strategy of reach-scale assessment leading to prioritized projects will be applied to the other two forks while implementation on the South Fork is underway. Prior to sub-basin plan completion small-scale projects, acquisition, and tree planting may be implemented; larger instream projects will wait until the assessments are completed. The projects will result in improved spawning and rearing conditions with long-term significant gains towards the recovery goals.

3. Ensure Floodplain Management Protects and Enhances Fish Habitat

A high percentage of the riverbanks along the mainstem as well as the North and South forks is armored with rock to protect property or roads from erosion and flooding. These same areas are important for fish. Consequently, habitat restoration and floodplain management for property protection must be closely linked to ensure fish and people will benefit in the future.

There are several steps to integrate these two efforts. The County is currently developing hydraulic models and revising their plan for flood hazard reduction of the Nooksack River. This work can be done with the habitat needs identified in this recovery plan for fish. A technical advisory committee will align flood control projects with salmon restoration needs. The habitat restoration priorities will be incorporated into floodplain management operations and projects, which will begin within 3 to 5 years.

As the restoration needs for fish are being integrated with floodplain management, Whatcom County will pursue a significant effort to protect existing river functions. By 2006, the County will map where the river naturally migrates across the floodplain. The Whatcom County Council and Washington Department of Ecology will consider regulations to protect this natural process. Channel migration zones will be set by late 2005 or early 2006, which will influence where and how development and armoring will occur in the floodplain. In ten years, protecting and restoring the river's ability to migrate will begin to improve egg and juvenile survival, and over time significantly enhance the productivity of the lower river.


Photo courtesy the Washington State Salmon Recovery Funding Board

Other parts of the floodplain strategy will include studies for how to manage sediment transport and storage in the river and potentially remove or setback levees, move roads, bridges and pipelines that constrain the river causing both property damage and fish impacts.

4. Protect Good Habitat Through Local Critical Areas Ordinances (CAO) and Shoreline Management Programs (SMP)

Although much of the river has been altered, there are still significant areas that are functioning well for fish. Increased human population growth and development must not degrade these areas from current levels if the restoration plans for the river are to increase the numbers and productivity of the fish.

The County, Bellingham, and other local governments are in the process of updating regulations and incentive programs to improve protection for existing environmental conditions by the end of 2005. The regulations must be periodically updated under state law. Their strategy is to use the salmon recovery plan as best available science to help guide the CAO and SMP update process. Several proposed changes to the CAO include larger buffers on wetlands and streams, prohibition of new permanent structures within the channel migration zone, and establishment of a mitigation program that more effectively reduces impacts from development. Implementation will result in preventing further degradation to riparian zones in the undeveloped areas of Whatcom County and from new permanent structures in the channel migration zone. Specific improvements to the SMP will be developed using habitat priorities identified in the local recovery plan, as well as more detailed assessments of the nearshore being prepared in cooperation with agencies and the Whatcom Marine Resources Committee.

5. Protect and Improve In-Stream Water Flows for Fish

In 1986, the Department of Ecology set instream flows--the minimum flows for given times of the year in local streams and rivers to protect the fish and other aquatic organisms. By setting the flows, future requests for water must ensure they do not negatively impact the flow. However, because the flow was set after water rights had been issued to many property owners, in many instances the flow standards are not met today. Over the last five years, an extensive planning and public effort developed a better understanding of the flows needed for fish and how to achieve them. In addition to water needs for fish, the water needs for agriculture and the growing human populations must also be addressed.

Out of the planning effort, a draft Instream Flow Selection and Adoption Action Plan was developed as part of the WRIA 1 Watershed management Plan and was adopted. The plan outlines a collaborative process for selecting and adopting new flow levels that are based on ecological needs, out of stream needs, and community input.

By the end of 2006, two pilot projects will set flows and actions to achieve them in the Middle Fork and Bertrand Creek. Remaining drainages will have flows and action plans by 2010. This will ensure improvements to stream flows where they are currently limiting the fish, and provide long-term certainty that water will be available for fish and other beneficial uses.

6. Identify Priority Estuarine and Nearshore Areas for Protection and Restoration

Estuaries as well as the nearshore, beaches and shallow waters, provide shelter from predators and food for young salmon and trout as their bodies adapt to saltwater. The fish migrate and feed along these nearshore corridors as they move to open water and then as returning adults they use these same areas to re-acclimate to the freshwater. Forage fish spawning areas are especially important nearshore habitats.

Computer models suggest these areas are vital to Chinook recovery in the Nooksack, especially for the North/Middle and South Fork populations. Because protection and restoration efforts will be expensive, there are several studies underway to assess how fish specifically use the nearshore in Whatcom County, and the quality of habitats and opportunities for restoration. Combined with work by the Bellingham Bay Demonstration Pilot Project, completing these assessments, along with analyzing their results will set a more specific course of action. This work will be integrated with the overall Puget Sound approach to nearshore protection and restoration to ensure priority actions are completed to the benefit of Nooksack populations and other fish using the area.

Some actions are already identified to be implemented. In the next ten years specific actions include;

- Restoring Marietta Slough
- Setting back or altering levees on the left bank of the Nooksack River between Slater Road and Marine Drive to increase floodplain connectivity and available habitat
- Restoring the main channel of the Nooksack River
- Restoring riparian habitats
- Restoring access to side channels isolated by tide gates and levees, and
- Decreasing contaminants in Bellingham Bay and cleaning up contaminated sediments, consistent with the action plan adopted as part of the Pilot Demonstration Project.

7. Restore Conditions in Lowland Tributaries and Independent Tributaries to the Fraser River and Strait of Georgia.

Although habitats in the three forks and mainstem are considered highest priority for recovering the North/Middle and South Fork populations, conditions in the lowland tributaries affect habitat in the mainstem, especially water quality and water quantity. Habitat conditions in the tributaries that drain directly to the Strait of Georgia also influence the function and accessibility of their estuaries to young fish that have recently migrated out of the Nooksack estuary.

The two populations use tributaries in the lower reaches of the Nooksack River and the smaller estuary areas along the shoreline for rearing and refuge. The late-timed Chinook run also uses some of these Strait of Georgia tributaries for spawning. The main strategies in these tributaries are to remove


Photo courtesy the Washington State Salmon Recovery Funding Board

barriers to fish passage, improve and protect riparian conditions, provide adequate instream flow, to enact key actions to comply with stormwater management rules and implement farm conservation plans. Results include the removal or replacement of 50-100 barrier culverts and improved riparian conditions along 20 to 40 miles of stream channel. Implementing these actions will result in access to the full range of historic habitats, restoration of ecological and physical processes in streams, maintenance or improvement of water quality and improved riparian conditions. A county-wide culvert inventory has been completed and priorities are being established for implementation.

Harvest — Strategy and Actions for Recovery

Harvest can impact genetic diversity as well as abundance, spatial structure and productivity. Current exploitation rates from all fisheries have been reduced to at or below 20% since 1996. Productivity and abundance of the Nooksack populations are so low that harvest has the potential to significantly impact recovery because there are fewer fish and each fish produces so few returns.

The harvest strategy for the Nooksack North/Middle Fork and South Fork populations is to limit fishing to levels that will foster recovery as the habitat improves. Working with NOAA Fisheries, the tribes and state will develop an agreed-to rebuilding Recovery Exploitation Rate (RER). In the event that the local, Canadian and Alaska fisheries exceed the RER, then the Tribes and State will encourage the fishery managers to equitably adjust fisheries to meet the recovery objectives of the two listed Chinook populations. The Pacific Salmon Treaty which guides the international harvest expires in 2008, and will be open for new considerations. The State and Tribes will encourage more consideration for the dire condition of the Nooksack populations during the negotiations.

Hatchery — Strategy and Actions for Recovery

Hatcheries play a key role in recovery of both populations. The main issue with the North/Middle Fork population is that the numbers of fish have been so low as to raise significant concerns that extinction could occur. The main strategy for the Kendall Hatchery program is to put enough fish onto the spawning grounds to re-colonize underutilized habitat and increase abundance while not impeding recovery of either of the two populations. The Kendall Hatchery supplementation program has increased abundances and largely maintains the North Fork population and is monitored and adaptively managed to support recovery of both populations. Because the supplementation hatchery program on the North Fork has dramatically increased hatchery origin Chinook, but natural origin fish are only slowly increasing, scientists believe that the main limiting factor for this population is poor habitat.

There are two main hatchery issues for the South Fork population. First, the abundance of the population is so low that extinction is an immediate threat that cannot be adequately addressed through habitat actions. The second is that the timing and location of South Fork spawning first overlaps with the North Fork hatchery fish and then with the abundant late returning fall Chinook. This creates significant competition for space and resources, and the potential for loss of genetic diversity.

There are two main strategies for the South Fork. The first is to maintain this population's genetic diversity by increasing the abundance of the population through the development and implementation of a rebuilding program (Skookum Supplementation Program). The second strategy is to reduce the number of strays into the South Fork from late-run Chinook and from Kendall programs such that over time there is a shift towards a greater proportion of natural spawning South Fork fish compared to hatchery fish from all programs.

Significant progress is poised to occur or has been made to reduce the hatchery impacts on the South Fork. To address the potential strays of late-timed fish in the South Fork several actions are proposed. These include: improving the Lummi Bay facility to attract returning hatchery production, maintain or reduce late-run Chinook releases in the lower river and investigate and implement alternate release strategies to minimize straying potential. All hatchery-origin Chinook are now identifiable with respect to release strategy and location, and this will assist in the adaptive management of all hatchery programs. The North/Middle Fork rebuilding program has recently been significantly downsized to minimize their use of the South Fork for spawning.

The hatchery program for the late-returning Chinook provides necessary opportunities for harvest. The fishery provided by these hatchery fish supports commercial and recreational fisheries. It also provides an important cultural bridge for the tribes until recovery is achieved; the fishery enables them to maintain their cultural and spiritual connection to the fish for now and for future generations.

Results

It is projected that full implementation of the 10 year action plan, and a similar level of effort in the 15 years following, will result in an abundance of 3,283 and 1,562 North/Middle Fork and South Fork fish respectively by 2030. Their respective productivity will increase to 3.4 and 2.9. The WRIA 1 Salmonid Recovery Board through a formalized agreement among the governments has assumed responsibility for implementation, monitoring and adaptive management.

The watershed plan for the Nooksack was reviewed by the Puget Sound Technical Recovery Team (TRT; a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan, but the reviewers felt they merited particular attention to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

This watershed and its two early populations are essential to overall ESU recovery. The Nooksack plan provides a comprehensive approach to address all the major factors affecting the fish. It documents the past studies that form the scientific basis. The additional details called for in the plan must be developed soon to ensure the actions are completed in the most effective manner. With only several hundred fish returning each year, combined with poor habitat conditions, they are at high risk of extinction. Significant improvements are needed in the next ten years if the populations are going to survive. Assuming the actions called for in the plan are implemented, over the long-term it is possible for the two populations to survive. The plan also preserves the opportunity for re-establishing a naturally adapted late-returning Chinook population.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

Habitat, harvest or hatchery management, if not undertaken with care, could unintentionally harm the low numbers of fish. This is particularly true for the South Fork population because of the

Photo courtesy the Washington State Salmon Recovery Funding Board

low abundance, poor habitat conditions and the recent large percentage of hatchery strays. These constraints require special and urgent attention as called for in the plan to establish a brood stock program for the South Fork population. The current high risk for the South Fork population also requires early implementation of actions necessary to monitor the impacts from late-run Chinook and North Fork hatchery programs and reduce impacts where they are deemed significant.

Habitat restoration efforts in the next ten years include extensive placement of log jams including engineered structures in the South Fork while waiting for the natural processes to recover. This strategy is important for improving the productivity of the South Fork in the long term. However, it is essential that the broodstock program be established before major large scale changes are made to the South Fork to improve the overall health of the river.

Protection of functioning habitat is essential to the recovery of the Chinook populations and bull trout. The plan capitalizes on a significant opportunity in the near future- the update of local land use regulations. The recommendations in the plan for protection increase the certainty for the populations. Gathering and using information about the functions of the different portions of the watershed would increase certainty about the effectiveness of protection strategies. It will also be important to closely tie the implementation of protection programs with efforts across Puget Sound that over time should provide a better understanding of the linkage between land use, habitat in the river and the result for fish.

Forestland management is another key factor that affects the degree of certainty in achieving results for fish in this watershed. Protection will require successful implementation of state forest practices laws and the federal Forest Management Plan. However, it is possible that timberland managers could be in compliance with the laws and still negatively affect ecosystem processes. Also, small forest landowners with property under 20 acres do not have to comply with the same buffer requirements of larger timber owners. To ensure protection, the local governments, tribes, state and landowners will have to work together to address their mutual interests for habitat protection and economic benefit. Lastly, the harvest rates from Canadian and Alaskan fisheries are a significant threat to the future of the two populations due to their low abundances and productivity. The rates may preclude recovery and should be reduced if possible. There is an opportunity to reduce these rates in a re-negotiated Pacific Salmon Treaty.

The adaptive management and monitoring program, slated for completion by December 2005, is expected to incorporate measures relating to the issues identified in the results section above.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the proposals above are implemented, this watershed and its two unique Chinook populations will provide a critical contribution to the recovery of Puget Sound Chinook. However, the short-term risks facing these populations are high and this watershed should be a priority for regional monitoring funding and technical assistance to ensure its success.

Watershed Profile:

San Juan

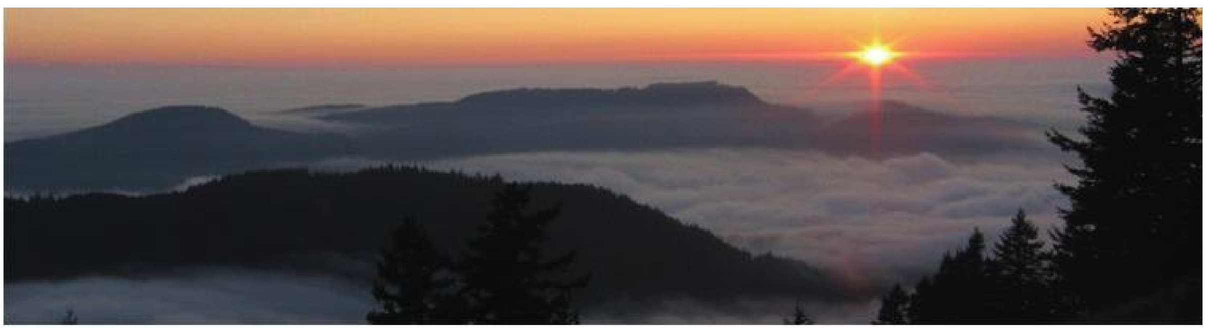

Photo by Levy Sheckler, courtesy the Washington State Department of Community, Trade & Economic Development.

The Place and the People

Located in northern Puget Sound, San Juan County is an archipelago consisting of four major islands – San Juan, Orcas, Lopez and Shaw – and more than 170 smaller islands. The islands are located in the banana belt of the Northwest, so they see the sun 247 days of the year, and average only about 18-28 inches of rain annually. San Juan is the smallest county in Puget Sound but boasts over 408 miles of shoreline, the most of any county in the United States. Despite 80 percent population growth in the last 20 years, the population in the San Juan Islands remains relatively small at just over 14,000. The Islands' rural charm and character attracts tourists from around the world seeking rest and relaxation in the moderate climate and stunning vistas offered throughout the year.

The San Juan Islands are located at the water cross-roads of the Strait of Juan de Fuca, the Strait of Georgia and Puget Sound. Because of their position at the junction of three major water bodies, the waters are rich in nutrients and food for marine organisms. The waters of the San Juan Islands are home to an abundant sea life population. Dall's porpoise, seals, Steller's sea lions, river otters, and a variety of fish including salmon, lingcod and rockfish live in its waters. The most famous residents of these waters are the southern community of Orca Whales and salmon are one of their favorite foods.

For many decades the islands were a rural hideaway for people interested in farming and fishing. But in the last two decades they have been discovered by people interested in investing in vacation homes near the sea. The number of people who live on the islands is small but the San Juans draw thousands of people annually to their shoreline and are the major destination for boaters from Seattle, Victoria and Vancouver. Much of the human activity, living and recreation, is concentrated on the narrow band of land and water at the sea's edge. These same places draw birds and sea life, including salmon on their way out to the ocean and back to their natal streams in Puget Sound.

The people of the San Juan Islands care deeply for their land and water. For several decades there have been active groups promoting conservation of the islands through private, local and state government efforts. In 1999, 73 percent of county voters renewed the San Juan Land Bank for an additional 12 years to continue its mission of preserving the Islands' natural heritage for present and future generations. Created in 1990, The Land Bank is funded by a one percent real estate tax on property purchases in the county.

The Salmon Recovery Plan for the San Juan Islands was developed initially by the Lead Entity Citizen's Committee facilitated by the San Juan Conservation District. The Lead Entity is part of the state-wide voluntary salmon protection and restoration process created by the 1999 Salmon Act (HB2496). Part way through plan development, the Lead Entity responsibility changed to San Juan County and the Marine Resources Committee (MRC). They were responsible for the final changes to the document. Both committees are a mixture of scientists, citizens and stakeholders. The San Juan County Board of Commissioners supports the development of the plan.

The Salmon

All twenty-two populations of Puget Sound Chinook salmon use this area for feeding on their way out to sea and on their return. This makes the San Juan waters and shoreline areas an essential part of the larger picture for salmon recovery in Puget Sound. Multiple species of salmon from other watersheds use the islands during different stages of their life cycle, although there are no known natural Chinook spawning areas in the islands. Salmon arrive at the archipelago as juveniles after first spending time in the estuary of their natal river and nearby marine shorelines. At this stage in their life cycle, they are larger in size and therefore feeding on larger prey and ranging to greater depths. Maintaining the food web around the islands is critical to the salmon.

Goals

The goal in the San Juan Islands is to sustain the environmental conditions that ensure the continued existence of wild salmon. This goal will be achieved by protecting existing freshwater and saltwater habitats and processes and restoring nearshore habitats to meet the needs of fish.

The County, MRC and others believe that an ecosystem approach is the best way to ensure the ultimate recovery of salmon populations in the Puget Sound and their goal and strategies reflect this approach.

Objectives supporting the goal

- Protect and restore the ecosystem processes that support marine biological diversity;
- Prevent further reductions in marine populations in the islands and promote recovery of depleted populations;
- Promote scientific research toward improving the understanding of ecological systems and processes necessary to sustain marine biological diversity;
- Promote increased education and awareness of the relationships between human uses and marine resource quality; and
- Restore spawning habitat in the islands.

What is the current status of the threatened salmon populations?

Natural-origin Puget Sound Chinook are at approximately 10% of their historic abundance.

What are the key factors contributing to the current status of the populations?

The major contribution San Juan County offers Puget Sound salmon recovery efforts is


San Juan Islands
Salmon Recovery Planning Area
Waldron Island
Orcas
Island
San Juan
Island
Shaw Island
Lopez
Island
Decatur Island
Land Ownership
Federal Conservation Lands
Other Federal Lands
State Conservation Lands
State Trust Forest Lands
County & Municipal Conservation Lands
Private Conservation Lands
Native American Tribal Lands
Land Cover - Land Use
Commercial & Residential Uses
Agricultural Uses
Disturbed Lands
Freshwater Wetlands
Undeveloped Uplands
Interstate Highways
State & US Highways
Secondary Roads
County Boundaries
Rivers, Lakes, Streams and Estuaries
Land ownership data has been overlaid on land cover / land use data to provide a useful context to communicate relative protection. Land cover / land use classification was derived from the USGS National Land Cover Database (1991). Land ownership was derived from the Washington Protected Lands Database (2003).

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high-quality habitat critical to salmon and their prey such as eelgrass meadows, kelp beds and tidal marshes. Nearshore habitats around the San Juan Islands are generally considered healthy and are assumed to perform the functions needed to support fish populations. Some losses have occurred, however, as nearshore areas have been affected by human uses of the shorelines and the lands above them; these losses warrant consideration for restoration. Most land and shoreline development occurs through incremental single-family residential development and the magnitude of impacts may become evident only cumulatively.

The San Juan Islands have one of the highest projected growth rates in Puget Sound at 35% over the next twenty years and most of the undeveloped parcels of land in the Islands are along their shorelines. Therefore, acting now to protect nearshore-marine habitat is important, as is educating property owners about salmon-friendly alternatives for shoreline development or modification.

Of 90 freshwater streams on the Islands, fewer than a dozen of them offer access to salmon. Nevertheless, the Islands' healthy shoreline habitat is used for refuge, rest and feeding by threatened Chinook and other salmon species from throughout Puget Sound, the Columbia River and British Columbia.

The islands' beaches are believed to be at historic levels and still provide eelgrass meadows, kelp beds and tidal marshes. Many of these beaches provide critical spawning habitat for forage fish such as sand lance and surf smelt. Forage fishes are a major food source for salmon. Overall only 5% (19 miles) of San Juan County's soft shore beaches have been modified by bulkheads. Most of the shoreline in San Juan County is already naturally hardened. Thus, the impact of bulkheads on the few miles of beaches and bays has the potential to be significant.

Even though the San Juan Islands likely provide a high degree of functioning habitats and processes there are still opportunities for improvement. These are noted below.

Tidal marshes

27 pocket estuaries have been identified with 11 noted as being at-risk from degradation due to development that alters freshwater inputs. Additionally, linear amounts of existing mixed and low marsh habitats have been identified. They are further defined as either continuous or patchy to assist in developing protection and restoration strategies.

Inter-and sub-tidal flats

Streams provide the sediment that sustains inter- and sub-tidal habitat areas. Marine currents and waves work in concert with stream flow dynamics to distribute and rework sediments, exerting primary control over the biological community on the flats. Salmon use these areas based on a seasonal shift in prey species abundance. Protection concerns are linked to road construction and residential development impacts that potentially lead to degradation in water quality and/or shifts in the sediment regime or wave and current action.

Eelgrass meadows

Recent assessments have been conducted to document existing eelgrass meadows. Eelgrass exists along approximately 20% of San Juan County shorelines in addition to significant meadows located in the bays. Historic conditions are unknown, but it is believed that historic coverage may have extended to most areas with shallow water and suitable substrates. Disturbances such as over-water structures, bulkheads, moorages, prop scour and dredging and filling are factors believed to contribute to eelgrass loss. Significant losses have occurred in Westcott Bay. Studies are currently being conducted in this area to understand what factors are causing the loss. Documentation of where these areas exist has been provided to state and local agencies for consideration during permitting. Losses have also been noted at 11 other shallow bays in San Juan

Photo courtesy the Washington State Salmon Recovery Funding Board

County, and research and additional mapping efforts are underway.

Kelp

Kelp beds are an important part of the overall marine ecosystem. Throughout the county, kelp beds near the shoreline have been mapped through the Washington State ShoreZone Inventory process. The Washington Department of Natural Resources mapped offshore kelp beds in the eastern half of San Juan County in the summer of 2004; Friends of the San Juan Islands in support of the Marine Resources Committee are seeking funding to complete mapping in the western half of the County this year. It is assumed identified kelp beds are now protected through existing regulations.

Forage Fish spawning: 80 miles of potential forage fish spawning beaches have been identified though less than 20% of suitable beach habitat actually supports spawning. Currently there are 63 documented surf smelt and sand lance spawning sites scattered throughout the Islands. Roads (14 miles) along the backshore and bulkheads (85) exist which potentially impact the ability of these areas to function for spawning. There are four high priority spawning habitat areas for forage fish. These are Westcott Bay on San Juan Island, the West Sound and Blind Bay regions on Orcas and Shaw Islands, the Mud/Hunter Bay region on Lopez Island and the Mackaye Harbor region also on Lopez.

The San Juan Islands have had and continue to have high quality clean water. Increased development and pressures from recreation however, pose a future threat to maintaining this asset. The most significant current threats to water quality are from stormwater run-off, small cities, septic systems, increased sediment and nutrients. The strategy is to incorporate salmon specific information into existing protection programs in order to improve the effectiveness of the programs to protect the fish.

Five percent of the county's shorelines are fully protected and 26 percent partially protected. Several of the islands are state parks and large tracts on many of the islands have been permanently protected. The San Juan Preservation Trust and the San Juan County Land Bank have purchased conservation easements or bought outright key shoreline habitat areas. These purchases will help protect or restore natural ecological processes that in turn will benefit salmon. Over 12 miles of forage fish spawning habitat are protected under state code. San Juan County's shorelines support eelgrass meadows, a critical habitat, also protected under state 'no net loss' regulations.

Overall Approach to Recovery

The San Juan Islands' Plan is based on an ecological process-based approach that links upland, shoreline and marine areas. The plan recommends protection and restoration strategies based upon initial hypotheses about potential fish use. Strategies are clustered by geographic area (island and adjacent marine water clusters) to aid in implementation. Details for specific actions will be completed in 2006. These strategies aim to protect factors they have identified as important and ultimately develop restoration priorities. Habitats and habitat-forming processes important to protect include: sediment transport processes and features (banks and bluffs), freshwater inputs, eelgrass meadows, tidal marshes and sand spits, beaches and backshore areas, water quality, forage fish spawning beaches, and kelp beds. The plan also recognizes the threat of catastrophic events and loss of nearshore functions and features due to cumulative impacts of development and land-use. It is assumed harvest and hatchery management are addressed regionally through existing management structures.

Key Strategies and Actions Supporting the Overall Approach to Recovery

The main habitat strategy is to improve protection of habitat functions and processes through better mapping and monitoring existing features such as sediment, water quality, eelgrass, tidal marshes, riparian areas and kelp beds. Various state and local agencies, such as the Department of Fish and Wildlife and San Juan County, will be able to use this information when permits are issued or future land-use decisions are made. Government agencies and non-governmental organizations can apply this information when they decide which areas to focus their protection and restoration efforts. This strategy has been advanced by recent efforts to bring together land use managers, regulatory agencies, conservation groups and scientists to share their knowledge of the environmental conditions and coordinate protection efforts. The County also plans to use the latest scientific information as it evaluates and updates its Growth Management programs and Shoreline regulations.

Photo courtesy the Washington State Salmon Recovery Funding Board

Another main approach is to provide information to citizens tailored to the type of land that they own. The information will describe what they can do on their land to support functioning nearshore conditions. The County is also considering a tax incentives program for property owners.

There continue to be significant data gaps about how salmon use the habitat around the San Juan Islands. Where protection and restoration strategies are limited by a lack of knowledge, research, further analysis and development of strategies and actions will fill the gaps. This includes the current known need to improve and refine protection and restoration strategies.

The San Juan County Board of Commissioners is pursuing ways to meet the needs identified in the salmon recovery plan. The first step has been to assume the Lead Entity responsibility from the San Juan Conservation District. The County also created a position dedicated to ensuring that human population growth in the County occurs in a manner that protects existing habitats and functions and contributes to recovery of the Chinook Evolutionarily Significant Unit.

Results

The watershed plan for the San Juan Islands was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan to some extent, but the reviewers felt they merited particular attention or additional effort to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties,

proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

Photo courtesy the Washington State Salmon Recovery Funding Board

The watershed plan takes an ecological process based approach to identifying the important functions for fish and the processes that create the habitats that they use. The high quality of current environmental conditions and the focus on protection through a variety of programs provides the region with certainty that ESU recovery can count on continued environmental quality in the San Juan Islands.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

The planned strategies and actions will need to be linked to results for fish, the Viable Salmonid Parameters (VSP; abundance, productivity, spatial distribution diversity) to describe the expected outcomes from plan implementation. Once the linkage between the ecosystem principles, stressors, and geographic priorities are linked to VSP, then these four parameters can be used as a measure for monitoring.

The adaptive management and monitoring program, slated for completion by December 2005, is expected to incorporate measures relating to assessing the effectiveness of protection measures to help salmon.

The plan wisely identifies implementing protection measures as part of their approach to salmon recovery. The certainty of the plan's effectiveness will be increased as San Juan County works to identify specific areas within the County where such protection measures should have highest priority. Linking such a strategy back to the hypotheses for what habitat factors are limiting salmon will strengthen the plan's outcomes.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore

strategies and actions with the regional nearshore chapter,

- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the proposals in the plan are implemented, and the above uncertainties are addressed, this watershed will provide a critical contribution to the recovery of Puget Sound Chinook.

Watershed Profile:

Skagit

The Place and the People

The Skagit is the largest drainage that flows into Puget Sound and the third largest river on the West Coast of the continental United States. It contains the largest and healthiest runs of wild Chinook and pink salmon in Puget Sound and is home to all six species of Pacific salmon, including steelhead.

The 3,100-square mile Skagit River watershed runs for 125 miles from the Cascades of British Columbia, Canada, into the state of Washington, and drains into Puget Sound, 60 miles north of Seattle. The upper half of the watershed is primarily within Mount Baker-Snoqualmie National Forest and North Cascades National Park.

The Upper Skagit combines with the Sauk/Suiattle river system just above Concrete. The upper elevations of these watersheds, most of which are already in designated wilderness, provide critical habitat for species such as king fishers, grizzly bears, and wolves. The wetlands adjacent to these rivers support the globally rare Salish sucker, juvenile salmon, and amphibian breeding sites. The riparian and conifer forests provide habitat for migrant birds, many of which are undergoing population declines in the Pacific Northwest. The Upper Skagit,

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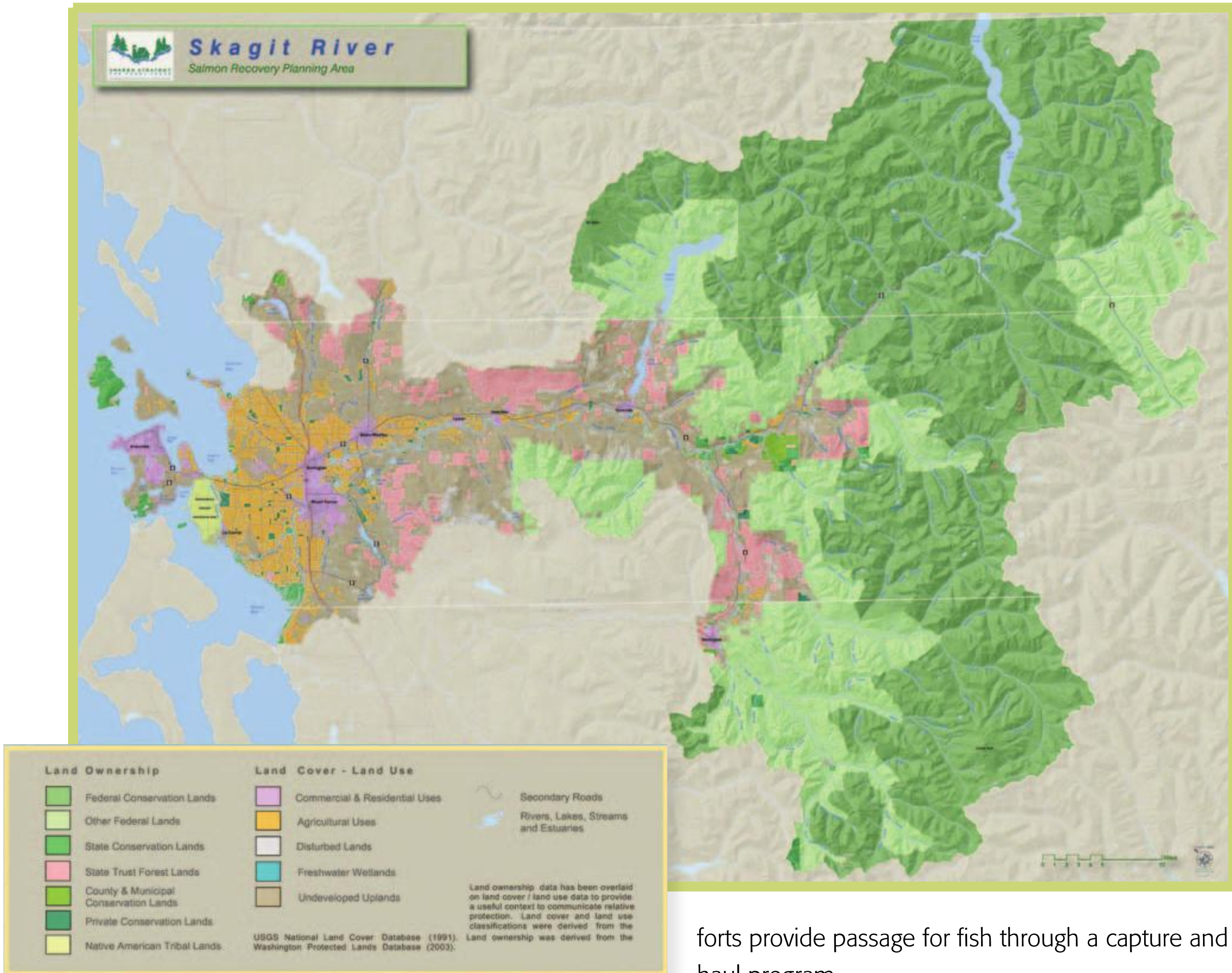

Sauk and Suiattle rivers are designated as Wild and Scenic, and the Sauk River is one of the largest un-dammed river systems remaining in the Pacific Northwest. The Skagit River Valley is a favored wintering area for bald eagles. This impressive gathering of bald eagles, one of the four largest in the contiguous 48 states, coincides with the spawning of chum salmon.

The Upper Skagit River is also home to the region's only major complex of dams, which are built near the upstream extent of previously-documented anadromous use. These dams — Diablo, Ross and Gorge — supply about 25 percent of Seattle's power demands. The Baker River, a tributary to the Skagit, also has two dams. These dams created barriers for Chinook and sockeye runs. Current efforts provide passage for fish through a capture and haul program.

The mainstem of the Skagit flows for miles through forest and agricultural lands that are dotted with small towns and individual residences. Most of the 104,000 people of Skagit County live and work in the lower mainstem areas where the river flows by Sedro-Woolley and then separates the rapidly growing cities of Burlington and Mount Vernon.

Interstate-5 transects the lower watershed where the floodplain landscape transitions into the vast Skagit Delta. Just below Mount Vernon and the interstate, the mainstem splits into the North and South fork at the beginning of Fir Island. Where the Forks of the river split, Fir Island begins. The North Fork of the Skagit drains into Skagit Bay south of La Conner and the South Fork empties into Skagit Bay just north of Camano Island.

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The native people developed their culture based on the seasonal abundance of the land and sea. This relationship grew for centuries, resulting in a harmony with their surroundings. They thrived until white settlers came to the region bringing with them illnesses that devastated the local tribes. Today, the Native Americans are a small percentage of their original numbers. They are organized in three recognized tribes with treaty fishing rights; Swinomish, Upper Skagit and Sauk-Suiattle. Harvesting the bounty from the Skagit watershed continues to be a fundamental cultural tradition and economic resource for the tribes. However, as these natural resources have declined, they have broadened their economic pursuits to survive.

Since white settlers first arrived in the 1850s, the Skagit River has experienced a constant rush of development. Miners burrowed into the ground and worked the river looking for gold. Loggers cut old-growth pine and Douglas fir and sent the timber downriver. Along the river delta, railroad companies leveled and filled the landscape to place tracks to carry the logs. Farmers diked and drained the land so they could plant on the rich arable soils of the delta.

Today the Skagit Delta is a highly productive farming region, producing everything from tulips to rutabagas. A 2001 study estimated the region generates $262 million in crops and a total of $500 million in economic activity, including recreation.

Photo by Dan Kowalski

While 700 generational farms utilize 90,000 acres of the lower watershed, there's increasing pressure for residential development, too. The rich soils of the river's broad delta support the region's most productive farmlands appreciated not only for their crops of berries, potatoes, and organic vegetables, but especially renowned for their bright fields of daffodils and tulips.

Today, even with the dramatic changes to the landscape, there remains a significant amount of ecological function. This area currently contains large concentrations of wintering waterfowl, shorebirds, and raptors. A significant portion of an entire Trumpeter Swan population winters at the site, as well as the entire gray-bellied Brant population. Birdwatchers are known to screech on their brakes in early spring to catch the inspiring sight of hundreds of snow geese rising off the fields in a graceful wave and settling down again a few feet away.

Photo by Dan Kowalski

These estuarine and intertidal ecosystems of the delta also play a fundamental role in salmon health, and the river's aquatic resources have suffered amid this rapid development of the Pacific coast. Studies now show that roughly 72 percent of historic tidal marsh habitat in the delta has disappeared since settlement. The Skagit Chinook populations of today are much less abundant and productive than their historic counterparts. These changes

Photo courtesy the Washington State Salmon Recovery Funding Board

occurred for many reasons and across many sectors.

The people of the Skagit care deeply about their place. This is reflected in the numerous farm organizations supporting the local agricultural community and the strong advocacy of the tribes and numerous others supporting the protection and restoration of the river for salmon and other species. Both the tribes and the farmers have a long history in the Skagit, Tribes for many centuries and farmers for many generations. It is a place where the people are connected to the land and water through their history and their daily lives. Because of its regional and national importance for fish and wildlife, and natural beauty, the Skagit is also a place that receives much attention from national organizations.

In the mid-1990s the broad interest in the salmon was focused through the creation of the Skagit Watershed Council. The Skagit Watershed Council (Watershed Council) is "a community partnership for salmon restoration" of over 40 diverse organizations, dedicated to voluntary protection and restoration measures that foster natural landscape processes that sustain salmon and aquatic resources. Members of the Watershed Council have completed restoration projects for tributary streams, sloughs, and floodplains in the delta and upstream; fish monitoring programs that focus on juvenile salmon, abundance of prey, vegetation and river channel form; acquisition of land and conservation easements; sediment reduction from roads through culvert placement; invasive species management; and feasibility studies and assessments.

The collective efforts of the members of the Watershed Council, the tribes, farm groups and Skagit County have combined to implement numerous restoration projects to improve the conditions for salmon. The strong interests in the Skagit have also brought conflict between those who advocate for farming and those who advocate for the fish. However, in the last couple of years, leadership from both groups is finding ways to work together and develop solutions to meet their mutual interests.

The 2005 Skagit Chinook Recovery Plan was developed by the Swinomish Indian Tribal Community, the Sauk-Suiattle Indian Tribe, and the Washington State Department of Fish and Wildlife (WDFW). This plan is summarized in the following sections of the profile. The Tribes and State hope to engage local groups and individuals to improve the plan and gain commitments for implementation to recover the salmon. They see the Skagit Plan as one pathway to achieve recovery goals but recognize the complexities of implementing recovery actions and the importance of securing support from a host of stakeholders. They welcome the views of others and seek to engage others in exploring methods that address the conditions necessary for the recovery of Chinook

Skagit Salmon

Ten anadromous fish species exist within the Skagit Basin. These include Chinook salmon (with six populations); pink salmon; chum; coho; sockeye; summer and winter run steelhead; sea run cutthroat trout; and Dolly Varden and bull trout. The six Chinook populations are the focus of this recovery plan but improvements for Chinook populations are anticipated to benefit other salmon species as well. These populations include: Lower Skagit, Upper Skagit, Lower Sauk, Upper Sauk, Cascade, and the Suiattle. The Upper Cascade, Suiattle and Upper Sauk populations comprise the Spring Management Unit. The Upper and Lower Skagit and Lower Sauk populations comprise the Fall/Summer Management Unit.

The six populations of Chinook use different parts of the river for spawning and some of their rearing. Lower Skagit mostly spawn in October in the Skagit mainstem and tributaries below the Sauk River, primarily between the Sauk and Sedro Woolley. Upper Skagit are those Chinook that spawn in the Skagit mainstem and its tributaries upstream of the Sauk River primarily from September through early October. The Lower Sauk spawn from September through early October in the Sauk mainstem and its tributaries (except the Suiattle) mostly between Darrington and the mouth of the Sauk. Upper Sauk spawn from late July through early September mostly between the mouth of the Whitechuck River and the confluence of the North and Sound Forks. Suiattle spawn from July through early September in the tributaries to the Suiattle River. Upper Cascade spawn in the Cascade River and its larger tributaries upstream of the canyon, beginning at river mile 7.8.

Recovery Goals

The goal of the plan as established by a 1994 Memorandum of Understanding between the Skagit Tribes and the WDFW is to restore Skagit Chinook to optimum levels. Optimum levels are defined as:

1. Levels that provide sufficient harvestable Chinook salmon to the tribes and the State to meet incidental harvest needs;
2. Provide meaningful directed harvests at levels consistent with treaty-reserved fishing rights; and
3. Meet Treaty/Non-treaty allocation objectives while protecting and enhancing the diversity, abundance, and productivity of wild Skagit Chinook and their ecosystems.

		Current	Recovered			
Management Unit	Population	Recent 3-year Average	Low	Recruits/ Spawner	High	Recruits/ Spawner
Skagit Spring Management Unit		1,120	1,200	3.0	4,800	1.0
	Upper Cascade	330	290	3.0	1,160	1.0
	Suiattle	420	160	2.8	610	1.0
	Upper Sauk	370	750	3.0	3,030	1.0
Summer/Fall Management Unit		11,900	10,630	3.5	47,630	1.0
	Lower Skagit	2,300	3,900	3.0	15,800	1.0
	Upper Skagit	8,920	5,380	3.8	26,000	1.0
	Lower Sauk	660	1,400	3.0	5,580	1.0

In calculating the quantified representation of this goal, the co-managers recognize the significant difference between years of high and low marine productivity which over the last 30 years has varied by a factor of three. The goals set forth by the co-managers are consistent with the range described by the Technical Recovery Team as necessary for sustaining viable populations.

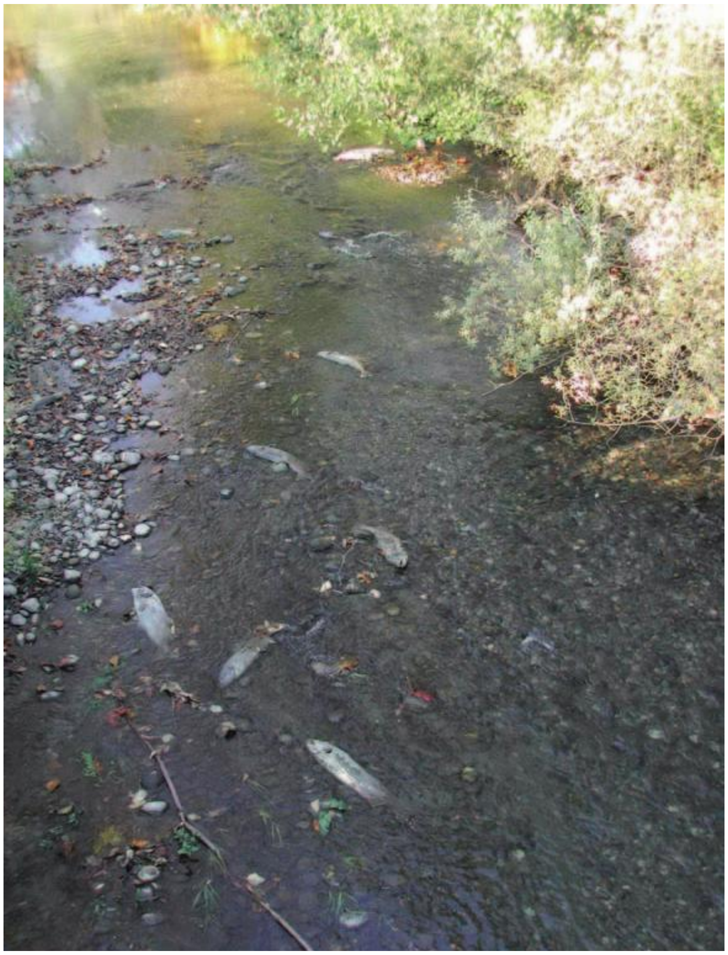
Photo courtesy the Washington State Salmon Recovery Funding Board

The goals were affirmed again as part of the Shared Strategy process in March 14, 2002 in a letter from the co-managers. These goals, which apply to 1990's average marine survival, and would be adjusted for natural fluctuations in marine survival, are in the table below. The populations are clustered by Management Units. The cumulative total for the three populations within each management unit is also provided.

The goal for diversity and spatial structure is to preserve the diversity of habitats and life history strategies that support Chinook salmon viability and production.

Harvest and Hatchery

The Skagit Tribes also specifically quantified annual terminal harvest goals as:

Near-term: 500 springs and 20,000 summer/falls

Longer-term: 1,000 springs and 30,000 summer/falls

What is the current status of the Threatened Salmon populations?

Skagit Chinook populations have been on a long decline over the last century. This is demonstrated by the significant declines in harvest from 40,000-50,000 in the 1930's to only a few hundred in the 1990s. The productivity of the populations has been less than one for the last twenty years, meaning that the returning fish number less than their parents. Recently, although the number of fish spawning in the river has been relatively stable, the number of juveniles produced by these spawners has been dropping, indicating there may be a significant recent loss in the ability of the habitat to allow for egg and juvenile survival.

What are the factors that are currently affecting the populations?

The Skagit River system still retains a significant amount of ecological and biological function. It is due to the significant amount of remaining habitat complexity, intact process function and high quality habitat that the Skagit has the most robust populations in Puget Sound. Nevertheless, the populations are at less than fifty percent of their historic abundance.

The Skagit recovery plan thus lists a number of factors limiting Chinook production based on results of decades of research, monitoring, and analysis. They did not consider the ocean a limiting factor but evaluated results based on favorable, unfavorable and worst case ocean conditions. Factors identified as limiting recovery are (1) seeding levels (density of spawners and juveniles), (2) degraded riparian zones, (3) poaching, (4) current hydroelectric operations, (5) sedimentation and mass wasting, (6) flooding, (7) high water temperatures, (8) hydromodification, (9) water withdrawals, (10) loss of delta habitat and connectivity, 11) loss of pocket estuaries and connectivity, and (12) illegal habitat degradation.

Estuary rearing is considered to be the most significant bottleneck at the current time. It is likely that there is competition for rearing space between the different populations and that habitat capacity is limiting for fish that rear in Skagit Bay, the delta and pocket estuaries.

Habitat

The main factors that limit Chinook production are:

Under seeding: Lower Sauk, Upper Sauk, and Upper Cascade populations may have less spawners than the habitat could support, but that is indeterminate at this time. The plan acknowledges that, if seeding level is a constraint, it is possible to address this through habitat, harvest or hatchery actions. The plan proposes addressing this factor through a combination of harvest actions and habitat improvements directed at survival. Hatchery supplementation is another option but is not being pursued in the Skagit at this time.

Riparian: Assessments have been completed for each Watershed Analysis Unit (WAU) and linked to the populations which are affected. The Lower Skagit, Upper Skagit, and Suiattle rivers all have significant riparian degradation. The areas which support spawning and early rearing for these respective populations are roughly 38-75% degraded. The Lower Sauk is heavily degraded in some areas and has areas of good function in others. The Upper Sauk has a more consistent level of moderate degradation. The Upper Cascade has good riparian habitat.

Poaching: The Suiattle population appears to be the hardest hit by poaching activities. After a crackdown on poaching in 1995, escapement of this population increased immediately from 200 fish per year to 450 fish. As poaching is an illegal activity, estimates of its impact are hard to determine. However estimates are that illegal harvest may account for 10-50% of the returns for the Suiattle population in some years. The other populations are also believed to be affected by poaching.

Dam operations: Significant improvements to mainstem dam operations have occurred over the last decade. Issues like the de-watering of Chinook redds have largely been addressed by the mainstem Skagit dams. Nevertheless, the construction of the Baker Lake dam caused a loss of approximately 60 miles of Chinook habitat and this and other impacts from the dams still need to be addressed. The Baker River dam mostly impacts Lower Skagit population but can influence all populations as they migrate and rear.

Sedimentation and mass wasting: The primary causes of human-caused sedimentation are road failures and clear-cutting. These human-induced events build on already high natural sedimentation levels in the Sauk-Suiattle Rivers from glacial run-off. Sediment budgets show current levels are higher than historic levels and are contributing to both the scouring and filling of the channel. The Lower Skagit Fall population is the worst in the system for incubation survival, while the Upper Skagit population is relatively good. The Lower and Upper Sauk populations are impaired by high sediment loads. The Suiattle system is largely pristine except there

Photo courtesy the Washington State Salmon Recovery Funding Board is one area which, due to geological instability combined with clearcuts, has significantly impacted incubation survival. Upper Cascade population currently has good incubation survival, though several roads have the potential to fail and cause serious problems. The Upper Cascade population faces high sedimentation levels downstream that may limit their rearing success.

Flooding: The greatest impact on egg-to-fry survival is flooding during egg incubation. Severe floods (15-20 year events) reduce survival by 75-80% when compared to 1 year flooding events. Ten year events reduce survival by 33%. In the Skagit, flood events are increasing in frequency and magnitude, which has serious impacts on survival. Flood events are especially severe in the Lower Skagit where the full brunt of a flood must be absorbed. Lower Skagit impacts are further magnified by increased impervious surfaces, land clearing and drainage networks that contribute to increased flows. Upper Cascade, Suiattle, and the Upper Sauk are all considered to be hydrologically functioning areas. Even though the Lower Skagit populations are hit hard with flood events, it is the Lower Sauk population that appears to suffer the greatest losses.

High water temperatures: High temperatures are caused by removal of riparian areas and reductions in stream flow. Eleven of the Lower Skagit tributaries are currently on the State's 303 (d) list. Four of these are known to significantly impact Chinook production.

Hydromodification: Hydromodification occurs in many parts of the Skagit system, though the Lower Sauk, the Lower Skagit mainstem and the delta have experienced the greatest loss. The Lower Skagit for instance has lost 60% of its natural banks and off-channel areas. Research has shown that the Sauk sub-yearlings use natural banks five times as much as hardened banks. Further upstream, the Sauk remains a highly dynamic system with hydromodification occurring in only a few specific locations. The Cascade system remains unmodified. The Suiattle system has four spots identified as issues necessary to address.

Water withdrawals: Existing flows are often below optimum levels for Chinook and increasing pressures for withdrawals are high. The Lower Skagit population is most impacted by low flows. Further increases in withdrawals would likely affect Upper Skagit and Sauk populations.

Loss of delta habitat: Habitat loss in the delta areas has been significant over the last two centuries. 87.7 percent of delta channel edges and blind channel habitats have been lost with a 73 percent overall loss of delta area. Most of the remaining habitat is on Fir Island with a fringe of estuarine habitats that extend from La Conner to the north end of Camano Island.

Loss of pocket estuary habitat and connectivity: Whidbey Basin plays a key role in supporting juveniles that have recently left the Skagit River system. Unfortunately there has been an 80 percent net reduction in pocket estuary habitats in this area that are used by Chinook. For the pocket estuaries that serve the greatest number of fish, those in close proximity to the delta, the loss is even higher at 86 percent. Studies show that increases in connectivity between habitats in the delta and adjacent shorelines corresponds to increased Chinook abundances and is correlated to higher growth rates and lower predation.

Availability of prey species: It is unknown at this time if forage fish production in Puget Sound is sufficient to support populations.

Illegal habitat destruction and degradation: Illegal actions occur that result in habitat destruction and degradation. Individual actions can cause significant impacts to the populations and also the cumulative impact of multiple actions is destructive to recovery efforts over time.

High seas survival: Ocean conditions significantly alter survival of populations. Good marine survival (estuary through return spawners) is approximately 1.5 percent and during low survival conditions can drop as low as 0.5 percent.

The following issues are not currently considered to be limiting: hatchery fish predation in rivers, river temperatures during incubation (dam-caused changes), small hydro impacts, nutrient/carcass/productivity levels, bird predation, competition/predation by other fish, disease, hatchery fish predation and competition in the estuary and Whidbey Basin, and marine mammal predation.


Photo courtesy the Washington State Salmon Recovery Funding Board

Harvest and Hatchery

Harvest rates have been reduced, in accordance with the Comprehensive Management Plan for Puget Sound Chinook: Harvest Management Component, to levels that should not impede recovery. Similarly, hatchery practices have been modified, in accordance with the Hatchery 4(d) rule and HSRG recommendations, so as to minimize impacts on wild Chinook. Consequently, by adhering to these plans, neither harvest nor hatchery practices are considered to be key limiting factors at this time.

Overall Approach to Recovery

The Skagit Plan proposes actions that if implemented would meet the recovery goals established by the co-managers for each of the six populations of Chinook. The plan is based on empirical data collected over the past 15 years. The foundation of the approach is the identification of the factors that are limiting the population at each step in their lifecycle and management tools (harvest, hatchery or habitat) that could be applied to resolve the issue. Harvest and hatchery management plans have already been developed which contribute to salmon recovery. The main approach was thus to create a comprehensive habitat program which could complement the harvest and hatchery efforts already underway and show how the programs act in concert for recovery.

The overarching habitat strategy is to approach protection and restoration of the system from a process-based and landscape scale. Within this context, a life cycle model was used to systematically and scientifically determine the actions most important for recovery of all six populations. Actions are provided at the largest scale possible and are designed to protect and restore processes.

Four different juvenile Chinook life history strategies have been identified in the Skagit; yearlings, parr migrants, tidal delta rearing migrants and fry migrants. Because of differences in habitat use, yearlings and parr migrants depend more on abundant and high quality freshwater habitat while tidal delta rearing migrants and fry migrants depend more on estuarine habitats (tidal delta and pocket estuaries). This difference in habitat use by individual life history strategies helps shape the habitat recovery actions proposed in the plan. Habitat recovery actions are proposed that benefit each life history strategy in an effort to maintain and strengthen diversity of Skagit Chinook as well as their abundance, productivity and spatial structure.

Successful recovery depends on the ability to produce an overall gain in the factors which support viable populations. The plan proposes actions that if implemented are intended to protect the existing

Photo by Dan Kowalski

it pertains to salmon recovery ultimately rests with every landowner and permitting authority charged with making decisions regarding how a piece of land will be developed and managed. The ability to reach recovery is based on taking the appropriate steps towards restoration while not reducing the current productivity of the system. Therefore the plan provides recommendations regarding those measures necessary to ensure that there will be no loss of productivity and that current habitat conditions for the fish not worsen.

level of production. If current conditions do not degrade then the restoration efforts will be able to more effectively increase the productivity of habitat in the watershed and the six populations.

In regard to habitat restoration, the plan proposes a diversified approach to recover wild Chinook populations based on the current limits they face. The restoration efforts ensure the most certainty for recovery and that there is no undue burden on any specific land use or governmental jurisdiction. The balanced portfolio of actions is comprised of identified opportunities across the basin.

Key Strategies and Actions supporting the overall approach to recovery

The plan lays out recovery actions as follows:

- Habitat protection
- Habitat restoration
- Harvest management
- Artificial production
- Research and monitoring

Actions proposed in these areas are modeled to bring all six populations to a recovered state.

Habitat Protection and Restoration

The plan recognizes that authority and responsibility for habitat protection and restoration as

Protection strategies focus on stream flows, basin hydrology, water and sediment quality and sediment transport, stream channel complexity, riparian areas and wetlands, tidal delta areas and nearshore, fish passage and access. Their strategy depends on adoption of adequate regulatory safeguards, vigorous enforcement of regulations, adequate incentives to promote voluntary protection, local planning that incorporates the needs of salmon in planning processes, and a desire on the part of the public and elected officials to provide for those habitat elements necessary to sustain recovered salmon populations. In the face of rapid growth, ongoing monitoring to determine the actual results of protection efforts is noted as critical. The co-managers will seek commitments for implementation of their proposed protection strategy or engage in discussions about alternative solutions.

The restoration strategy assumes that fish respond differently to restoration in some areas. Thus, all areas are not treated equally in their ability to show gains in fish productivity. The relative importance of a restoration action is determined based on the degree to which it restores landscape conditions in the basin and thus contributes to the long-term recovery of one or more populations. Each life cycle stage has its own restoration strategy. Each proposed action states an expected biological response from the populations and expected changes in physical habitat conditions.

Spawning area restoration seeks to address the causal mechanisms of watershed impairment that lead to degradation or loss of spawning habitat. Largely this focuses attention on hydrology and sediment as two key processes. In Skagit, actions to address this are focused on road improvements, removal of channel constrictions and rip-rap. These actions are projected to increase channel complexity and secondary channels, reduce or eliminate sediments, reduce channel instability, and allow for the reformation of pools and riffles. Actions will increase egg and juvenile survival and rearing capacity.

Freshwater rearing restoration is focused on improvements to floodplain areas. Focus is especially directed where gaps in connectivity are known to exist and habitat restoration opportunities exist. Actions focus on removing or upgrading hydromodification along the main river channels, protecting functioning floodplain habitat, restoring natural floodplain processes and/or reconnecting historic floodplain channels. These actions are projected to increase riverine wetland areas, increase accessibility to off-channel habitats and increase channel edge complexity. This strategy largely benefits parr migrants.

The tidal delta rearing strategy is to increase the amount of tidal marsh habitat and improve pathways that juvenile salmon can find and occupy in the delta. The strategy also identifies the need to better understand the role that transitional habitats (scrub-shrub) and the forested riverine tidal zone play for salmon recovery. Proposed actions are directed at increasing the amount of tidal marsh habitats in the delta including the amount of available channel area. Two actions are also proposed that seek to re-connect juvenile access to estuarine habitats. The results of the implementation of these actions are projected to be significant gains in juvenile productivity and survival.

The nearshore rearing strategy is to increase the opportunity for juvenile salmon to utilize pocket estuary habitat close to their natal rivers and throughout Whidbey Basin and to ensure healthy and functioning nearshore beaches connecting pocket estuaries. This strategy supports juveniles in safely transitioning from fresh to salt water and rearing and traveling within Whidbey Basin. It also benefits forage fish and larger Chinook life history strategies. The strategy requires that the coastal and watershed processes that influence nearshore habitats remain or are restored. High short-term priority has been placed on the tidal delta area and the nearshore areas in close proximity to the natal delta as these currently impede recovery.


Photo courtesy the Washington State Salmon Recovery Funding Board

Harvest Management Actions

Fisheries will be managed according to the 2004 Comprehensive Management Plan for Puget Sound. Actions described in the Skagit Plan were developed through the Comprehen-

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sive Management Planning process. This process established new fisheries management actions such that exploitation rates (the percent of adult returning fish harvested by Alaska, Canada and U.S.) will be low enough to allow for the population to rebuild as habitat conditions are improved. It also ensures that harvest (targeted or incidental) will only take place if it does not impede achievement of recovery goals.

Harvest reductions can result in meeting abundance numbers, but cannot affect the productivity of the fish. Harvest reductions only lead to recovery if the habitat available to the increased returning fish supports higher levels of productivity. Harvest reductions are taken in the short-term as protection and restoration actions are taken to improve habitat.

Artificial Production--Hatchery Management Actions

Two management plans cover artificial production and are currently under review by NOAA Fisheries. One plan focuses on hatchery Chinook releases and their potential effects on listed Chinook and summer chum. The other plan deals with other species of salmon. Together, these hatchery plans provide the frameworks for the co-managers to ensure they are meeting the conservation requirements of the Endangered Species Act.

Current hatchery programs for Chinook within the Skagit River have been established for indicator stock purposes. The objective of these indicator stock programs is to obtain representative data on harvest impacts and marine survival of Chinook salmon so that the co-managers get an understanding of how they should conduct harvest management on wild Chinook populations. No new hatchery Chinook programs are proposed for the Skagit at this time, and existing programs will continue as they are currently managed. However, the co-managers have developed contingency plans if one or more of the populations decline to low levels.

Research and Monitoring

The main research strategy is to continue research actions which test and refine the working hypotheses for the basin which form the foundation for the protection and restoration strategies and actions. Recovery success will be evaluated at both the project and the basin-wide scales.

Results

The watershed plan for the Skagit was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan, but the reviewers felt they merited particular attention to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

The six Chinook populations in the Skagit River system belong to a group of ten populations remaining in the Whidbey Basin. The Snohomish and Stillaguamish rivers are each home to two Chinook populations each. Together, these ten salmon runs comprise the Chinook inhabiting a key sub-region in the Puget Sound Evolutionarily Significant Unit. The potential for early success in moving populations out of high risk in the Whidbey Basin is an important part of the regional strategy to reduce risk to the overall ESU. Such a strategy is especially important because salmon runs elsewhere in the Puget Sound face greater constraints, and achieving recovery objectives in those areas is likely to take longer. The TRT and interagency committee believes that because of the current status of the Skagit populations, the remaining ecological function of the watershed and the technical understanding of what is necessary for recovery, the Skagit River has the potential to support robust populations of salmon once again and plays a key role in Puget Sound recovery.

The Swinomish and Sauk-Suiattle tribes and WDFW crafted a comprehensive technical approach to recover the six salmon populations. A quantitative model was used to demonstrate the biological result of each restoration action and that the collective actions if implemented would reach recovery.

Though the strategies and actions for recovery are technically sound, it will be necessary to develop an adaptive management and monitoring plan to ensure long-term success.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the above uncertainties are addressed, the Skagit watershed will make a significant contribution to the overall ESU recovery effort. It has the opportunity to improve from current conditions in the short-term and the possibility to achieve low risk status for six Chinook populations.

Community Comments

As mentioned previously in this profile, the 2005 Skagit Plan was developed by the Swinomish Indian Tribal Community, Sauk-Suiattle Indian Tribe and the Washington State Department of Fish and Wildlife. Upon completion of the draft plan in June 2005 the Tribes and DFW hoped to engage the broader community to improve the plan as well as gain support and commitments for implementation to recover the salmon.

Following completion of the Draft Skagit Plan (June 2005), Skagit County and the Western Washington Agricultural Association (WWAA) provided detailed written comments to the Tribes, DFW, NOAA and Shared Strategy for Puget Sound. Skagit County and WWAA expressed support for salmon recovery and the specific goals for the Skagit

Chinook. Their comments were directed at how to best achieve the goals and gain specific commitments from affected parties and overall public support. In general, they suggested a broader strategy and activities beyond the predominately regulatory approach proposed in the plan for habitat protection and restoration. They noted a lack of consideration for current efforts by the County, forest landowners and farmers, and the need to address the impacts of urban development.

The Tribes and DFW met several times with some of the stakeholders during the summer and fall of 2005 to understand and consider changes to the plan. Several changes were made and are included in the new draft Skagit Plan (December 2005) which is contained in Volume Two of this Puget Sound Salmon Recovery Plan.

However, the changes have not been fully vetted with the parties and some issues have not been fully addressed or resolved. Further discussions with the affected groups as well as the general public will be necessary to determine the extent to which the plan has addressed the issues and whether additional work remains. These issues include:

1. A more detailed, phased approach to estuarine restoration that addresses needs of salmon and the impacts on agriculture consistent with the Skagit Tribal-Agricultural Accord.
2. Streamside buffers requirements that could be more tailored to site-specific ecological functions and current conditions.
3. Assessment of salmon habitat benefits from the current practices under the Forest and Fish Agreement and newly adopted Forest Practices Rules.
4. Additional details on measurable goals and objectives for the ultimate results of Skagit salmon recovery as well as desired results in the first ten years of implementation.
5. Acknowledgement and assessment of results from current County regulations and practices to protect existing ecological functions.
6. A description of harvest management that clearly defines the actions and results from current and anticipated practices in Skagit River, Puget Sound and Pacific Ocean.
7. Additional definition of how water quantity and quality currently impacts the fish and limits recovery as well as how they will be managed to protect and restore fish runs.
8. How the final Skagit plan will be considered under the State Growth Management Act in regard specifically to the terms of best available science.

The Tribes and DFW have committed to continue discussions in the community with the general public and interested groups. NOAA Fisheries supports continued discussions and is interested to hear from groups and individuals about the draft Skagit Plan.

In response to comments from the WWAA and Skagit County, Bob Lohn, NOAA Fisheries Regional Administrator, sent a letter in October 2005. The following points are important to consider during the public review of the plan.

"The Skagit chapter developed by the Skagit River System Cooperative and Washington Department of Fish and Wildlife (hereafter referred to as the Skagit Co-manager proposal) was submitted late in the Shared Strategy process, but was reviewed for its technical merits by the Puget Sound Technical Recovery Team (TRT). The TRT concluded that the Skagit Co-Manager proposal provided a comprehensive technical basis to recover the six Chinook salmon populations in the watershed and if implemented, would be consistent with the TRT's recommendations for viable populations in the Skagit system.

As issues are resolved in the Skagit Community, these resolutions can be jointly or individually forwarded to NOAA before and during the public comment period for inclusion during final plan adoption. Clearly, agreements between the Tribe, Skagit County, and the agricultural community will have great influence on what is adopted by NOAA Fisheries Service as a final recovery plan. For areas where no agreement is reached, NOAA Fisheries Service will need to make a determination among competing interests regarding the most appropriate path to take regarding adoption of a final plan."

Watershed Profile:

Stillaguamish

The Place and the People

From the rocky and snowy peak of Whitehorse Mountain to the estuarine confluence of Port Susan and Skagit Bay, the Stillaguamish watershed is home to foresters, farmers, rural and small city residents and tribal members. The watershed begins in the peaks of the forested foothills of the Cascade Mountains, rolling sharply down steep hillsides into streams and creeks that feed the North Fork and South Fork of the Stillaguamish River. The North Fork, South Fork, and Mainstem of the Stillaguamish River are home for the North and South Fork Chinook salmon populations. This watershed is also home to bull trout.

The North Fork and South Fork meet at the bustling small city of Arlington, forming the mainstem Stillaguamish. From Arlington, looking east and north across the landscape, one sees the North Fork meandering through its broad glacial valley. The river is edged by farms and forested slopes. Following the South Fork upstream to the east and south, the river bounces from side to side within this much narrower valley. Rural residences and small farms sprinkle the valley and surrounding hills like jewels. Draining 700 square smiles, the Stillaguamish watershed spans parts of both Snohomish and Skagit counties. As the fresh water from the Stillaguamish mainstem pours into Skagit Bay and Port Susan it deposits fine sediments and mixes with saltwater to create brackish nutrient-rich estuarine habitat.

During the last ice age, glaciers plowed through this landscape, scraping up soil and churning it into loose glacial till. As the ice retreated, mounds of till were deposited over the contour of the foothills, and provided fertile soil for the rich stands of timber that have driven a robust forest resource economy for nearly 150 years. Much of the Stillaguamish basin is still in commercial timber land.

Gradually sediment eroded from the hills and was carried down the North Fork, South Fork, and mainstem Stillaguamish River. Layer by layer the soil was deposited on the three broad floodplains, creating fertile valleys perfect for growing things. At the turn of the century, deciduous trees like red alder, black cottonwood, and big leaf maple dominated the floodplain along the lower reaches of the river. Prior to European settlement, many Native Tribes used the Stillaguamish Valley for its abundant resources, particularly from Barlow Pass to the river's mouth near Stanwood. When Europeans began moving to the area and logging the giant trees near the streams, they recognized the farming potential of the valleys, and set to work diking, draining, and clearing the floodplains to grow crops in the productive soil.

The highest point in this relatively low elevation watershed is Three Fingers Mountain, standing at 6,854 feet. As a result of this basin's low elevation, hills do not get the same kind of winter snow pack that builds in the higher elevations of other watersheds. Precipitation varies throughout the basin. In the western lowlands of the Stillaguamish, tucked inside the last of the rain-shadow of the Olympic Mountains, precipitation averages 30 inches a year. The eastern edges see about 150 inches in the higher elevations where moisture laden clouds pile up against the Cascade Mountains. Approximately 75% of the precipitation falls between October and March. Stream flows are highest in late autumn and winter as a result of storms, rapid snowmelt, and rain falling on existing blankets of snow during "rain-on-snow" events. Because the Stillaguamish watershed accumulates less snow-pack, the river often runs low in the drier months of summer, though groundwater stored in gravel along the valley walls seeps into the river year-round helping to defray the effects of low summertime flows.

Working the land as fishers, foresters and farmers, the citizens of the Stillaguamish basin are both independent and community minded. Staples of the early Western Washington economy, forestry and farming are still major players in the Stillaguamish watershed. It is one of the few largely undeveloped rural areas adjacent to major urban centers in Puget Sound. Though I-5 runs through the basin and across the Stillaguamish River, this basin has uniquely low levels of commercial development along the interstate corridor. Residents in the basin feel a strong sense of community and pride in their area. The strong sense of ownership and remaining natural resources provide a significant opportunity to protect key salmon habitat and restore or enhance properly functioning ecological conditions.

The Stillaguamish watershed is also home to an early collaborative effort to address watershed health. In the early 1980's the Stillaguamish Tribe and Tulalip Tribes initiated the Stillaguamish Implementation Review Committee (SIRC) to address

Key Facts:

Land use in the portion of the watershed inhabited by salmon is 76% forestry, 17% rural residential, 5% agricultural and 2% urban.

▪

Spanning northern Snohomish and southern Skagit counties, cities within the watershed include Arlington, Darrington, Granite Falls and Stanwood.

▪

Major public landholdings are managed by the U.S. Forest Service Mt. Baker-Snoqualmie National Forest, and the Washington State Department of Natural Resources.

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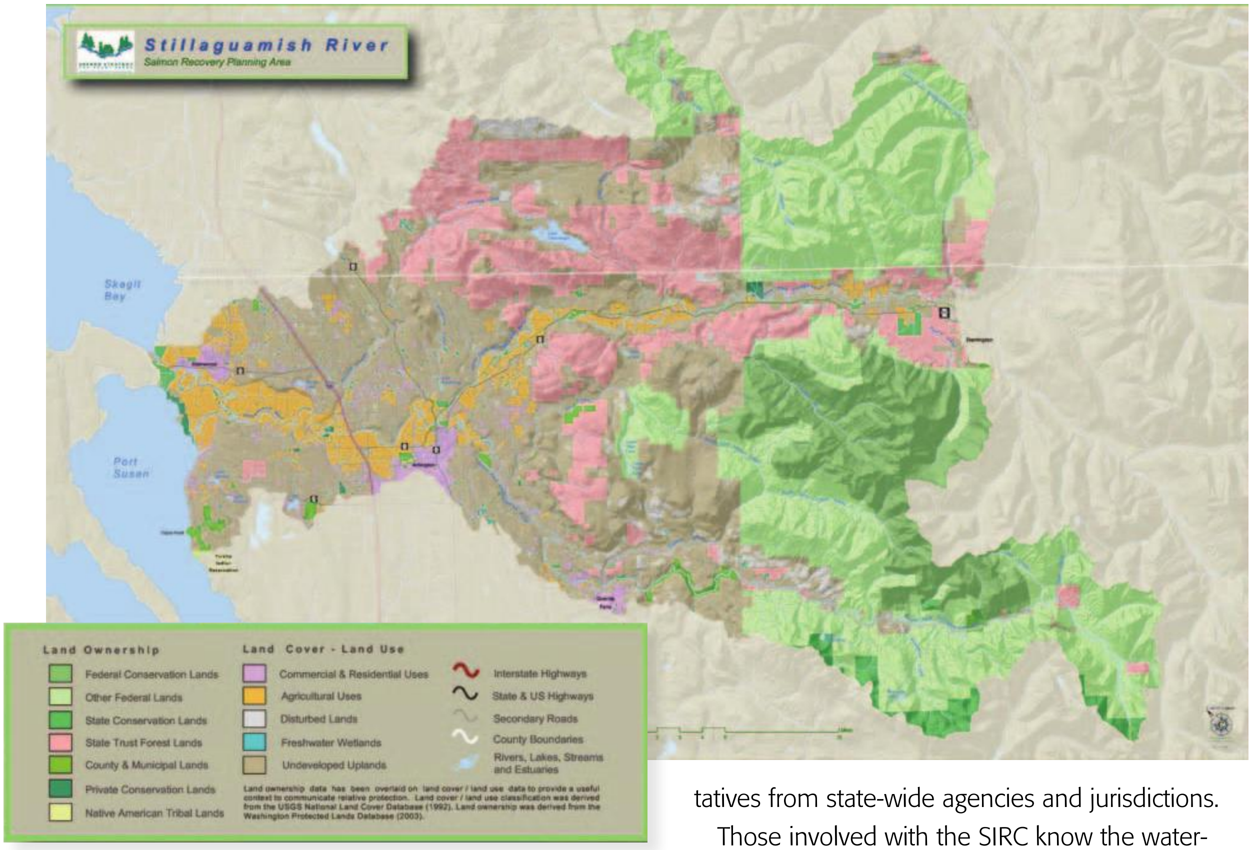
The planning area for the watershed under the state Watershed Management Act is Watershed Resource Inventory Area (WRIA) 5.



water quality problems. In 1990, local stakeholders, including Snohomish County, the Tulalip Tribes and Stillaguamish Tribe, farmers, forest land owners, citizens and local agency representatives committed to a set of actions to improve water quality. By the mid-1990's, with leadership from the Stillaguamish Tribe and Snohomish County, this group began to broaden its scope to include salmon habitat restoration. The SIRC currently includes staff representation from the local farming community, City of Arlington, Snohomish County, non-profit groups, the forestry sector, City of Stanwood and Granite Falls and others. In 2003, the SIRC committed to participate in the development of a salmon recovery plan, focusing their efforts on Chinook salmon.

Being a small rural watershed, the people participating in the plan tend to be those who work locally, care about, and are affected by the actions that take place in the watershed. There is significant involvement from the farming community, citizens and staff from small non-profits and local representatives from state-wide agencies and jurisdictions.

Those involved with the SIRC know the watershed intimately and spend significant time living, working, and recreating in the watershed. Although the SIRC is broadly representative of citizens, local government, tribal, and state agency interests, some of these interest groups have been less active participants in the SIRC's deliberations. An example is the limited involvement of State and Federal forestry policy-makers that has made it difficult to craft solutions that work for the forestry industry and for the Stillaguamish populations. This is a particularly important issue in this basin due to the combination of natural and human-caused circumstances. The SIRC has crafted a plan that makes significant improvements to the two populations in the 10-year timeframe, and hopes that over time they can involve those critical to reaching the long-term recovery goals. They know they are the stewards of the land and the stewards of their community so they approach and resolve problems in a manner that unites these two responsibilities.

The Stillaguamish Salmon

The Stillaguamish is home to two populations of listed Chinook, the North Fork and the South Fork populations. The watershed also supports Stillaguamish and Deer Creek coho salmon; North and South Fork pink salmon and fall chum salmon; summer steelhead in South Fork, Deer Creek, and Canyon Creek; Baker Sockeye salmon; and resident and sea-run cutthroat trout. The Stillaguamish bull trout are also listed as threatened.

Over three quarters of North Fork Chinook spawn in the middle and upper reaches of the North Fork, with the rest choosing the larger tributaries that flow into it. North Fork Chinook select spawning areas that are associated with tail outs, riffles, and bars that contain large gravel in the deeper sections of the low flow channel area. South Fork Chinook spawn in tributaries such as Jim Creek and lower Canyon Creek, while only a few spawn above the Granite Falls fish ladder.

The South Fork population is genetically unique from the North Fork population, and appears to be more closely related to the Snohomish and South Puget Sound Chinook populations while the North Fork is similar to the Skagit populations. Genetic analysis in the watershed is complicated by the fact that hatchery fish from outside the Stillaguamish system were planted in the river over a period of about twenty years starting in the 1950s. It is unknown how those hatchery implants affected the genetic make-up of the wild South Fork population, but current studies still indicate this population is genetically unique.

Juvenile Chinook from both populations rear throughout the river system, and 91-96% of them spend less than one year in freshwater. This means they rely on the estuary and nearshore areas for a significant portion of their rearing and growth. Access to the remaining range of habitat is still largely intact, but fish use has been limited by poor habitat quality.

Recovery Goals

The primary goal of the SIRC is to restore healthy, viable populations of Chinook salmon to a level where natural population production is healthy enough to support ceremonial, subsistence, recreational and commercial fisheries. Inherent in this goal are the re-establishment of a targeted fishery on both the North Fork and South Fork populations and the re-establishment of a wild North Fork run through the eventual phasing out of the hatchery program. The SIRC has emphasized its desire for a comprehensive approach that balances protection of Chinook salmon habitat with preservation of property rights. They believe this balance can be

Photo by Dan Kowalski

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achieved through use of a variety of regulatory tools and voluntary and incentive based actions.

The SIRC also has goals that represent their commitment to broader community values. They believe that the salmon recovery plan should be implemented in a way that promotes fair treatment and shares the burden of cost among stakeholders, respects the right of private property owners to request compensation for restoration activities, integrates existing voluntary and regulatory programs, and recognizes the contribution of the community in developing and implementing creative solutions to reaching goals. In doing these things, they believe they will be able to protect and preserve community, social, and economic values while they recover salmon.

Fish Population Goals

The SIRC has adopted the Technical Recovery Team's parameters for viable salmon populations: abundance, or the size of a population at any given time; productivity, or the population's ability to replace itself or grow; spatial structure, or the amount and location of fish use of the river; and genetic diversity, which makes the salmon better able to withstand disease and other challenges. The SIRC uses these parameters as a framework for structuring their planning and measuring success over time. They have adopted the following quantitative targets as their 10 and 50 year goals. All numbers in the table are results of the Ecosystem Diagnosis and Treatment (EDT) model. Because these numbers are modeled based on habitat conditions and do not represent actual fish return numbers, the numbers in the population status section are different.

Chinook Population	VSP Parameter	Current (model results)	10 Year Target[1]	50 Year Target
South Fork	Abundance (Number of fish at any given time)	861	3,196	15,387
	Productivity (Number of fish that return to the river for each adult spawner)	1.4	3.4	10.7
	Diversity (Genetic diversity)	45%	79%	100%
North Fork	Abundance	2,430	5,950	17,795
	Productivity	2.7	5.4	11.9
	Diversity	58%	86%	100%

Quantitative targets for Chinook recovery in the Stillaguamish watershed, based on Ecosystem Diagnosis and Treatment (EDT) modeling results. Current abundance numbers are based on total run size before harvest.

[1] Predicted long-term results of 10 year actions

What is the current status of the Threatened Salmon populations?

Chinook

The Stillaguamish has two Chinook populations, the North Fork, which returns to spawn in the river in the summer, and South Fork, which returns to spawn in the fall. Both populations have been stable at a very low abundance for the last 10 years. Stillaguamish Chinook populations may have historically had a lower productivity than some of the other river systems due to natural conditions such as flows and sediment, but current productivity is approximately at 10% of the expected potential for the system. The escapement goal, or the goal for mature fish returning to the river to spawn, has not been met since 1976.

The North Fork population is the stronger population in the Stillaguamish basin, with an average number of 1,080 fish that return to spawn. This represents a combination of wild fish, hatchery supplements and hatchery fish that return to the natural spawning grounds. It is estimated that the historic North Fork population would have averaged approximately 25,000 fish annually. North Fork salmon have a productivity of 2.7, meaning an average of almost three fish return from the ocean for each parent that spawns in the river.

The South Fork Chinook enter the river later than the North Fork population, typically arriving in mid-September. Because they enter the river and spawn later than the North Fork fish, they are more vulnerable to warm water temperatures and restricted access to tributaries due to low flows. Historically, the South Fork population probably averaged around

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21,000 fish a year. With a current average of only 246 fish returning, the South Fork is considered to be at the threshold of extinction.

Some of the current numbers of South Fork Chinook can be attributed to hatchery strays from the Tulalip hatchery and hatchery fish supplementing the North Fork. However, the ratio of wild to hatchery fish in the South Fork is generally unknown as the South Fork has only been monitored once.

Photo by Dan Kowalski

Bull Trout

There are four local populations of bull trout in the Stillaguamish watershed that migrate from their birth place: the North Fork Stillaguamish River; the South Fork Stillaguamish River; Canyon Creek; and Upper Deer Creek. There are also populations of bull trout that don't migrate. Since the range of Chinook salmon habitat in the Stillaguamish is also used by bull trout, it is believed that actions taken in this plan to recover Chinook salmon will also benefit bull trout populations in areas of overlap.

What are the factors that are currently affecting the populations?

There are several naturally occurring conditions in the Stillaguamish watershed that limit salmon populations, leading some to believe historic productivity of Chinook was probably not as high here as it was elsewhere. The basin is made up of steeply sloped, unstable hills that are low in elevation, with river flows more extreme due to common rain-on-snow events. This means winter flows can be at flood levels, because rain falling on existing snow can cause it to melt and inundate the river. Conversely, rivers can suffer from low flows and higher water temperatures in the summertime when the Puget Sound receives less rainfall and a supply of cold glacial melt water is lacking. All of these factors have been compounded by human activities and present problems for Chinook and other salmon. The naturally unstable geology is prone to landslides, which provide a constant source of sediment washing down the hills and through the river system.

Europeans first settled the lower Stillaguamish basin in the early 1860s, and began diking and draining the floodplain for agricultural uses. Removal of log jams in the river allowed boat access to upriver areas that were subsequently cleared and settled, giving rise to several small towns. By the turn of the 20th century, nearly all of the floodplain land on the mainstem had been cleared of trees and converted to agricultural lands.

Currently, farming is the most prevalent land use in the lower floodplain. Converted riparian areas and wetlands along the mainstem and larger tributaries are also still actively farmed. To maximize available farmland and prevent fields from flooding, streams and rivers were squeezed into narrower channels and contained within hardened banks. Drainage ditches were constructed in floodplain areas to keep the land dry enough to farm. Dikes, levees, revetments, and tide gates were installed

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to protect agricultural lands from floods and tidal influences. These changes to the landscape have increased the flow of water, nutrients, and sediment into stream reaches used by salmon, and they have disconnected many sloughs and side channels that could potentially offer productive juvenile rearing habitat. Not only do these landscape changes limit Chinook salmon productivity by restricting them from habitat, they also prevent or inhibit the meander and floodplain processes that form and maintain habitats.

The amount of historic timber harvest activities and the manner in which forestry was historically practiced have also contributed significantly to the decline in local salmon populations. Timber harvesting in riparian zones and on steep or unstable slopes, inappropriate forest road construction, and draining of forested wetlands have altered the delivery and rate of water to rivers, increased the amount of loose sediment, limited the amount of large woody debris entering rivers, raised water temperatures, and generally altered other important freshwater salmon and bull trout habitat conditions needed by all life stages.

Increased frequency and magnitude of high stream flows is due in part to the loss of forest cover from timber harvesting and the routing of surface runoff from forest roads into streams; thus the naturally challenging hydrology of the basin is exacerbated. High flows have contributed to scouring upstream salmon spawning beds, and smothering downstream spawning beds with high sediment levels. Peak flows may also flush juvenile salmon out of normally slower moving reaches of the river that are used for rearing habitat. In the future, climate change may lead to wetter winters and drier summers, aggravating the current flow challenges.

Extensive landslides and increased frequency and magnitude of high stream flows in the Stillaguamish watershed are also attributed in large part to past timber harvesting and forest road management practices. When forests are removed from unstable hillsides, the naturally loose soil has nothing to hold it in place, and slides or slumps can occur. Many of the landslides which originate in glacial blue-clay sediments are deep-seated, and a chronic source of turbidity and suspended sediments in the river systems. Increased sediment loading has reduced the amount and quality of deep holding pools, spawning gravel, and rearing habitat. Accretion of sediment at the mouth of the river has created extensive sand and mud flats that may make migrating juveniles and returning spawners more vulnerable to predators and offer less productive areas for finding food.

The River has experienced a deterioration of water quality and current efforts are underway by Department of Ecology to develop Total Daily Maximum Loads (TMDLs) for temperature, fecal coliform, pH and dissolved oxygen.

Given the challenges presented by land use practices, it is critical that all stakeholders participate in salmon recovery planning in the Stillaguamish basin. Balancing future growth, maintaining the viability of fishing, agriculture, and forestry and restoring 2,000 acres of estuary and 150 acres of floodplain is a significant endeavor for a rural watershed. Bringing fish from 8% of historic to 80% of historic is a significant undertaking by a small rural community that depends on the very same land as the fish for their own prosperity and survival. Given the scope and complexity of the improvements necessary, reaching recovery for the two populations will take, at a minimum, 50 years. The SIRC recognizes the great political and technical uncertainty of predicting success 50 or more years from now and thus is pushing to maximize efforts in the near-term.

Future threats

- As in most Puget Sound watersheds, human population growth is a future threat to properly functioning conditions in the Stillaguamish watershed. Zoning of the rural floodplain areas currently allows for a doubling of the existing number of households in the floodplain. This

Photo courtesy the Washington State Salmon Recovery Funding Board

can result in further loss of riparian or floodplain functions and restrict future long-term opportunities for restoration of habitat forming processes.

- Rate, timing, quantity and quality of water will potentially be negatively impacted due to population growth and increased impervious surfaces, cumulative impact of forest harvest and/or climate change. The degree to which cumulative impacts of forest harvest will impact hydrologic function is unknown.

Overall Approach to Recovery

The SIRC has developed an approach to salmon recovery that links land uses to the ecological processes that shape hydrology, sediment and channel formation, and the way that these processes affect habitat and fish use in their watershed. Computer modeling has shown that when properly functioning ecological conditions are restored to the Stillaguamish, and harvest and hatchery are managed for recovery, then fish should be able to recover to the point where planning goals are achieved.

Recognizing that it takes time to restore the underlying ecological processes that form healthy fish habitat, the SIRC will undertake both projects that provide immediate support for salmon, like building engineered log jams in rivers, and projects that will restore function over time, like planting trees along riverbanks. Over the next ten years, as the SIRC focuses on recovery actions through habitat improvements, the co-managers will continue to support the North Fork population through hatchery supplementation. Co-managers will also explore hatchery supplementation of the South Fork population to minimize the risk of extinction, given their dangerously low levels. These adjustments complement the already existing changes in harvest management that ensure sufficient returns to the system to maximize growth of the population as habitat conditions improve.

The SIRC has chosen to define a locally-ambitious 10-year plan, mainly relying on restoration projects that they could commit to achieving.. They expect this will result in an increase in the populations

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from 8% to 30% of historic numbers. The habitat management and restoration actions proposed follow a series of geographically based criteria that highlight the best locations for habitat restoration projects throughout the watershed. They have a strong desire to build upon current momentum and minimize reliance on uncertain future recovery actions. They believe that this recovery strategy provides the highest degree of certainty possible at this time, given the current political climate and technical capacity in the watershed. Success of restoration actions however, depends on the implementation of a strong habitat protection program that results in the protection of remaining habitat function.

Assuming that the South and North Fork populations have been self-sustaining under the current degraded habitat conditions and harvest management guidelines, these populations should respond in a positive manner to the implementation of improvements to sediment, large woody debris, floodplain connectivity, hydrology, riparian and estuary and nearshore habitats. With improved habitat conditions, Stillaguamish Chinook should show an increase in all four of the parameters for healthy salmon runs.

The SIRC believes that over time this plan's positive results for people and salmon will create a culture of stewardship and a broader foundation of support for salmon recovery. This new foundation will bring to the table key decision-makers who are not currently involved in the planning process. Their participation in creative problem-solving will be necessary to achieve the magnitude of change required for Chinook recovery in the Stillaguamish. The SIRC's plan specifically highlights important issues where partner support is necessary to achieve. The SIRC will continue to seek the support of those agencies and groups to achieve their goals.

Key Strategies and Actions supporting the overall approach to recovery

The habitat approach in the Stillaguamish basin is three-tiered. First, it is to prevent further fragmentation of aquatic habitat; second, to improve the connectivity between isolated habitat patches; and third, to protect and restore areas and the necessary functions surrounding critical salmon habitat from further degradation and allow for the expansion of existing refugia.

The strategy is further refined by setting priorities for restoration in key reaches where Chinook are currently productive, and sequencing projects so actions build on each other rather than detract or minimize effectiveness. Over time, these actions will increase Chinook productivity and abundance by improving riparian coverage, estuary function, watershed drainage and stream flow, the presence of large woody debris in rivers, connection to the natural floodplain, and sediment processes.

The SIRC has structured its recovery planning effort around six main categories described below. It is believed that these categories represent the key processes and habitats that must be protected and restored to reach recovery.

Riparian forests: Mature riparian vegetation exists in 53% of the area within 300 feet of streams; the remaining 47% of the land adjacent to streams bears hydrologically immature forest, or forests too young to slow and absorb water effectively. The lower mainstem Stillaguamish has been particularly impacted, and has lost 84% of its mature riparian cover. These losses have led to changes in hydrologic function, increased water temperatures and a loss of the large wood inputs which provide cool pools for rearing and protection.

In order to meet the ten year habitat recovery goals for restoring riparian forests and the ecological processes they support, 400 acres of riparian vegetation will be planted, and 195 acres restored.

Delivery and routing of wood: Log jams in rivers form cool pools and back eddies, providing nursery areas for young fish and resting place for adults migrating upstream. Counts show current conditions provide approximately 1 piece of large woody debris for every river mile, compared with the desired 80 pieces per mile. This results in a

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significant loss of channel complexity and function for rearing and refuge.

Over the next ten years, people of the Stillaguamish will create 51 engineered log jams to provide immediate channel complexity. As riparian planting and other restoration actions take place, the habitat forming processes that contribute large woody debris to the river will recover.

Floodplain: Historically, the floodplain of the Stillaguamish contained wetlands, side channels, and oxbow lakes which provided safe, nourishing places for juvenile fish to feed and grow. When the river reached high volumes, water would overflow the bank and spill into the floodplain, preventing catastrophic flooding events downstream, and providing a safe place for young fish to wait out the flood. As riverbanks were armored to protect property, those important habitats were disconnected from the river. About 14-16% of the lower and middle North Fork and the lower South Fork Stillaguamish have hardened river banks.

The lower mainstem Stillaguamish has armoring along 53% of its shoreline. Approximately 31% of the side channel habitat in the mainstem Stillaguamish has been lost, primarily from the construction of dikes and revetments. It is believed that this is currently limiting rearing success. As people continue to move into the Stillaguamish basin, growth and development pressure in the floodplain will intensify; the SIRC is organizing a subcommittee of key stakeholders to develop a comprehensive floodplain strategy to address this and other critical floodplain issues.

The ten year action plan for the floodplain is to restore 30 acres, and remove 4.1 miles of armoring.

Estuary & Nearshore: Approximately 1,530 acres of estuary are currently present (out of a historic acreage of 4,439). However, more than half of those acres are recently formed saltmarsh that have a lower habitat value than the original saltmarsh that contained well-formed distributary channel networks. Water temperatures above 21˚celcius (optimum is 12-14˚celcisus) are frequent in the estuary during hot summer months. They create a temperature barrier that returning adults are reluctant to cross, and may cause juveniles to exit to Puget Sound before they are ready. High water temperatures may also cause lower oxygen concentrations, which present an additional barrier to fish.

The nearshore is the zone along Puget Sound that reaches from the tops of the bank or bluff out into the water to a depth of about 30 meters. Like estuaries, nearshore habitat is critical to juvenile salmon for feeding and growing in preparation for their trip into the Pacific Ocean. Approximately 75% of the twenty-two miles of shoreline in the Stillaguamish have been armored, disrupting beach forming erosion processes and decreasing access to juvenile salmon rearing habitats. Second growth marine riparian areas cover portions of the marine shoreline, but are impacted as they are cleared to create water views from residential homes.

The SIRC proposes 195 acres of estuary for restoration, and 120 acres created over the next ten years. Studies still need to be conducted in the nearshore to create specific goals for improvements, though computer modeling suggests that in the long run, restoring 80% of the original estuary habitat area is necessary to recover Stillaguamish Chinook salmon populations. The local Marine Resources Committee is identifying potential nearshore protection and restoration sites, which would also contribute to Stillaguamish Chinook salmon recovery.

Sediment: In the freshwater system increased fine sediment and peak flows are considered by some to be the biggest drivers limiting freshwater Chinook survival in the Stillaguamish watershed. Steep and geologically unstable slopes contribute to a naturally high sediment load. Three quarters of the inventoried landslides in the Stillaguamish resulted from poorly built logging roads or clearcuts, and 98% of the volume of sediment making its way into the river is associated with these two sources. About 124 miles of logging road currently exist on potentially unstable slopes. Two large deep-seated glacial landslides in the watershed are two of the largest contributors of sediment to the river, and have a devastating affect on the aquatic environment downstream.

Recent changes to the Washington State forest practice rules as a result of the Forests and Fish agreement are encouraging. The Agreement lays out ways to balance forest harvest, forest road building and forest practice activities on steep slopes and riparian areas with the need to consider the effects on salmon habitat. The SIRC has identified additional issues to discuss with forest landowners in the watershed including limits on cumulative areas of clear cutting within certain timeframes, exemptions for small woodlot owners, riparian zone thinning and the amount of immature forest in the basin at any one time. New forest practices will need to be funded, implemented and monitored if the changes are to be effective. It's uncertain whether these updated regulations will provide the necessary improvements for fish in the Stillaguamish, and the SIRC does not have consistent participation from forest managers in the planning process. Over the next ten years, the SIRC will work on bringing those decision makers to the table, will monitor the changes to the watershed, and will treat the two most significant landslides so they no longer contribute sediment to the rivers.

Hydrology: Hydrology, or the distribution and drainage of water in the basin and river, is considered in terms of frequency, magnitude and quantity. The Stillaguamish watershed is a low elevation system that lacks glacial melt water and significant summer snowmelt. The resulting low flows from July through September can impede adult salmon migration, decrease available spawning and rearing habitat, contribute to high water temperatures and low dissolved oxygen levels and increase the concentration of pollutants in tributaries. The North Fork Stillaguamish River has also shown a trend toward increasing peak flows both in frequency and magnitude, resulting in higher Chinook salmon mortality. Historically, every twenty years there was

Photo courtesy the Washington State Salmon Recovery Funding Board

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an especially large flood event; now these high flood water levels occur every two years. Loss of forest cover that slows and absorbs water is thought to be a major contributing factor.

The strategy for restoring hydrologic and sediment functions to the basin is to implement a combination of regulatory and voluntary protection and restoration actions. These are directed at improving forest cover, riparian areas, floodplains, and wetlands to increase infiltration, slow runoff, and reduce downstream peak flow impacts, and will be accomplished through the habitat actions outlined above.

The Stillaguamish Tribe, Snohomish County and Northwest Hydraulics initiated a Stillaguamish Instream Flow Assessment Pilot Project. The pilot study will connect human-induced flow changes to their affect on salmon and bull trout, and will provide a series of management recommendations by fall of 2005. The State of Washington is also in the process of establishing an instream flow rule that will set instream flows needed in streams at specific times and locations to protect fish spawning and rearing among other objectives.

Harvest: The long-term harvest strategy is to conduct harvest in a manner that does not impede recovery of Stillaguamish Chinook. This can be accomplished by changing harvest guidelines as abundance or productivity of the fish responds to changes in habitat or hatchery practices. This integrated management is a significant change from historic harvest practices where harvest targets were not based on fish response to habitat and hatchery actions. The objective of harvest management is to ensure that the right amount of spawners return to the Stillaguamish watershed each year to take advantage of available habitat.

Harvest is not currently believed to be limiting the population as a result of recent changes. The net result of changes in the management of harvest of Stillaguamish Chinook in all areas over the past two decades has been a reduction in overall exploitation rates from approximately 80% to 30%. These

Photo by Dan Kowalski

greatly reduced exploitation rates have resulted in increasing numbers of fish making it back to the river to spawn. The current level of mortality is the result of by-catch from fisheries that target other species or strong hatchery Chinook stocks. There is currently no fishery on the North or South Fork Chinook populations, and neither the Stillaguamish nor the Tulalip Tribes have practiced a ceremonial, subsistence, or commercial fishery on these populations for more than 20 years.

Poaching, or the illegal harvest of fish, occurs annually in the Stillaguamish watershed. Although state and tribal enforcement efforts have been bolstered in the watershed, staffing and funding are still considered inadequate to reduce this problem to an acceptable level. Under the current harvest management plan, exploitation rates should be reduced further to approximately 25%.

Hatchery: The hatchery supplementation program currently lowers the risk of extinction for the North Fork population and is not believed to impede recovery of the South Fork. It exists solely to support and help recover the threatened North Fork population, and is one of six essential hatchery programs within Puget Sound necessary for Chinook salmon recovery. Actions have been taken to address genetic integration of hatchery and natural origin fish, to mark all hatchery fish to enable easy identification and minimize masking the status of the wild fish, and to ensure an effective breeding population size. Hatchery smolts may pose a threat to wild juvenile survival. Ecological interactions between wild and hatchery fish must be studied to improve hatchery management practices.

The North Fork hatchery will continue to provide supplemental naturally spawning fish for recovery purposes until habitat improves to the point that hatchery supplementation is no longer necessary. The North Fork hatchery program also inserts coded-wire tags into hatchery Chinook, in order to help harvest managers assess fishery impacts on Stillaguamish Chinook, and researchers learn more about overall production.

There is currently no hatchery supplementation program for South Fork Chinook. Because this run is so endangered, the SIRC is considering initiating a restoration program if the population drops to a point where it is at genetic risk.

The 10 Year Protection Plan

The SIRC put forward a series of policy recommendations on protection; it will seek to gain commitments from decision makers and stakeholders to support and implement these recommendations. The recommendations are structured as non-regulatory and programmatic actions, suggested improvements to local comprehensive plans and land use policies, and compliance and enforcement of existing regulations. The SIRC will conduct an evaluation of the effectiveness of existing land-use regulations and make recommendations on how to fill the gap.

If the projects listed in the 10 year action program are completed, the SIRC expects to reach approximately 30% of the planning targets. The SIRC has also set 50 year habitat goals for restoration, acquisition, and enhancement; if implemented, these habitat goals should provide habitat and processes sufficient to reach their salmon recovery targets. These include quantitative goals for acres of riparian vegetation planted, acres of estuary restored or created, engineered log jams constructed, miles of shoreline armoring removed, acres of floodplain restored, landslides and forest roads treated for sediment, and possible acres of land acquired.

Adaptive Management

The SIRC is the organization committed to the long-term implementation of the salmon recovery plan. The adaptive management plan identifies habitat, harvest and hatchery actions to be monitored for implementation and effectiveness. The plan lays out a series of triggers and a prioritized list of monitoring elements. It also defines a lead agency and reporting and evaluation frequencies. Overall, the Stillaguamish Technical Advisory Group will review all monitoring results and submit them to the SIRC for appropriate management response per stated reporting and evaluation frequencies.

Results

The watershed plan for the Stillaguamish was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan, but the reviewers felt they merited particular attention to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

The Stillaguamish Implementation Recovery Committee (SIRC) shows a comprehensive understanding in their plan of what it will take to achieve recovery for the two Chinook populations in the basin. The plan identifies significant improvements to habitat expected to lead to increases in abundance and productivity of the North Fork population. One of its strengths is the discussion on integrating

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habitat, harvest and hatchery management actions (H-Integration strategy). The H-Integration strategy would be strengthened by including potential ecological impacts of hatchery fish on natural-origin Chinook. This plan also offers a good beginning framework for an adaptive management and monitoring program, expected to be completed (as with other watersheds in the Sound) later in 2005.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

There is technical uncertainty of achieving plan outcomes due to the magnitude of change needed to achieve low risk for the two Chinook populations. The certainty can improve over time if the early actions identified in the plan are implemented, and more detailed actions are added over time based on adaptive management and monitoring results. Also, because the SIRC based their EDT modeling baseline on current conditions and not on a current path that includes build-out scenarios, their predictions about the future responses of habitat and fish may be overly optimistic. This adds to the uncertainty of achieving plan outcomes.

While the first ten-year action plan starts this watershed down an improvement trajectory, it will be necessary to identify, in their adaptive management and monitoring plan, what comes after the completion of the first ten years of this plan.

The reviewers identified the potential impacts on hydrology and sedimentation from forest practices as a key area of concern. It will be important to improve the connection with State and Federal policy-makers for the forestry sector to address these issues.

This plan outlines a process for creating a hatchery broodstock program for the South Fork Chinook population because of its low abundance status. The TRT believes that the trigger for when a hatchery program would be initiated is very important to reconsider to ensure that the South Fork population does not go extinct as habitat recovery proceeds.

As with other watersheds and as acknowledged in their current plan, it will be important to the success of this plan to assess the effectiveness of various protection mechanisms for achieving results for fish.

Water quantity and water quality are also both important issues in this watershed. The TRT recommends that the SIRC pay special attention to flow issues in the floodplain. For water quality, monitoring should continue to determine the effectiveness over time of the various programs and efforts underway to address temperature, fecal coliform and dissolved oxygen problems, in addition to any others that may arise.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,

- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the SIRC's plan is implemented and above uncertainties are addressed, the Stillaguamish watershed will make a significant contribution to the overall ESU recovery effort. It has the opportunity to improve from current conditions, the possibility to achieve low risk status for the North Fork population, and the likelihood to improve the connectivity among watersheds in the Whidbey Basin.

Watershed Profile:

Whidbey and Camano Islands

The Place and the People

Island County is home to two large islands, Whidbey, the third largest island in the lower 48 states (after Long Island and Isle Royale), and Camano. The County also includes the three small islands of Ben Ure, Strawberry and Smith. Long and narrow, Whidbey Island rests at the east end of the Strait of Juan de Fuca and the northern edge of the Puget Sound. Skagit Bay lies between Whidbey and the mainland north of Camano Island, and Saratoga Passage is formed between Whidbey and Camano. Between Camano Island and the mainland lies a protected marine area called Port Susan. Taken together, this sheltered marine area provides a vital ecological asset to the Puget Sound region.

As glaciers retreated from the Puget Sound region, they left behind large deposits of rich glacial till. Over time the till has become fertile soil that supports farms and forests on Whidbey and Camano Islands. The till also formed bluffs that erode, feeding and nourishing the beaches, spits, and mud flats that drive a productive food web that supports animals from ghost shrimp to gray whales.

Whidbey Naval Air Station has two sections. One is on the northwest side of the island, looking toward the

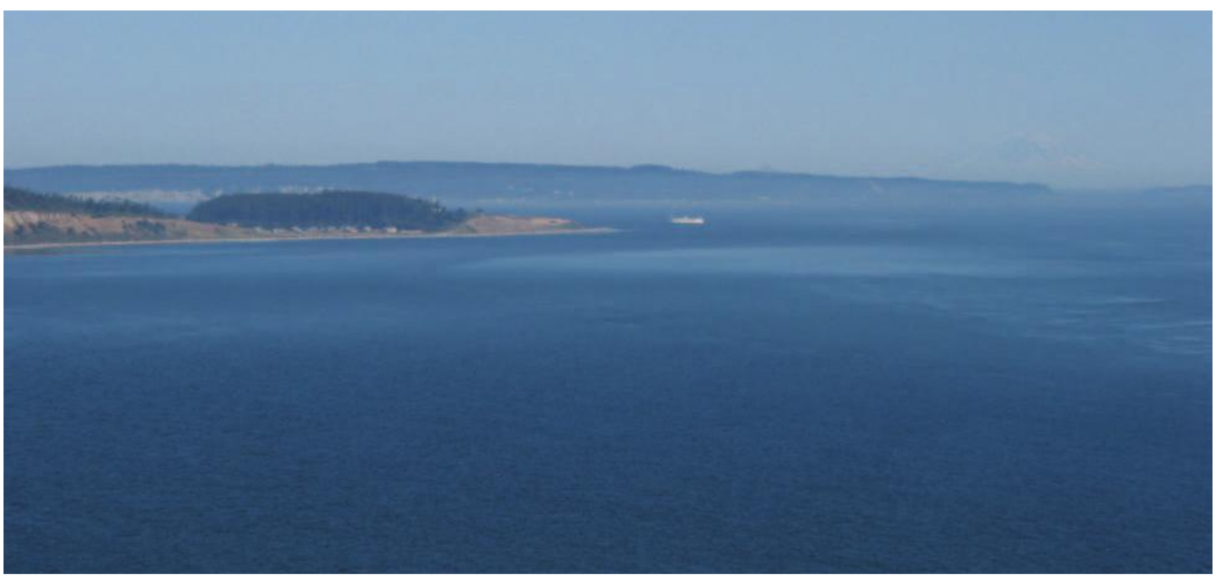

Photo by Domonique Lewis.

San Juan Islands; the other is just to the east of Oak Harbor along the edges of Crescent Bay. Essential to the community and economy of this watershed, salmon recovery planners are committed to creating strategies that support and honor the naval presence on the island as they develop actions that support salmon recovery. Small towns like Langley and Coupeville, and the small city of Oak Harbor are concentrated along the islands' shorelines. These areas along with the unincorporated rural areas are home to business owners, military families, farmers, retired professionals, artists, and others who enjoy the rural quality of life found throughout the islands.

Sightseers from around the world flock to Deception Pass Bridge, which connects the north end of Whidbey Island to the mainland, to witness one of the Northwest's marine wonders. The 182 foot high bridge spans Deception Pass where powerful tides push boiling currents through a narrow channel. This confined gorge connects the Strait of Juan de Fuca to Saratoga Passage. Kelp beds line the sides of this marine pass, and eagles, seals, and heron forage for fish and other marine organisms that get stirred up in the swirling sea water.

Chinook populations that originate in watersheds throughout the southern and central parts of Puget Sound depend on the shorelines and marine waters of Island County. As juveniles heading out to the ocean and as adults returning to spawn, they use these waters and shoreline areas for refuge and feeding. With 212 miles of shoreline, these areas provide healthy marine, shoreline, estuary and coastal stream habitats to support Chinook salmon and other small non-commercial runs. Citizen stakeholders with support from Island County want to provide healthy conditions for these fish and other aquatic species that live in or pass through Island County waters.

The Island County Water Resources Advisory Committee (WRAC), 12 citizens appointed by the Island County Commissioners, serves as the citizens' committee for salmon recovery in Island County. The Salmon Technical Advisory Group, a subcommittee of the WRAC, is the primary working committee for salmon recovery planning, project development and implementation. The WRAC, Island County Board of Commissioners and the Salmon Technical Advisory Group all endorsed the plan. As efforts move forward, work with staff from neighboring areas and other salmon recovery efforts will help to improve and refine the approach to salmon recovery.

In addition, the Island County Commissioners established a local Marine Resources Committee (MRC) and appointed citizen members in August, 1999. The 13 members represent a cross-section of the community — shore-land property owners, the Navy, local planners, environmental advocates, marine scientists, Washington State University's local extension program, two local port commissioners, recreational and commercial fishers, and farmers. The MRC is focused on improving marine health in Island County and plays an important role in Island County salmon recovery.

The Whidbey and Camano Island Salmon

Only coho salmon are known to spawn in streams within Island County and they are found on the southern part of Whidbey Island. Resident coastal cutthroat populations have been confirmed in several streams on Camano and Whidbey. Coho, chum, and Chinook juveniles have been documented in other streams on Whidbey and Camano islands, but Chinook spawning is not known in those streams. Juvenile Chinook from Skagit, Stillaguamish, Snohomish, Hood Canal, Lake Washington, Green, Puyallup, White and Nisqually rivers likely use Island County shoreline and marine habitats with regularity prior to moving off-shore to deeper waters. Skagit, Stillaguamish and Snohomish populations are probably the most abundant among these, and use the north and eastern shores of Whidbey and Camano as key habitats for foraging and rearing. Returning adults also use

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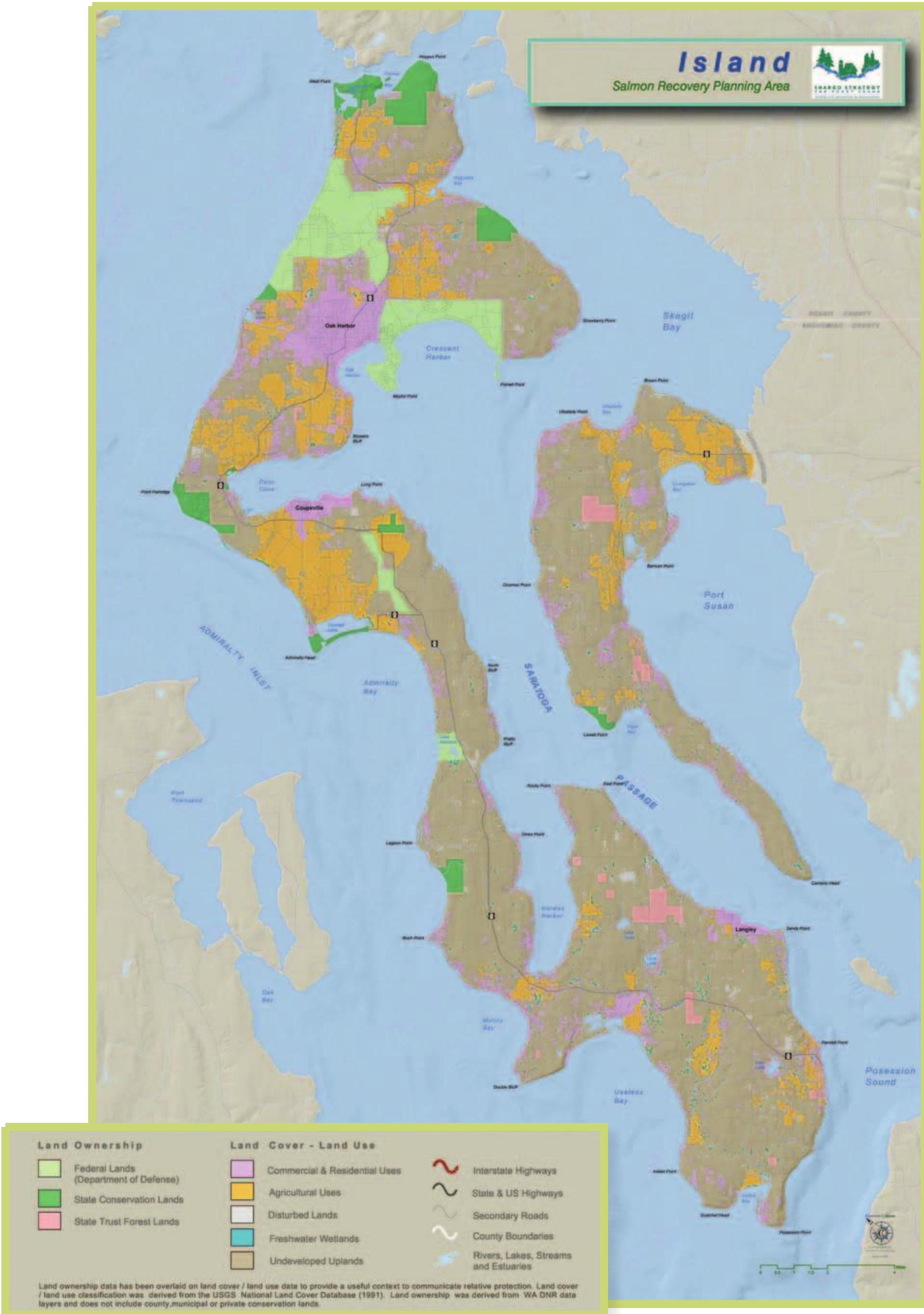

Island
Salmon Recovery Planning Area
Oak Harbor
Coupeville
Langley
Skagit Bay
Crescent Harbor
Port Susan
Saratoga Passage
Admiralty Inlet
Admiralty Bay
Useless Bay
Possession Sound
Land Ownership
Federal Lands (Department of Defense)
State Conservation Lands
State Trust Forest Lands
Land Cover - Land Use
Commercial & Residential Uses
Agricultural Uses
Disturbed Lands
Freshwater Wetlands
Undeveloped Uplands
Interstate Highways
State & US Highways
Secondary Roads
County Boundaries
Rivers, Lakes, Streams and Estuaries
Land ownership data has been overlaid on land cover / land use data to provide a useful context to communicate relative protection. Land cover / land use classification was derived from the USGS National Land Cover Database (1991). Land ownership was derived from WA DNR data layers and does not include county,municipal or private conservation lands.

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these waters. Areas such as Admiralty Inlet and Possession Point are generally recognized by the Puget Sound fisheries community as being very important for migratory adults; many adults returning to Puget Sound rivers are also known to hold off the southern tip of Whidbey prior to entering their home rivers. Bull trout from the Skagit, Stillaguamish and Snohomish systems also use Island County nearshore as marine foraging areas.

Recovery Goals

The long-term goal is to achieve a net increase in salmon habitat through protection, enhancement, and restoration of naturally-functioning ecosystems that support self-sustaining salmon populations and the species that depend upon them. It is not feasible at this time to set quantifiable habitat targets that will result in salmon recovery. A process has been established that will help develop quantifiable habitat targets by 2010.

The WRAC and the Island County Commissioners believe it is necessary to find solutions that work for both fish and people. They believe that protecting neighboring private and public land uses and the surrounding environment, involving willing landowners, not adversely impacting Naval operations, and providing significant benefits for salmon are critical components in achieving this balance. They believe salmon recovery can be an integral part of the county's economic and social structure if solutions are crafted that support these other multiple interests too.

Fish Population Goal

Chinook

Those supporting the plan acknowledge the Chinook planning targets developed by the Washington Department of Fish and Wildlife and local tribes as the overall quantifiable goals for Chinook recovery. The plan's habitat based goals, objectives and actions are designed in support of achieving these targets. In particular, actions are being designed that specifically support the Skagit, Stillaguamish and Snohomish populations' use of the nearshore and estuaries. The salmon planning targets are put forth with the understanding that there is currently no means to quantitatively link habitat actions in the Islands to progress made toward the planning targets for the various Puget Sound Chinook populations.

Bull Trout

Island County nearshore and marine waters support marine foraging of independent populations of bull trout from the Skagit, Stillaguamish and Snohomish systems. The plan supports achieving the planning targets established for these populations. The WRAC believes that actions in the nearshore that improve habitat functions for salmon species will also support bull trout. Bull trout use some of the same habitats used by juvenile and adult salmon.

What is the current status of the populations in the Puget Sound Chinook Evolutionarily Significant Unit?

Chinook

The twenty-two Chinook populations that inhabit the Puget Sound Chinook Evolutionarily Significant Unit (ESU) are, taken together, currently at around10% of the historic abundance.

What are the key factors contributing to the current status of the Puget Sound Chinook Evolutionarily Significant Unit?

Island County supports Chinook populations that migrate through and use the nearshore and estuarine waters for rearing. Thus factors are identified that contribute to the status of all populations migrating through Island County's nearshore and estuarine environments. These factors are described as a combination of the functions that different types of habitats provide for salmon and the habitat forming processes that create and maintain those functions. Examples of habitat forming processes include sediment and freshwater transport processes and tidal processes. Examples of processes that affect habitat quality include transport of nutrients to the nearshore, the timing and quantity of freshwater entering the marine areas, and food web interactions. Habitats provide a range of functions, and these are often overlapping. These functions include refuge from large waves, strong currents, and predators; support of transition between fresh- and saltwater; migratory corridors to and from the ocean, and food production.

Island County's estuarine and nearshore areas still have many remaining attributes that contribute to healthy habitat for Puget Sound salmon; compared to other parts of Puget Sound, this area has relatively low levels of human impact, with only 25% of its shoreline modified. Some of the last remaining stretches of functioning shoreline in Puget Sound are found on these Islands.

Nevertheless, human population growth has impacted the health of these shorelines and marine waters, and has impacted some types of habitats and processes more than others. Nearly 80 percent of the parcels that make up the county's 212 shore miles are developed or slated for residential development. More than 60% of the county's coastal lagoons have been isolated from natural tidal processes. When these natural processes are artificially changed, there is often a domino effect on the rest of the ecosystem.

As people develop the shoreline for residential and industrial purposes, they change its shape and structure. Wetlands were filled and diked, earth rearranged, and vegetation cleared to build homes and marinas along the shoreline. Tide gates have been installed along small stream outlets to prevent saltwater from flooding upstream as the tide comes in. Bulkhead and riprap have been installed to protect homes and property. These hardened areas prevent wave action from eroding sediment that feeds and nourishes beaches and eelgrass beds. In pursuit of water views, people keep riparian vegetation low or remove it entirely, reducing shade needed for smelt and sand lance spawning habitat, and eliminating the source of leaf litter that feeds the insects that small salmon eat.

Juvenile salmon feed on forage fish, insects and other food found in estuaries, along the shorelines, and in the marine waters. It is in these environments that salmon grow big and strong enough to weather the ocean conditions they will face as adults. A forage fish is any fish eaten by a larger fish, seabirds or marine mammals. Forage fish are an important link in the marine food web because they transfer energy between primary and secondary producers, such as plankton, to top predators such as seabirds and larger fish. These forage fish are also important to the diet of juvenile salmon who feed on the smaller species or on the young of larger species. A number of nutrient sources, including leaky septic tanks, agricultural runoff, and sewage discharge from boats change the nutrient dynamics of the marine ecosystem This, in turn, can change the species composition, and the food available to young salmon.

Various beaches in Island County are historic spawning habitats for two types of forage fish-sand lance and surf smelt-while a third, herring, spawn directly onto the lush vegetation in the many eelgrass beds that surround the islands. Bulkheads, docks, piers, jetties, and marinas from old and new residential and industrial activity change the shape of the beaches where smelt and sand lance lay their eggs. They also change how gravel and sand move along the shoreline, which can reduce the eelgrass beds in which herring lay eggs. These activities affect the survival of forage fish eggs. As populations slowly decline, the amount of food available to juvenile and adult salmon may be decreasing.

Upland development also changes the patterns of small creeks and streams that drain down to the saltwater. Culverts divert the flow of water and the way it carries sediment, impermeable surfaces like rooftops and parking lots change the quantity and timing of water flow, and non-point source pollution, like oil that is dripped onto driveways and

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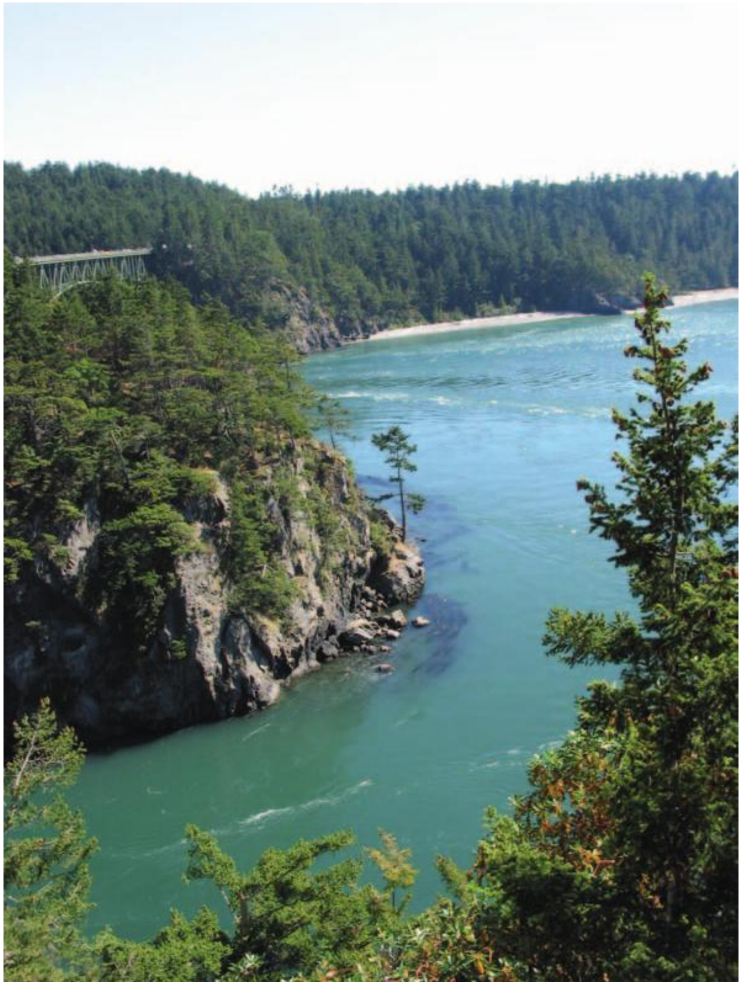
Photo by Domonique Lewis.

fertilizer spread on lawns, washes down creeks into the nearshore habitat. These changes can, cumulatively, affect the health of the estuarine and marine areas that fish need.

Future Threats

Largely residential, since commercial and industrial development has been limited to less than 1% of the shoreline, many human communities are located on sand and gravel beaches or along spits. These areas overlap with historic or current habitat for salmon and forage fish. Many of these beach communities were platted years ago, prior to the development of shoreline regulations, and are therefore exempt from these new regulatory protection measures. These communities are generally the areas of highest residential impact to the shoreline. In many cases they are currently the focus of development or re-development activities which have the potential to be an opportunity or a threat.

Overall Approach to Recovery

The primary contribution to salmon recovery for this area will be through preservation, restoration, and enhancement of nearshore habitats and the ecological processes that form them. Through these actions, the goal is to achieve a net increase in healthy salmon habitat over time. The immediate focus is on preservation.

In developing the plan, the Salmon Technical Advisory Group (TAG) used a salmon life cycle model that connects fish at different stages of life to specific habitats. Current or potential high value habitats were further prioritized based on their distance from the three rivers that empty into the Whidbey Basin, a qualitative assessment of the number of Chinook and bull trout populations likely to use the shoreline, and whether or not the shoreline is included in a proposed critical habitat designation. Protection, restoration and enhancement actions are then targeted to these areas. This plan does not yet identify a comprehensive prioritized list of sites or site-specific actions. Further inventory of current healthy habitats and processes, and an improved understanding of historic conditions will provide the scientific basis to set quantitative protection and restoration goals that link to viable salmonids population parameters and a list of site specific actions by 2010. The goal is to ensure protection of key habitats and processes and accomplish at least five restoration projects within the ten year timeframe.

Those in Island County are approaching recovery with an understanding that their watershed is inextricably linked to other areas and larger processes.

Photo by Domonique Lewis.

They acknowledge their connection to the Whidbey basin and the ten populations that first enter into saltwater around their shores. The plan cites a National Oceanic and Atmospheric Administration Fisheries study that states 50%, 75%, 65%, respectively, of the Skagit, Stillaguamish, and Snohomish planning areas are armored compared to only 25% of Island County. For this and other reasons, they understand a key role that protection of functioning habitat must play in their contribution to ESU recovery.

Key Strategies and Actions Supporting the Overall Approach to Recovery

To advance salmon recovery in the Whidbey and Camano watershed, planners have identified and prioritized geographic locations most important to Chinook, and identified the most important types of habitats nested within those geographic areas.

The top priority geographic areas include Deception Pass, Skagit Bay, and Port Susan, as these shorelines are within five miles of the mouths of the Skagit, Stillaguamish, and/or Snohomish Rivers. This combined area is likely used by the largest number of Chinook juveniles during their nearshore migration from their home river. These shorelines are also primary pathways for migrating bull trout. Medium priority areas include Saratoga Passage, Possession Sound, Southeast Admiralty Inlet, and Northwest Whidbey Island. The west side of Whidbey south of West Beach and north of Double Bluff is included in a lower priority area because it is not adjacent to any of the rivers with Chinook populations and it is at the entrance to Puget Sound where most of the shoreline experiences high wave and current energy. Regional scientists think this area is a migratory corridor for salmon, and also contributes to the production of food salmon eat.

Within the priority geographic areas, high priority habitats include mud flats, marshes, and pocket estuaries. Marshes and pocket estuaries provide shelter from predators and refuge from high-energy waves, and are key areas for food production. Pocket estuaries allow young salmon's bodies to transition from a freshwater environment to a saltwater environment. Moderate priority habitats include sand flats, and sand and gravel beaches.

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These habitats are often associated with eelgrass beds and provide habitat where forage fish can spawn. Both juvenile and adult salmon are frequently found feeding along these areas. Lower priority habitats include cobble beaches, rock cliffs, and man-made structures. While these habitats may be associated with eelgrass or kelp beds, they are frequently along shorelines that experience high-energy waves and currents. It is thought that salmon tend to migrate quickly through these areas.

In the context of these prioritized guidelines, the WRAC has established a set of strategic goals that will help coordinate and shape salmon recovery in the Whidbey/Camano watershed.

1. Over the long term, achieve a net increase in salmon habitat through protection, enhancement, and restoration of naturally-functioning ecosystems that support self-sustaining salmon populations and the species that depend on salmon.

This goal focuses efforts on protecting what remains in Island County and restoring habitats and processes where there is supporting scientific knowledge and local landowner and community commitment. Island County still retains a lot of high-quality nearshore and freshwater habitats that are at risk of degradation. Immediate focus on these areas is a critical component of creating a foundation for recovery actions.

2. Develop a better understanding of habitat functions and the distribution of forage fish species, salmon, and marine mammals in the Whidbey/Camano watershed.

The WRAC and the TAG will work to fill key ecosystem data gaps by collaborating with state and federal agencies, contractors, and non-profits on research projects. Groups, including the Marine Resources Committee, will survey and regularly update the status of marine habitats and habitat forming processes like connectivity of feeder bluffs to beaches, size and locations of eelgrass beds, forage fish spawning beaches, shoreline armoring, the locations of stormwater outfalls, and other factors that affect the quality of salmon habitat.

In order to understand the connection between salmon recovery and other animals, the WRAC believes it is important to quantify and evaluate the effects of predation by marine mammals and other wildlife on salmon and forage fish populations. This includes learning more about the relationships between fish and Orca whales, sea lions, harbor seals, great blue heron, cormorants, humans, and others. The WRAC will participate in studies of predation on salmon and forage fish in hopes of understanding and establishing realistic levels of predation.


Photo by Domonique Lewis.

3. Engage an informed community in identifying, protecting, enhancing, and restoring salmon supporting ecosystem processes and habitats.

Because most of the shorelines are in private ownership, strong voluntary stewardship is critical to protection and restoration strategies. The WRAC knows it is important to educate the community about the habitats used by juvenile and adult salmon, the ecosystem processes that form healthy habitats, and challenges that salmon face and then engage their creative thinking in finding solutions that work for them and for the fish. They plan to do this through development and implementation of a comprehensive strategy for community education and communication activities. Through this they hope to increase community participation in, and commitment to, salmon recovery activities. WSU-Beach Watchers and the Shore Stewards program are two examples of established programs designed to increase and support stewardship of shorelines by private property owners.

It will be necessary to address community concerns about the perceived loss of property rights and undue economic hardship caused by protection and restoration actions. Careful selection of protection, restoration, and enhancement sites in areas that have community support and on public lands will help demonstrate the benefits that can result from salmon recovery actions. Targeting actions in areas that are known to be important for salmon recovery will help satisfy community concerns about the cost-effectiveness of restoration projects.

4. Cultivate a supportive environment for salmon recovery by supporting policies that protect salmon habitats, advocating for adequate program staffing, encouraging cross-sector and public-private partnerships, pursuing adequate, reliable funding, and implementing effective project and program evaluations.

The WRAC plans to continue to play an active and supportive role in the community to help build the infra-structure necessary to contribute to salmon recovery. This includes staffing, seeking regular funding and encouraging cost-effective cross-sector and public-private partnerships. A key component of success will be the development and implementation of a salmon recovery adaptive management program. The program will include a set of ecosystem process and habitat indicators, a system to monitor trends, and regular summaries and reviews by technical staff and decision-makers.

Human Population Growth

The conceptual approach adopted for this plan places the highest immediate priority on protecting healthy nearshore processes and habitats. Voluntary protection actions form the foundation of additional protection actions needed for salmon recovery. This voluntary approach is taken because an underlying supporting condition is the suite of current land use regulations which provide significant protection for habitats that have not been altered. It is not yet clear what combination of regulatory, voluntary and incentive-based programs will adequately protect these areas.

The main strategy for ensuring habitat protection is to educate shoreline landowners about the importance of healthy nearshore habitats. Focusing first on properties slated for development or redevelopment, the WRAC will educate landowners about shoreline regulations and potential development impacts on nearshore habitats, encourage landowner participation in Shore Stewards and forestry programs, educate private property owners on practices that contribute to recovery, and pursue property acquisition in key locations.

Also critical to success will be the development and implementation of a private and public land protection strategy that focuses existing conservation programs (Shore Stewards, PBRS and conservation easements) on key parcels for salmon recovery. Developing an inventory of areas where open space and natural habitats may be subject to land-use conversions, and developing a prioritized action list to address this threat by 2006 will be a part of the acquisition strategy. Maintenance of freshwater and marine water quality will depend on promotion and implementation of pollution prevention strategies by the WRAC, local Conservation Districts, and other local and state agencies.

Harvest & Hatchery

While there are only limited hatchery operations in Island County, there may be negative interactions between wild and hatchery fish caused by these

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and other hatchery programs. It will be necessary for others to research these ecological interactions and share findings that will help those in Island County refine and improve their current habitat strategies. Since Island County does not have jurisdiction over harvest management, it is assumed implementation of regional harvest strategies will aid in salmon recovery.

Results

The watershed plan for the Whidbey/Camano watershed was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan to some extent, but the reviewers felt they merited particular attention or additional effort to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

There are ten Chinook populations whose natal freshwater systems empty into the Whidbey basin. The Skagit River is home to six Chinook populations, the Stillaguamish home to two, and the Snohomish home to two. Together, these ten salmon runs form a key sub-region in the Puget Sound ESU. The results produced by the Whidbey/Camano plan are an important component to minimizing the risk to the overall ESU because most recovering salmon runs elsewhere in the Puget Sound face greater constraints than these populations.

This plan presents a good approach to prioritizing places to protect and identifying priority areas to restore, by determining the importance of habitat types in specific geographic locations. The TRT applauds the use of the conceptual models outlining the hypotheses in Appendix F.

The overall goal stated in the plan is a net increase in healthy estuarine/nearshore habitat, which will benefit salmon significantly if accomplished. Because the habitat strategy is based in large part on implementing protection measures to achieve habitat improvements, the responses of the habitat and Chinook to different protection approaches should be closely tracked. Three of the four supporting goals deal with educating & involving the public and creating a political climate conducive to salmon recovery. The review team commends the Island County Board of Commissioners, the WRAC and the TAG for their commitment to the effort and their work to create a plan that will be implemented.

The plan identifies the need to coordinate with nearby watersheds (the Skagit, Stillaguamish and Snohomish) and the reviewers strongly encourage taking steps soon to implement this idea.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

The following issues will be important to address through the adaptive management program (expected to be completed later this year). The Whidbey/Camano watershed plan is habitat based, though the planners recognize and acknowledge the work being done on hatcheries and harvest in other watersheds. One of the key uncertainties is that it is not clear how the stated habitat strategy relates to the hatchery and harvest management strategies. Specifically, it will be important to the success of this plan to estimate how hatchery fish use the Whidbey/Camano nearshore habitats (e.g., issues of competition and predation, implications of hatchery production, etc.) and estimate the capacity of the nearshore to support hatchery-origin and natural-origin Chinook and other salmon using those waters. Since the plan does not discuss how the food web of Puget Sound (including hatchery salmon, any competitors, prey species or predators) will affect salmon recovery, and what strategies could be used to address these problems these are also important components to include. It is also necessary to design a monitoring program that assesses the response of salmon to recovery actions. Since this plan relies heavily upon existing regulatory and voluntary protection measures, it will be necessary to assess the effects of these measures on the biological results for fish and make adjustments as needed.

The planned strategies and actions will need to be linked to results for fish, the Viable Salmonid Parameters (VSP: abundance, productivity, spatial distribution, diversity)-to describe the expected outcomes from plan implementation. Once the linkage between the ecosystem principles, stressors, and geographic priorities are linked to VSP, then these four parameters can be used as a measure for monitoring.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,

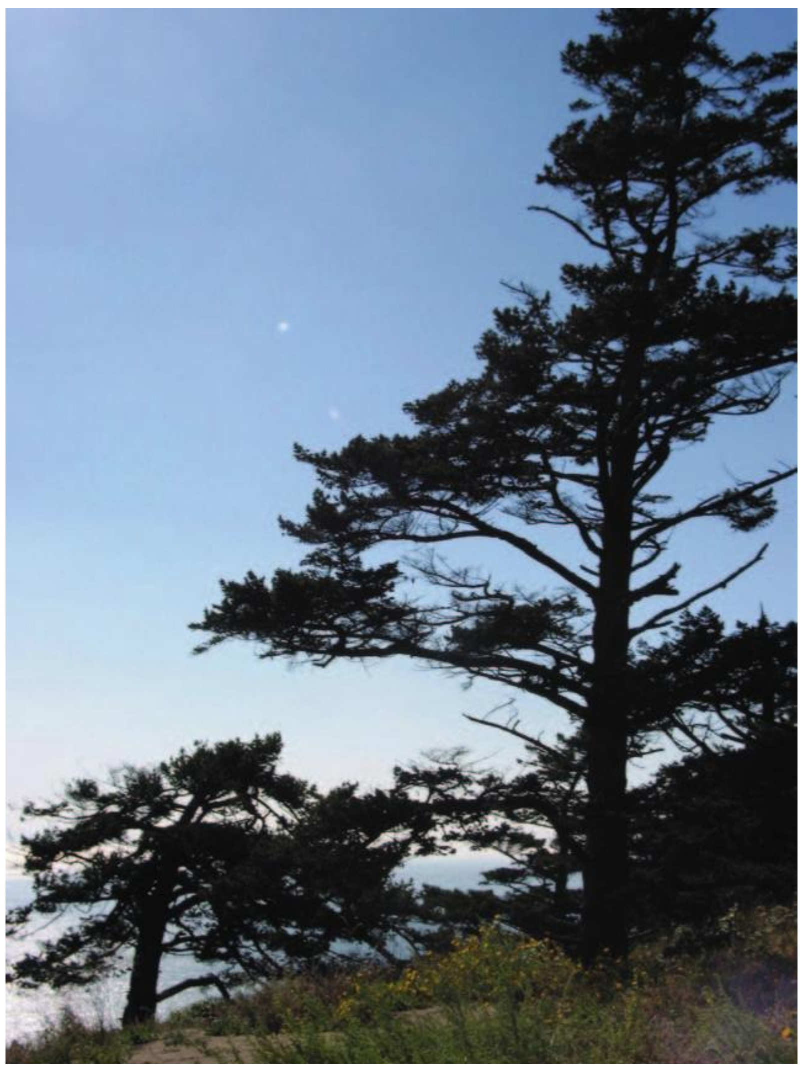

Photo by Domonique Lewis.

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- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the recovery plan is implemented and above uncertainties are addressed, this watershed will make an important contribution to the ability of Chinook salmon in the Puget Sound ESU to reach a recovered state.

Watershed Profile:

Snohomish

The Place and the People

The Snohomish River Basin in east central Puget Sound lies in two counties-Snohomish and King-and covers an area of 1,856 square miles with over 1,700 identified rivers and tributaries. It is the second largest watershed in the Puget Sound. The basin's varied topography ranges from low, rolling terrain near Puget Sound to the steep Cascade mountains along the eastern border.

This watershed has long been known for its enviable quality of life. The quality of life is characterized by attractive job opportunities, fertile agricultural lands and extensive timber resources, diverse outdoor recreational opportunities, vast areas of public land, and abundant natural resources extending from Puget Sound to the Cascade crest.

Streams and creeks in the upper reaches of the Snohomish basin flow through forestlands including the popular Alpine Lakes Wilderness. The Snohomish basin currently retains significant ecological assets that contribute to salmon recovery. Overall, 75% of the basin remains in forest lands or wilderness which contributes to greater hydrologic and riparian function and better sediment conditions than are found in other basins across Puget Sound.


Photo courtesy the Washington State Salmon Recovery Funding Board

The Skykomish River drains the northern Snohomish Basin. Streams originate in the ragged peaks of the Cascade Mountains, and the north and south forks of the river converge in the shadow of Mount Index. The upper Skykomish mainstem is steep. It transports sediment quickly through its narrow, confined channel that is characterized by boulders and numerous rapids. Downstream, toward the cities of Gold Bar and Sultan, the river flattens and the gravel and cobble settle out, forming multiple braided channels and excellent spawning riffles and rearing areas for salmon. From Sultan to Monroe the sediment supply and deposition begins to balance, and the channel becomes more stable. This stretch of river still provides some spawning and rearing habitat for Chinook. Here the river bank is significantly armored. This armoring protects adjacent land uses from erosion, but it also isolates the main river from off-channel habitats that are important for rearing. Rural communities retain their small town charm.

The Snoqualmie River and its tributaries drain the southern Snohomish Basin. Like the Skykomish, the Snoqualmie begins in the Cascade Mountains, although it is not glacier fed. Snoqualmie Falls, one of the best-loved scenic treasures in Washington State, divides the steep upper reaches from the low-gradient river that eventually joins the Snohomish River. The Tolt and Raging Rivers are both major tributaries to the Snoqualmie. The Tolt is critical for contributing gravel that is important for Chinook spawning habitat, and the best spawning habitat in the Snoqualmie is found at the mouths of both of these rivers. Gliding past the communities of Carnation and Duvall, the Snoqualmie winds through productive farms and rural residences, where river banks have been hardened and the river straightened.

Formed by the confluence of the Skykomish and Snoqualmie Rivers, the mainstem Snohomish River flows through a broad valley and multi-threaded delta for 21 miles on its journey toward the Sound. Some of the best farmlands remaining in Western Washington flank the Snohomish and the lower portions of its two major tributaries, the Skykomish and Snoqualmie Rivers. Portions of the Snohomish have been straightened and the banks have been armored, particularly in the lower river. The upper end of the Snohomish River provides important spawning habitat for the Skykomish Chinook and holding and rearing habitat for both the Skykomish and Snoqualmie Chinook populations and many other species of salmon.

As with many large rivers in the Puget Sound, urbanization has caused a loss of off-channel habitat such as oxbows. This is important salmon rearing habitat and provides fish shelter from major flood events. Reconnecting access to those channels for fish in the lower river is part of a suite of mainstem actions that include restoring bank edges and riparian forests, opening access to side channels and creating logjams in strategic locations. Recovery planners can build on successful restoration efforts to date by continuing to work effectively with farmers and other private landowners.

Before reaching the sound, the Snohomish River flows through the estuary. In addition to providing habitat for rearing and returning salmon, the estuary is also home to at least 350 different kinds of birds and countless varieties of mammals and plants, including blue heron, eagles, osprey, seals and

Key facts:

Forest lands and wilderness cover about 75% of the basin; 5% is agricultural. Urbanization is concentrated near the estuary.

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Located in King and Snohomish counties, towns and cities in the watershed include Carnation, Duvall, Everett, Granite Falls, Gold Bar, Index, Lake Stevens, Marysville, Mukilteo, Monroe, North Bend, Skykomish, Snohomish, Snoqualmie, and Sultan.

▪

The Tulalip Reservation is located north of the Snohomish estuary.

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The Snohomish Basin is one of the fastest growing areas in Puget Sound with projected population growth of 59 percent from 2000 to 2030.

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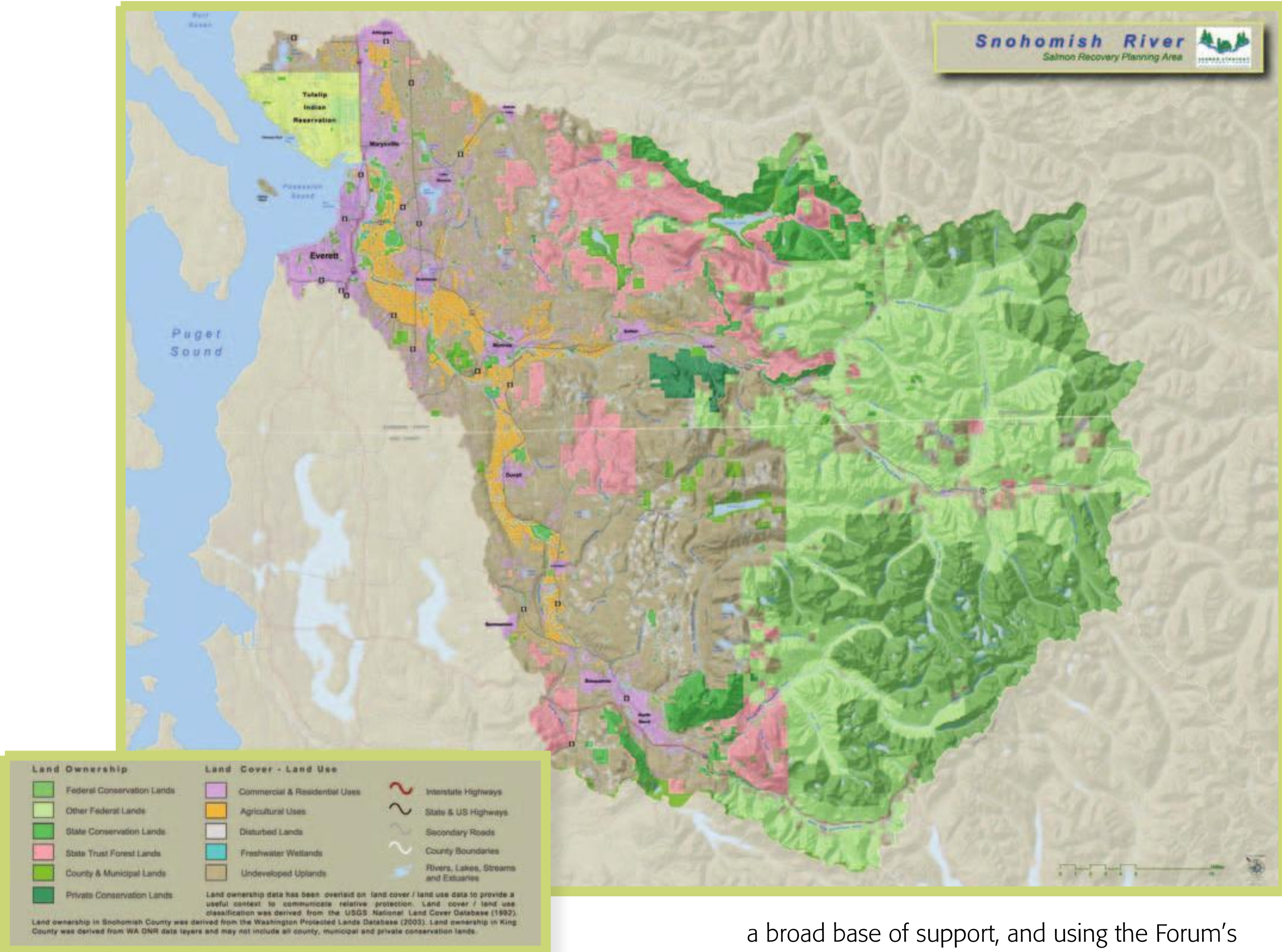
The planning area for the watershed under the state Watershed Management Act is Watershed Resource Inventory Area (WRIA) 7



otter. As the tide rises and falls, saltwater extends about 15 miles upstream of the actual river mouth. Estuaries benefit people by acting as a natural filter that cleans water before it passes into the Sound, and also like a giant sponge, absorbing and slowing floodwaters. The Snohomish estuary is also a place where people from throughout the Puget Sound can watch birds and appreciate the scenic beauty of our region. The Snohomish River empties into Puget Sound north of Everett, the region's third largest city and a major industrial and commercial center that includes the Port of Everett.

The Snohomish Basin Salmon Recovery Forum (Forum) uses an inclusive process, with representation from many sectors including local governments, tribes, farmers, businesses, non-governmental organizations and citizens. The Forum has a broad base of support, and using the Forum's guidance, members and other partners have demonstrated success in completing restoration and protection projects. One of the Snohomish basin's strongest salmon recovery assets is participation from the Tulalip Tribes and the Washington Department of Fish and Wildlife, who work together to co-manage salmon harvest and hatchery production, and to protect and restore habitat. Developing actions that best mix the immediate benefits from changes in harvest and hatchery practices with longer term improvements to altered habitat conditions will move the Snohomish salmon more quickly toward a healthy state.

Achieving their goal of healthy salmon runs will require sensitivity to the needs of both the people and fish that live in the Snohomish basin. The people of the Snohomish basin are committed to meeting the challenge, and have already begun.

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Since 1998, governments and organizations including Snohomish County, King County, the Tulalip Tribes, City of Everett, Cascade Land Conservancy, Stilly-Snohomish Fisheries Enhancement Task Force, Washington Trout and others have completed approximately 100 projects. The people and organizations care about the place they've inherited, and believe that with innovative solutions both human needs and salmon can be supported. They know that their river basin is a valuable resource that contains a thriving urban center that supports a diverse community, forestry and farming activities that help preserve the rural way of life, and wilderness areas that preserve ecological functions and provide recreation opportunities. This combination of urban, rural and wild is perhaps the Snohomish basin's greatest strength: there is a large enough urban center to provide significant scientific and planning support, while the basin retains the ecological assets and opportunities for restoration upon which the Forum can build its recovery effort.

Photo courtesy Snohomish County.

The Snohomish Salmon

The Snohomish watershed is home to threatened Chinook and bull trout, as well as declining coho salmon runs. Populations of chum, pink, sockeye salmon, and steelhead, rainbow, cutthroat trout, and mountain whitefish also inhabit the Snohomish system.

Chinook rely primarily on the Snohomish and the lower Skykomish and Snoqualmie Rivers for spawning and rearing. The Snoqualmie and Skykomish Rivers are each home to one spawning population of threatened Chinook salmon and the Snohomish River provides essential habitat for both as they migrate up and down the river. These populations, along with those in the Skagit and Stillaguamish rivers, form the backbone of Chinook populations in Puget Sound.

The Skykomish Chinook population spawns in the Skykomish and Snohomish Rivers and their larger tributaries. The Snoqualmie Chinook population spawns in the Snoqualmie and its larger tributaries. The highest concentrations of spawning Chinook in the Snohomish system are currently located in the Skykomish.

Coho, on the other hand, spend much of their freshwater lifecycle in the smaller tributaries of major rivers. Coho are relatively abundant compared to the Chinook in the Snohomish watershed, which offers hundreds of miles of high-quality habitat in its middle and upper reaches. In fact, the Snohomish is home to the largest population of wild coho of any watershed in the Sound, though recent impacts to these areas have resulted in declines in the populations.

There are four bull trout populations in the Snohomish Basin: North Fork Skykomish, South Fork Skykomish, Salmon Creek, and Troublesome Creek. They can be found throughout the Snohomish River basin, generally downstream of barriers that block the passage of fish swimming up river. Unlike other salmon species, bull trout can migrate between fresh and saltwater several times in their lifetime, making migratory corridors between upland and lowland areas critical.

Three of the four populations of bull trout migrate to the estuary and nearshore for the spring and summer, and immature fish use the lower reaches of the Snohomish River from Ebey Slough to Thomas' Eddy during the winter months. Mature adult fish migrate all the way upriver to spawn primarily in the Upper North Fork Skykomish River and its tributaries, as well as in the Foss River above Sunset Falls, which is accessible only by a trap and haul system. Recent surveys by the US Fish & Wildlife Service indicate that the number of bull trout redds (nests in the gravel where they lay their eggs) are increasing.

Recovery Goals

The Forum has set a long-term vision for the future and has identified the need for a significant level of habitat improvement in the next 10 years. They believe that this is the time to be bold because there is a window of opportunity to maximize habitat recovery efforts while funding is available, ocean conditions appear to be favorable, and because harvest and hatchery management actions have improved. The Forum created a thoughtful, cost-effective plan that focuses on the areas where measurable progress toward the fish population goals stated below can be achieved. By supporting both people and fish through innovative solutions, the Forum has affirmed the importance of maintaining and sustaining agriculture and forestry in the basin, protecting the health and safety of those who live there, working cooperatively and respectfully with landowners, and enhancing the conservation ethic that supports both salmon recovery and healthy ecosystems in general.

Fish Population Goals

Scientists on the Puget Sound Technical Recovery Team have established four parameters for healthy salmon populations: abundance, or the number of fish in a population at any given time; productivity, or that population's ability to replace itself or grow

Population	Average Number of natural origin spawners (1996-2000)	Planning Targets	
		Low Productivity	High Productivity
Skykomish	1,700	39,000 (1.0)	8,700 (3.4)
Snoqualmie	1,200	25,000 (1.0)	5,500 (3.6)

with the next generation; spatial structure, or the amount and variety of habitat salmon occupy in a river; and genetic diversity, which makes the populations better able to survive and adapt to disease and other challenges. As salmon recovery actions are taken over time, these parameters provide a means to measure their success.

The Forum has adopted the following planning targets set by the tribes and state of Washington for abundance and productivity. These are approximately 50 year goals. Low productivity represents one fish returning from the ocean for every adult that spawns; high productivity represents an average of three and a half fish for each adult spawner.

Bull Trout

For the three bull trout populations that migrate down rivers and may move into the marine environment seasonally, the US Fish & Wildlife Service set the following recovery goals as best estimates for what is required to reduce their risk of extinction: Each migratory population needs to have greater than 100 adults, and the total number of adult bull trout in the Snohomish system should equal 500. The remaining bull trout population is considered resident, meaning those fish do not migrate from the place where they hatch; this population does not have recovery targets.

What is the current status of the Threatened Salmon populations?

Chinook

Since the late 1970s, the Skykomish population has experienced a steep decline in total number of fish. Between 1999 and 2003, the Skykomish population has averaged about 1,755 natural-origin fish that return to the river to spawn, and the Snoqualmie has averaged approximately 1,776. Together this means that the populations are at approximately 3.4% and 5.7% of their historic numbers respectively. These numbers do not include hatchery fish that return to the natural spawning ground; when hatchery fish are included, the number rises to 4,099 for Skykomish and 2,245 for the Snoqualmie. The Skykomish run has the highest recovery target for abundance of those set for Puget Sound Chinook populations; the Snoqualmie run has the third highest target.

Bull Trout

The total number of bull trout in the Snohomish Basin is unknown, though it is believed that only one migratory population has greater than 100 individuals.

What are the key factors contributing to the current status of the populations?

The Snohomish basin has been altered significantly since Europeans began moving into the area. Early settlers recognized that the expansive floodplains, rich with sediment and organic material, would make for excellent farmland. They cleared the land of lowland forests, and created dikes along the river to prevent floodwaters from sweeping over the new fields. At the same time, they cleared the large log jams out of rivers to make transportation by boat easier. Over time, the basic ecological processes that form habitat that salmon depend on were altered. This means that there is less habitat for salmon to use and the quality of some of the remaining habitat is reduced. This is because many of the processes that create those habitats no longer exist or are greatly diminished. In spite of these changes, the ecological integrity in the Snohomish basin is still relatively intact and scientists and the community see a path to restoring these watershed processes and salmon habitats.

Several factors are significant to address in the Snohomish Basin. Juvenile salmon, particularly

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Chinook, rear in mainstem margins, and need high quality habitat. The loss of rearing habitat quantity and quality is the primary factor affecting population performance and so processes and habitats that support this life stage are key restoration priorities. The following list represents factors that have been degraded across the basin. The impact these losses have on salmon recovery vary within the basin and are addressed through the Plan's geographically focused recovery strategies. Losses include:

1. Loss of estuarine and marine habitats due to residential and industrial development and urbanization. The mouths of rivers were convenient places to locate cities and factories when the primary source of transportation revolved around moving people and cargo on ships;
2. Poor quality riparian forests and decreased forest cover as a result of clearing land for timber, farming, road building, and residential and urban development;
3. Lack of habitat complexity that provides pools and back-eddies, providing homes for insects and small fish, and therefore food and refuge for salmon. For example, logjams create important in-stream habitat. In the past, thick forests grew along the banks of river systems, providing a source of large woody debris. Before the river was restrained and confined to one channel, natural bends and sand banks would create hang-ups for these logs and branches as they swept downstream.
4. The loss of hydrologic function. Flood flows now scour nests of eggs and sweep young salmon downstream before they're ready, because the river can no longer overflow its banks and spill out across its historic floodplain.
5. Loss of floodplain function. This includes a loss of wetlands and off-channel habitats These changes have occurred through diking and draining activities, bank hardening, urbanization and residential development.
6. Disruption of sediment processes that create and sustain high quality habitat over the long-term.
7. Access to habitat is critical for salmon and is often blocked by poorly designed culverts and other human-made structures.

Other concerns that are not yet considered high restoration priorities across the basin are low flows and water quality.

While degradation in the above areas has already occurred, much habitat remains forming the foundation for restoration and enhancement actions.

Future Threats

The Snohomish River Basin is among the most rapidly growing regions of the Puget Sound at 59 percent projected population growth from 2000 to 2030. Areas along the mainstem rivers in some locations and along some lowland tributaries are most likely to be affected by growth and development pressures.

As people continue to move to the area, how and where development takes place across the basin will have a tremendous impact on the ability of Chinook and bull trout to recover. Once wild

Photo courtesy Snohomish County.

Photo by Dan Kowalski

or working lands are converted to residential and urban areas, forest cover and ecosystem processes are altered or lost. The change is almost always permanent. New buildings, roads, and infrastructure bring with them impermeable surfaces like rooftops, parking lots, and asphalt. This makes rainwater less able to soak into the ground, and as it runs off, contaminants like oil and pesticides can be carried into streams. However, growth can occur in a manner such that it minimizes impacts to salmon habitats. The Forum recognizes that growth will occur and provided information in the plan that shows where growth overlaps with salmon recovery needs. This information provides a tool that helps decision-makers and those planning in the basin to think strategically and realistically about salmon recovery.

The threat of growth potentially affects planning in all geographic sub-basins. The following are known areas of overlap.

Nearshore: Possible residential development north of Priest Point, and development of the Maulsby mudflat, marinas and piers (both new and modified) are potential actions that could degrade existing nearshore habitat.

Estuary: Further loss of habitat could result from development within the urban growth boundary, which extends into portions of the estuary downstream of I-5. Further expansion of the I-5 corridor to include a carpool lane in both directions is scheduled to begin in 2008.

Snohomish, Skykomish, and Snoqualmie mainstems: Urban zoning comprises approximately 8% of the land area, and will absorb future growth in the Snohomish basin. The cities of Monroe, Sultan, Gold Bar, Duvall and Carnation are located near high quality spawning grounds. If current trends continue, in 25 years forest cover could drop by 10% and impervious surface area could increase by 4%.

Modeling suggests that the rate, timing, quantity and quality of water will continue to change as a result of population growth and climate change. While not listed in the top tier of current limiting factors described above, flows are a current factor negatively impacting salmon and bull trout in some years and locations. Known locations of flow issues, suspected causes and timing of problem are documented in the current Snohomish Basin recovery plan. Forty-four streams are listed as having low flow problems, where at times there isn't enough water to support healthy fish. There is also concern

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about whether flows will be adequate for salmon because the population served by the Snohomish system is expected to grow from 965,000 to 1,390,000 by 2020 resulting in an increased water demand by 53 million gallons per day.

Overall Approach to Recovery

The Snohomish Basin Salmon Recovery Forum's approach to salmon recovery is to structure goals, strategies and actions around specific groups of geographic areas in the basin, rather than broader limiting factors. The Forum has divided the basin into five major groups of sub-regions, described as the nearshore, estuary, mainstems, lowland tributaries (including urban areas), and headwaters.

The Forum chose this approach for several reasons. Salmon and bull trout populations are not distributed uniformly across the landscape, so identifying areas of high and potential salmon use helps to direct scarce resources where they will have the greatest effect. In addition, sub-basins within these broader geographical groups play similar roles in supporting salmon, have similar physical features, and share similar land use issues. In this way, goals, strategies and actions can be tailored to different life stages of Chinook and bull trout according to the unique challenges and potential partnerships present in each place. This geographically specific approach helps people and governments clearly understand their roles and responsibilities in salmon recovery. It also provides tools for planners, decision-makers and those with regulatory authorities to use when weighing priorities, updating growth management and shoreline regulations, and developing best management practices.

The Forum recommends that most of the resources for capital projects focus on improving the amount and quality of habitat in nearshore, estuary, and mainstem portions of the rivers. Improvements in these areas will allow for rapid gains in the Chinook populations and provide visible results that can be seen by the community. The Forum's recommended strategy is to focus restoration in areas that have local support, have a high potential for restoration of habitats and the processes that naturally create and maintain them, and can provide significant gains for abundance, productivity, spatial structure and diversity.

Actions in these areas alone will not produce viable Snohomish populations in the long-term. Protecting and enhancing spawning areas and improving egg survival within large tributary sub-basins will also be necessary. Thus, the Forum's approach also includes actions to minimize habitat losses and make habitat gains through restoration throughout the rest of the Snohomish basin. This includes focusing actions on areas that improve habitat complexity and connectivity near and downstream from Chinook spawning grounds. The Forum chose this overall approach because it targets actions in areas where they will make the most difference for Chinook, spreads actions across the basin, involves many people, and is designed to help improve habitat for other salmon such as coho.

Photo courtesy the Snohomish Conservation District.

Recovery will be implemented through three major areas: capital projects, regulatory and policy actions, and programs and technical assistance. The existing salmon recovery planning structures of the Snohomish Basin Salmon Recovery Forum (the Forum itself, Policy Development Committee and the Snohomish Basin Salmonid Recovery Technical Committee), will be used to track implementation and effectiveness of actions and will refine the plan's hypotheses, strategies and actions as necessary to improve overall effectiveness.

Key Strategies and Actions Supporting the Overall Approach to Recovery

The following describes each of the key geographic areas selected in the overall approach, linking salmon use of the area, specific factors limiting recovery and the strategies and proposed actions for addressing the factors. The Forum set overall habitat milestones for the estuary, nearshore, mainstems, and lowland tributaries for the year 2015. These measure the cumulative result of protection and restoration actions. Restoration goals are based on the assumption that protection efforts will prevent further habitat loss.

Nearshore: The nearshore is defined as the strip of shoreline that extends from the top of the bank or bluff into the water to a depth of about 30 meters. The nearshore zone is important to salmon for many reasons: it provides a place for juvenile salmon to hide, feed, and grow in preparation for their journey in to the Pacific Ocean, it serves as an important migratory corridor for salmon as they leave for and return from the ocean, and it provides habitat that supports the food that salmon eat, like marine insects and forage fish.

The nearshore in the Snohomish basin is considered moderately degraded. About 40% has been hardened by rocks and cement bulkheads. Development and modification of the shoreline have caused plant and animal species that salmon depend on to decline. A significant portion of this is due to the presence of the Burlington Northern/Santa Fe railroad which runs along four miles of the beach. Bulkheads that protect the tracks and other property from erosion, docks and piers along the industrial waterfront, and dredging have affected the natural erosion processes that feed and form beaches, impacted the quality of riparian conditions, and degraded inter-tidal conditions. Low quality riparian conditions alter large woody debris recruitment, shading, and contributions of leaf litter and insects to nearshore salmon and forage fish habitat. Forage fish like sand lance and surf smelt lay their eggs in the gravel along the upper beach; in areas that lack a shady riparian zone, eggs can have a harder time surviving.

Modifications to the shoreline have also reduced low gradient beaches from Preston Point to Mukilteo and from Priest Point to Kayak Point. The shallow water edge environment is especially important as feeding and refuge areas for juvenile salmon, as well as migration pathways.

The most important focus for the nearshore is to increase survival of juvenile Chinook. The Snohomish Basin Salmon Recovery Forum recommends that the best way to do this is by focusing on protecting and restoring shoreline conditions, restoring the natural sediment transport processes, and protecting habitats like eelgrass and kelp beds, as well as the freshwater and saltwater processes that create and support them. Existing WDNR regulations protect known eelgrass habitat and kelp beds, and the beach forming processes that create and support them will be improved where possible. This will be accomplished by removing shoreline armoring, using more ecological designs to protect property instead of riprap and traditional bulkheads, and restoring beaches with sediment harvested during dredging activities. By re-connecting naturally eroding feeder bluffs to the marine environment, beaches will be nourished with a natural source of sediment, and by removing barriers like bulkheads, structures, and piers, wave action will again transport sediment to form beaches. Where possible, native plants should be planted between the railroad tracks and the Sound and on private property. The Forum recommends that protection efforts focus on undeveloped areas predominately located north of Priest Point, in particular forage fish spawning beaches and bluffs that provide beach-forming sediment.

Specific proposed ten year actions include gaining at least 1 mile of shoreline that provides both juvenile rearing habitats and the landscape processes that create and support them. The Forum recognizes that it may be difficult to achieve the longer term goals for the nearshore. While additional restoration in the estuary may help offset the lack of opportunities in the nearshore, the habitat functions provided by the estuary will be different from those in the nearshore.

Estuary: The Snohomish estuary is among the most productive in the region, even though its health and productivity have been greatly diminished. Agricultural and urban development have significantly changed naturally functioning estuarine habitat. The estuary is considered to be degraded, with a loss of 85% of the historic tidal marsh area, two-thirds of the channel edge along the mainstem and distributary channels hardened, and only 11% of the channel containing intact riparian areas. As a result, there are many significant losses for salmon. Off-channel habitats that provide places for juvenile fish to feed and grow have been greatly diminished; areas of tidal exchange where they transition from freshwater to saltwater have been lost; healthy shoreline conditions, including riparian cover for shelter, shade, and a source of large woody debris have decreased. The Interstate-5 corridor runs through the upper portion of the Snohomish estuary, creating a significant constraint to the processes that form habitats and for restoration.

With directed effort, the Forum believes gains can be made in the estuary that support all of the parameters that contribute to strong and healthy salmon and bull trout populations. The Forum's recommended strategy is to restore habitat and habitat forming processes through actions that reconnect estuarine tidal marsh, protect remaining functioning habitats or maintain restoration opportunities in the lower estuary where development pressure is high. Approximately 50% of the estuary (over 2,700 acres) is publicly owned by Snohomish County, The Tulalip Tribes, City of Everett, City of Marysville, Port of Everett, and Washington State Department of Fish and Wildlife who are all active Forum participants.

Opportunities exist for large and complex projects in the estuary. Proposed actions include protecting existing critical estuarine habitat, and gaining 1,237 acres of tidal marsh habitat through restoration and acquisition. This can be done by reconnecting large blind tidal channels and sloughs isolated behind dikes, and improving connectivity between channels, sloughs, and marshes that provide rearing habitat for juvenile salmon, filter water, and absorb flood level flows. The Forum recommends that actions be directed at restoring the habitat on existing public lands first, where habitat gains will be highest and where existing projects can be expanded.

Another strategy for improving the estuary is to pool restoration and mitigation funds to create larger and more effective projects at lower cost. For example, the Interstate-5 expansion could be coordinated with proposed restoration projects resulting in substantial cost savings and habitat improvements.

Mainstems of the Snohomish, Skykomish, and Snoqualmie Rivers: The mainstems of all three rivers are considered to range between moderately degraded and degraded, although the Snohomish and Snoqualmie watersheds are more impacted than the Skykomish. Dikes, bank armoring, roads, railroads, and bridges confine these mainstem rivers, disconnect off-channel habitat, reduce edge habitat complexity, and increase peak flows downstream. Combined, 82% of the off-channel sloughs and ponds have been disconnected from the rivers, and are no longer available for salmon. Forty-four miles of dikes isolate the river from the floodplain, and subsequently Chinook smolt production has decreased. Several thousand acres of marshy wetland, particularly in the lower Skykomish and Snoqualmie Rivers, have been disconnected, and channels lack pools and side channels, partly because there are low levels of large woody debris and logjams. Riparian forest cover has been substantially degraded as people have cleared the land for other uses.

Excessive erosion of stream banks, culverts that block fish passage on small streams, and degraded water quality (including high temperatures, low dissolved oxygen, high fecal coliform counts, and high levels of toxic metals,) all diminish the ability of salmon to thrive in the Snohomish basin, though the extent of these impacts is currently unknown.

Major improvement of habitat conditions within the mainstem rivers are necessary to ultimately reach the salmon recovery goals. Mainstem rivers need to have more room to move, overflow their banks, recruit large woody debris from healthy riparian forest, and form pools. If improvements are achieved, both abundance and productivity for Chinook are expected to improve.

The long-term strategy is to reduce further degradation of the mainstem rivers by protecting existing healthy habitat, and restoring the connection of rivers and floodplains This will improve improve wood recruitment from riparian areas, and enhance channel complexity within and upstream of spawning reaches. This can be done, in part, by increasing enforcement of existing regulations to protect those processes. Dike setback and innovative armoring will allow river channels to shift from side to side, increasing the amount of off-channel habitat available for juvenile fish while still protecting farms, homes and businesses from flood events. Planting trees and native vegetation along the channel margins will provide better habitat along the river edge, contribute large

Photo courtesy Snohomish County.

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woody debris, provide shade, and buffer the river from adjacent land uses. The Forum recommends that significant improvement be made in all three river systems. The Forum believes that this can be accomplished by building on the existing cooperative effort between local landowners, community organizations and governments to implement proposed projects and regulatory and incentive programs.

The ten year proposed mainstem actions are to gain 10.4 miles of restored river edge habitat, 256 acres of riparian habitat, 41 logjams and 167 acres of off-channel habitat. The plan also includes recommended gains for riparian forest cover and off-channel habitat in slightly lower priority mainstem areas.

Lowland Tributaries and Headwaters

Similar challenges face the lowland tributary streams and rivers. Urban streams are highly degraded for Chinook and bull trout functions, facing even higher surface and stormwater run-off, and increased water quality problems. High in the headwaters, road densities of 3.4 to 1 miles per square mile change the way that the upland forests drain, and feed sediment into salmon bearing rivers. Poorly constructed culverts block fish access and stream forming processes. In the rural and urban tributaries, as well as the headwaters, recommended actions focus on protecting existing healthy habitat and habitat forming processes, and restoration activities will be directed towards improving riparian forest cover and improving watershed processes. The plan includes habitat milestones for riparian forest and off-channel habitat in lowland tributaries.

Additional key strategies covering the entire basin include:

Protect existing habitat

Preservation of habitats and habitat forming processes are needed across the entire salmon migratory journey. The Forum recommends that existing habitat and watershed processes be protected through a variety of tools and creative solutions. These include regulatory programs, acquisitions, voluntary and incentive stewardship programs, and public education. Habitat goals were established for 2015. These goals can be reached through a combination of protecting of current habitat and restoration. Restoration milestones were set assuming the protection of current habitat.

Snohomish County is currently updating their development regulations. Information from the Snohomish Basin Salmon Conservation plan was used to help develop science-based policy recommendations. King County recently updated their regulations and improvements to protection are expected from these changes.

The goals of the Growth Management Act's Critical Areas Regulation (CAR), Shorelines Management Programs, and a variety of incentive and voluntary programs overlap with those planning for salmon recovery. Thus the opportunity exists over the long-term to increasingly coordinate updates to regulations and other programmatic tools with salmon recovery planning efforts. The Forum has provided salmon-habitat focused guidance that local governments can consider during their updates. Commitments have been included in the plan that show many Forum members have considered or are considering these recommendations in their update processes.

High and Low Flows

Current information about flows is included in the plan and preliminary analyses have identified low- and peak-flow problem areas. The Forum has identified steps that would need to be taken to more completely address this in the future. The group has discussed working cooperatively to address water quantity as it relates to salmon recovery.

Harvest management strategy

There has been a significant change in how harvest is managed. Historically, harvest rates on the Skykomish and Snoqualmie were nearly 80%

and probably exceeded the harvestable surplus of Chinook, contributing to the observed decline in numbers of fish returning to the spawning grounds. There is currently no fishery (tribal, commercial or recreational) that targets wild Skykomish or Snoqualmie Chinook. Harvest rates on Chinook from the Snohomish basin have been reduced to 20-30% which represents fish caught incidentally during fisheries that target other species, hatchery Chinook, and mixed stocks. This has resulted in increased numbers of fish that return to spawn. The goal of harvest management is to maintain fishing rates low enough (24%) so that wild Chinook can take advantage of the habitat that has been or is being protected. Over time, this will allow the populations to expand. In addition, controls on the timing and location of fisheries targeted toward hatchery fish will help minimize the incidental harvest of wild fish.

Hatchery management strategy

Hatcheries are now being managed to minimize impacts on wild fish. Changes made to the two Snohomish programs include using only in-basin broodstock, limiting the location and timing where broodstock can be collected, and establishing a numeric range of local broodstock that will contribute to the hatchery program. Hatchery fish provide opportunities for commercial and sport fishing, as well as ceremonial and subsistence harvest while wild Chinook are rebuilding toward harvestable levels.

Keep working lands in business

Farming is a major land use along mainstem rivers and tributaries and forestry comprises a significant portion of the basin. The Forum recognizes that well-managed farms and forests offer more and better quality salmon habitat than urban areas and fragmented rural residential development. It is important to the Forum that these land uses remain viable and sustainable in the Snohomish basin.

Setting back dikes and removing armoring, re-connecting the river to side-channel habitats, replanting riparian forests, and implementing agricultural best management practices will provide the greatest returns in population performance of any restoration actions in the freshwater environment. The Forum recommends working with willing landowners on habitat protection and restoration by providing technical assistance, creating incentives, sharing costs, and recognizing their efforts.

Similarly, loss of forest cover is one of the greatest risks in the Snohomish River basin due to pressures on private lands to convert to non-forest uses such as rural residential development. Maintaining viable and sustainable forestry will help retain forest cover and retain watershed processes that will, among other things, protect flows. Recent improvements to forestry practices are anticipated to improve the 75% of the basin that is in federal, state or private ownership. The Forum recommends sharing information with forest managers such as the US Forest Service, the Washington Department of Natural Resources, and private landowners to help ensure that the priorities in the plan are being addressed. The Forum recommends that rural residential development occur in ways that maintain existing forest cover, and that forest cover be restored in urban areas where possible.

Photo courtesy the Snoqualmie Watershed Forum.

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Results

The watershed plan for the Snohomish was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan, but the reviewers felt they merited particular attention to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

The two Chinook populations in the Snohomish River basin belong to a group of ten populations in the Whidbey basin. The Skagit River is home to six Chinook populations, and the Stillaguamish is home to two. Together, these ten salmon runs form a key sub-region in the Puget Sound Evolutionarily Significant Unit. The potential for early success in moving populations out of high risk in the Whidbey Basin is an important component to minimizing the risk to the overall ESU because salmon runs elsewhere in the Puget Sound face greater constraints. The TRT and interagency committee believe, based on the Snohomish Recovery plan and substantial letters of commitment and endorsement, that the Snohomish River has the potential to support robust populations of salmon once again and plays a key role in Puget Sound recovery.

The Snohomish Basin Salmon Recovery Forum has created a comprehensive plan that will start these populations on a strong trajectory toward recovery over the next ten years. The Forum has a solid understanding of the conditions needed for recovery, and has made a good connection between underlying habitat forming processes, the habitat function that results, and the response of salmon population to the improvements. The plan is particularly strong in terms of protecting and restoring the estuary and historic floodplain, where juvenile salmon feed and grow.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

While the first ten-year action plan starts this watershed down an improvement trajectory, it will be necessary, through their adaptive management and monitoring program, for the Snohomish Forum to identify over the long-term what comes after the completion of the first ten years of this plan.

Given the relative importance of these Chinook runs to the ESU, and given the human population pressure that the Snohomish basin will receive in the coming years, the reviewers feel that there is uncertainty this plan will provide sufficient protection for existing healthy habitat and habitat forming processes. If salmon recovery is to succeed, the people of the Snohomish basin will need to "hold the line" regarding loss of habitat and process function to development and urbanization. This is especially true in the lower river where development pressure will be greatest, in the tributaries where the potential loss of forest cover is high, and in the headwaters where there is a reliance on maintaining hydrologic and sediment function. The results of existing protection regulations are uncertain throughout the Puget Sound and an approach to increasing certainty is provided in the Protection section of this plan.

Reviewers cited the importance of developing a program to address the impacts and limitations from low flows in this watershed. They understand that the Forum has identified the steps needed in order to address low flows in the next several years. In the meantime, it will be important to determine if the current instream flows are protected and to describe how the restoration strategy will accommodate full hydrology concerns.

It will be important to continue research on hatchery and wild fish interaction in the lower river and nearshore marine habitats.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

The TRT and interagency committee believe, based on the Snohomish Recovery plan and substantial letters of commitment and endorsement, that the Snohomish River has the potential to support robust populations of salmon once again and plays a key role in Puget Sound recovery. If the carefully crafted actions in the Snohomish Basin Salmon Recovery Forum's plan are implemented, and the above uncertainties are addressed, this watershed and its two Chinook populations provide a critical foundation for the recovery of the Puget Sound Chinook ESU.

Watershed Profile:

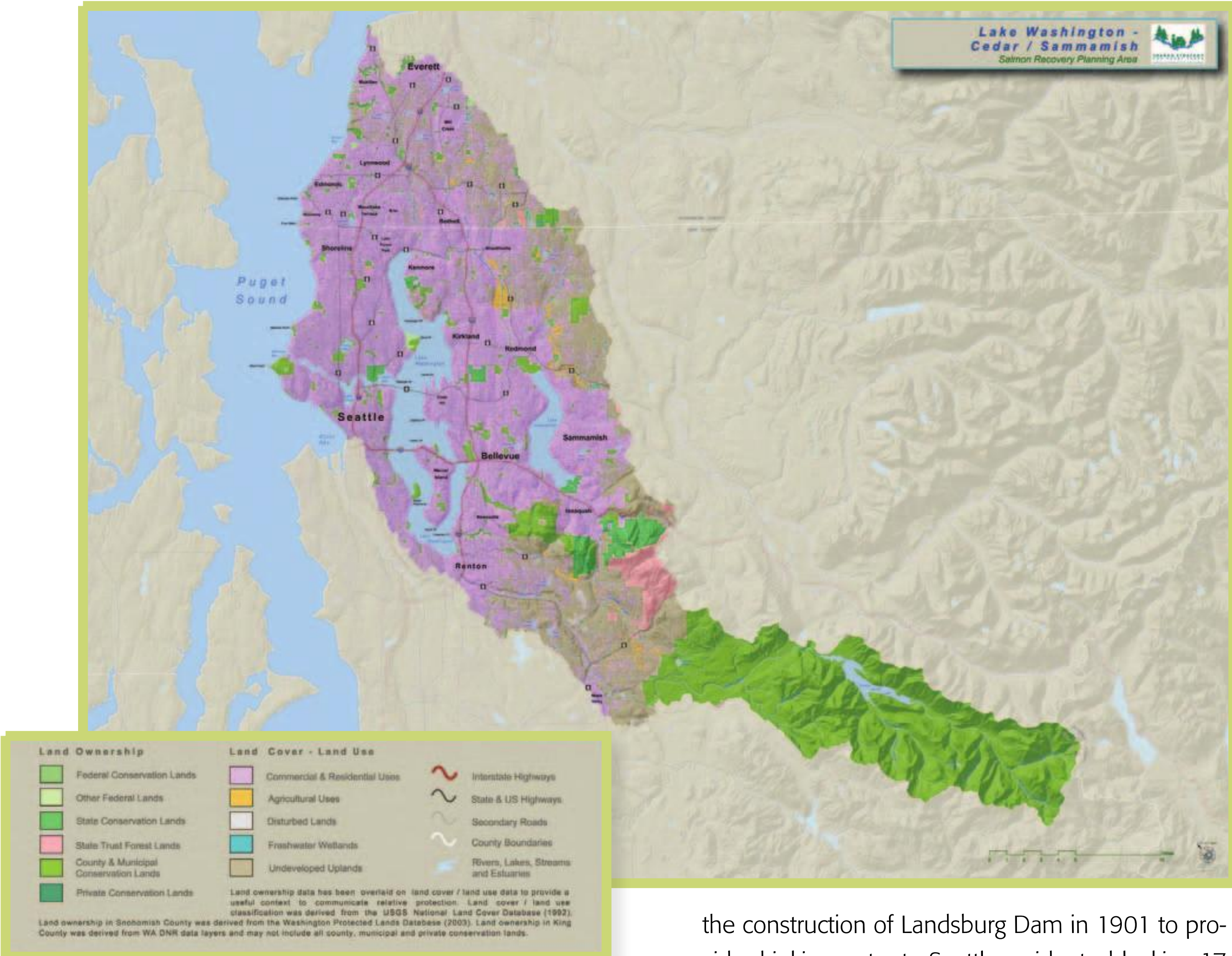
Lake Washington/ Cedar/Sammamish

The Place and the People

The Lake Washington/Cedar/Sammamish watershed contains two major river systems-the Cedar and the Sammamish-and three large lakes. Lake Washington, which has 80 miles of shoreline, including about 30 miles along the shore of Mercer Island, is recognized as the second largest natural lake in the state of Washington. The salmon recovery planning area includes Lake Sammamish, numerous creeks, including Issaquah and Bear creeks, and a number of small watersheds that drain directly to Puget Sound between Elliott Bay and Mukilteo. The watershed is located predominantly within King County's borders, with about 15% of its area in Snohomish County. It is bounded on the west by Puget Sound. To the east, the headwaters of the Cedar River reach the crest of the Cascade Range near Stampede Pass. Nestled between the Snohomish/Snoqualmie and the Green/Duwamish watersheds, the northern and southern boundaries follow hilltops, ridges, and plateaus that define the drainage divides.

The Lake Washington/Cedar/Sammamish watershed is dramatically different from what it was in the past. Not only is it highly developed and urbanized, its waters and rivers have been re-routed and significantly altered from historic conditions. For example, before the Hiram M Chittenden Locks (Ballard Locks) were built in 1916, Lake Washington drained into the Black River which joined the Duwamish River and emptied into Elliott Bay. When the Ship Canal opened, the level of the lake dropped by about nine feet, draining wetlands along much of the shoreline, and changing the flow of tributaries into

Photo by Domonique Lewis.



the lake. The Ship Canal became the lake's sole outlet. Also during the Ship Canal's construction, the Cedar River, which used to flow into the Black River, was diverted into Lake Washington.

The level of Lake Sammamish and the wetland complex along the corridor between Lake Sammamish and Lake Washington were similarly affected. Historically, lake levels fluctuated as much as 6.5 feet during flood events; currently, they are managed so that the levels fluctuate no more than 2 feet. Also, the 8.6 mile Ship Canal and Ballard Locks did not provide the rich and diverse saltwater wedge, or transition zone, and estuary so important to migrating juvenile salmon. Construction of the Ship Canal resulted in the loss of over 1300 acres of shallow water and wetland habitat.

Fish runs on the Cedar River also suffered with the construction of Landsburg Dam in 1901 to provide drinking water to Seattle residents, blocking 17 miles of spawning habitat. Diking and channeling of much of the lower river to prevent flooding, as well as urbanization, also damaged fish habitat. Since the 1920s, the major impacts on habitat processes have been due to increased urbanization. The loss of forest cover increased the frequency and size of high flows, and significant floods in the 1950s led to an expansion of levee systems in the Cedar and Sammamish rivers. The railroad, which runs along about 87% of the watershed's marine shoreline, curtailed natural beach-forming ecological processes along the nearshore.

The watershed's Conservation Plan was developed by a multiple stakeholder process and funded by 27 jurisdictions within the watershed through an interlocal agreement (ILA). The cohesive group of key officials and stakeholders has significant

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influence on habitat actions necessary for salmon recovery, including supporting the infrastructure to ensure coordinated implementation, monitoring and adaptive management activities. The participants include jurisdictions that were successful in the cleanup of Lake Washington, which is regarded as one of the most successful, large scale restoration programs undertaken on a regional level.

The Salmon of the Lake Washington/ Cedar/Sammamish Watershed

Despite the physical changes described above, the watershed continues to support Chinook, sockeye, coho, kokanee (a resident form of sockeye salmon), steelhead, bull trout, and rainbow and coastal cutthroat. The cold and flowing waters of the mountainous upper Cedar River watershed are identified as a core area for bull trout by the US Fish and Wildlife Service. Bull trout also use the lower parts of the watershed, including the lakes and accessible tributaries, as foraging, migrating and over-wintering habitat.

Chinook Salmon

The Puget Sound TRT has identified 2 populations of Chinook that occurred historically in this area: the Sammamish (including Issaquah Creek and north Lake Washington tributaries) and Cedar River populations. The WRIA 8 Technical Committee has identified three populations-- the Cedar River, North Lake Washington, and Issaquah. WDFW is currently conducting a genetics study that is expected to help resolve the different population identifications.

Currently, Chinook spawn in the Cedar River, which flows into Lake Washington; in Cottage Creek and Bear Creek, which flow into the Sammamish River; and in Issaquah Creek, which flows into the south end of Lake Sammamish. Chinook also spawn in smaller tributaries of the Sammamish River, such as Little Bear Creek, Swamp Creek and North Creek. Juvenile Chinook use the freshwater tributaries, lakes Washington and Sammamish, and the corridor out through the Locks and the Puget Sound nearshore during their rearing stages.

The Landsburg diversion dam used to block access to the waters of the Cedar River above RM 21, but a recent fish passage project as part of a habitat conservation plan mitigation, now allows Chinook access above the dam to an additional 12 miles of habitat.

Chinook currently have access to about ten miles of Bear Creek and three miles of Cottage Creek. Adults returning to Issaquah Creek are generally considered to be of hatchery origin; however, natural spawning occurs in Issaquah Creek up to the hatchery, and fish not needed for hatchery purposes are allowed to spawn upstream of the hatchery.

Recovery Goals

Chinook

The habitat plan proposes near-term (ten year) and long-term recovery goals. The table below provides near-term and long-term goals for Chinook abundance. The planning team found it useful to think about habitat and population goals in terms of overall trends because the populations are in decline and the productivity of the populations must increase if extinction is to be avoided. This is a key point and strategy of their overall approach.

In the short-term, the plan proposes to increase productivity to twice the current survival for juveniles and smolts within the basin. The long-term goal is to have two or more adult returns per spawner two to four years out of ten. State and

	Near-Term Goal (10-yr)	Long-Term Goal
Chinook Abundance	Meet co-manager goals of 1,250 naturally spawning adults on the Cedar River and 350 naturally spawning adults in Bear and Cottage Lake Creeks (North Lake Washington/ Sammamish)	WDFW Target: 1,000 -8,200 spawners on the Cedar River, and 1,000-4000 spawners in North Lake/Washington Sammamish (The lower targets assume higher productivity, the higher targets assume lower productivity.)


Photo by Domonique Lewis.

reaching PFC may turn out to be unrealistic, and accordingly, may be adjusted to achieve modified PFC.

Bull Trout

The watershed plan does not have numeric goals for bull trout populations using the lower watershed. Actions taken to benefit Chinook are assumed to benefit bull trout in their use of the lower watershed for foraging, migrating and over wintering purposes.

What is the status of the Chinook and bull trout populations?

Chinook returns in recent years have been less than 500 fish overall, and the current abundance levels of the North Lake Washington and the Cedar River Chinook populations raise serious concerns about the potential risk of extinction. Spatial structure is greatly reduced from historical conditions because of the fewer spawning and rearing locations available or suitable for Chinook. Diversity also is greatly reduced from historical because of the predominance of hatchery Chinook in the Sammamish Basin. Currently, the productivity of the Cedar River and North Lake Washington Chinook population is below one (0.993 - 0.966), meaning that spawners are not replacing themselves. If this range of productivity were to continue, abundance would drop below theoretical minimum viable population thresholds. Productivity of the North Lake Washington population is estimated to be between 0.995 and 1.077.

Bull trout abundance and distribution has declined from historic levels throughout their range. Although the adult spawner abundance appeared to be at extremely low levels in the 1990s, recent returns strongly indicate that this population has likely rebounded to near or recovered levels (Lakey, Key or Focal Species & Habitats/Geography, p.9).

tribal co-manager targets are 1.0 to 3.1 returns per spawner in the Cedar, and from one to three returns per spawner in the Sammamish (North Lake Washington and Issaquah).

Short-term and long-term habitat goals will be based on percentage increases over current conditions. Ecosystem Diagnosis and Treatment (EDT) modeling during 2005 will be used to assist in assigning quantitative goals for instream and landscape habitats. The long-term goal in some areas of the watershed is the achievement of properly functioning conditions (PFC), with the nearshore goal being a percentage (unspecified) increase over current conditions. Due to the highly altered state of some of the sub-areas within the basin such as the lakes, estuary, and nearshore, the long-term goal of

What are the key factors contributing to the current status of the populations?

What are the key habitat factors supporting salmon populations?

The construction of the fish ladder at Landsburg Dam has provided Chinook with about 12 miles of additional habitat that had been historically available to them for spawning and rearing.

Most of the Middle Cedar River subarea is rural and forested, while the Lower Cedar subarea is more urbanized, including the City of Renton. The existing functioning habitat provides spawning and rearing habitat, which will increase from implementing restoration actions.

The upper two-thirds of the Cedar River watershed is owned and managed by the City of Seattle. It is almost entirely coniferous forest, and management is governed by the Cedar River Watershed Habitat Conservation Plan (HCP). The watershed plan assumes that the HCP includes strong protection and restoration measures. Actions taken under the HCP are resulting in improved processes and functions that benefit fish populations in the upper watershed as well as bull trout and salmon downstream. Instream flows, potential impacts of the sockeye hatchery with Chinook, and other factors are considered in the monitoring and adaptive management plan. The effects of these factors on Chinook are not well understood.

The Lower and Middle Cedar, Bear Creek, Cottage Creek, and Issaquah Creek (including tributaries) are areas of highest abundance and most consistent use by Chinook for spawning and rearing.

The plan builds on regulatory and programmatic efforts such as the comprehensive plan updates and revisions to critical areas ordinances based on Best Available Science. Shoreline Master Programs will be updated during the ten year planning period, and jurisdictions are expected to adopt NPDES Phase 1 and Phase 2 municipal stormwater permits during 2006. A number of jurisdictions in King and Snohomish counties have recently completed their critical areas ordinance updates and have adopted or proposed for adoption stronger regulations and incentives to protect remaining high quality habitat.

In addition to a "start-list", the plan recommends a coordinated approach to adaptive management and monitoring and identifies a variety of structures and staffing options. These include technical assessments, progress evaluation, data management, and fundraising for action implementation.

Habitat performance standards and measures will be developed and adopted after analysis of EDT modeling scheduled for completion by December 2005.

Actions taken to benefit Chinook are expected to benefit bull trout.

What are the key habitat factors limiting salmon populations?

Major alterations, including the construction of the Landsburg Diversion Dam, Ship Canal, and Hiram Chittenden Locks (Ballard Locks) have dramatically altered aquatic habitat conditions and processes that form and maintain the habitat conditions that support Chinook and other fish populations. The factors of decline listed below affect Chinook habitat in lakes, rivers and creeks throughout the system and vary in the severity of their impact. The cumulative impact of interactions between the fac-

Habitat Limiting Factors affecting lakes, rivers and creeks	
Altered hydrology	Low base flows, higher peak flows following storms, and increased "flashiness" (more frequent and rapid responses when it rains)
Loss of floodplain connectivity	Reduced access to side-channels or off-channel areas due to bank armoring and development close to shorelines
Lack of riparian vegetation	Due to clearing and development
Disrupted sediment processes	Too much fine sediment deposited in urban streams, or sources of spawning gravel disconnected from the river channel
Loss of channel and shoreline Complexity	Lack of woody debris and pools
Fish passage barriers	Road crossings, weirs, and dams
Degraded water and sediment quality	Pollutants and high temperatures

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Photo by Dan Kowalski

tors also compound the negative effects on habitat conditions and processes. Hydrology is recognized as the most important factor in the ecological processes that create and sustain aquatic habitat.

Bull trout habitat quality has declined rangewide. Land and water management activities that depress bull trout populations and degrade habitat include some aspects of operation and maintenance of dams and other diversion structures, forest management practices, agriculture practices, road construction and maintenance, and residential development and urbanization.

Future threats

Growth and development: The Cedar/Sammamish/Lake Washington watershed (WRIA 8) has the highest human population of any water resource inventory area in the state. The total population in King County and the southern portion of Snohomish County, which is in WRIA 8, is projected to increase by 24% between 2002 and 2022. Fifty-five percent of the land area of WRIA 8 lies inside the Urban Growth Boundary (UGB). Over 90% of the WRIA's total population increase expected in both King and Snohomish counties will occur inside the Urban Growth Area, either in areas which are already incorporated or those which are planned for annexation. The increase in the population, both within and outside of the UGAs, will continue to pose challenges, potentially exacerbating limiting factors such as water quality and flows.

The plan provides a number of general guidelines for minimizing the impacts of growth, including holding the UGB firm, promoting low impact development techniques and clustering, and minimizing new road crossings. During 2005, the planning team will evaluate the relative impacts of growth management, stormwater management and other land use proposals on salmon performance. The team will model impacts of a build-out scenario under current and proposed land use regulations and incentive programs using inputs from integrated water quality, quantity and hydraulic models. Results may be used to help further define a strategy to address where growth should occur and how to reduce its impacts.

Hatchery stray rates/genetic diversity: In 2003, approximately 50% of the spawners in WRIA 8 were hatchery-origin fish, with percentages as high as 75% in some stream systems. (Conservation Plan draft, Volume 1, 4-61, 4-62). The Issaquah Creek Hatchery uses Green River Chinook salmon stock. Straying of in-basin and out-of-basin-produced Green River origin hatchery Chinook poses a potential risk to the genetic integrity of naturally spawning Chinook populations in the Cedar River, which is considered a separate independent population from the Sammamish.

WDFW acknowledges that the Issaquah Hatchery management practices may need to be altered to preserve genetic traits of any remaining natural-origin spawners. Initial modeling results from WDFW indicate that without hatchery strays, the ability of natural-origin spawners to maintain themselves in the natural environment is unlikely. Harvest rates may need to increase on hatchery-origin fish in the system.

The Conservation Plan Technical Committee hypothesizes that restoring habitat in the Issaquah and Lake Sammamish systems could increase the already high spawning contributions from hatchery strays in the watershed. This would increase the risk to genetic diversity of the Cedar and North Lake Washington Chinook populations.

Ecological interactions of sockeye with Chinook: WDFW operates a sockeye hatchery in the Middle Cedar River watershed. To assess the effects of the sockeye on Chinook populations, the hatchery managers will need to monitor and manage for competition on spawning grounds, predation, and depletion of prey resources and food web interactions in Lake Washington.

Nearshore and estuarine habitat: There is a very limited amount of functioning nearshore and estuarine habitat available to Chinook. The lack of natural estuarine habitats due to the Ship Canal and the bank armoring along the entire shoreline interrupts normal shore zone habitat forming processes and attributes which benefit Chinook.

Lakes Washington and Sammamish: More than 82% of the Lake Washington shoreline is armored, and shading from more than 2,700 piers and docks affects food sources and contributes to predation of juvenile Chinook. The shoreline habitat of Lake Sammamish is similarly degraded. Water quality limiting factors such as temperatures and dissolved oxygen need to be addressed. Opportunities for shoreline and creekmouth restoration are limited due to lowered lake levels and current management of the lake levels for recreational purposes. Lake Washington's shoreline processes have been changed by the regulated lake levels and extensive armoring. Therefore, removing some bank hardening structures may not be sufficient to create sandy beaches; there may also be a need to augment sediment supplies and create sandy beaches.


Photo by Dan Kowalski

Overall Approach to Habitat Recovery

Pending completion and analysis of the modeling effort that will be used to define quantitative targets, the habitat plan proposes key strategies and a ten-year action plan to make progress toward recovery.

The Conservation Strategy recognizes four ecosystem objectives for salmon habitat protection and restoration. The objectives, provided below, serve as the basis for developing and prioritizing habitat actions that respond to habitat factors of decline.

- Maintain, restore or enhance watershed processes that create habitat characteristics favorable to salmon;
- Maintain or enhance habitat required by salmon during all life stages and maintain functional corridors linking these habitats;
- Maintain a well-dispersed network of high-quality refuge habitats to serve as centers of population expansion;
- Maintain connectivity between high-quality habitats to allow for population expansion into recovered habitat as degraded systems recover.

The overall set of strategies is described below:

1. Protect and manage upper watersheds (Cedar, Bear and Issaquah) to maintain their intact habitat values and the benefits for downstream Chinook.
2. Encourage direction of growth into existing urban areas. Reduce impacts of urban growth.
3. Manage rural development to avoid or reduce impacts through the Critical Areas Ordinances, flood control, acquisition and other regulatory and voluntary programs.
4. Restore the Cedar mainstem to add more rearing habitat; restore productivity in the Sammamish River, Lake Washington, and the Lake Washington tributaries.

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Photo by Domonique Lewis.

5. Where possible improve habitat in Lake Washington and the Ship Canal.
6. Restore the nearshore where possible; conduct experimental projects.

The plan sequences priority actions by sub-basins. The Cedar Chinook population is at the highest relative risk due to steeply declining abundance trends, followed by the North Lake Washington population and the Issaquah population. Accordingly, the strategy recommends that protection and restoration actions focus on areas used by the Cedar River Chinook population as the first priority, followed by the North Lake Washington population, and then Issaquah.

Sub-basins were further ranked according to the habitat condition and processes that would affect Chinook abundance and productivity. Protection and restoration actions are identified in the plan according to benefits to Chinook and ease of implementation. The Conservation Plan provides separate comprehensive lists of land use recommendations, watershed wide and site-specific habitat protection and restoration projects, and public outreach actions.

The ten-year planning horizon is viewed as the timeframe over which the initial plan priorities are most likely to be useful as guides for habitat actions. The planning team will initially assess the plan's effectiveness in year three. At year ten, the team anticipates shifting priorities based on monitoring results. Initial technical and process actions that will occur once the plan is ratified include setting the baseline for monitoring, initiating the monitoring, reporting and evaluating, and connecting ratification to resources for implementation activities.

Cedar River Chinook Population

Because Cedar River productivity is limited by lack of juvenile rearing habitat, the management approach includes addressing the lack of pools and off-channel habitat in the mainstem so that juveniles delay their migration into shallow shoreline areas of Lake Washington for rearing, where they are subject to predation from bass and other predators. Improvements to the shoreline areas of Lake Washington and particularly the south end of the Cedar and around creek mouths are also expected to reduce predation on juvenile Chinook.

Cedar River actions within the next ten years:

Over 300 acres of habitat in the Cedar River are targeted for protection. Redevelopment options will be explored for the most urbanized reaches of the Cedar River. Restoration projects include three flood buyouts and floodplain restoration projects; one levee removal and floodplain restoration project; and one side-channel restoration project. Riparian vegetation will be protected and restored in specific reaches of the river. A study will be conducted to identify where and how large woody debris should be added to the Cedar River (upper and lower). Regulations, incentives, and educational outreach will be used to protect forest cover, soil infiltrative capacity, floodplain connectivity, instream channel complexity, and water quality.

Lake Washington actions within the next ten years:

Salmon-friendly docks and shorelines along the lake will be encouraged through regulations, incentives and targeted educational programs. Opportunities to remove bank hardening and restore shoreline vegetation and shallow-water habitat will be pursued, particularly at the south end of Lake Washington. The mouths of approximately 7 small tributaries entering the lake are targeted for enhancement as refuge areas for juvenile Chinook.

Cedar River Tributary actions within the next ten years:

Flows for migrating Chinook in Rock Creek will be enhanced. Restoration projects include floodplain restoration at the mouth of Rock Creek and restoration of 800 feet of lower Taylor creek.

North Lake Washington Chinook Population

Efforts to restore habitat will include the Sammamish River and Lake Washington as well as the North Lake Washington tributaries. Approximately 90% of the population currently resides in Bear Creek, which empties into the Sammamish River in the City of Redmond. The restoration potential of the Sammamish River is approximately equal to the combined restoration potential in Bear, North and Little Bear Creeks, and is therefore a critical element in recovering Chinook. Restoration of habitat quantity (pool habitat areas with adequate cover, habitat diversity, large woody debris and riparian function) and water quality (temperatures that limit migration) will benefit juvenile rearing and adult migration, resulting in increased productivity, spatial distribution and life history diversity.

Bear Creek actions within the next ten years:

Headwater wetlands and Cold Creek groundwater springs will be protected through regulations, incentives, and acquisitions. Undeveloped, forested properties throughout the Bear/Cold Cottage Creek basin are targeted for protection. Restoration projects to be implemented include restoring riparian vegetation and adding large woody debris in specific reaches; two large scale projects to restore meanders, channel complexity of straightened reaches in lower Bear Creek; and one bank hardening removal and floodplain restoration. Two farms are targeted for reduction in fine sediment inputs to the creek and restoration of riparian vegetation. Regulations, incentives and educational outreach will be used to protect forest cover, soil infiltrative capacity, riparian vegetation, floodplain connectivity, instream channel complexity, water quality and instream flow.

Sammamish River actions within the next ten years:

Restoration projects to be done include: regarding banks; creating flood benches and restoring riparian vegetation in at least two reaches of the Sammamish River; restoring the meander of the Sammamish River below the Lake Sammamish weir; enhancing and reconnecting wetlands and side channels in three locations; restoring a large wetland complex at the mouth of Swamp Creek; and restoring the mouths of ten small tributaries to create cool water refuge areas. Also, extensive areas of invasive, non-native plants will be removed and replaced with native plants along the Sammamish River. Regulations, incentives, and educational outreach will be used to protect cool, clean water inflows to the river and to encourage re-meandering of the river, setting back banks, and revegetation of banks.

Little Bear and North Creek actions within the next ten years:

Over 400 acres of undeveloped, forested wetlands in the headwaters of Little Bear Creek are targeted for protection. Three restoration projects to restore floodplain function, instream channel complexity and riparian vegetation are proposed for North Creek as well as protecting remaining forest cover in the basin.

Issaquah Creek Chinook Population:

Some of the best remaining habitat in the Lake Washington/Cedar/Sammamish Watershed is in the Issaquah Creek basin. Seventy-five percent of the Issaquah basin is forested and 40% is in public ownership. Protecting this high quality habitat is a high priority. However, the Conservation Plan Technical Committee is concerned about the high stray rate of Chinook from the Issaquah Creek hatchery and the effect this may be having on the genetic diversity of the other Chinook populations in the system. A genetic study is being conducted that will help shed light on the genetic impact of hatchery straying on WRIA 8 Chinook populations. Until more is known about the genetics of WRIA 8's Chinook populations, restoration activities in the Issaquah Creek basin are a lower priority.

Issaquah Creek actions within the next ten years:

Undeveloped, forested properties throughout the Issaquah Creek basin are targeted for protection. Regulations, incentives, and educational outreach will be used to protect headwaters and sources of groundwater; forest cover and soil infiltrative capacity; riparian vegetation; floodplain connectivity and instream channel complexity; water quality; and instream flows.

Lake Sammamish actions to be taken in the next ten years:

Salmon-friendly docks and shorelines along the lake will be encouraged through regulations, incentives, and targeted educational programs. The mouths of 2 small tributaries entering Lake Sammamish are targeted for restoration.

Locks, estuary and nearshore:

The strategy at the Ballard Locks is to continue to study ways to improve the Locks for fish passage. The strategy for the estuary and nearshore is to protect and restore habitat processes, with emphasis on sediment sources that support eelgrass beds; restore "pocket" estuaries that support juvenile rearing; and protect and restore marine riparian vegetation as a source of food for salmon and other fish species. Because 53% of the nearshore environment is within Snohomish County, the planning team anticipates continuing to work cooperatively and in concert with the Snohomish County and other jurisdictions within the WRIA 8 boundaries.

Estuary and Nearshore actions to be taken in the next ten years:

Efforts to improve conditions at the Locks to improve juvenile Chinook outmigration will continue. Pilot studies will be conducted to reconnect

Photo by Domonique Lewis.

feeder bluffs to the nearshore where they are now cut off by the railroad and to restore beach-creating processes. The feasibility of removing extensive bulkheading and daylighting streams in the park immediately downstream of the Locks will be studied. Projects to reconnect and enhance backwater areas and creek mouths to create pocket estuaries for juvenile Chinook will be implemented in four locations.

Water quality and water quantity:

Improvements in water quality conditions through the planning area are expected to occur through regulatory and incentive-based programmatic efforts. Jurisdictions within the planning area are expected to adopt NPDES Phase 1 and Phase 2 municipal stormwater permits during 2005. The instream flow management strategy in the Cedar River HCP includes a guaranteed flow regime with minimum and supplemental flow commitments and operational constraints to limit the rate at which stream flows may be reduced, funding to promote municipal and industrial water conservation, and oversight by the Cedar River Instream Flow Commission which includes federal, tribal, and state resource management agencies, King County and the City of Seattle.

Harvest:

There has not been a directed terminal harvest on Chinook in the planning area for over ten years. Through the North of Falcon process, harvest rates are regulated in international and coastal waters as well as Puget Sound and the marine waters of Washington State by Washington State treaty tribes and WDFW.

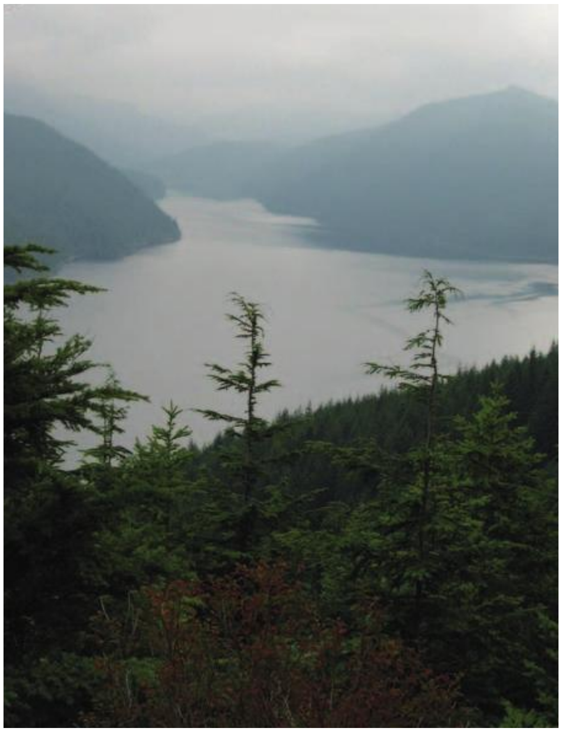

Photo by Domonique Lewis.

Hatchery:

The Issaquah Hatchery operated by WDFW, located on Issaquah Creek, is the center of hatchery Chinook salmon production for the Sammamish population. Its primary purpose is to produce fish for subsistence, ceremonial, commercial and recreational harvest while minimizing adverse genetic, demographic or ecological effects on listed fish (WDFW 2002). The hatchery uses Green River Chinook salmon stock. The University of Washington also produces Chinook salmon for research at a small hatchery on Portage Bay in Lake Washington. The Cedar River Hatchery, located in the Middle Cedar River watershed, is used to produce sockeye and Lake Washington winter steelhead (incubation only) to support subsistence, ceremonial, commercial and recreational harvest.

In 2002, WDFW committed to eliminating the Ballard Chinook Net Pen operations and the Halls Lake, Glendale, and Kelsey Creek Cooperative projects to ensure genetic integrity of the Lake Washington stocks. Actions taken to minimize adverse genetic, demographic or ecological effects on listed fish include timing of hatchery releases to reduce competition with wild fish and coded wire tagging. The plan recommends that co-managers adopt Hatchery Scientific Review Group (HSRG) recommendations and make other appropriate management changes that may be at the Issaquah hatchery and other Puget Sound hatcheries that are necessary to reduce risk to Chinook populations in WRIA 8.

All H-Integration:

The planning team anticipates that it will continue to have access to WDFW as a co-manager and continues to seek and welcome the participation of the Muckleshoot Indian Tribe and the Suquamish Tribe at the technical staff and policy levels.

Results

The watershed plan for the Lake Washington/ Cedar/Sammamish watershed was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan to some extent, but the reviewers felt they merited particular attention or additional effort to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

This plan clearly identifies and recognizes the challenges caused by the watershed's highly altered "plumbing" system and hydrology and offers a solid approach for improving conditions for fish within those constraints. At the same time, the altered

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environment also makes success uncertain.

Reviewers especially noted the importance of four major sets of strategies and actions in the plan for improving fish conditions:

- The significant effort in King County to protect remaining habitat through regulations and incentives;
- Protection and rehabilitation of the Cedar River;
- Improving rearing habitat in Lake Washington; and
- Improving fish passage in the Ship Canal and Locks.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

Reviewers had trouble finding clear information about which Chinook life stage problems are most limiting populations, and how the recovery strategies specifically address these. When conducting the EDT analysis later in 2005, the watershed planners should be able to get an idea of where the major life cycle bottlenecks are in the whole system. These results will help better prioritize and sequence the different actions throughout the watershed. Considering these priorities in the face of continued development through 'build-out' scenarios also would greatly increase the certainty in this plan. Such prioritization will increase the certainty in their conclusion that they can achieve recovery goals in the Cedar River and Lake Washington.

The strategy for addressing how to restore flows consistent with recovery objectives is not clear. This is an especially challenging problem in this watershed, given the highly altered hydrological conditions. The strategy can be bolstered by carefully examining the geo-morphological context in which restoration projects will occur, and explicitly examining the effects of such projects on overall hydrological processes in the system.

The Cedar River portion of the WRIA 8 recovery plan does not specifically address how flow levels described in the Cedar River Habitat Conservation Plan (HCP) complement recovery objectives stated in the watershed plan. It is important that the recovery strategies outlined in the plan include hypothesized effects of the HCP, and that the plan provide for monitoring and analysis to illustrate how flows resulting from the Cedar River HCP affect the Chinook population's recovery trajectory for all 4 VSP attributes. Furthermore, whether the presence of hatchery-origin Chinook (hatchery fish from within or outside of the basin) above and below Landsburg Diversion Dam is consistent with recovery objectives for the Cedar River population is not clearly stated. Clarifying the strategy and associated actions for achieving the recovery objectives for the Cedar River population would greatly increase the certainty of the plan.

There is uncertainty in how operation of the sockeye hatchery addresses Chinook VSP attributes. The TRT encourages monitoring of the sockeye hatchery program effects on Chinook VSP attributes and making changes as needed to address any impacts that negatively affect attainment of recovery objectives in the Cedar River population.

There is a similar concern about the impact of the Issaquah hatchery on the Sammamish Chinook population, especially related to genetic impacts. It will be important to identify this hatchery's role in the overall watershed strategy to recover Chinook populations and to address impacts from the hatchery practices on the naturally spawning Sammamish Chinook population.

Reviewers recommend that this watershed consider implementing hatchery reforms early in the priority sequence of actions to take advantage of the potential benefits. Often changes to hatchery practices show a quicker result than do habitat actions.

The current lack of participation by the Muckleshoot Indian Tribe and the Suquamish Tribe inhibit the ability to develop a comprehensive strategy to integrate harvest, hatchery and habitat management practices consistent with Chinook recovery.

The reviewers strongly urge the appropriate authorities and parties to develop H-Integration goals and strategies early in the implementation phase. It will also be important to closely monitor hatchery and harvest effects on VSP attributes.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementations actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the plan is implemented and above uncertainties are addressed, this watershed has the opportunity to improve from current conditions within a highly altered system, to provide important ecological benefits to the ESU by increasing ecological functions provided by anadromous fish, to preserve a lake-type diversity, and to test re-colonization as a recovery approach above the Landsburg Diversion dam.

Watershed Profile:

Green/ Duwamish

The Place and the People

The Green/Duwamish and central Puget Sound Watershed starts high in the Cascade mountain range at the headwaters of the Green River. The upper third of the Green flows through a forested terrain of steep slopes and narrow valleys. Below the Howard Hanson Dam, the Green starts flowing through a broader valley that opens into farm lands, small woodland lots, state and county parks, small towns, and eventually reaches the busy suburbs of the Seattle metropolitan area. The lands surrounding the river become more urban and industrialized as it moves downstream. The Green becomes the Duwamish River about eleven miles from its mouth where the Black and Cedar Rivers once entered. The Duwamish is flanked by land uses that shift from suburban to industrial as it approaches the east and west waterways at the delta. Here, sports stadiums built on a formerly expansive mudflat and giant shipping cranes welcome the Duwamish as it empties into Elliott Bay.

The Central Puget Sound marine environment is anchored by Elliott Bay to the north and Dash Point State Park to the south on the mainland. Short independent streams drain to Puget Sound from West Point south to Federal Way and the associated shorelines of Puget Sound, including Vashon and Maury Islands. Together with the shores of Vashon and Maury Islands, the Green/Duwamish and central Puget Sound Watershed provides 92 miles of marine shoreline to Pacific salmon, crabs, geoducks and other marine life.

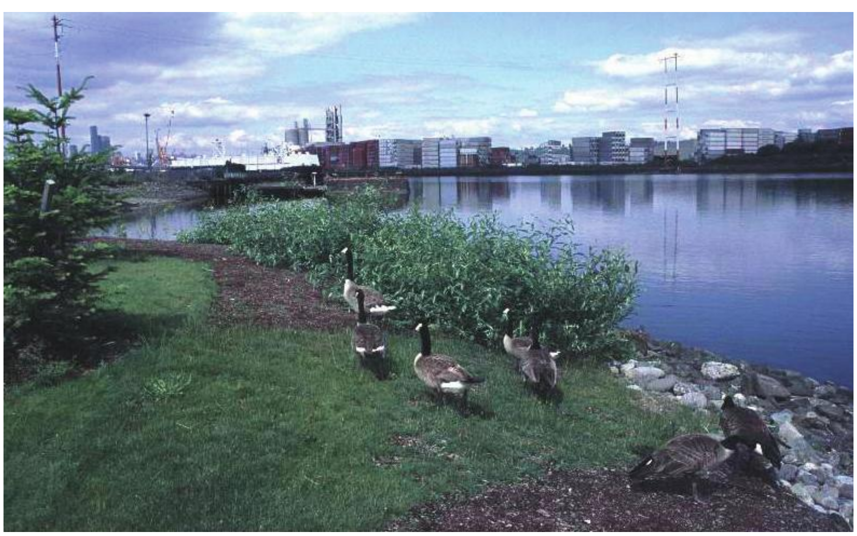


Photo courtesy the Washington State Salmon Recovery Funding Board

Along the Green, recreational boaters launch canoes and kayaks, heading for stiller parts of the river. Whitewater adventurers raft the scenic Green River gorge near Flaming Geyser State Park. Commercial forestry in the Upper Green subwatershed conveys a sense of what the land was like when it was dominated

Photo by Dan Kowalski

the flows and landscape even more. Today, the Duwamish River still has one historic remnant oxbow and about 2% of the historic mudflat/estuary. As people say when describing the changes from historic conditions, this river has been significantly "re-plumbed."

Despite these changes, the river still offers a rich diversity of habitat, fish and wildlife. At the same time, it embodies all the challenges facing Puget Sound salmon — growth pressures, shoreline alterations, combined sewer overflows and stormwater runoff, contaminated sediments, industrial development and up-river passage barriers and habitat changes due to dams, commercial forestry, and agriculture. The fact that fish have persisted in this degraded environment has inspired people living and working in the watershed to come together to protect and restore salmon habitat where possible.

The watershed's cities, along with King County, came together in 1998 to begin their first coordinated effort to address salmon habitat recovery. City and County officials quickly learned of the significant efforts over the past several decades to protect and improve the river. The valley cities and the Corps of Engineers worked together for over two decades to establish more fish-friendly flood control practices and re-create some of the side channels and wetlands that once existed. King County developed strong environmental regulations and an innovative program called Waterways 2000 to protect the remaining high quality habitat of the Middle Green above Auburn. Seattle and others reduced sewer overflows and toxic wastes entering into the Duwamish. An innovative pro-

by conifers. Fishers of all ages still walk the creeks and riverbanks, enjoying one of the top ten steelhead rivers in Washington. The Green River's Bass Lake wetland complex has the greatest bird species diversity of wetlands surveyed in King County.

Historically, the Green/Duwamish basin was different. The Green River used to join with the White River in Auburn. Further downstream, in what is now Tukwila, the Cedar and Black Rivers flowed into the combined Green and White Rivers and formed the Duwamish River. The Duwamish meandered about 15 more miles until it emptied into braided salt water marshes, an expansive delta and intertidal mudflats before ending up in Elliott Bay.

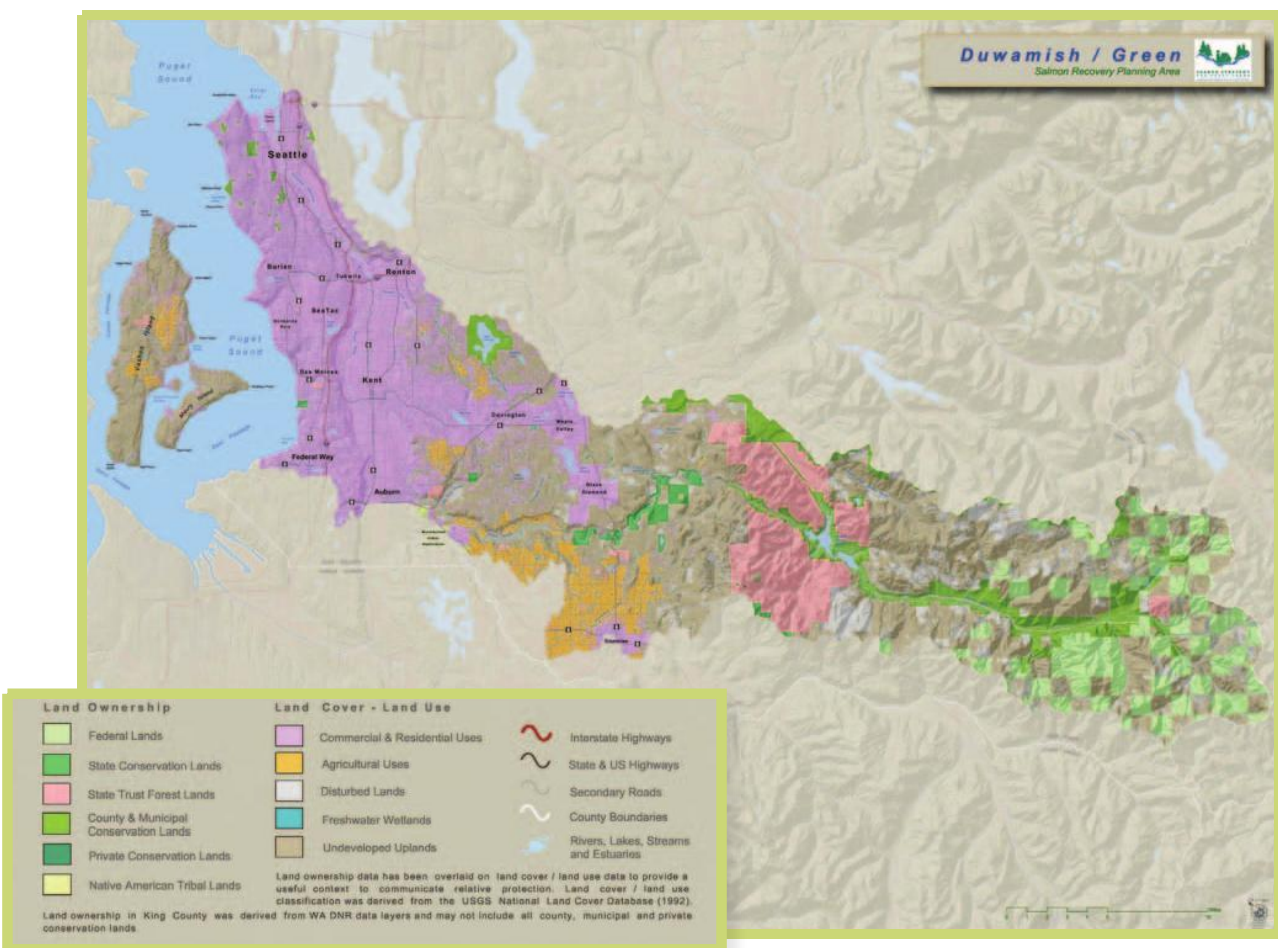
Industry and commerce took root in the watershed in the 1850s. From the turn of the century to about 1940, the lower river's meandering course was straightened (channelized), filled and dredged to provide for Seattle's burgeoning industrial and manufacturing district and port.

The White, Cedar and Black Rivers were rerouted away from the Green in the first two decades of the 20th century. Water diversions beginning in 1913 to help provide water for Tacoma's growing residential areas and industries blocked salmon from access to the upper reaches of the Green River. Construction of the Howard Hanson Dam in 1962 changed gram in the Duwamish industrial areas works with local businesses to reduce their use and discharge of chemicals. The City and Port of Seattle and others are cleaning up toxic sediments and providing some new estuarine habitat for salmon as they pass through the altered lower river.

The collection of 15 cities, King County, and City of Tacoma officials felt confident that more could be done to help salmon based on the successful habitat protection and restoration efforts that had already occurred. They developed a process, building on the foundation of these other efforts, which resulted in a watershed-wide coordinated salmon habitat conservation initiative. Participants count on each other to make and keep commitments; their efforts have already begun to improve conditions for fish. The Green/Duwamish and Central Puget Sound salmon habitat plan represents a significant milestone in a long-range process designed by these communities. They will review and evaluate goals, objectives and achievements in the ninth or tenth year of plan implementation. They will use the results to shape the implementation activities for the next ten year horizon.

The Salmon of the Green/Duwamish Basin

The Green/Duwamish basin is home to Chinook, pink, chum, coho and steelhead as well as coastal cutthroat trout, Dolly Varden char, and other fish. Bull trout utilize the marine/nearshore areas for foraging, migrating and over-wintering. Historically, Chinook returned from the ocean to the river in the spring and fall. The early run Chinook typically spawned in the headwaters. They are believed to have declined to such low numbers that people



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doubt that the population persists, even in remnant numbers. The decline is believed to be due to the re-routing of the White River and the migration blockage posed by the construction of Tacoma Headworks Dam. Pink salmon are periodically observed, and small numbers of adult sockeye - perhaps strays from Lake Washington--spawn in low numbers in the basin. Naturally spawning winter steelhead and a hatchery origin summer steelhead use the basin and rely on the freshwater habitat in streams throughout the year.

Chinook

The Green/Duwamish Chinook population is an integrated wild-hatchery population with a major role played by hatchery fish. There are several hatcheries operated by the Muckleshoot Tribe and Washington State Department of Fish and Wildlife. The co-managers operate the hatcheries for harvest purposes. Chinook salmon in this basin return to spawn in the summer and fall. Some of the hatchery fish spawn, as the wild-origin fish do, in the mainstem reaches of the Middle Green River, in Soos Creek and in Newaukum Creek. Juvenile Chinook are found throughout the marine nearshore, including Vashon and Maury Islands. Adult Chinook salmon are generally not found in streams draining directly into the marine nearshore. Due to support from the Chinook hatchery on Soos Creek, recent numbers of returning Chinook have not reflected the downward trend reported in other major rivers in Puget Sound. Nonetheless, there is concern that recovery to a naturally sustaining harvestable population is hindered by habitat factors as well as competition for habitat and food sources between naturally spawning fish and hatchery fish.

Estimates of historical population size vary. Independent methods predict the historical run size at approximately 37,700 returning adult fish. Green River hatchery-origin Chinook from the hatchery on Soos Creek have been returning to the river since 1904. The current mean natural-origin run-size estimates vary between 11,200 (Technical Recovery Team, 2002) and 14,700 (Weitcamp and Ruggerone, 2000). Natural spawners in Neuwakum Creek are genetically similar to Green River hatchery fish. The Technical Recovery Team estimates the mean natural-origin recruit spawners at 618. Forty to sixty percent of the Chinook spawning in the Green River are Green River Hatchery Chinook.

Chinook Recovery Goals

Currently there are two competing goals for the population that have not been reconciled. The co-managers are managing the river largely for hatchery production and harvest. The long term goal of the local governments working on habitat is to recover Chinook to naturally sustaining, harvestable levels. The plan developed by the Green/Duwamish and central Puget Sound Watershed Forum is intended to improve the watershed aquatic ecosystem with a focus on the needs of listed salmonid species and is the focus of discussion and conclusions in this profile.

As a practical matter, the draft plan proposes to increase the number of natural origin recruit (NOR) spawners in the river basin over the next 50 years. Knowing how many fish the habitat supported in the past, and what can be reasonably expected given current conditions is an important backdrop to choosing a target number of fish both in the short term and the long term. At the present, there isn't a complete understanding of either historic numbers or current habitat capacity.

Over the next 10 years, the Watershed Forum plans to focus on increasing the productivity of adult Chinook returning to spawn. Productivity is defined as the number of adults returning for each adult that spawns. If at least one fish returns from the ocean for each spawning adult, the expected goal is 1,000 to 4,200 natural origin spawners.

In the long term — over the next 50 to 100 years — with continued increases in Chinook population abundance and productivity, the target is 27,000 returning natural-origin spawners. This is in the mid-point of the planning range provided by the

Technical Recovery Team (17,000 to 37,000 with a productivity of 1.0, meaning that one fish will return from the ocean for each adult that spawns). However, these numbers may not be achievable unless there is agreement on how the fish are managed by the tribes, State and local governments.

What are the Key Factors Contributing to the Current Status of the Population?

What are the Key Factors Supporting the Current Population?

Despite the lack of consensus on the overall goal, a number of factors support the current status of Chinook and provide a foundation for improving conditions. Among these are strong scientific and technical studies. These have contributed to an understanding of the basin - what is working best and where, and what can be improved--so that policies and management actions are targeted where they can make the most difference for Chinook spawning and rearing.

In the Upper Green subwatershed, a fifty year Habitat Conservation Plan (HCP) negotiated between Tacoma Public Utilities and NOAA and the U.S. Fish and Wildlife Service (USFWS) is expected to result in habitat projects and monitoring focused on salmon. The Forests and Fish Rules and the pending HCP, covering commercial forestry activities, are also expected to result in improvements that will address limiting factors in both the Upper and Middle Green subwatershed.

In the Middle and Lower Green, two major programs, principally funded by the U.S. Army Corps of Engineers (ACOE), and conducted in cooperation with the Muckleshoot Indian Tribe, local jurisdictions, and other parties, are underway and already improving conditions for Chinook. A variety of habitat restoration projects undertaken through the Green/Duwamish Ecosystem Restoration Project (ERP), and the Howard Hanson Additional Water Storage Project (AWSP), which is designed to improve flows in the river and also entails habitat project implementation and studies and monitoring, will improve habitat conditions, and the capacity of the system to support more salmon who return home to spawn. The Green/Duwamish Ecosystem

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Photo by Dan Kowalski

Restoration Project consists of 45 projects, most of which will benefit salmon habitat across the watershed. Work on the initial projects has begun. The shared funding between local governments and the federal government in this partnership is a successful model that the local governments expect will characterize additional salmon recovery efforts in the years ahead.

Of great significance for spatial structure, actions by the Corps of Engineers and Tacoma Public Utilities are expected to allow fish passage to and from the Upper green River for the first time in nearly a century. Beginning in 2007, adult salmon will be passed upstream around the Tacoma Headworks and Howard Hanson Dam. Facilities at both dams will safely pass migrating juveniles downstream.

Prior to the formalized and coordinated habitat restoration efforts that began in the late 1990s, the Port of Seattle, Corps of Engineers, USFWS, Suquamish Tribe and Muckleshoot Indian Tribe collaborated in the first restoration projects to improve estuarine and nearshore habitat for juvenile Chinook through the Coastal America program. In the early to late nineties, an expanded set of stakeholders worked with natural resource trustees -- NOAA, USFWS, The Washington Department of Ecology, the Suquamish Tribe and the Muckleshoot Indian Tribe -- to identify additional habitat restoration projects and sediment clean-up projects in the lower Duwamish and Elliott Bay. This gave a further boost to the habitat value of the estuarine area up to what is referred to as the "salt water wedge", or the "transition zone", where young Chinook adapt from freshwater to saltwater in preparation for their ocean voyage.

King Conservation District grants that are funded by district-wide assessments support watershed priorities through habitat projects, technical studies, and stewardship opportunities.

Significant habitat factors limiting the Chinook

A little more than a century ago, a migrating adult Chinook salmon returning home to spawn would have entered a watershed of about 1,600 square miles with extensive estuarine, lake, and mainstem river, side channels and cool, shaded stream habitat for spawning and rearing. Now, a Chinook returning home has a far different experience, entering a basin that is about 30 percent of the size it was a century ago, with about 1/3 of its historic habitat and about 30% of historic flows. A mere 2% to 3% of the historic estuarine mudflats, saltwater marshes and wetlands remain for juvenile Chinook to use as they make their way from freshwater and the saltwater wedge out into the Sound as they head for the ocean waters.

Among the significant and major differences in current habitat conditions when compared with historic options for Chinook spawning and rearing are fish being blocked from habitat above the Tacoma Headworks and the Howard Hanson Dam, and the rerouting of rivers which reduced instream flows and further barred returning adult spawners from rich and varied habitat. The reduced spatial diversity, together with commercial logging in all parts of the basin, dredging, filling, flood control measures, combined with agriculture and urban development resulted in degraded habitat conditions in all parts of the basin.

For the purpose of determining strategies and actions addressing factors presently limiting Chinook, factors of decline are separately defined for the freshwater and nearshore/marine environments.

1. Reduced water quality — changes to dissolved oxygen, temperature, chemical contaminants and nutrients, suspended sediment/turbidity. Primary causes include stormwater runoff, lack of shade due to loss of riparian vegetation, failing septic systems and increases in impervious surfaces, wastewater and historic industrial effluent.

2. Hydromodification — changes to estuarine tributary and distributary channels, cutoff of sediment supply (spawning gravels), reductions in the amount of in-channel large woody degris, and alteration of nearshore independent tributary channels. Primary causes include bank hardening, levees, clearing of mature streamside vegetation, dams, channel straightening, dredging, filling, loss of side channel and other off-channel habitats, loss of channel and habitat complexity, loss of connection to floodplain, and loss of channel migration.

3. Loss of habitat in marine nearshore rearing and migratory corridor — degradation or elimination of shallow-water habitats, such as mud flats, eelgrass, and kelp beds. Primary causes include

Photo courtesy the Washington State Salmon Recovery Funding Board

shoreline armoring, dredging, filling, vegetation clearing, and overwater structures.

4. Reduced Sediment Quality — increased presence of metals, organics and other substances in sediments at levels that exceed standards or affect food chains. Primary causes include historic and current stormwater runoff and point source discharges, primarily in the lower Duwamish.

5. Alteration of Habitat Forming Processes — interruption or other modification of processes that form nearshore habitat, such as sediment transport and freshwater input. Primary causes include shoreline armoring, developing on top of and below banks, bluffs, and beaches, changes in flow due to diversion of rivers or streams.

6. **Degraded Riparian Condition** — altering the presence or absence of native riparian vegetation along the shorelines. Primary causes include shoreline armoring, overwater structures such as piers and docks, residential and other urban development and vegetation removal.

7. Non-native Species — Introduction of plant and animal species whose natural distribution did not include Puget Sound. Primary causes include ballast water discharge, packing materials from foreign seafood, intentional or unintentional establishment by the aquaculture industry.

Future Threats

Lack of coordination and agreement between the Muckleshoot Indian Tribe, the Suquamish Tribe, the state and habitat managers on how to reconcile habitat actions with hatchery and harvest management practices will continue to impact Chinook recovery.

The Green/Duwamish and Central Puget Sound Watershed experienced rapid population growth and urbanization in the latter part of the 20th century and is now home to nearly 10% of the population of Washington State. Although the Upper Green subwatershed is protected from development due to being devoted mostly to commercial forestry, land uses in the Middle Green, Lower

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Green, Duwamish and in the nearshore environments are much more intense. It is estimated that about 89% of the population lives in the Urban Growth Area (UGA), with 11% residing in rural areas. Current estimates indicate the highest rates of future development will be experienced in the Middle Green, which has functioning spawning and rearing habitat, and along the nearshore, an important area to juveniles, but which is limited in terms of restoration and rehabilitation options.

Overall Approach to Habitat Recovery

The Green/Duwamish and central Puget Sound Salmon Habitat Plan includes geographically specific recommendations for management actions. The draft plan proposes the following watershed-wide priorities for the protection and restoration of habitat to support Chinook salmon recovery:

- Duwamish Estuary transition zone habitat;
- Middle Green River, Lower Green River, Duwamish Estuary, Marine Nearshore rearing habitat, and
- Middle Green River and upper Lower Green River spawning habitat.

Also important is providing access to the Upper Green by passing fish safely upstream and downstream past the Howard Hanson Dam and Tacoma Headworks.

The goals of the draft plan are intended to:

- Protect and restore physical, chemical and biological processes and the freshwater, marine and estuarine habitats on which salmon depend,
- Protect and restore habitat connectivity where feasible, and
- Protect and improve water quality and quantity conditions to support healthy salmon populations.

Looking at the basin system as a whole, and considering factors currently limiting Chinook, the draft plan proposed the following watershed-wide hypotheses. These hypotheses are a portion of the scientific basis for the recommendations intended to achieve the goals of the plan:

- Protecting and improving riparian conditions would provide greater juvenile growth and survival
- Allowing natural flows would result in more spawning and rearing, increasing available habitat, greater juvenile growth and higher survival rates
- Protecting and improving water quality would enhance survival of adult salmon, incubating salmon eggs and salmon prey
- Protecting and improving access to tributaries would improve amount of available habitat and result in greater juvenile salmon growth and higher survival rates
- Preventing new bank/shoreline armoring and fill would improve juvenile growth, increase available habitat and improve diversity.

Habitat management actions identified for freshwater environments are intended to protect or restore natural channel geomorphology, sediment recruitment, off -channel habitats, tributary habitats and inaccessible mainstem segments, refugia, riparian areas, water quality and water quantity. In marine and estuarine nearshore areas, actions are focused on shallow water habitats, riparian areas, sediment recruitment, habitat formation and maintenance, migratory passage, water quality, sediment quality, pocket estuary, water quantity, submerged aquatic vegetation, beaches and backshore, and salt marshes.

Key Strategies and Actions Supporting the Overall Approach to Recovery

Taking into account the irreversible historic changes within the basin, the strategy emphasizes habitat actions in all parts of the basin, with special consideration given to:

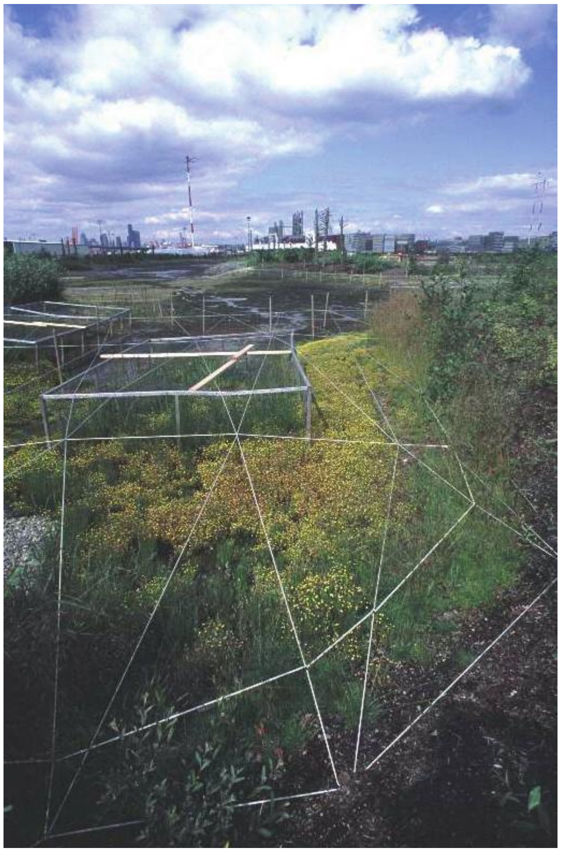
Photo courtesy the Washington State Salmon Recovery Funding Board

- The Duwamish Estuary transition zone in the vicinity of river miles 7.0 - 5.5 (and possibly extending downstream to river mile 4.8),
- Spawning habitat in the Middle Green River and upper Lower Green River, and
- Rearing habitat in the Middle Green River, Lower Green River, Duwamish Estuary, and Marine Nearshore subwatersheds.

The Upper Green subwatershed represents 45 percent of the total watershed area and stream mileage. The plan envisions restoring Chinook access to about 65% of the historically used habitat areas. Getting naturally spawning Chinook above the Howard Hanson Dam into the streams and spawning and rearing habitat that Chinook historically used, is believed to be one of the most significant actions that would increase spawning habitat for Chinook.

Actions in the next ten years: The Habitat Conservation Plans (HCPs) and new forest management rules coupled with restoration and rehabilitation efforts are expected to improve large woody debris recruitment (LWD), sediment recruitment and other processes. Water quality improvement projects are planned and protection is focused mainly on structural features of the habitat and landscape - spawning areas, side channels and late seral timber stands. Actions include one bridge and two culvert replacements, decommissioning 10 miles of USFS roads, restoration of at least 20 miles of off channel habitat, levee setback projects, and meander jams and large woody debris in the mainstem.

A fish ladder and trap-and-haul system to pass fish upstream over the dams was recently completed in 2004 by Tacoma Public Utilities. A downstream fish passage facility at Howard Hanson Dam was well under construction by the Corps of Engineers as of 2005. NOAA Fisheries recently agreed to allow fish passage above the Howard Hanson Dam for all salmonids except hatchery-origin steelhead and Atlantic salmon.

The Middle Green subwatershed starts at the Howard Hanson Dam, at RM 64.5 and extends downstream to RM 32, near the eastern boundary of Auburn. This part of the watershed provides mainstem, off-channel and tributary habitats important to Chinook. Based on spawning survey data from 1997 to 2002, it has been concluded that about 80% of Chinook redds occur in the Middle Green mainstem. According to a 2001 report by the Trust for Public Lands, the Middle Green is one of the best river reaches for salmon remaining in Puget Sound.

Goals include restoring functioning habitats to about 65% of historical habitat area, improvements in sediment recruitment and transport rates to increase the productivity of spawning areas, and to maintain and develop spawning riffles, shallow channel edge, and other habitat, and maintenance of sources of cool, clean water from surface and ground water.

Photo by Dan Kowalski

Actions in the next ten years include: 18 large wood jams, invasive plant removals and revegetation (118 acres), placement of 12,000 tons of gravel, at least ten levee removals/setbacks, and acquisition of 383 acres for habitat protection and restoration purposes.

The Lower Green Subwatershed, beginning at about RM32, flows through a low gradient, wide valley. About 50% of the area is residential with about 27% devoted to industrial and commercial uses. Close to one fourth of the land is devoted to parks, agriculture, and mixed land uses.

The Lower Green reflects channel and floodplain modifications and intensive development, with a substantial loss in quantity and quality of mainstem spawning, winter and summer rearing, and adult holding habitat (large, channel-wide pools). About 40% of the wetlands have been filled, and about 87% of the floodplain forest has been lost.

Goals include restoring spawning habitat to about 45% of historical levels and restoring hydrologic connection to floodplain, tributaries and historical off-channel habitat to achieve access to about 45% of historical habitat area.

Actions in the next ten years include: side channel reconnections (restoring about 5 acres), at least 7 levee setbacks, and acquisition of about 240 acres for habitat restoration and protection purposes.

The Duwamish Estuary Subwatershed has undergone the greatest change in habitat capacity, diversity and productivity. The decrease in fish productivity, assessed as the factor most linked to the decrease in salmon population viability, is believed to be closely associated with the loss of estuarine capacity and productivity. Insofar as there is a limiting factor, the Duwamish estuary transition zone in the vicinity of the area from RM 5.5 to RM 7.0 (and possibly extending downstream to RM 4.8) is identified as a key component of Chinook recovery. About one percent of the original mudflats and eleven percent of the original tidal marshes remain in the Duwamish. In the estuary, saltwater wetlands are now gone, along with all but seven of the historic 200 hectares of freshwater wetlands. The critical transition zone, or salt water wedge, is where Chinook salmon undergo changes and acclimate to marine water. Typically, these areas provide a food-rich environment where Chinook grow and rear before moving to nearshore/marine waters. The fact that so much of this habitat has been lost underscores the importance of protecting what remains and restoring, rehabilitating or substituting habitat functions wherever possible.

Though much has been lost, restoration of 15-20 acres of intertidal habitat and sediment clean-up efforts undertaken through Coastal America and natural resource trustees in the 1990s are showing promising results.

In addition to relying on the EPA Superfund cleanup for the Lower Duwamish, the habitat strategy for the estuary includes protection of restored areas, rehabilitation of remnant habitat, and creation of new habitats. Actions include side channel reconstruction, revetment channel reconstruction, and creation of shallow water habitat.

Habitat goals to achieve necessary future conditions in the estuary to support more Chinook include:

- Improvement of mainstem, off-channel and tributary functioning habitats representing about 30% of the historical area,
- Expansion of the estuarine habitat to about 30% of the historical area.

Actions within the next ten years: Actions include restoring about 30 acres of shallow water habitat, 5 levee and revetment setback projects, re-vegetation, and acquisition of about 57 acres for habitat restoration and protection purposes.

The Marine Nearshore Subwatershed historically provided rich and diverse habitats for the abundant juveniles that moved up and down the shoreline, using shallow water habitat for food and refuge from predators. The availability of vegetated shallow nearshore and marsh habitat has been considerably reduced. About 63% of the total shoreline has armor and Seattle is the most heavily armored (90%). There are over 500 overwater structures, boat ramps, jetties, groins or breakwaters. The types of actions necessary to support larger numbers of Chinook as progress is made toward recovery goals include protection and enhancement of vegetated shallow nearshore and marsh habitat, sediment transport processes, pocket estuaries and small tributaries.

Actions within the next ten years include: culvert replacements for the mouths of five creeks and the creation of shallow water bench habitat is planned for at least 3 locations. Estuarine restoration, weir removals, and revegetation projects are also proposed.

Water Quantity — Low Flows

The Watershed Forum commissioned an assessment of current water quantity conditions. The report identifies and characterizes significant surface and groundwater linkages and inputs to the Green River system and provides a coarse water budget for people and fish in the study area. The technical work was performed in the broader policy context of identifying opportunities to manage water resources and to limit degradation of important sources of cool, clean water in the Green River. (WRIA 9 Water Quantity Assessment, Draft March 21, 2005). Recommendations and findings from this study are being evaluated by the watershed recovery team, ACOE and other stakeholders. Management actions will be tracked through monitoring and adaptive management.

Addressing Human Population Growth and Development

The key strategy for protecting habitat is to implement the state and local growth management programs. The plan calls for continued encouragement of growth in existing urban areas where new environmental impacts will likely be less than by development in rural areas. The habitat plan recommends no expansion of the urban growth boundary. In addition to guiding growth to existing areas, the plan calls for actions to reduce impacts, such as:

- Establish and enforce riparian buffers along rivers, streams, estuaries and the marine shoreline.
- Minimize impervious surfaces and forest cover removal in Rural Areas.
- Promote low impact development including natural filtration systems, grassy buffer strips, and other methods to manage runoff from paved areas, clustered development and narrower roads, and porous concrete where soils allow.

- Establish specific instream habitat goals for lowland streams.
- Reduce or eliminate industrial discharges and combined sewer overflows into waterways.
- Actively manage riparian buffers to ensure a long-range goal of at least 70% of the stream corridor as mature, coniferous-dominated forest. Strive to achieve and maintain a near-continuous riparian corridor.

Hatchery Strategy and Actions for Recovery

The goal of the hatchery program is to provide fish for harvest. The program was established using Chinook originating from the Green River. The Soos Creek Hatchery, together with its satellites, supports the Chinook salmon hatchery production program and is operated as an integrated program. The hatchery release goal is 3.2 million fingerlings at 80 fish per pound. Each year the Icy Creek satellite is stocked with 302,000 fin clipped fingerlings from Soos Creek that are released in May. All juvenile hatchery Chinook are mass marked and an index group are coded-wire tagged. The mass marking is important to provide monitoring and harvest opportunity and the coded wire tagged index fish provide an indicator of mortality and marine survival. Returning adult spawners that are not needed at the Soos Creek hatchery are often allowed to pass upstream to spawn naturally. Soos Creek fish make up approximately 33.4% of the wild spawners in the Green River (WDFW and Puget Sound Treaty Tribes, 66, 67).

The draft habitat plan recommends that co-managers consider modification of hatchery practices to support and achieve recovery, for example, by altering the schedule for hatchery fish release to reduce negative impacts on naturally spawning Chinook. Other recommendations include more natural rearing conditions, smaller releases, and genetic management.

WDFW will investigate the feasibility of removing hatchery fish from the Green River above Soos Creek in an attempt to reduce the number of hatchery fish on the spawning ground. The agency will also conduct a study to determine the relative reproductive success of naturally produced and hatchery produced fall Chinook spawning in Soos Creek. WDFW also intends to remove the trapping facilities from the mainstem of Soos Creek. Co-managers will regularly evaluate research and monitoring results with the intent of adjusting, as appropriate, the HGMPs consistent with stock recovery and fishing objectives.

WDFW intends to eliminate the Ballard Chinook net pens and the Des Moines Net Pen Fall Chinook Program. WDFW and the Muckleshoot Indian Tribe will continue to use progeny originating from Fall Chinook salmon adults volunteering to Soos creek hatchery for the Keta Creek hatchery program, the Soos Creek Hatchery program, and the Icy Creek satellite program. (WDFW and Puget Sound Treaty Tribes, 68, 69).

Harvest Strategy and Actions for Recovery

Reduced harvest rates for Green River Chinook have had a positive effect on the number of returning adults. Currently, the majority of fishing impacts occur in recreational, net and troll fisheries for Washington (2001, Comprehensive Chinook Management Plan - Harvest Management Component, 78). Currently, the co-managers goal is to ensure that 5,800 Green River Chinook return to home waters to spawn. The overall intent is to ensure that harvest management practices do not impede recovery of the Chinook ESU. The Comprehensive Chinook Management Plan reports that "the central objective of terminal area fisheries management is to assure adequate natural spawning escapement and to supply broodstock to the fisheries enhancement program" (ibid, 79). Concern has been expressed that hatchery-origin spawners, by inter-breeding with natural-origin spawners, are reducing genetic fitness of the natural-origin fish. However, no genetic distinction between natural-origin recruits and hatchery adults has been detected (op.cit.).

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The draft habitat plan suggests using live capture techniques to catch hatchery salmon in order to release natural salmon thus reducing mortality of naturally-produced salmon (4-39).

Results

The watershed plan for the Green/Duwamish and Central Puget Sound watershed was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan to some extent, but the reviewers felt they merited particular attention or additional effort to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

The Green/Duwamish Watershed Forum plan is based on a solid foundation of information about how the landscape conditions affect habitat attributes in the river for Chinook. The plan lays out the conditions believed necessary to achieve a naturally self-sustaining population of Chinook based on the assumption that since the watershed is much reduced in size and altered irreversibly from its historical conditions, then strategies and actions can only support a reduced population. Neither historic conditions can be met nor can fish numbers be expected to recover to near-historic levels. Achieving the results predicted for a self-sustaining population will require major changes to the current river conditions and surrounding landscape. Since the river and land have been highly altered, and integrated habitat, harvest and hatchery strategies have not been developed, there is significant uncertainty about the technical feasibility of restoring natural processes that would support a self-sustaining system.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

One of the first priorities in the next two years should be to gain consensus between the Tribe, State and Watershed Forum on the goals for Chinook in this system. The agreement will influence the watershed priorities, including habitat actions, that would logically follow.

In the interim, reducing harm to the fish as they migrate through the lower Duwamish, and protecting the Middle Green will be important regardless of the ultimate objectives for the fish. This approach will preserve future options for the population.

The adaptive management and monitoring program, slated for completion by December 2005 is expected to incorporate measures relating to the issues identified in the results section above.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the proposals above are implemented and the uncertainties addressed, this watershed and its Chinook population will provide a critical contribution to the recovery of Puget Sound Chinook and a spatial linkage between the Central-South Sound fish and their neighboring watersheds in the North.

Important Note re draft plan: The draft plan was developed by the Steering Committee and released for public review and comment on March 10, 2005. Following the comment period, which closed on April 25th, the Steering Committee will make revisions and present the draft to the Forum, made up of elected officials representing the 17 jurisdictions who are funding the effort. Forum members will be asked to approve the Final Plan or refer it back to the Steering Committee. No later than November 16, 2005, Forum members will refer the plan to the local governments of the inter-local agreement for ratification.

Watershed Profile:

East Kitsap

The Place and the People

The East Kitsap watershed's sinuous shorelines form the eastern portion of Kitsap County, including Bainbridge Island. East Kitsap harbors countless small streams that empty into the marine waters of Puget Sound. Quiet and easy-paced compared to the cities of Tacoma and Seattle less than 20 nautical miles away, small-scale and hobby farms still dot the landscape in Kitsap, helping to maintain the area's rural heritage.

The Kitsap Peninsula as a whole is 400 square miles in size, surrounded by 360 miles of saltwater shoreline. In fact, the shorelines account for nearly half of the nearshore habitat in south and central Puget Sound and provide vital habitat for threatened Chinook and bull trout populations from watersheds throughout those areas. The East Kitsap plan addresses the eastern portion of Kitsap Peninsula and nearshore, which includes the City of Bainbridge Island. It does not address any part of the Kitsap peninsula that is within the jurisdiction of Pierce County. The Nearshore and streams on the west side of the peninsula flow into Hood Canal and are included in the recovery strategy developed through the Hood Canal Coordinating Council.

Photo by Dan Kowalski

The East Kitsap basin includes numerous separate lowland streams entering the saltwater, with quiet, shallow waters that provide ideal foraging and rearing habitat for juvenile and adult salmon returning to spawn from populations across the Puget Sound. Because water access was the only way early settlers could reach the Peninsula, nearly every community in Kitsap has a water view, marina or stretch of beach to enjoy.

The hydrology of the streams in East Kitsap is unique compared to other watersheds in Washington. Stream flows in East Kitsap are dependent on precipitation and groundwater contribution, as the drainages do not receive snowmelt runoff from either the Olympic or the Cascade mountains. Maintaining this system is imperative in order to keep salmon habitat intact. The soils throughout much of the basin are comprised of a thin veneer of pervious topsoil over a deep deposit of densely compacted glacial till. This allows precipitation to be retained, held in wetlands, and naturally released out to the streams which provide surface flows even through the dry summer months.

East Kitsap has a strong history of building partnerships to forge collaborative solutions on a variety of natural resource issues such as stormwater management as well as numerous salmon habitat protection and restoration projects. Conserving and restoring salmon habitat in the East Kitsap watershed is primarily being approached through locally coordinated and implemented programs. The Suquamish Tribe, the City of Bainbridge Island, Kitsap County, and state agencies are providing the support and technical expertise necessary to develop a recovery plan and help the community move forward with a strategy to safeguard salmon in the basin.

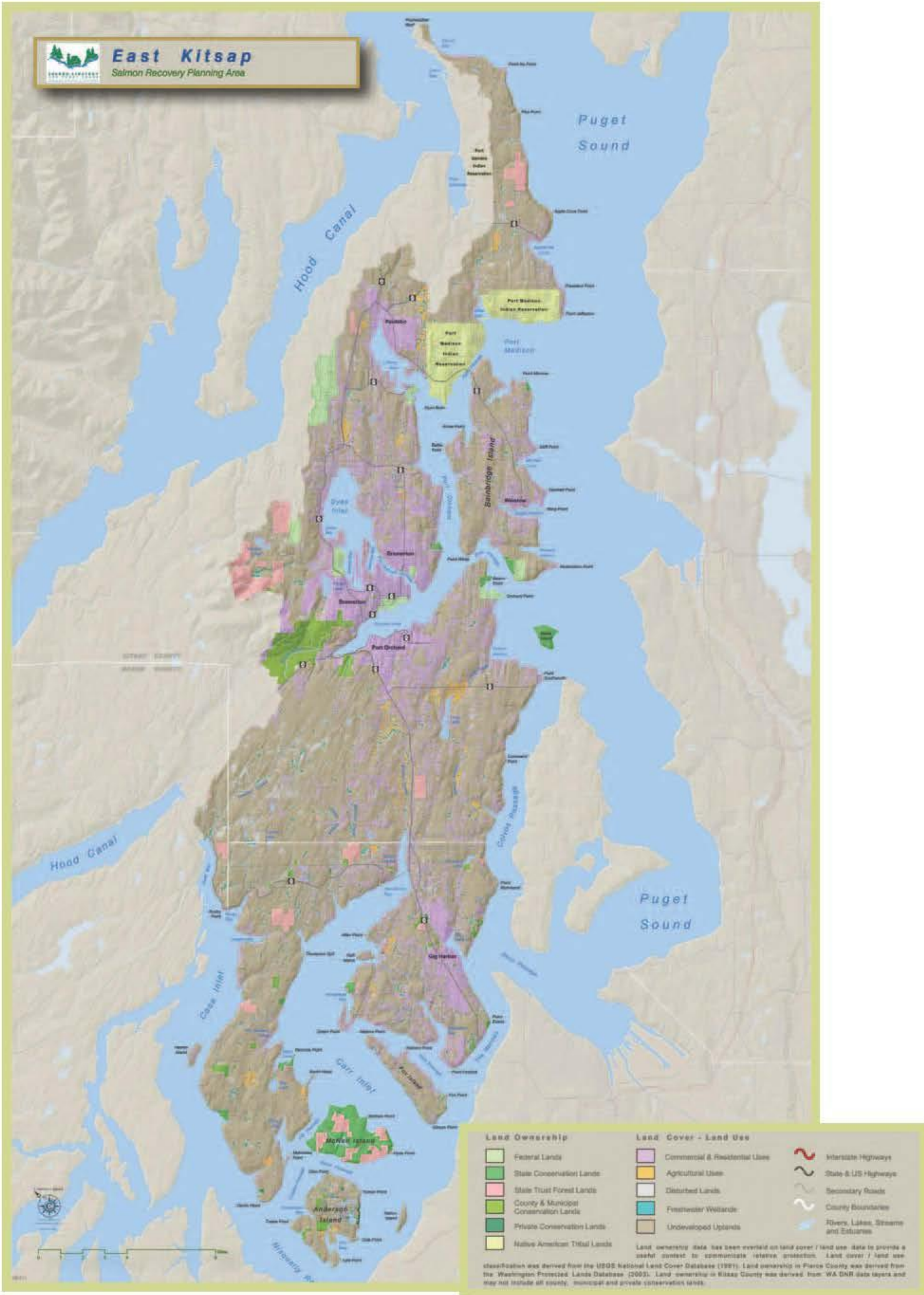
To contribute to the recovery of threatened Chinook, technical folks and policy decision-makers will continue to work with the Kitsap community to gain support for habitat protection and restoration actions, provide landowner incentives for habitat protection and restoration on private lands, and continuously search for solutions that balance the needs of both fish and people.

Photo by Dan Kowalski

East Kitsap Salmon

While the Technical Recovery Team (TRT) did not identify independent Chinook populations originating from East Kitsap streams, there are numerous streams entering saltwater in East Kitsap that are known to support salmon originating from East Kitsap and other watersheds.

Chum, coho, steelhead and cutthroat trout regularly use streams in East Kitsap. Most of the Chinook that use East Kitsap streams appear to be from the Suquamish Tribe's hatchery program or from Minter Creek Hatchery, White River Hatchery and other hatcheries. During years of strong salmon runs in Puget Sound, wild Chinook are likely to stray into the streams. The Suquamish Tribe marks all hatchery Chinook to identify them in their out-migration studies and estuarine and nearshore beach


East Kitsap
Salmon Recovery Planning Area
Puget Sound
Hood Canal
Hood Canal
Puget Sound
Bainbridge Island
Dyes Inlet
Port Orchard
Gig Harbor
Colvos Passage
Case Inlet
Carr Inlet
McNeil Island
Anderson Island
Land Ownership
Federal Lands
State Conservation Lands
State Trust Forest Lands
County & Municipal Conservation Lands
Private Conservation Lands
Native American Tribal Lands
Land Cover - Land Use
Commercial & Residential Uses
Agricultural Uses
Disturbed Lands
Freshwater Wetlands
Undeveloped Uplands
Interstate Highways
State & US Highways
Secondary Roads
County Boundaries
Rivers, Lakes, Streams and Estuaries
Land ownership data has been overlaid on land cover / land use data to provide a useful context to communicate relative protection. Land cover / land use classification was derived from the USGS National Land Cover Database (1991). Land ownership in Pierce County was derived from the Washington Protected Lands Database (2003). Land ownership in Kitsap County was derived from WA DNR data layers and may not include all county, municipal and private conservation lands.

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seining studies. Grovers Creek Hatchery Chinook are coded wire tagged as one of the Pacific Salmon Treaty Puget Sound indicator stocks. More recently, a double index coded wire tag program has been initiated for the Grovers Creek Hatchery Chinook.

Threatened Chinook populations from north, south, and central Puget Sound watersheds are believed to use the East Kitsap nearshore habitat for refuge, resting and feeding on the way to and from the ocean. Shallow nearshore waters provide protection from predators and support prey that salmon eat. Recent studies indicate that Chinook occupy the nearshore regions of East Kitsap nearly year-round. Beach seining surveys in the shore zones of Bainbridge Island and throughout East Kitsap County indicate that juvenile Chinook are present from March through December and most numerous from May through August.

The independent tributaries in East Kitsap are not typical Chinook habitat because of relatively small stream size and low flows during the late summer/early fall spawning season. However, spawning adult Chinook are observed on a regular basis in numerous streams. Most of the returning Chinook are believed to be hatchery-origin fish released from the Gorst Hatchery rearing ponds. Despite higher escapements, there appears to be poor natural Chinook production from this system based on adult upstream and juvenile outmigration weir counts on Gorst Creek conducted by the Suquamish Tribe.

Although bull trout are believed to use the nearshore/marine waters as foraging, migrating and over-wintering habitat, no observations have been reported from beach seine studies initiated in 1979 and continued more recently from 2001 to the present.

Recovery goals

The City of Bainbridge Island approaches salmon recovery and conservation in accordance with the vision and timeframe provided by the City Council and the Bainbridge Island Comprehensive Plan, as well as technical guidance. The overall goal is to "restore and conserve self-sustaining and harvestable wild salmon populations on the Island and contribute to regional salmon recovery and conservation in a manner that is ecologically sound and socially equitable; does not jeopardize other species; and enhances our community, our quality-of-life, and our economy."

The goal of the East Kitsap planning group led by Kitsap County is to protect, restore and enhance the nearshore natural processes and habitat that benefit Chinook and bull trout in order to contribute to Puget-Sound wide recovery. In the long term, the overall goal is to restore Chinook, coho, and other salmon species to naturally spawning, sustainable, harvestable levels. The future envisioned by the county is one "in which viable communities, with healthy economies, coexist with and maintain viable salmon populations sustained at harvestable levels."

The Recovery plan for East Kitsap is generally intended to be implemented over a period of 5-10 years through restoration and protection projects funded through SRFB and other habitat protection and programmatic efforts. However, conservation and recovery of salmon is expected to take much longer and therefore, the recovery plan will be

Photo by Dan Kowalski

reviewed and updated periodically based on the knowledge gained from its active implementation.

What are the key factors contributing to the current status of the populations?

Since the East Kitsap role in regional recovery is to focus on nearshore processes and the health of the freshwater, estuarine and marine ecosystems, the plan identifies nearshore related habitat factors that contribute to the status of the salmon populations. These include:

Wave energy

The force of waves can be modified by the composition, encroachment, and design of shoreline armoring structures. Exposure to human-made waves, where naturally there were none, results in turbulence that can displace rooted aquatic vegetation like eelgrass, and can reduce the natural retention of large woody debris that is important for salmon habitat.

Light

The loss of natural shade where it is needed or the addition of artificial shade from over-water structures where it is not desirable can affect water temperature and the growth of vegetation. Shade is lost when riparian vegetation is removed as a result of development. Conversely, structures such as piers, docks, and other floating or overwater structures can reduce the availability of light marine plants need for photosynthesis. Changes in the light regime can affect biodiversity and the presence of salmon prey and predators, water temperature, and can cause fish to avoid certain areas which may in turn alter migratory patterns.

Sediment Supply and Substrate Type

Armoring, or hardening, the shoreline substantially affects the abundance of sediment within that section of shoreline. Built structures such as groins and ramps can also affect sediment supply. Excessive sediment can smother eelgrass beds that are important for salmon refuge and prey production, among other biological affects. Armoring can also involve modifying or replacing the natural substrate, for example when gravel and sand is replaced by solid concrete. Altering substrate can have several affects including reducing the habitat of salmon prey.

Depth or Slope

Built structures and alterations, such as ramps and dredging activities, can also affect the natural slope of the beach and depth of the water in the intertidal zone. This can result in a reduction in landscape connectivity, and can alter biodiversity and salmon migratory corridors.

Pollution

Pollution, including toxic contaminants, fecal coliform bacteria, excessive nutrients, and altered salinity and temperature regimes, is often associated with proximity to outfalls (areas where contaminants are discharged) or with marinas and fish farms. Extensive development and the associated increase in impervious surfaces and armored shorelines adjacent to upland areas can also lead to an increase in pollution as contaminated runoff flows unobstructed into the water. Riparian areas can act as a filter and a buffer to this affect, thus the removal of riparian vegetation also can lead to an increase in pollution. Pollution can degrade or destroy vegetation that salmon rely on for refuge and prey production, can fragment the landscape, and can result in direct toxicity to the fish and their prey.

Hydrology

The alteration of natural stream hydrology has been identified as perhaps one of the largest impacts/threats to salmon habitat. Hydrology refers to tidal inundation regimes or patterns of groundwater and surface water flow. The East Kitsap Watershed is low elevation, dependent on rainfall, wetland storage, and groundwater infiltration to stream channels. Most of East Kitsap has shallow soils over deep compacted glacial till, resulting in limited groundwater storage potential. Armoring can alter groundwater and surface flows and can disturb slope stability. Alteration of groundwater and surface flows may impact riparian vegetation


Photo by Dan Kowalski

distribution and slope stability and can result in disturbances to plants and animals.

The increase in impervious surfaces associated with development decreases the infiltration of precipitation into the soils and wetlands and also increases the frequency and magnitude of peak stream flows. The result is less water is available to sustain flows through the dry months, and the increased peak flows during the rainy season result in increased bank and streambed instability, channel scour, and loss of instream habitat diversity, all of which adversely affect salmon production.

Physical disturbances

Recurring physical disturbances associated with human activities in marine and riparian shoreline habitats which result from docks, mooring buoys, culverts, dams and human noise and activity can cause stress to vegetation and bottom dwelling organisms that salmon prey upon. Physical disturbances can also directly affect salmon migration patterns.

Growth/urbanization

Kitsap County's population growth from 2000 to 2020 is estimated to be 54%. Pressure to expand urban growth areas (UGAs) to waterfront areas is being experienced in North Kitsap as well as other areas. The City of Bainbridge Island has experienced periods of rapid growth in recent decades, from 4,132 in 1950 to about 20,000 in 2000. The population is projected to increase by 41% by the year 2025.

Overall Approach to Recovery

East Kitsap approaches salmon recovery by planning and implementing salmon habitat restoration projects that address limiting factors through the state salmon recovery laws (the HB 2496 process) and through the state watershed management laws (the HB 2514 process). Planners and biologists from county, city and tribal government agencies collaborate through the 2496 technical and citizen committee process on selection and implementation of habitat protection and restoration projects.

Habitat protection is approached through the use of regulatory and voluntary programs, along with outreach and education activities.

The East Kitsap Salmon Recovery and Conservation Plan emphasizes the value and importance of the nearshore to a variety of Puget Sound Chinook and other salmon populations, especially juveniles. Kitsap County, the City of Bainbridge Island, the Suquamish Tribe and the Washington Department of Fish and Wildlife present a general strategy of protection, restoration, conservation, education, and incentives to achieve their goals. The basic premise of their strategy is that human-induced stressors causing modifications of the estuarine and near-shore/marine environments have altered habitat-forming processes and structures resulting in a decrease in the ability of these habitats to support Chinook populations.

The City of Bainbridge Island and Kitsap County are building their strategy on a variety of existing policy directives and implementing ordinances and non-regulatory programs that give special consideration to salmon and their habitat. These programs are primarily focused on protecting existing habitat from the impacts of development and other land use activities. Comprehensive plans, Shoreline Master Programs, the Critical Areas Ordinances, Stormwater and Zoning Ordinances represent the major policy and implementing regulatory programs in East Kitsap. Existing non-regulatory programs such as Kitsap County's open space land designation under the current use tax benefit rating system provides property owners the opportunity for property tax relief; land owners can enroll properties that contain important fish and wildlife resources. Other programs, like the City of Bainbridge Island Open Space Bond, enable local jurisdictions to work with local land trusts and park districts to purchase fee-title property or conservation easements for conservation purposes, including properties that contain important fish and wildlife resources.

Photo by Dan Kowalski

Key Strategies and Actions Supporting the Overall Approach to Recovery

Assessments

The City of Bainbridge Island has completed a nearshore assessment and a subwatershed assessment will be conducted which will be updated every 7 years. The subwatershed assessment will inventory and characterize habitat, fish passage, hydrology, and land use and identify actions in these areas to achieve their goals. An additional shoreline roads study will evaluate alternative solutions to shoreline roads with erosion, slide and flooding problems.

Kitsap County will begin a nearshore assessment during 2005, which will result in an inventory and characterization of nearshore functions and attributes.

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Fish passage barriers

High priority activities on Bainbridge Island include land acquisition and projects addressing fish passage restrictions in streams that provide important salmon refugia, productive capacity, and habitat. Kitsap Conservation District expects to complete an inventory of privately owned fish passage barriers in Kitsap County soon. Proposals for culvert replacements and barrier removals have also been submitted for funding.

Protection and Restoration

Protecting and restoring marine nearshore areas is considered a priority based on benefits to all salmon stocks using these waters. Restoration activities are also occurring in Gorst Creek and include the placement of gravel, large woody debris, revegetation along 1.5 miles of stream, and restoration of 1,200 feet of shoreline.

Stormwater runoff

Kitsap County is currently exploring how to best achieve compliance with NPDES Phase II requirements that regulate stormwater discharge. County staff members discuss the impacts of increased total impervious surface areas during presentations, at community planning workshops, and other public education and involvement programs.

Regulatory Tools

Kitsap County recently initiated its Comprehensive Plan compliance review which is scheduled for completion in late 2004. Bainbridge Island initiated the revision process for the shoreline management master plan in the fall of 2002. The process includes workshops for the community concerning effects of marine/nearshore modifications and possibilities for alternatives to bank armoring, revegetation, and related best management practices.

Harvest and Hatchery Management:

The Suquamish Tribe and Washington Department of Fish and Wildlife conduct salmon harvest under the guidance of the Harvest Management Plan for Puget Sound Chinook, part of the Comprehensive Chinook Management Plan to guide recovery of Chinook in Puget Sound. State and Tribal hatchery operations are governed by Resource Management Plans which include Hatchery Genetic Management Plans, the State/Tribal Fish Health Policy, and other elements. Both Hatchery and Harvest elements are presently covered by a 4(d) exemption issued by NOAA-Fisheries.

Adaptive Management

Kitsap County is currently developing an adaptive management and monitoring and plan.

The City of Bainbridge Island provides for near-term (5 year), mid-term (5-10 year) and long-term (beyond 15 year) evaluations of progress in protecting and restoring habitat functions and values. The city's monitoring program gives consideration to specific monitoring goals, scale (effort in time and space), timing, sampling design and replication, reference site designation, attribute selection, sampling methods, and costs. Monitoring efforts link processes to the nearshore habitat structure, integrate a multitude of nearshore habitats that support a variety of functions, establish relationships between structure and function, and link local processes to the broader Puget Sound ecosystem. The table above provides key monitoring attributes.

Key Nearshore Monitoring Attributes (COBI monitoring program)	
Controlling factors	Land use-land cover assessment, nearshore riparian cover, shallow water aquatic habitats
Habitat structure	Fish assemblages, exotic species
Ecological functions	Due to clearing and development

Potential actions include education and outreach programs, forage fish and other surveys, development of tools and methods. Examples are develop-

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ing long range planning tools to address potential impacts to surf smelt and sand lance spawning areas and development of incentive programs to encourage removing unnecessary shoreline armoring and use of soft bank protection; and revegetation of public lands "wherever possible."

The City of Bainbridge Island salmon plan is tied to iterative updates to the Comprehensive Plan, CAO and Shoreline Master Plan. Accordingly, nearshore assessments, watershed assessments and the salmon plan will be updated and evaluated two years prior to the scheduled updates, i.e., in 2009 for the 2011 updates, and 2016 for the updates scheduled to occur in 2018.

Results

The watershed plan for the East Kitsap watershed was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan to some extent, but the reviewers felt they merited particular attention or additional effort to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

The plan recognizes that East Kitsap's nearshore and marine areas play an important role in providing support for Chinook salmon from the South/Central Puget Sound region. To protect and restore the nearshore and marine areas, the City of Bainbridge Island and Kitsap County have each developed recovery plans with slightly different approaches and have loosely merged their efforts into a single plan.

The City of Bainbridge Island prioritized areas based on an ecosystem-based conceptual model and has started to incorporate adaptive management into their plan to make sure that their strategies and actions have the greatest benefit for the fish. The city identifies both short-term (10-year) actions and long-term strategies. The city is also the only jurisdiction in the region, as far as reviewers are aware, that has passed an ordinance restricting dock construction to protect the nearshore ecosystem in a specific part of the watershed.

The County's plan focuses recovery planning efforts on ensuring that existing protection measures and voluntary programs are implemented.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

The planned strategies and actions by both the city and county will need to be linked to results for fish, the Viable Salmonid Parameters (VSP: abundance, productivity, spatial distribution, diversity) to describe the expected outcomes from plan imple-

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mentation. Once the linkage between the ecosystem principles, stressors, and geographic priorities are linked to VSP, then these four parameters can be used as a measure for monitoring.

The certainty of achieving plan outcomes will increase if adaptive management is incorporated into the strategy in Kitsap County. Certainty will also be increased by considering completed assessments and assessments yet to be developed by both the city and county and other municipalities that will identify ecological functions more specifically, along with the results of strategies and actions taken in the freshwater and the nearshore.

It will be important to coordinate and reconcile local nearshore actions with the regional nearshore chapter. A nearshore monitoring effort coordinated across the region will allow areas to be prioritized so that efforts in each nearshore watershed have the greatest benefit for fish and contribute to overall ESU recovery.

As in other watersheds across the Sound, it will be important to assess the results for fish from the various protection mechanisms this plan relies upon.

The impact that hatchery programs in East Kitsap have on wild Chinook populations remains uncertain. Hatchery reform and the integration of hatchery, harvest, and habitat strategies must be undertaken with care to avoid unintended impacts on fish that could be detrimental to populations across the region.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land

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use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,

- The need to develop or complete a robust adaptive management and monitoring program.

If the above uncertainties are addressed, the East Kitsap watershed will support salmon populations using its nearshore and marine waters and provide an important contribution to overall ESU recovery.

Watershed Profile:

Puyallup/ White Basin

The People and the Place

Shaped by a series of mudflows running down Mount Rainier starting about 5,600 years ago, the Puyallup/ White River basin is geologically the youngest watershed in Puget Sound. The Puyallup and its two major tributaries, the White River and the Carbon River, are glacially-born on the flanks of Mount Rainer. The Puyallup flows from Klapatche Ridge on the southwestern slopes of Mount Rainier to empty into Commencement Bay at the Port of Tacoma, the third largest port in the western U.S. The White River flows about 68 miles from its headwaters on the northeast face of Mount Rainier before joining the Puyallup River at Sumner. The Carbon River flows from the Carbon glacier to its confluence with the Puyallup River near Orting.

South Prairie Creek, a major tributary of the Carbon River, is considered one of the most productive reaches used by Chinook for spawning habitat that is available for natural salmonid production in the basin. Most of the watershed lies within Pierce County. It includes more than a dozen cities and towns, including the state's third largest city, Tacoma. In total, the Basin drains an area of approximately 1,065 square miles, and has over 728 miles of rivers and streams which flow over 1,287 linear miles.


Photo by Dan Kowalski

Annual average rainfall in the basin ranges from 40 inches at the city of Puyallup to 70 inches at the Electron Dam. Eighty percent of this precipitation occurs in the fall and winter months. Sixty percent of the basin lies at an elevation of 1,000 to 4,000 feet, an area where neither rain nor snow predominates. This topographical feature often leads to moisture conditions that are capable of generating tremendous amounts of runoff. Flood events normally occur in the winter months and are followed by less severe spring runoffs generated by snowmelt.

There are three hydroelectric facilities in the watershed. The Electron Dam, operated by Puget Sound Energy, is on the Upper Puyallup River. Mud Mountain Dam, about five miles upstream from Buckley on the White River, is used to regulate flows to protect Sumner, Auburn, Puyallup and other lowland areas by holding back water from heavy rains and snow melt in the reservoir, then releasing it slowly back into the river. When returning adult salmon are trapped at the diversion dam at Buckley they are trucked upstream of the Mud Mountain Dam where they are released into the Upper White River. Fry pass through the dam's tunnels as they head downstream for Puget Sound.

Downstream of the dam, between Enumclaw and Buckley, Puget Sound Energy operates a diversion dam--the White River Hydroelectric Facility (completed in 1911). This dam redirects up to 2000 cubic feet per second of the water from the White River through a canal and flume system into Lake Tapps.

The Puyallup River Basin was one of the earliest areas to be settled by Euro-Americans in the Puget Sound region. They prized the basin for its deep-water embayment, large tracts of pristine old growth forests, fertile river valley soils and abundant runs of salmon. Homesteads and settlements began appearing in the early 1850s. The Puyallup River basin was also one of the first watersheds in Puget Sound to experience the full impacts of industrial, urban and agricultural development. Extensive urban growth, heavy industry, a large modern marine port, hydropower, an extensive revetment and levee system, and agriculture have combined to significantly alter the natural landscape. These activities and land uses have led to negative impacts on the salmon populations that had thrived in the basin. Nonetheless, functioning, productive habitats still exist for salmon to spawn and rear, especially in the middle and upper White, Puyallup, and Carbon watersheds and in the South Prairie Creek watershed.

Pierce County, the Port of Tacoma, the Puyallup Tribe, WDFW, US Forest Service, and other stakeholders collaborated in the development of an Ecosystem Diagnosis and Treatment (EDT) modeling exercise to help guide decisions on restoration and protection efforts. Salmon recovery efforts are focused on addressing the loss of floodplain habitat. Dikes and levees have been used extensively to contain the White, Puyallup and Carbon Rivers' natural inclinations to meander.

Pierce County, the Puyallup Tribe, the Muckleshoot Indian Tribe and the Washington Department of Fish and Wildlife (WDFW), have each been active in developing and coordinating recovery efforts in the Puyallup basin. The two tribes, along with other natural resource trustees, are engaged in identifying estuarine areas for clean-up of contaminated sediments.

Major restoration projects completed and/or slated for action include levee setbacks and oxbow restoration while simultaneously continuing to provide for flood control. Limiting the impact of new development is also critical in any highly-urbanized watershed. Pierce County recently worked with a developer and engineering firm to introduce low impact development technologies in the Fife Heights (Meadow on the Hylebos) area and is promoting the approaches with other developers.

The County, Puyallup Tribe, agencies, and other stakeholders and residents of the watershed will build on these recent efforts to continue to work towards protecting and restoring their watershed into the future.

Puyallup/White Salmon and bull trout

The basin is home to early and late run Chinook, three native chum stocks, pink salmon, and steelhead. There are three native populations of bull trout, and the basin is considered a core area for

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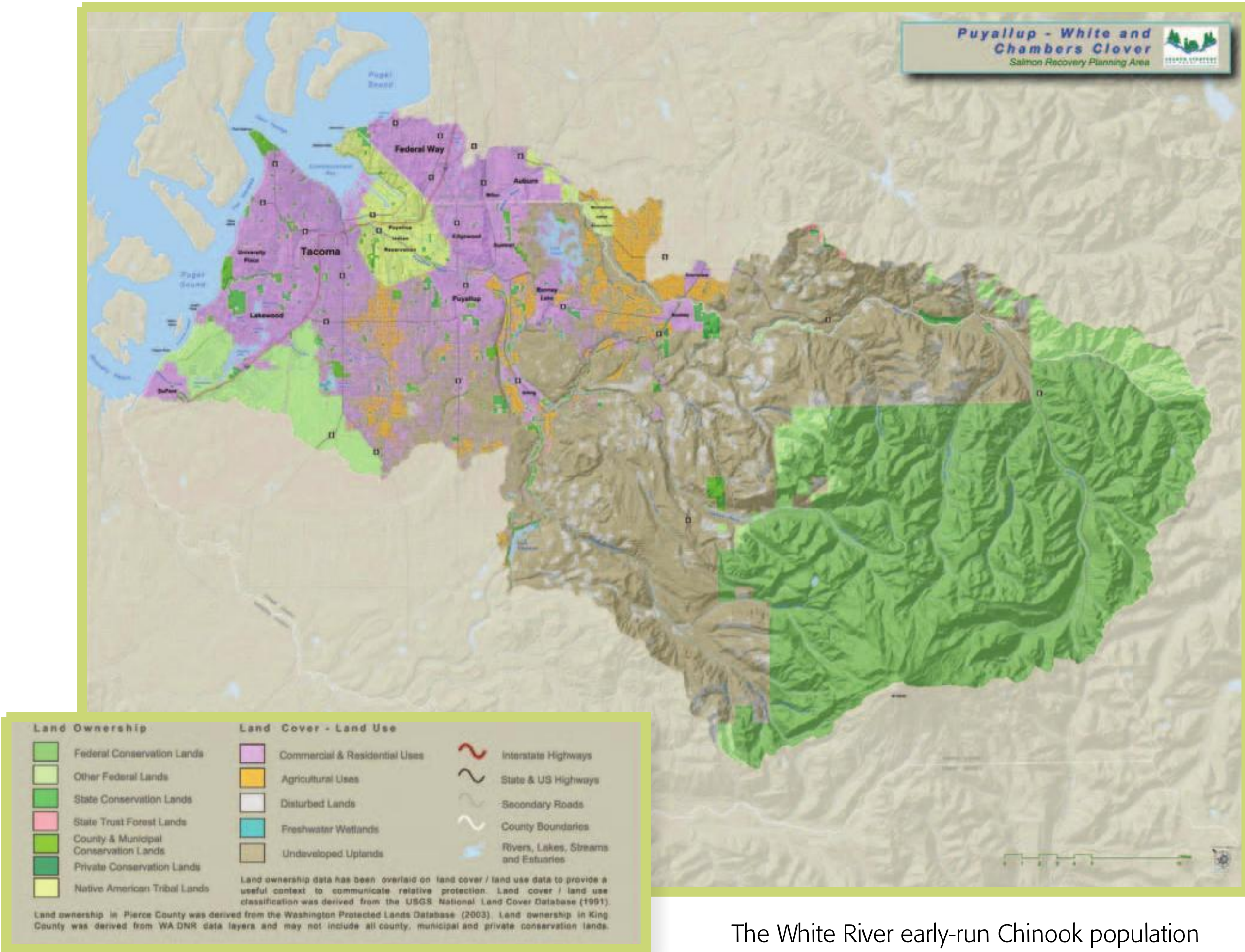

bull trout recovery. The US Fish and Wildlife Service has identified five local bull trout populations within the Puyallup core area — Carbon River, Greenwater River, Upper Puyallup and Mowich Rivers, Upper White River and West Fork White River. There is one potential bull trout population in the Clearwater River.

Chinook

The Puyallup River basin supports two populations of Chinook salmon -- the early returning White River Chinook, which spawn in the upper and lower White River, and the late returning Chinook population that spawns in the Carbon River, Puyallup River, and associated tributaries. There are also some late returning Chinook that spawn in the lower White River that will need to be assigned to one of the populations.

The White River early-run Chinook population is genetically the most distinctive stock in central and south Puget Sound. It is the last existing early returning "spring" Chinook population in southern Puget Sound. Most natural spawning occurs in the mainstem White River upstream of Mud Mountain Dam, and in major tributaries such as the Clearwater River, Greenwater River, Huckleberry Creek, Boise Creek and potentially the West Fork White River. The early Chinook also spawn in the White River downstream of the water diversion at RM 24, where some late returning Chinook also spawn.

Most Puyallup Chinook natural spawning occurs in South Prairie Creek up to RM 15, the Puyallup mainstem up to the Electron Dam, the lower Carbon River, Voights's Creek and Kapowsin Creek. Some spawning is believed to occur in the upper Puyallup now also since passage has recently been established at the Electron diversion dam.

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Recovery Goals

Ecosystem Diagnosis and Treatment (EDT) analyses conducted by Pierce County in collaboration with the Puyallup Tribe, WDFW, the U.S. Forest Service, Port of Tacoma, and other stakeholders was used to estimate reasonable recovery goals based upon a relatively comprehensive list of restoration actions.

Puyallup River Chinook: The Technical Recovery Team planning range for abundance is 17,000 to 33,000 (productivity of 1.0). The planning target for abundance is 5,300 (productivity of 2.3) to 18,000 (productivity of 1.0). The EDT analysis estimates that the basin can potentially support abundance at 6,170 spawners after implementing a series of actions.

Measurable recovery goals are under study by the co-managers and will be developed as H-Integration is achieved. The current escapement goal (number of fish allowed to "escape" harvest to spawn) for the Puyallup River Chinook is 1,200. Currently, for South Prairie Creek, co-managers want to see at least 500 adult spawners return to the Creek. The long term goal stated in the Puyallup Fall Chinook Baseline Report (2000) is "to ensure that Puyallup River natural fall Chinook are allowed to continue to respond and adapt to their local environments and that the stock be maintained at or, if necessary, restored to a healthy, productive status."

White River Chinook: The EDT analysis estimates 3,225 Chinook in the upper and lower White River combined assuming discontinuation of the White River hydroelectric facility flow diversion.

Measurable goals for the White River population are under study and will be developed as H Integration is achieved. Currently, the co-managers short term goal is for 1,000 or more adult natural origin spawners returning to the Buckley Dam. The long term goal stated in the White River Recovery Plan (1996) is "to restore the native population of White River spring Chinook stock in the White River watershed to a healthy, productive condition… The escapement goal should reflect the watershed carrying capacity and should be met with a full compliment of directed and incidental harvest in sport, commercial, and tribal fisheries."

Bull trout: The US Fish and Wildlife Service recovered Puyallup core area adult abundance target for bull trout is 1,000.

What is the current status of the threatened fish?

EDT analysis suggests that the average historic abundance of the Lower White River Chinook was 15,000; currently, it is estimated at 200. The average historic abundance of Upper White River Chinook according to EDT analyses was 6,700, with 500 as the current abundance estimate (Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Habitat Assessment Report, Vol. 11, 2003.) White River Chinook escapement fell to below 100 through the 1980s, and in two of those years, was below 10. The hatchery supplementation program has raised escapement to levels ranging from 300 to 600 between 1992 and 1998. (Comprehensive Chinook Salmon Management Plan, 2002).

EDT modeling results estimate that the Puyallup River supported 42,000 Chinook historically; the estimate of current abundance is 1,300 (Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Habitat Assessment Report, Vol. 11, 2003.)

Over the last ten years, natural spawning escapement of Puyallup Chinook ranged from 1,500 to 5,000, with averages over the last 8 years of 2,500. The median natural escapement to the South Prairie spawning grounds was as low as 25 in the 1970s and 1980s.

What are the key factors affecting the current salmon populations?

Supporting factors

Nearshore and estuarine habitats provide food and refuge for juvenile salmon as they prepare for their journey to the ocean; but, flood control

Photo by Dan Kowalski

funded by SRFB and other sources in the next ten years.

Most of the Upper Puyallup River watershed is managed under the Forests and Fish agreement and Habitat Conservation Plans. Forest Service ownership on the east headwaters is contiguous with Mount Rainier National Park. The upper watershed offers an opportunity to increase spawning and rearing habitat for Chinook through road decommissioning and other restoration actions. The Puyallup Tribe entered into a Resource Enhancement Agreement with Puget Sound Energy (PSE) in 1997. Among the actions that benefit Chinook are provisions for minimum instream flows based on the needs of Chinook and completion of a fish ladder to get fish above the Electron Dam to about 26 miles of stream habitat.

projects, Port of Tacoma activities and urbanization have resulted in severely degraded conditions and significantly reduced the amount of functioning habitat. Since the 1990s, EPA and the natural resource trustees, including the Puyallup Tribe and the Muckleshoot Indian Tribe, have been working with the Port of Tacoma and Port tenants on sediment remediation and habitat restoration projects in Commencement Bay and the Hylebos. The estuary factors and restoration strategies identified through the Puyallup watershed EDT assessment build upon the work of the trustees, particularly the Commencement Bay Aquatic Ecosystem Assessment (Simenstad, 2000).

South Prairie Creek, a tributary to the Carbon River, has been characterized as "the backbone of natural salmonid production" in the Lower Carbon River sub-basin and Puyallup watershed. While the area currently has the highest productivity for Chinook, it was recently placed on the 303(d) water quality list for high temperatures. Pierce County developed and is implementing a plan to address high temperatures. The County Water Program actively participates with Cascade Land Conservancy and Pierce Conservation District to acquire properties for protection and restoration purposes. The County has provided and expects to continue to provide matches for at least three acquisitions

County management has made a commitment to support and participate in the development of good environmental science through such processes as the EDT modeling effort, nearshore habitat assessments, the Biodiversity Analysis (GAP analysis), and PSNERP. Directions, Pierce County's critical areas protection package, was updated in 2004 using Best Available Science (BAS). BAS is used for sub-basin planning, Comprehensive Plan amendments, GMA and other regulatory updates, including the Shoreline Management Plan update scheduled to begin in 2006 and conclude in 2011.

The County conducts regulatory program gap analyses prior to proposing regulatory program updates, as was done with the "Directions" package in 2000. The county analyzes population growth projects and buildable lands when preparing for GMA updates.

The County uses regulatory updates, community planning and sub-basin planning and similar programmatic measures as vehicles to educate members of the public concerning habitat actions that will benefit salmon.. These activities include discussions of Biodiversity Management Areas, Subbasin Plans, support for Low Impact Development, workshops for marine shore zone owners, and information on the Public Benefit Rating System.

Significant habitat factors limiting Chinook

Fish Access: Fish access to spawning and rearing habitat is limited by hydroelectric power projects as well as numerous flood control diversions, dikes, and stream channelization projects through the Puyallup, White and Carbon River systems and many of the tributaries. The Mud Mountain Dam and White River Hydroelectric Project eliminated 9.6 miles of mainstem spawning and rearing habitat. Returning adult salmon are trapped at the diversion dam and trucked upstream of the Mud Mountain Dam impoundment where they are released back into the White River at RM 33.9. About 70% of the known culverts within the Puyallup river watershed in 1999 acted as partial barriers to salmon migration upstream and downstream; about 40% were determined to be complete barriers. EDT modeling is being used to analyze effects of removing some of the culverts.

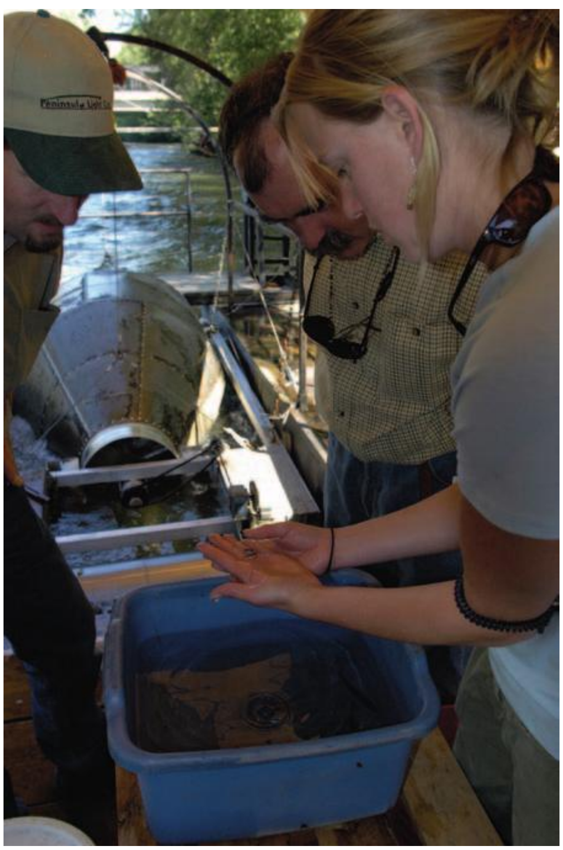
Photo by Dan Kowalski

Sediment transport: Mud Mountain Dam disrupts the natural delivery of sediments by impounding fine sediments during high flow and/or high load periods and discharging them for prolonged periods during lower flow periods. This causes increased localized deposition and results in the reduction of spawning area and destruction of redds. Sediment deposition in Dumas Bay, a 253 acre intertidal sandflat habitat integral to the nearshore ecosystem slightly north of Federal Way, is occurring at an accelerated rate due to increases in peak flows of Lakota and Joes Creeks, shoreline armoring, clearing of vegetation on slopes, and wastewater treatment plant discharges.

Lack of estuarine and nearshore habitat: Out of more than 5,900 acres of estuary habitats that historically existed at the head of Commencement Bay, only about 200 acres remain due to dredging, filling and activities associated with development. The substantial loss of estuary habitat support for the Chinook populations has reduced capacity, productivity, and diversity. Contaminated sediments which have further limited the nearshore/estuarine habitat have resulted in additional reductions in Chinook productivity.

Flows: Diversion of flows from the 24 mile bypass reach of the lower White River has reduced spawning and rearing habitat and has disrupted the use of the river as a migratory corridor. Diversion of flows from the ten mile reach of the Puyallup River between the Electron Powerhouse and the dam has also reduced spawning and rearing habitat and disrupted the migration corridor. Periodic manipulations of flows associated with operations of both facilities are believed to result in recurrent fish strandings and kills. Numerous kills have been

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documented in the White River bypass reach during these flow manipulations. A lack of adequate screening in the diversion dams also impacts salmon. Screens were installed in the White River Diversion and appear to have largely corrected this issue--the effectiveness of the guidance system at Electron is being studied.

Water Quality: Point and non-point source pollution due to industrial and commercial activities, residential development and agriculture adversely impacts water quality. Water quality parameters are exceeded in the vicinity of the White River due to sanitary sewage effluent from the cities of Buckley and Enumclaw. Many of the streams in the basins suffer from combinations of high fecal coliform levels, low dissolved oxygen levels, and other water quality impacts.

Impaired riparian functions and condition: The lack of large woody debris in the upper Puyallup due to logging and associated road construction and other activities reduces pool quantity and quality, elevates water temperatures, and increases the vulnerability of the stream channels to instability. Habitat in the lower reaches of the mainstem Puyallup River is fragmented and disconnected. Only about 5% of the riparian habitat is rated as high quality. Large woody debris from Mount Rainier is typically broken into smaller pieces by the high energy stream and boulder resulting in inadequate in-stream structures that provide resting and feeding areas.

Floodplain processes and off-channel habitat: The loss of floodplain processes and off-channel habitat along the Puyallup, White and Carbon Rivers limits spawning and rearing habitat in the Puyallup. Levees along the Carbon River and Puyallup mainstems have been constructed to protect residential, agricultural and industrial lands from flooding. Downstream of the confluence with the White River, the Puyallup has been described not as a river, but as "a single purpose conveyance system".

Future Threats

Flows will remain a key threat in the future unless flows to the White River Puget Sound Energy bypass reach and more normal flows from Mud Mountain Dam are restored. Attempts to achieve positive changes in flow management from Mud Mountain Dam and the PSE bypass have not been successful to date. While progress seems to have been made recently on the White River, further work appears to be needed on protocols to protect fish during flow manipulations associated with operations and maintenance at both diversions. Fish stranding and mortalities need to be minimized to the greatest extent practicable, consistent with recovery goals.

Lack of consistent collaboration on many aspects of recovery planning among Pierce County, the co-managers, municipalities and other stakeholders inhibits and prevents developing much needed strategies to integrate habitat, hydro, harvest, and hatchery objectives and management actions that are consistent with recovery (H-Integration).

Straying of Voights Creek Hatchery fish into various areas of the Puyallup/White system has been identified as a threat to the recovery of the White River Chinook. In 2002, about 20% of the fish that were captured and passed upstream of Mud Mountain, and about 30% to 50% of the adult spawners in South Prairie creek, are believed to have been Voights Creek Hatchery strays.

Setback opportunities from critical areas and floodways are lost as new developments proceed in Orting, Sumner, Puyallup, and other areas. It is critical to protect remaining habitat and preserve options for restoration, especially in areas pressured by growth and development in the lower river, floodplain and estuary.

Actions needed to remove or ameliorate migration barriers particularly at the Electron Dam diversion have not been implemented.

Overall Approach to Habitat Recovery


Photo by Dan Kowalski

Pierce County has developed a habitat recovery plan using EDT modeling. The Puyallup Tribe and WDFW participated in analyses and developed management actions to support salmon recovery. The co-managers are currently revising the White River Chinook Recovery Plan published in 1996, and have submitted a recovery plan for Puyallup River Chinook. Co-managers and the County are just beginning to work together to determine the compatibility of their respective plans within an all-H context.

Key Strategies and Actions Supporting the Overall Approach to Recovery

Habitat

The multi-jurisdictional team that participated in EDT modeling and analysis developed strategic protection and restoration priorities for specific geographic areas. The strategic priorities provide the backdrop to Pierce County's recovery activities. These priorities are also used by the WRIAs 10 and 12 Lead Entity processes.

According to EDT analyses, long-term and near-term management actions that will be most effective in improving conditions necessary to support increased fish populations are as follows:

- Restoration of estuary habitat and floodplain connectivity in the lower Puyallup, lower White and lower Carbon Rivers.
- Increased protection and restoration of tributaries which currently have relatively high productivity, including South Prairie Creek, Boise Creek, Greenwater River, Huckleberry Creek, and the Clearwater River.
- Major management actions noted in the plan as necessary but beyond the purview of Pierce County are changes in flow management for Mud Mountain Dam and PSE bypass, removal and amelioration of migration barriers associated with the Electron Dam.

Habitat Restoration and Protection Strategic Priorities and Actions

Puyallup River Chinook

Key environmental factors needing to be addressed include habitat diversity, channel stability and sediment load, as well as barriers to fish migration for both adults and juveniles. Areas of highest priority for restoration projects include Puyallup mainstem downstream of Orting (to estuary), the estuary, and the diversion screens associated with the Electron Dam. Areas of highest priority for protection include the South Prairie Creek mainstem and estuary.

Actions:

- Pierce County is initiating a Levee Setback Feasibility Study in 2005 which will be completed in two years. The study will consider the entire levee system on the Lower White, Lower and Mid Puyallup and Lower Carbon. Results will be used to identify and prioritize potential setback projects. Pierce County commits to pursuing funding for 2-3 projects that will be brought to a 30% design level. Additionally, Pierce County commits to pursuing funding for property acquisitions for projects where acquisition is indicated. In addition to using its own funds, Pierce County intends to pursue other potential sources.

- Old Soldiers Home levee set back – Construction will begin at the end of 2005 or in 2006.

White River Spring Chinook

Key environmental factors needing to be addressed include habitat diversity, channel stability, sediment loading, habitat quantity, and flow conditions. Areas of highest priority for restoration projects include portions of the lower mainstem river and the estuary. Areas of highest priority for actions that consider both protection and restoration include the estuary and portions of the mainstem.

Actions:

- Large woody debris, riparian restoration projects in the Upper White: The U.S. Forest Service is the lead for projects in the Upper White, including the Greenwater River and Huckleberry Creek restoration projects. Pierce County provides an in-kind match.
- At least two large woody debris and riparian restoration projects are scheduled for Boise Creek, and funding is being sought for additional projects on the near-term list of projects.
- The County is committed to supporting a TMDL Implementation Plan that was developed in the first quarter of 2005.

Hylebos Chinook

Key environmental factors needing to be addressed include habitat diversity and flow conditions. Areas of highest priority for restoration projects include lower mainstem below the forks and lower reaches of the West Fork. Areas of highest priority for protection include the upper West Fork, followed by the lower West Fork.

Chambers-Clover Chinook

Key environmental factor needing to be addressed is habitat diversity. Areas of highest priorities for restoration projects include mainstem Chambers Creek; Chambers Bay is highest ranked area when reach lengths are normalized. Highest priorities for protecting against further degradation include mainstem Chambers Creek and, when normalizing for reach length, Chambers Bay.

In-stream Flows:

The County is pursuing projects to understand the low flow issues in WRIA 12 and is currently participating in studies that are expected to identify actions that can be taken to repair the natural stream seal.

Pierce County staff members are reviewing the Puget Sound Low Flow Survey (review draft 2004). The survey identified reaches with flow problems for fish and other studies, and the county will develop and propose implementation of 3-5 projects that will address flow problems.

All H-Integration:

Habitat and harvest management actions and decisions are the purview of the state and tribal co-managers. The co-managers have expressed their intent to work with Pierce County to achieve H-Integration.

In the Habitat Plan, Pierce County offers the following observations:

EDT results demonstrate that the habitat measures alone, even conducted on a very extensive scale, are unlikely to achieve desired fish production levels in the Puyallup/White basin in the near term. For the foreseeable future hatchery production should continue to be given a role in the Puyallup-White basin; the White River hatchery supplementation program is recognized as vitally important in the White River system. For the Puyallup River, it appears that hatchery production will also be important to help maintain natural production until more progress is made in habitat restoration. However, there is a need to determine how hatchery management tools and approaches can be used more effectively to supplement natural production.

Hatchery strategy

The White River Spring Chinook Hatchery program is located on the White River at the water diversion dam near Buckley. The White River hatchery is managed to help sustain and rebuild the White River early-run Chinook. The long term restoration goal for White River Chinook is to restore the population to a healthy, productive condition. Chinook are reared and released from the White River Hatchery and acclimation ponds in the upper White River watershed above the Mud mountain Dam. The remote hatchery program at Hupp Springs/ Minter Creek hatcheries is ongoing until White River watershed recovery goals are achieved.

The Voight's Creek hatchery and Puyallup Tribal satellite hatchery at Diru Creek operate as the main Chinook facility for the Puyallup and Carbon River systems. Program operations for Puyallup Chinook are designed to provide fish for harvest while minimizing adverse genetic, demographic or ecological effects on listed fish. For example, juvenile Chinook are released as smolts to minimize emigration time to saltwater thereby minimizing potential competition with and predation on natural-origin listed fish.

Harvest strategy

In the short term, harvest management actions are intended to allow a portion of the Puyallup Chinook returning adults to spawn naturally in order to rebuild self-sustaining populations. Currently, insofar as is possible as the natural population increases, fishing efforts are directed to the harvest of hatchery rather than naturally spawning Chinook. Harvest opportunities are provided for the Puget Sound recreational fishery and tribal net fisheries in Carr Inlet, and harvest on the Muckleshoot reservation for ceremonial purposes. The long term goal is to achieve self-sustaining populations to provide for commercial, ceremonial and subsistence harvesting.

White River Chinook are harvested in the mixed stock Chinook fisheries and a current management objective, given the need to protect the viability of the stock, is to limit incidental impacts from coho, sockeye and other fisheries. As recovery occurs, directed fisheries on the White River Chinook may begin at low levels, increasing only in concert with population recovery. Tribal fisheries in the Puyallup watershed and estuary are timed to avoid capture of White River early Chinook.

Adaptive management and monitoring

Pierce County will track progress toward recovery goals by determining how many of the near-term and long-term strategic priorities identified in the lead entity (Salmon Recovery Funding Board) strategy are accomplished and will assess the results. County staff will also use EDT online to update environmental information as needed and to develop and analyze new restoration scenarios.

Monitoring results from sponsors of projects within the watershed will be requested for the EDT updates (e.g. monitoring data developed by the U.S. Forest Service for actions on the Upper White). Pierce County will take the lead on monitoring habitat preservation and restoration projects in which the county is the sole sponsor or a principal partner.

Part of Pierce County's adaptive management plan is to incorporate any changes made to the EDT modeling tool. Pierce County anticipates sponsoring a large modeling effort within the next ten years that will include new actions and reexamine actions that were originally proposed.

Adaptive Management activities would include an annual review of monitoring results of all projects undertaken in the watershed under NRDA, the lead entity strategy and other programs. Technical and policy leads of Pierce Co, Port of Tacoma, and co-managers (WDFW, Puyallup tribe, and Muckleshoot Indian Tribe), the Lead Entity coordinator and committee chairs will review results and compare them with projections and EDT analyses and recommend adjustments in the ten-year plan as appropriate.

Results

The watershed plans for the Puyallup/White were reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan to some extent, but the reviewers felt they merited particular attention or additional effort to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

The habitat protection and restoration plan submitted by Pierce County and the state and tribal co-manager salmon recovery plan together show a good understanding of the actions needed to achieve low risk status for the two Chinook populations in the basin.

The White River Chinook is the only remaining early-run population in the south/central region of the Puget Sound evolutionarily significant unit (ESU), and as such it needs to achieve low risk status over time to meet ESU recovery criteria. At this time, the certainty of achieving this status is low. The Puyallup River population needs to at least improve from current conditions to meet the ESU criteria. For this reason it is important to protect this population from further decline and preserve options for its recovery.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

In the immediate near-term, it is critical that the co-managers and the County agree on and adopt a common set of recovery goals for both populations in the watershed. Developing and implementing strategies to integrate harvest, hatchery and habitat management actions are key to increasing the certainty of being able to meet recovery criteria.

Harvest objectives need to be linked to the four Viable Salmonid Population (VSP) parameters and recovery goals.

The implicit hypothesis in this watershed is that the hatchery programs, which in this basin are intended to provide harvest, will not interfere with recovery. However, the plan lacked recovery goals that could be tied to an explicit recovery hypothesis. A particular concern is the Voight's Creek hatchery fish straying into the White River and impacting wild Chinook. New straying data reported in South Prairie Creek show that natural spawners have 30-50% hatchery-origin fish. The reviewers strongly encourage the movement toward hatchery reforms to be more consistent with recovery goals.

Significant water flow issues due to water diversions (from the Cascade Water Alliance Agreement for Lake Tapps and the Mudd Bay and Electron dam diversions) are also a significant concern in this watershed. Currently there is no evaluation of the effects of flows on fish populations. It will be important to establish a time table and set of actions to understand the impact of flows for salmon populations and achieve flows necessary for salmon survival.

The effects of disrupted sediment processes on the ability of the two Chinook populations to recover have not been addressed in the plan. Including consideration of sediments being trapped behind dams and their effects on riverine processes in the recovery strategy would increase its certainty of success.

A key strategy for salmon recovery in this basin is floodplain management. There is an active program in the Puyallup/White River system that is beginning to be funded. However, there is a significant amount of development underway in the lower river system that is putting major stress on the lower river floodplain and estuarine areas. Consequently, opportunities for large scale restoration in this part of the watershed are dwindling. It is critical for achieving plan outcomes to preserve options for protection and restoration in these areas. It is also important to coordinate estuary improvement efforts with the Port of Tacoma and the Commencement Bay effort.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the above uncertainties are addressed, the Puyallup/White watershed has the opportunity to contribute significantly to overall ESU recovery.

Watershed Profile:

Nisqually

The Place and the People

The Nisqually River Watershed is a land of wind and wildlife, glaciers and storms, towering firs and diminutive banana slugs. Yet it is also a land greatly affected by human decisions and activities. As one of the least developed rivers in southern Puget Sound, the Nisqually links the snows and ice of Nisqually Glacier on Washington's highest peak, Mount Rainier, to the marine waters of Puget Sound.

The Nisqually journeys from sub-alpine meadows and old-growth Douglas-fir forests through foothills of timberlands, across lowland prairies to estuarine marshes and tidal mudflats. Its watershed encompasses a broad range of land uses and jurisdictions - rural communities, national and state parks and forests, public and private timberlands, municipal hydropower dams and reservoirs, farmlands, the Nisqually Indian Reservation, Fort Lewis Military Reservation and the Nisqually National Wildlife Refuge. It is the only watershed that begins in a National Park and ends in a National Wildlife Refuge. It also has a military base that has been nationally recognized for its unique focus on protecting wildlife, native plants and fish.

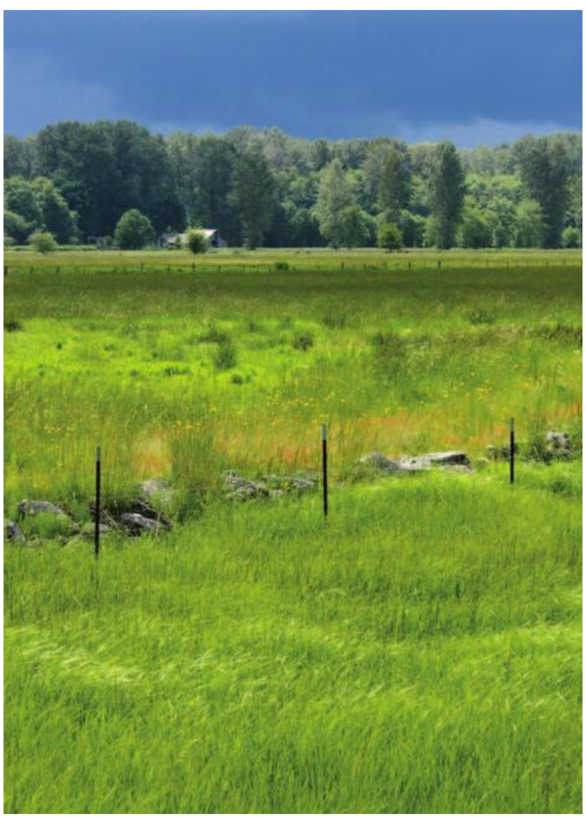


Photo by Dan Kowalski

The lower portion of the Nisqually River is considered to be some of the best remaining salmon habitat in the region. Between river miles (RM) 4.5 and 12.7, the river meanders freely across the valley floor; large woody debris is present in healthy amounts, and there is a healthy riparian zone. The Nisqually River also has the largest undeveloped delta in Puget Sound.

The Nisqually watershed supports one threatened Chinook population and numerous other species of salmon, including a unique late-season returning population of chum.

Despite a backdrop of different values, views and lifestyles, the members of the Nisqually River Council have been a driving force for balancing natural resources and local economies. It is the center of community participation and support for salmon recovery activities. The Nisqually Tribe has pioneered agreements among local, state and Tribal governments, area businesses and land owners to sustain the natural bounty of the river and the local economy.

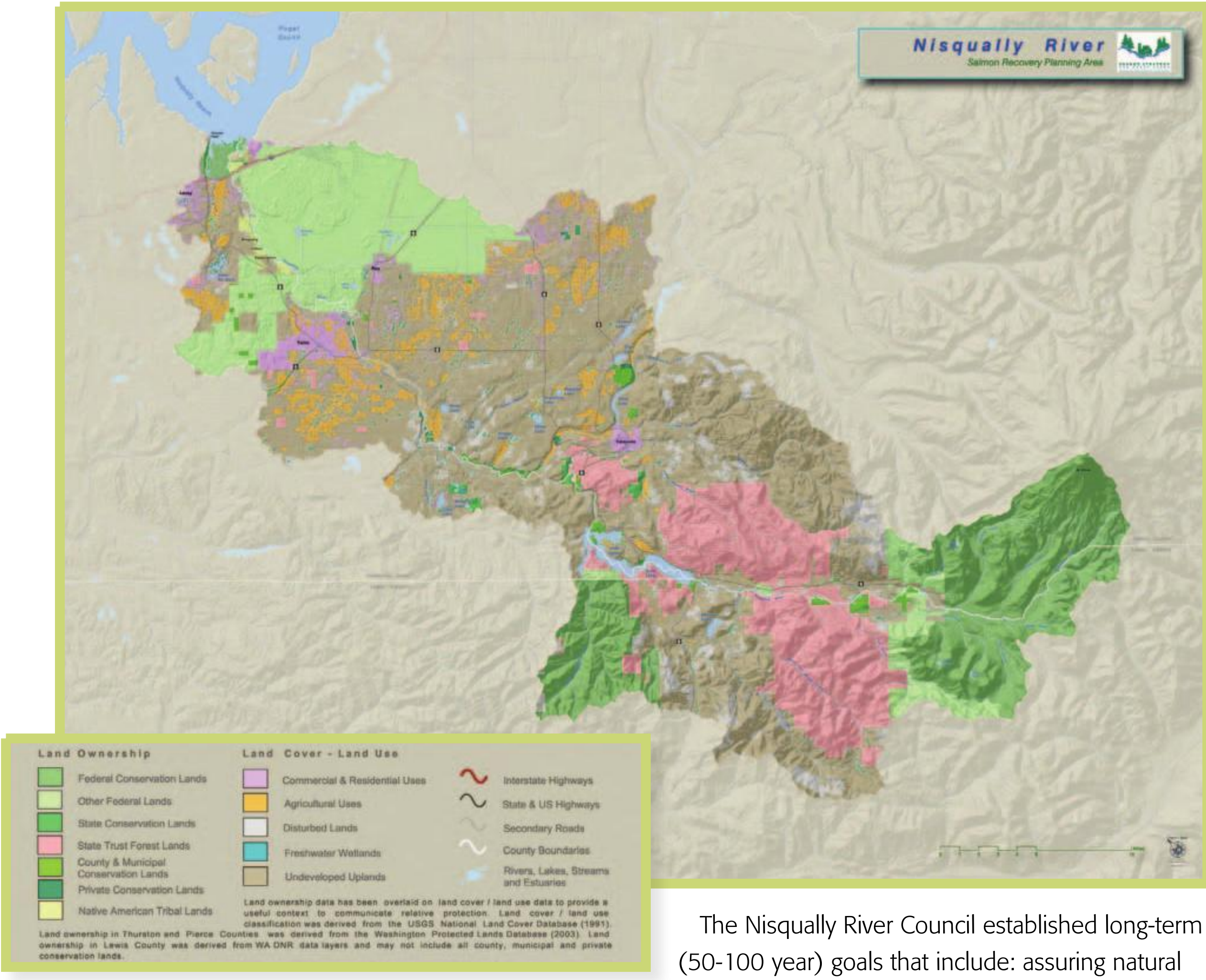
For decades, the Nisqually has been richly endowed with leaders that have provided local innovation and set the course for the State in natural resources. Billy Frank, Jr. and other tribal members challenged the federal and state governments to win back fishing rights for all tribes and set up a co-management structure between the Puget Sound tribes and the State Department of Fish and Wildlife to care for the treasured salmon and other fish and shellfish. Billy was joined two decades ago by some of the finest leaders in the State's history in creating the Nisqually River Council. These leaders brought together skeptical farmers, timber companies and local government officials to create a future for all. Today, the Nisqually Tribe continues to work closely with Fort Lewis, the Counties, city governments, and watershed residents to find solutions that allow the military, farming, forestry, the local economy and fish to thrive.

Over the last 30 years, significant advances have been made to protect and restore the watershed. Seventy percent of the mainstem river is in protected status under federal, state, local and private agreements. Recently, the Nisqually Tribe acquired 410 acres of the Braget family farm, most in the lowlands and estuary of the Nisqually. The purchase will result in restoration of all diked habitat on the farm. More than 30 acres of the farm were restored as tidal habitat when a dike was breached in November 2002, and the Tribe plans to restore an additional 110 acres on the property within the next year. In addition, the Nisqually Wildlife Refuge just completed its Comprehensive Conservation Plan which includes plans to restore an additional 700 acres of estuarine habitat in the Nisqually Delta.

Photo by Dan Kowalski

The Nisqually Salmon

The Nisqually River hosts several species of salmon including Chinook, coho, winter steelhead, chum, pink, and sea-run cutthroat. Bull Trout also use the estuary for foraging, migrating and over-wintering purposes. As in other watersheds, Chinook because of their large size, rely mainly on the wider and deeper mainstem Nisqually River for spawning. The Mashel River, Ohop Creek and the lower reaches of smaller tributaries are also used and are important so that Chinook, as part of the



species' survival strategy, have several alternative places to spawn and rear.

Recovery Goals

The 2001 Nisqually Chinook Recovery Plan lays out the strategies and actions for salmon recovery in this watershed. This plan is the work of a multitude of interests and expertise in the watershed. The Plan has the full support of the Nisqually River Council and was adopted officially by unanimous vote in 2001. Members include the co-managers, Thurston and Pierce counties, and the incorporated cities in the watershed. The implementation of the plan is supported by those members through participation in the NRC as well as through local regulatory updates to critical area ordinances.

The Nisqually River Council established long-term (50-100 year) goals that include: assuring natural production of fall Chinook in perpetuity by providing high quality, functioning habitat and by developing a self-sustaining, naturally spawning population. The goals translate into specific targets for returning adult fish with an average 3,600 natural origin recruits. Achieving these numbers of fish will ensure sustainable harvest, provide significant contributions to the recovery of other important species at risk and enhance natural production of all salmonids. The collaborative efforts used to reach these fish goals will also ensure that the economic, cultural, social, and aesthetic benefits derived from the Nisqually ecosystem will be sustained in perpetuity.

Over the next twelve years, in pursuit of their long-term goal for a self-sustaining population, the Council will strive to achieve an annual return of

1,200 fish to their spawning grounds, with a contribution of hatchery origin recruits comprising no more than 30% of the spawning population. They hope to also have an annual in-river harvest of 10,000 - 15,000 fall Chinook provided it is consistent with conservation objectives in the previous goal.

Chinook Population	Mean spawner abundance 1996-2000	Low Productivity		High Productivity
		Planning Range for abundance	Planning targets for abundance (with productivity in parentheses)	
Nisqually	890	13,000 – 17,999 (1.0)	13,000 (1.0)	3,400 (3.0)

What is the current status of threatened Salmon populations?

The Nisqually Chinook enter the river from July through September and peak spawning occurs in mid-October. Historically some fish returned earlier in the spring, but these were last observed in the early 1950s.

Since the mid 1970s, Nisqually Chinook have been managed as a single population for the purpose of supporting treaty and non-treaty fisheries. Native Chinook have been extirpated as a consequence of habitat loss, hatchery introductions, and high harvest rates. The current production consists primarily of hatchery releases with some natural spawning in the mainstem and lower reaches of major tributaries. Since 1999 the co-managers have been managing for an escapement objective of 1,100 fish. This objective has been met or exceeded in five of the past six years.

What are the key factors contributing to the current status of the populations?

Habitat degradation is one of the primary reasons for the decline of Chinook in the Nisqually basin. Hydroelectric development accounts for one series of events that has contributed to habitat degradation. In the 1900s two major hydroelectric projects were constructed in the basin: the City of Centralia's Diversion Dam, and the City of Tacoma's Nisqually Hydroelectric Project at Alder LaGrande. The Centralia Dam, located approximately half way up the anadromous portion of the Nisqually River, did not have a fish ladder for many years, limiting Chinook access to important upstream habitat areas. There was also no mechanism to ensure juvenile salmon migrating downstream did not pass through the Centralia powerplant turbines. In addition, until flow management agreements were reached during the federal relicensing process for the dams, both the Centralia and the Tacoma projects created significant changes in flow in the river, dewatering the river during important juvenile rearing periods and scouring salmon eggs out of the river bottom with sudden massive flow releases.

Other impacts to habitat, beyond the dams, have been caused by past forestry and agricultural practices and encroaching urbanization. Some of the

Key Facts

Land use and ownership patterns in the upper watershed is 78% forestry and recreation, 18% national park lands, 2% agriculture and 2% urban. In the lower watershed 22% forestry, 18% forest/prairie (military-owned), 4% agriculture, 49% rural/residential, 3% residential, 2% urban.

▪

Located in Thurston, Pierce and Lewis counties, cities in the watershed include Eatonville, Roy and Yelm.

▪

The planning area for the watershed under the state Watershed Management Act is Watershed Resource Inventory Area (WRIA) 11.


Photo by Dan Kowalski

the upper portions of the watershed that have been in forestry production were not managed to protect the streams. Impacts included loss of mature forest riparian buffers and severe sedimentation problems from forestry road construction. Past agricultural practices included the ditching and straightening of streams and draining of wetlands including much of the lower four miles of Ohop Creek and the diking of most of the estuarine wetlands to create farmland. Encroaching urbanization has resulted in bank hardening and removal of riparian buffers at certain locations along the mainstem Nisqually, Mashel River and Ohop Creek limiting their ability to migrate within their floodplains.

The natural population of Nisqually late returning Chinook were also impacted by historically high rates of harvest. These rates have increased since the turn of the century with fishing in unconstrained mixed-stock sport and commercial fisheries. Hatcheries were built throughout the South Puget Sound in an attempt to satisfy the burgeoning fisheries. As more hatchery fish were produced from the 1950s through the 1990s, the Nisqually River Chinook population became even more established as a hatchery or secondary management unit.

During this period generic measures were taken in an attempt to control this impact, including fishery management models used in the Pacific Fisheries Management Council forum, the North of Falcon process, and the development of the Pacific Salmon Treaty. Direct benefits to the Nisqually Chinook were small.

Hatcheries are also an important factor in understanding the current status of Chinook in the Nisqually. The need to preserve the genetic composition of native Chinook was completely ignored in early hatchery programs. From 1942 to 1970, a total of 8.4 million juvenile hatchery Chinook were introduced from other Puget Sound basins and released into the Nisqually Basin. From 1971 to1990 a total of 22.5 million hatchery Chinook were out-planted in the basin.

In recent years, there have been efforts to address these hatchery issues. The Nisqually Indian Tribe has begun to reform its hatchery enhancement efforts. The Tribe operates two hatcheries in the basin: one at Kalama Creek and one at Clear Creek. Each of these facilities includes an adult trap for returning broodstock. Returning Chinook from both facilities are known to contribute to natural spawning. The objective for fall Chinook escapement to the spawning grounds in excess of 1,100 has been met for five out of the last six years. In 2004, 2,600 Chinook returned to the river, which is described as “drastically up from 400 a decade ago” (NWIFC NewsNet 4-5-05). Additionally, the Nisqually Tribe is working with the Hatchery Scientific Review Group (HSRG) to design a program to reform hatchery practices in the next 12 years.

The Nisqually Fall Chinook are beginning to benefit from the results of a twenty year effort to protect and restore critical habitat. These successes include the permanent resolution of a number of challenges to Nisqually Chinook survival.

Instream flows, the minimum amount of water required in a stream to maintain the existing aquatic resources for salmon and other species, have been set for the mainstem Nisqually River in

1985 through the FERC relicensing process for the river's hydroelectric facilities. The instream flows were established based on the needs for Chinook and steelhead during spawning and for steelhead juveniles during summer rearing. The flow settings also accommodate the needs of other species. In addition, the tributary instream flows in the basin are regularly being met, except in the Mashel River near Eatonville. Currently, the Nisqually Chinook Recovery Team is investigating actions to increase the reliability of these tributary flows.

Tributary watersheds which are important for Chinook spawning, specifically the Mashel River and Ohop Creek are managed, mostly in the upper portions, under habitat conservation plans and the Forests and Fish agreement. Best management practices and cooperative collaborative relationships have led to agricultural practices that are more consistent with the needs of salmon. Both of the lower reaches of Mashel River and Ohop Creek are targeted for substantial restoration efforts in cooperation with local landowners in the next few years.

In the lower basin, large sections of land adjacent to the Nisqually River are protected from urban development because they are enclosed by Fort Lewis, the Nisqually Indian Reservation, and the USFWS Nisqually Wildlife Refuge. Other sections of land are safeguarded as major public landholdings. These include the Gifford Pinchot National Forest, Washington Department of Natural Resources, Mt. Rainier National Park, WDFW lands, the Nisqually-Mashel State Park, City of Centralia Hydroelectric Project, and the City of Tacoma Nisqually Hydroelectric Project. The non-profit land conservancy in the watershed, the Nisqually Land Trust also is the owner of a number of significant salmon habitat properties. To date, about 70% of the mainstem riparian habitat of the Nisqually River has been placed in permanent protection.

There are four significant habitat factors continuing to limit the Chinook population:

1. The I-5 Bridge and placement of fill on which portions of the Interstate highway runs through the lower Nisqually restricts natural channel migration and limits the upper extent of the estuary.
2. The Centralia Diversion Dam
3. Human population growth is a concern especially in the Mashel River and Ohop Creek tributary watersheds. The NRC is concerned that in the future, portions of these watersheds may convert to a high percentage of urban or rural-residential use. (2001, 10)
4. Development along the nearshore environment has resulted in significant hardening of the shoreline.

Overall Approach to Recovery

The Nisqually River Council is structuring their approach to recovery around strategies related to addressing the habitat needs of Chinook, harvest practices, and hatchery management. The NRC has

Photo by Dan Kowalski

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Photo by Dan Kowalski

identified the need to protect, enhance, and restore prioritized habitat in the basin. The plan calls for the development of a single genetic stock to be maintained through appropriate hatchery practices. Harvest practices will be managed to allow sufficient numbers of adult Chinook to reach spawning grounds.

Recovery strategies were developed with the understanding that the I-5 and the Centralia Diversion Dam were factors currently beyond the reach of the Council to reform. A scientific model (EDT) was used to analyze each stream reach in the Nisqually River to identify other habitat attributes that have contributed to the loss of Chinook performance from their historic status (August 2001, 32). The highest priority restoration area in the watershed is the Nisqually Estuary. The model suggests that by restoring all available estuary habitat in the Nisqually that the number of naturally produced Nisqually Chinook salmon could double. The Nisqually Chinook Recovery Team's strategies also focus on improving spawning and rearing habitat in freshwater that will result in higher productivity, abundance, and life history diversity. The plan places a high priority on the nearshore and marine habitat for out-migrating juveniles.

Habitat recovery goals will be achieved through protection and restoration strategies. Long-term protection will be achieved by identifying key areas where protection is most needed and acquiring them, and by working with regulatory agencies to develop, maintain, and enforce strong regulatory protections. (5/05, 14). Acquisition of certain properties and/or development rights will occur where necessary to prevent degradation and to allow for active and passive restoration, and/or where development is incompatible with protection of aquatic systems.

Freshwater habitat restoration efforts are focused on Ohop Creek, the Mashel River, and the mainstem because it is estimated that about 70% of the historic production would have originated

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from the mainstem Nisqually, and more than 25% of the historic population would have originated from Ohop Creek, Mashel River, and the mouths of smaller mainstem tributaries. Currently, the mainstem comprises nearly 90% of the Nisqually Chinook population. The higher percentage of fish using the mainstem than was historically the case is primarily due to the decreasing quality of habitat in the tributaries, forcing salmon to seek refuge in the better quality habitat found in the mainstem (Nisqually 2001, 31).

The primary strategy for hatcheries in the Nisqually is focused on fostering locally adapted late returning Chinook in the Nisqually basin. Currently, the Nisqually Tribe is working with the Hatchery Scientific Review Group (HSRG) to design and implement a programmatic hatchery change by 2006 to become compatible with the natural stock objectives. The target stock composition, if achieved, will help reduce the effects on both the productivity (the biological system's ability to supply organisms with energy and resources to feed, grow, and survive) and other ecological effects of interactions with fish that have spent essentially all of their life-cycle in the wild and whose parents spawned in the wild (natural origin fish) by limiting the amount of direct interaction and influence with hatchery fish.

A significant part of the Council's strategy revolves around "H- Integration," or the integration of habitat, hatchery, and harvest programs and actions considering the collective impacts and interactions of all three components. The habitat recovery strategy described in the 2001 Nisqually Recovery Plan is being revised to ensure that it is consistent between habitat, hatchery and harvest sections. A model developed by the HSRG (the AHA model), is being used to analyze the combined effects of hatchery, harvest and habitat actions and to evaluate the potential success of meeting specific goals and objectives.

Key strategies and Actions Supporting the Overall Approach to Recovery

Habitat

1. Restore estuary and nearshore marine environments

A substantial portion of estuarine habitat important to juvenile late returning Chinook, has been impacted by railroad construction beginning in 1912, the Interstate 5 crossing, and diking. The I-5 Bridge and placement of fill restrict natural channel migration and limit the upper extent of the estuary. Historically, the Nisqually estuary extended upstream of I-5, and multiple slough channels crossed the Nisqually delta. Downstream of I-5, the delta is now largely within the National Wildlife Refuge. Much of the area is currently not accessible to juvenile and adult Chinook because of extensive dikes originally constructed for farming on the saltwater face and riverine side of the estuary. (2001, 23). To restore and protect these estuarine and nearshore environments, the Nisqually Recovery Plan

Photo by Dan Kowalski

Photo by Dan Kowalski

seeks to acquire and protect all non-public estuary properties, restore former estuarine habitat, work with USFWS to restore former habitat (especially in the Nisqually Wildlife Refuge), work with Fort Lewis and private landowners to restore former estuarine and palustrine habitat, as well as conduct studies to further identify and prioritize key habitat areas.

2. Restore and Preserve the Nisqually River mainstem

Generally, all mainstem geographic areas were determined to be essential for preservation because of their high use by Chinook and because habitat conditions, although moderately degraded in some reaches, are intact. The Reservation reaches along the mainstem are considered the best example of pre-1850 conditions. These are considered near pristine and are ranked highest for protection. The goal is to acquire, protect or restore habitat values on 90% of 84 miles of shore lands along the mainstem Nisqually (Mainstem sample actions Appendix 4, 2001).

Protection will be achieved by acquiring mainstem shoreline habitat, securing commitments for permanent protection of critical tribally owned properties, and securing commitments for permanent protection on critical publicly owned properties (USDOD/Fort Lewis, Tacoma Public Utilities and City of Centralia properties). Restoration will be achieved by restoring lost off-channel habitat and enhancing existing habitat, investigating placement of in-stream large woody debris, developing and implementing a long-term plan to reduce impacts of existing residential development in the floodplain, and by developing and implementing a long-term plan to restore a river meander belt and reestablish connections with side channels along the mainstem.

3. Restore and Preserve the Ohop Creek and the Mashel River subbasins

Restoring and preserving the Ohop Creek and Mashel River subbasins are a high priority because of their importance to the life history diversity of Nisqually Chinook. Specific attributes targeted for restoration in the Ohop and Mashel sub-basins are sediment load, riparian and in-stream habitat, channel stability and in-stream flows.

To address these priorities, a comprehensive Lower Ohop Restoration Plan will be developed within the next couple of years. Elements will include (1) identifying all current landowners willing to allow restoration plans to be developed, 2) assembling relevant site information needed to develop a stream corridor and wetland restoration plan, 3) developing restoration designs for specific areas within the reach that will address the stream's ability to meander in areas that have been straightened, 4) reconnecting wetlands, and re-establishing wetland vegetation, 5) channel configuration, planting and instream structures, and 6) preparing cost estimates, long term maintenance needs, and monitoring recommendations.

In the Mashel sub-basin, biological assessments determined that protection strategies are needed for the downstream stretch of the Mashel River and that restoration was needed for the upstream stretch of the river. Due to forest management activities, some reaches in the Mashel sub-basin currently experience greater sediment supply and lower recruitment of wood to the channel than they did historically. Improved forestry management practices are expected to restore channel stability, habitat diversity, and to reduce sediment load.

A restoration plan will also be developed for reaches affected by the City of Eatonville, which will also emphasize the Mashel River, as well as Lynch Creek and Twenty-five Mile creek. Elements of the plan include 1) working with city and private landowners to identify areas for which restoration plans can be developed, 2) assembling relevant site information needed to develop a stream corridor restoration plan, 3) development of restoration designs for specific areas within the reach that will address channel configuration, planting, dike removal or setbacks, 4) restoration of summertime stream flows in the de-watered section, and in-stream structures, and 5) cost estimates for long-term maintenance needs and monitoring recommendations.

4. Protect and restore key mainstem tributaries

While mainstem tributaries currently make a much lower contribution to preserving the abundance of Nisqually Chinook, protecting these streams from further degradation is important for maintaining population life history diversity. The main factors of decline are habitat diversity and sediment load, reduced flow during fall and early winter affecting adult migration and channel stability (increased bed scour during egg incubation). Actions for protecting and restoring mainstem tributaries include evaluating the effects of changing water withdrawal by the City of Olympia, acquiring development rights in targeted areas (Lackamas, Toboton, Tanwax, Powell, Horn and Murray Creeks), and developing a long term plan to restore natural channel configuration in certain areas. (August 2001).

5. Evaluate the effects of water well withdrawals

In order to ensure achievement of established minimum flow levels, the effects of well water withdrawals on summertime stream flows will be evaluated in both deep and shallow aquifers.

Hatchery

1. Utilize brood stock only from the Nisqually River basin

When hatchery fish with a different genetic composition from wild Chinook native to the Nisqually River basin are used in hatcheries, fish that escape the hatchery program and mate with wild Chinook negatively impact the genetic diversity of the wild population. Using Chinook from only the Nisqually River to propagate the subsequent generation of hatchery fish will reduce the impact on wild fish from hatchery-origin fish that mate with wild fish.

2. Implement a mating strategy to reduce the loss of genetic diversity

Hatcheries often do not mimic natural mating processes and can result in a loss of genetic diversity. Efforts will be made to use mating strategies in hatcheries that will reduce negative impacts to genetic diversity.

Harvest

1. Stagger the fishery

The current strategy for managing harvest is to schedule the fishery for four days on and three days off to allow Chinook throughout the run time to pass upstream, rather than concentrating all the fishing effort on the early portion of the run and allowing only the later returning fish to pass upstream. This strategy mimics nature in that it allows migrating adults to spawn throughout the timing of a natural run and leads to a locally adapted stock.

2. Install a seasonal weir above the hatcheries

Scientific models are being used to evaluate the implications of various strategies that will enable the Nisqually watershed to meet its goals, including appropriate harvest rates and hatchery contribution on the spawning grounds. One of the strategies being evaluated is the use of a seasonal weir in the river just above the hatcheries that will allow them to control the contribution of hatchery and natural origin fish on the spawning ground.

3. Continue to implement a coded wire tag

Harvest managers will continue the coded wire tag and mass marking program and will develop a reliable methodology for calculating spawning escapement (the number of fish allowed to escape harvest to spawn).

Adaptive Management

Though the most recent revision of the plan was drafted in 2001, the plan is considered to be a living document that will be implemented and adapted over time. The Nisqually Chinook Recovery Plan is currently in its fourth year of adaptive management.

The adaptive management process is driven by an annual work plan. Monitoring and evaluation actions are viewed as an integral part of adaptive watershed management. The current program addresses implementation, effectiveness, and validation monitoring and uses the EDT approach for organizing, recording and documenting new data and information and for tracking progress. A revised monitoring and evaluation plan will be developed by fall of 2005 using Managing for Success, a model originally developed for hatchery actions by the HSRG and currently being expanded to accommodate harvest and habitat actions. The tool will also allow the team to choose variables that are affected by multiple actions across the landscape to provide a coherent and integrated approach to monitoring and evaluation.

An intensive pilot monitoring program is being developed for the Mashel River. The planning team anticipates that it will be used as the basis for a similar basin-wide monitoring plan.

Monitoring the productivity of the natural stock will show whether planned actions to limit direct interaction and influence of hatchery fish will be effective in reducing negative effects to natural origin fish.

A monitoring and evaluation program to track natural origin recruits and hatchery origin recruits in the fishery and on the spawning grounds is currently being implemented and is subject to refinement. Hatchery fish have been mass-marked for the past four years. Monitoring the marks in the fishery - both Tribal and creel census and also in a test fishery and on the spawning grounds - will be used to develop alternative and accurate methods of estimating escapement. The data will also assist in gaining a better understanding of the hatchery stray rate and the effectiveness of harvest and other strategies for reducing the hatchery stray rate.

Results

The watershed plan for the Nisqually watershed was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan, but the reviewers felt they merited particular attention to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

The long-term history of the Nisqually River Council and the Nisqually Chinook Recovery Team proves the benefits of a collaborative approach among key stakeholders and interests. Over the past 20 years, significant actions have protected and restored important portions of the watershed. Of particular note is the protection of the mainstem and restoration of the estuary. The overall plan for recovery is comprehensive and well documented. The Council is commended for their use of adap-

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tive management over the last several years since adoption of the Nisqually River Plan. Recent adoption of an in-stream flow program will ensure flows are protected and improved where necessary for recovery of the Chinook populations.

Increased focus on the Ohop and Mashel tributaries called for in the plan will provide important information to improve the fish use and productivity of these main tributaries. It is important that restoration plans for both of these tributaries be completed in the next few years to determine the potential of these systems, ensure adequate protection and initiate restoration where it will have a significant benefit for the Chinook population.

Unfortunately, the Nisqually population, like others in Puget Sound, has suffered from past hatchery and harvest activities, resulting in the loss of the native Chinook population. The NRC approach to developing a locally adaptive population over time is the best approach given the current conditions. Achieving this goal will be one of the biggest challenges for creating a low risk population in the Nisqually. It will be essential that the hatchery and harvest management programs assess progress over time to determine if the right mix of hatchery fish and naturally spawning fish are achieved. The Nisqually approach to H-Integration is one of the strongest in Puget Sound. One critical component is early implementation of efficient approaches to capture hatchery returns to ensure that too many do not overwhelm the returning naturally spawning adults.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the proposals above are implemented, this watershed and its Chinook population will provide a critical contribution to the recovery of Puget Sound Chinook.

Watershed Profile:

South Sound

The Place and the People

Photo courtesy the Squaxin Island Tribe.

For the purposes of recovery planning for threatened Chinook, "South Sound" is defined as that area of Puget Sound south of the Tacoma Narrows that includes the marine, nearshore, estuaries, and freshwater environments. Geographically, the South Sound lies within the Puget Lowland physiographic province — a broad, low-lying region situated between the Cascade Range to the east and the Olympic Mountains to the west.

The dominant landform features of this area are the glacial plains cut by numerous streams and dissected by the inlets of Puget Sound. These shallow inlets divide the South Sound and cause poor circulation of seawater. As a result, water does not mix or dilute nutrient inputs to the same degree as in deeper areas. Many of the bays and inlets are more productive than the rest of Puget Sound. The highly productive intertidal zones provide habitat for many animal and fish species, and the flat, sandy areas of the nearshore are home to flounder, shrimp and other animals. Nisqually Chinook, White River early run Chinook, and Puyallup Chinook are among the creatures that use these nearshore waters.

The Nisqually is the primary river system that empties into the southern part of Puget Sound. The region is also home to the Deschutes and the Kennedy-Goldsborough, as well as smaller, independent tributaries which flow from lowlands in the area and help create South Sound's distinctive and irregular coastline of small, shallow inlets including Hammersely, Little Skookum and Totten as well as portions of Eld and Case Inlets. Eld Inlet boasts a salt marsh, forested shorelines and a local stream, supporting salmon in every part of their life cycle. Hammersely is the skinniest of major Puget Sound inlets and a popular kayaking destination.

Residential neighborhoods, bordered by second-growth forest, are found along Totten and Little Skookum inlets. In 1993 citizens took a bold step, creating the state's first clean water district which provides the financial resources to improve water quality and protect public health.

The South Puget Sound Salmon Recovery Group (SPSSRG) is a local planning group comprised of representatives from tribes, state agencies, local governments, and salmon recovery organizations with interest in the South Puget Sound nearshore. The SPSSRG is working to coordinate protection and restoration efforts around South Sound.

The South Sound Salmon

Chinook

Recovery planning in the South Sound primarily supports the larger Nisqually Chinook Recovery Plan because this is the major river system that empties into the South Sound; however, it also benefits other recovery efforts throughout Puget Sound.

Studies by tribal biologists have revealed that juvenile Chinook and bull trout from other natal watersheds rely heavily on South Sound as a "nursery" for extended periods.

Chinook use the South Sound habitats for feeding and growth, refuge from predation and extreme events, physiological transition between fresh and salt water, and migration. From this context, the South Sound strategy is focused on the nearshore environments. There are, however, Chinook in the South Sound that spawn in McAllister Creek, Deschutes River, Percival Creek and other independent tributaries such as Woodland Creek, Mill Creek, Goldsborough Creek, Case Inlet streams, Carr Inlet streams, and East Kitsap streams.

Historically, South Sound tributaries probably did not possess sustainable populations of Chinook. The marine/nearshore areas, however, are currently utilized by Puyallup River Chinook, White River early run Chinook, which is the sole remaining early run stock in South Puget Sound, and the Nisqually Chinook, a summer/fall stock.

Key Facts:

The Deschutes watershed is located in Thurston County, with a small portion in Lewis County; major cities in the watershed include Olympia, Tumwater and Lacey. Kennedy-Goldsborough is located 85% in Mason County and 15% in Thurston County; the major city is Shelton.

▪

Land use in Kennedy-Goldsborough is primarily forest (71%) with urban and agricultural use accounting for 4% each. Land use in the Deschutes is 54% forested, 39% non-forested vegetation, 16% agricultural and 5% urban.

▪

Projected population growth is 51% for Thurston County and 41% for Mason County.

▪

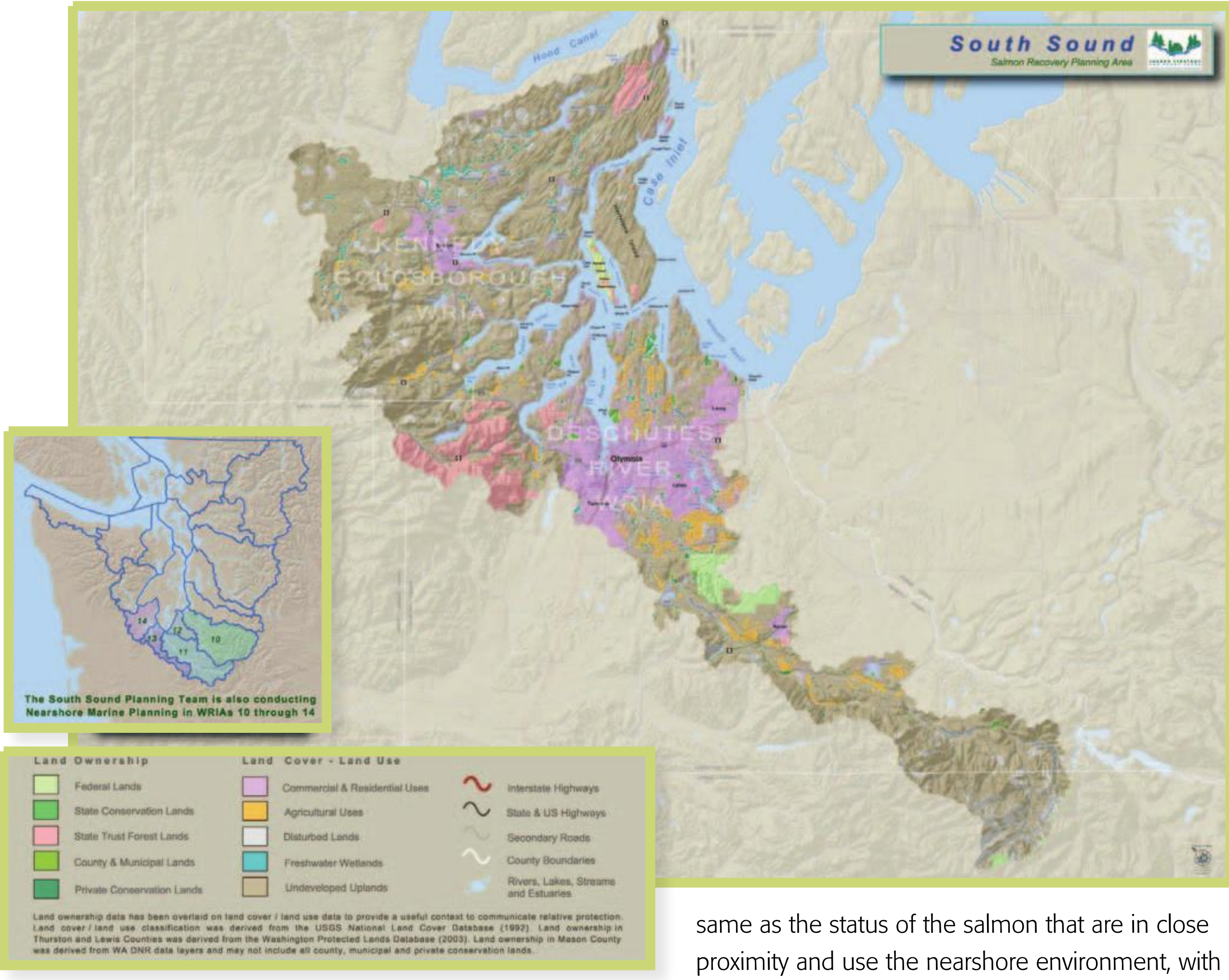
The Nisqually watershed is an important river system in this area and has its own profile.

▪

The planning area for the South Sound is under the state Watershed Management Act are Watershed Resource Inventory Areas 13 and 14. The nearshore of the Nisqually is in WRIA 11. Portions of WRIA 12 (Pierce Co.) and WRIA 15 (Kitsap County) are also included in the nearshore area covered by the South Puget Sound Salmon Recovery Group.

Bull Trout

While there are very few reports of bull trout in the South Sound region, the US Fish and Wildlife Service identifies the South Sound marine and nearshore as a potential area of importance for foraging, migrating and over-wintering habitat for bull trout.



Recovery Goals

The goal of the South Puget Sound Salmon Recovery Group is to restore Chinook, Coho and other salmon species in the South Sound to a sustainable, harvestable level by ensuring that there are properly functioning nearshore habitats that serve their rearing, refuge, feeding, physiological transition, and migratory needs. The South Puget Sound Salmon Recovery Group also accepts the Nisqually Chinook spawner abundance planning targets, and harvest and hatchery goals.

What is the current status of the threatened salmon populations?

For the purposes of this planning effort, the status of the salmon in the South Sound is considered the same as the status of the salmon that are in close proximity and use the nearshore environment, with the Nisqually salmon considered the primary users. In general, all independent populations of Chinook salmon in the South Sound ESU sub-region are at a high risk of extinction.

What are the key factors contributing to the current status of the populations?

The key factors that contribute to the status of the populations in the Nisqually and Chambers-Clover Creek basin are also considered key factors contributing to the status of these populations in the South Sound (see Nisqually and Puyallup/White Recovery Plans). The SPSSRG also identified the following additional human-induced stressors to key nearshore and freshwater tributary environments.

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Shoreline armoring and other built structures

Shoreline armoring impacts nearshore erosion and sediment transport processes. This alters the size and type of beach sediment and can decrease the amount of sediment that is transported. Armoring also increases the energy of waves and reduces the water quality by altering the natural flow of water and accumulation of drift material. Shallow nearshore environments, which are crucial habitat areas for many species, are often lost as a result of armoring. Overwater structures and ramps have similar effects on salmon. Overwater structures especially can limit the sunlight that is needed by many of the chemical and biological components that comprise a functioning nearshore system.

Loss of riparian areas

Loss of riparian areas due to development has resulted in less shade and prey for salmon as well as increased water temperatures.

Modified wetlands and estuaries

Wetlands and estuaries have been modified which impacts tidal exchange, erosion and sediment transport. This can lead to a loss of habitat connectivity, and increase beach scouring.

Input of toxic compounds

Industrial and agricultural development has resulted in the release of toxic compounds in the marine and nearshore waters. Toxics can impair the development, growth, reproduction, and sensory functions of salmon.

Boat traffic

The wakes from boats and other water vessels can disrupt natural flows and are often more forceful than would be naturally found in the environment. This can increase erosion which can lead to a loss of habitat, a loss of habitat connectivity, and can disrupt natural sediment transport processes.

Invasive Species

The introduction of species that are not native to the South Sound has a variety of negative impacts on salmon, including increased competition for food and habitat, as well as increased predation.

Shellfish Aquaculture

Cultivating shellfish in the South Sound results in the loss of shallow nearshore habitat and habitat diversity that is important to salmon. These impacts can be potentially positive or negative depending on the type of aquaculture practice.

Photo courtesy the Squaxin Island Tribe.

Growth

In the future, population growth and development are likely to be key threats for salmon in the South Sound. This will not only decrease the size of available habitat, but will also result in an increase in impervious surfaces which causes an increase in storm runoff which in turn decreases water quality.

Overall Approach to Recovery

The South Sound Recovery Plan takes an ecosystem approach. For the short term, this plan addresses threatened Chinook salmon and bull trout. However, in the long term, the conceptual model and recovery strategies and actions will be broadened to address factors limiting Coho and other salmon species. SPSSRG also recognizes that while recovery efforts in the South Sound will benefit the Nisqually Chinook population specifically, populations throughout the Puget Sound will gain from improved nearshore and marine environments.

The SPSSRG additionally recognizes that salmon recovery depends not only on addressing habitat, harvest, and hatchery issues, but also on a shift in community attitudes. To bring about social change, the SPSSRG advocates that education and marketing strategies will need to be employed, and people in local businesses, social groups and religious organizations will need to be engaged in the recovery effort.

The SPSSRG also believes that salmon recovery in the South Sound will not be possible without cooperative leadership from all levels of government. To meet their recovery objectives, the SPSSRG will use cooperative planning, including the formation of a South Sound Advisory Science Team and a regional inter-jurisdictional forum for recovery planning, addressing the effectiveness of regulations and enforcement activities, and developing a plan for land acquisition and habitat restoration activities.

The South Sound Recovery Plan has identified the following action objectives to address the human-induced stressors that are contributing to the status of the salmon.

Key strategies and actions supporting the overall approach to recovery

Shoreline Armoring

The SPSSRG suggests and encourages the removal of armor from publicly owned sites; identification and removal of bulkheads that are not essential; when feasible, use of soft shore protection measures to protect shorelines; placing moratoria on new armoring through local ordinances; and removal or modification of shoreline armoring that blocks the passage of material from feeder bluffs.

Overwater Structures and Ramps

Designing overwater structures that allow light through would allow sub-tidal and intertidal vegetation to survive. The SPSSRG will seek funding for the removal of old homes, floats, debris, old piling anchors and derelict vessels. The plan also suggests minimizing the number of docks and ramps and encourages community facilities. Where possible and with landowner agreement, boat ramps that impede sediment transport processes will also be identified and removed.

Stormwater and wastewater

Several strategies address stormwater and wastewater. The plan encourages retrofitting stormwater systems and treatment plants to improve water retention and treatment. The plan also promotes land use practices that prevent stormwater flows, monitoring and wastewater reuse, and a street-sweeping program.

Riparian Loss

To address the loss of riparian areas along the nearshore, the plan calls for re-establishment and maintenance of riparian buffers. It is widely accepted that riparian buffers are important for salmon and trout in freshwater systems. Buffers along the marine nearshore serve a similar purpose. The plan encourages several other actions to address riparian loss including: building setbacks, native plantings along the shoreline, increasing public ownership, and retaining undeveloped shorelines in open space areas.

Photo courtesy the Squaxin Island Tribe.

Wetland and Estuarine Modification

Past diking and hydrologic isolation of the wetlands caused substantial loss of estuarine and tidally influenced wetlands. This occurred primarily to support agricultural purposes. The plan recommends the use of incentives and buy-back programs at the state and federal level to remove dikes and put restrictions on agricultural use of estuarine wetlands. This would help restore estuarine functions. Many of the recommended programs already exist and are supported by the planning group.

Toxic Components

The SPSSRG's objective is to support public education efforts that focus on using Best Management Practices (BMPs) for preventing the entry of toxic contaminants into nearshore and marine waters. They also support the study of the use and effect of PBDEs (a chemical found in flame-retardants) on salmon health. The group also identifies existing and future toxic sediment clean-up projects and pesticide education programs as key to addressing toxic impacts on the nearshore-marine environment.

Boat Traffic

The plan identifies the need for programs to reduce the speed of boats and re-direct boating routes to reduce erosion from the wake these vehicles can cause.

Invasive Species

The plan supports the requirement that ballast water in commercial ships be exchanged or treated before release in South Sound to combat the introduction of nonnative species.

Shellfish Aquaculture

Another set of actions in the plan concerns identifying shellfish aquaculture impacts and improving the management practices for the production and harvest of shellfish.

Results

The watershed plan for the South Sound was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan to some extent, but the reviewers felt they merited particular attention or additional effort to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

This plan has a well laid out conceptual model that identifies stressors linked to the landscape and the fish needs (VSP parameters). The plan includes local habitat assessments for each region, which while not linked to the effects of impaired processes to VSP, are linked to changes in habitat conditions.

There is a good guidance framework with maps to identify priority protection and restoration locations providing a good scientific basis for these priorities. The plan did a good job in designing assessments to determine what the actions should be; the assessments provide a good foundation for the needed next step of identifying more specific actions. It will also be important to assess the results for fish from the protection tools on which the plan relies.

Photo courtesy the Squaxin Island Tribe.

The SPSSRG came up with an interesting and different way of looking at the problem and identifying who does what, when for implementation. This approach may be useful in other watersheds.

The certainty of achieving plan outcomes is increased by the fact that Thurston County has agreed to use the plan as Best Available Science. The reviewers also understand that the Puget Sound Action Team (PSAT), the authors of the regional nearshore chapter, agreed to do some additional work, so the plan has more longevity than is apparent in the document.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

One of the key uncertainties of this plan is that it is not clear how the stated habitat strategy relates to the hatchery and harvest management strategies for recovery of the populations and the objectives for harvest in southern Puget Sound.

It will be important to the success of this plan to analyze how hatchery fish use the South Sound habitats (e.g. issues of competition and predation, implications of hatchery production, etc.) and estimate the capacity of the South Sound nearshore to support hatchery-origin and natural-origin Chinook and other salmon using those waters.

How the food web of Puget Sound (including hatchery salmonids, any competitors, prey species or predators) will affect salmon recovery, and what strategies could be used to address these problems are not included in the plan and should be addressed in the adaptive management and monitoring program (expected to be completed later this year).

Water quality in shallow bays is a significant concern. It will be important to assess the magnitude of impact, reduce contamination where necessary, and ensure protection of processes that maintain water quality sufficient for salmon recovery and other objectives the Puget Sound ecosystem is expected to support.

The planned strategies and actions will need to be linked to results for fish, the Viable Salmonid Parameters (VSP; abundance, productivity, spatial distribution, diversity) to describe the expected outcomes from plan implementation. Once the linkage between the ecosystem principles, stressors, and geographic priorities are linked to VSP, then these four parameters can be used as a measure for monitoring.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the above uncertainties are addressed, the South Sound will support salmon populations using its nearshore and marine waters and provide an important contribution to overall ESU recovery.

Photo courtesy the Squaxin Island Tribe.

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Watershed Profile:

Mid Hood Canal Chinook

This plan focuses on the Mid Hood Canal Chinook population. State and tribal co-managers are in the process of writing a separate plan for the Skokomish Chinook population. The Hood Canal Coordinating Council is preparing a separate recovery plan for the Hood Canal summer chum Evolutionarily Significant Unit (ESU).

Photo courtesy the Washington State Salmon Recovery Funding Board

The Place and the People

Located in western Washington, Hood Canal is not really a canal at all but rather a picturesque glacial fjord that sits in the shape of a backwards checkmark or a fish hook between Puget Sound and the Olympic Peninsula. Five major rivers with upper reaches protected inside Olympic National Park flow east into Hood Canal. The Dosewallips, Duckabush, Hamma Hamma, Skokomish, and Big Quilcene rivers mix in the Canal with the waters of countless smaller streams and creeks that flow west from the Kitsap Peninsula. Endowed with an abundance of biologically-rich estuaries, Hood Canal produces Pacific oysters, known world-wide for their unique flavor, as well as a smorgasbord of other shellfish, crab and shrimp.

The retreat of the huge and heavy ice sheets of ancient glaciers carved the inland waterways of Puget Sound, including those along east Jefferson County and Hood Canal. As the ice retreated northwards and approached the Strait, an isolated drainage route was created connecting Dabob Bay with Discovery Bay via the Leland-Snow Creek valleys. This glacial history had important consequences for the evolution of stream drainages, headwater wetland formation, and fish colonization/movement among basins.

The Hood Canal watershed lies predominantly in the rainshadow of the Olympic Mountains, which intercept much of the precipitation from the Pacific Ocean. Due to this rainshadow effect, Hood Canal has been called the driest coastal region north of southern California (SCSWAT 1996). The southern part of the watershed experiences increased precipitation to as much as 70 to 80 inches per year along the foothills of the eastern Olympic Mountains (Parametrix, Inc. et al 2000). Eighty-five percent of the rainfall occurs in the winter. Many streams are naturally flow-limited and some dry during the summer months. This condition renders streams particularly vulnerable to habitat impacts such as elevated water temperatures or channel de-watering stemming from human removal of riparian vegetation and water extraction.

The Skokomish Tribe, along with the Lower Elwha S'Klallam Tribe, Jamestown S'Klallam Tribe, Port Gamble S'Klallam Tribe, and the Suquamish Tribe, have adjudicated usual and accustomed fishing areas in Hood Canal. The Hood Canal watershed currently includes a variety of land uses including forestry, agriculture, urban development, rural residential, light industry, and recreation.

Much of Jefferson County is in public ownership given its position within the Olympic National Park, Olympic National Forest, and state trust lands. The upper two thirds of the planning area is within eastern Jefferson County. The lower third lies within Mason County. Only 11% of the entire county is in private land ownership, with a higher percentage of private lands in east Jefferson County. Significantly, most of the anadromous fish habitat is on private land. The forestry and agricultural practices have contributed to habitat impacts throughout the planning area through channelization (straightening a stream or river and preventing it from meandering), riparian loss and removal of instream structures such as large woody debris. Rural residential development has added to these impacts.

Jefferson County is now one of the fastest growing (per capita) counties in Washington. In 1996, the population was approximately 24,792 and future projections estimate that by 2016 the population will reach 38,392 — a net increase of 13,600. About 40 percent of the population increase is expected to occur in the urban growth area of Port Townsend and another 20 percent of the increase is projected for the Port Ludlow

Key Facts:

Land ownership in the watershed is 48% federal and includes portions of Olympic National Park and Olympic National Forest, 39% private, 12% state and local, and 1% Tribal trust lands.

■

Hood Canal is 62 miles long by boat with a total of about 358 miles of shoreline. This is about 15% of the total inland marine shoreline, or 25% of Puget Sound proper.

■

Mid Hood Canal Chinook watersheds are in Jefferson and Mason counties.

■

Projected population growth for Jefferson County is 43% between 2000 and 2020 and 41% and 54% for Mason and Kitsap Counties respectively.

■

The planning area for Mid Hood Canal Chinook includes parts of Watershed Resource Inventory Area (WRIA) 16 and the nearshore of Hood Canal.

Master Planned Resort. The remaining portions of east Jefferson County are expected to increase by a total of about 5,200 people between now and 2016 (Parametrix, Inc. et al 2000). Population pressure increases demand for water and developed residential properties, particularly with views, which can increase impacts to fish habitat through stormwater runoff, riparian degradation and surface and ground water withdrawal. Washington State's Growth Management Act is designed to minimize, but not eliminate, many of these impacts to fish habitat productivity.

The staffs of Mason, Jefferson and Kitsap counties are currently working collaboratively with the tribes and the Hood Canal Coordinating Council, which is composed of representatives of Tribes and local governments, to ensure that Hood Canal is a place where both people and fish thrive.

Mid Hood Canal Chinook Salmon

The Mid Hood Canal Chinook Population, comprised of the Dosewallips, Duckabush and Hamma Hamma sub-populations, is one of the two genetically distinct Chinook populations that historically and currently exist within the Hood Canal area of the Puget Sound Chinook salmon ESU, the other being the Skokomish Chinook population. Early reports on salmonid use of Hood Canal streams documented early-returning Chinook life histories in the Skokomish, Dosewallips, Duckabush and Hamma Hamma rivers, but more recently, only late-returning Mid Hood Canal Chinook are present. The Skokomish River is the largest river system in the Hood Canal basin, and historically produced the region's largest runs of salmon and steelhead. The Skokomish Chinook population is being addressed in a separate plan under development by the co-managers.

Chinook spawn in the lower reaches of all three of the Mid Hood Canal rivers. In the Hamma Hamma River mainstem, spawning occurs up to RM 2.5, where a barrier falls prevents higher access. When water flows are high enough to permit access, spawning can also occur in John Creek. A series of falls and cascades typically block access to the upper Duckabush at RM 7, and to the upper Dosewallips River at RM14, though spawning may also occur in Rocky Brook Creek, a tributary to the Dosewallips. Because most tributaries to the three rivers are inaccessible, high gradient streams, the mainstems are vital in terms of production potential.

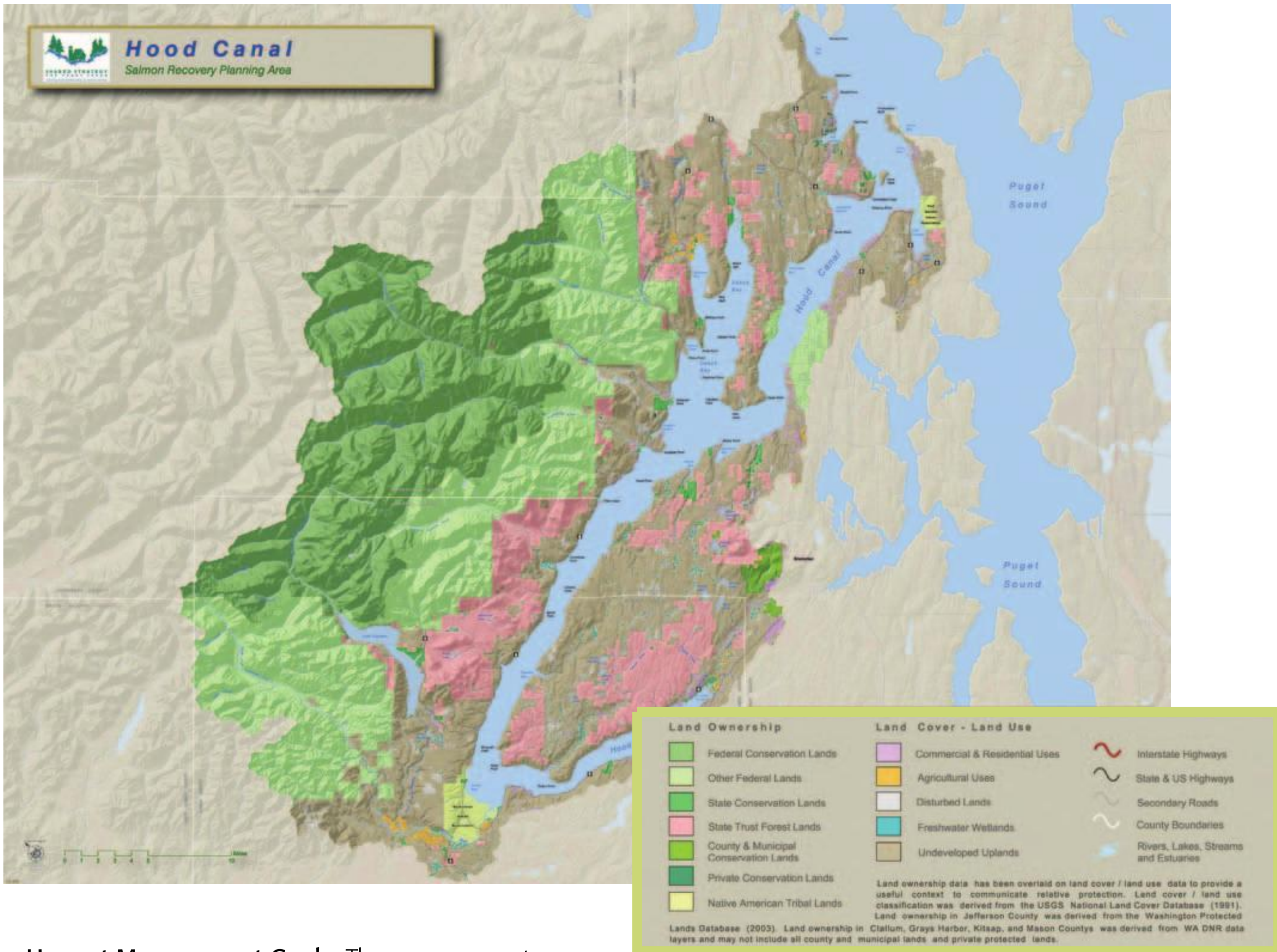
Mid Hood Canal Chinook Sub-Population Goals

Planning targets for abundance and productivity are provided in the table below. Escapement is the number of salmon allowed to "escape" a fishery to spawn and is a common measure used to determine abundance. Two combinations of abundance/productivity numbers are given because a more productive population with fewer spawners has the same risk level as a less productive population with more spawners returning. Another way of putting this is that if each pair of parents produces more surviving offspring (e.g., 3 surviving offspring per parent means they have higher productivity), fewer parents are needed to sustain a population, compared to one in which each set of parents produces only 1 surviving offspring. The plan notes, and the table reflects, that the lower escapement target for each sub-population is substantially higher than the average escapement from 1993 to 2004.

Chinook Sub-population	Escapement planning targets (productivity in parentheses, expressed as adults produced per spawner)		Mean escapement (1993-2004)
Hamma Hamma R.	1000 (1.0)	250 (3.0)	152
Duckabush R.	1200 (1.0)	325 (3.0)	31
Dosewallips R.	3000 (1.0)	750 (3.0)	84

Source: Mid Hood Canal Chinook Recovery Chapter, p. 17

Co-managers anticipate that the combination of harvest and hatchery management strategies, along with habitat protection and implementation of restoration projects, will improve Chinook population diversity and spatial structure (see page 18 of the Mid Hood Canal Chinook Recovery chapter).



Harvest Management Goals: The management objective for the Mid Hood Canal Management Unit is to maintain and restore sustainable, locally adapted, natural-origin Chinook sub-populations. Harvest Management practices constrain harvest to the extent necessary to enable rebuilding of natural Chinook populations to occur, assuming the implementation of management actions to protect and restore habitat needed to achieve recovery. The ultimate goal is to rebuild natural productivity so that natural Chinook populations will be sufficiently abundant to provide ecological functions, ensure that cultural values to society are not lost, and sustain commercial, recreational, ceremonial and subsistence harvest.

Hatchery Management Goals: There are three goals of the hatchery Chinook salmon programs in Hood Canal:

- Produce fish for subsistence, ceremonial, commercial and recreational harvest.
- Aid in recovery and reestablishment of natural populations.
- Provide mitigation for reduced natural production in the Skokomish River system, primarily caused by hydroelectric dams on the North Fork Skokomish.

Co-managers have developed and implemented conservation hatchery programs and harvest hatchery programs for Chinook in Hood Canal.

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

The Hamma Hamma Chinook supplementation program is a conservation hatchery program that is being managed to reduce the risk of extinction for the Chinook population and to help rebuild the population to sustainable levels. The Hoodsport and George Adams hatcheries and Long Live the Kings Rick's Pond are examples of harvest hatchery programs. These hatchery programs are managed so as not to impede the recovery of natural populations.

What is the current status of the threatened Chinook populations?

Levels of abundance of the three Mid Hood Canal sub-populations are low. In 2002, the stock status was rated as critical, primarily because of chronically low spawning escapements. The average escapement abundance over the 1991-2002 period did not meet the established low escapement threshold of 400 Chinook.

What key factors currently affect the populations?

Supporting Factors

The largest landowners in the Dosewallips River watershed are the Olympic National Park and the Olympic National Forest. Together, they comprise 93% of the watershed, and a significant portion of the national forest land is protected as wilderness area. The remaining 7% is divided between privately held forestlands, rural residential, parkland and commercial uses. Commercial zoning is concentrated in the lower reaches. The predominant residential zoning in the watershed is one resident per 20 acres.

The Riparian Reserve Program adopted by the US Forest Service (USFS) has the potential to improve riparian conditions, including temperature control, large woody debris recruitment, streambank and migratory corridor stability, and riverine functions downstream.

Habitat protection and restoration actions developed by the Hood Canal Coordinating Council as part of the Hood Canal Summer Chum recovery plan are expected to benefit Mid Hood Canal Chinook sub-populations.

Population projections and growth rates for the Dosewallips and Duckabush watersheds reflect an assumed estimated rural growth rate of 1.09%. Boundaries drawn by Jefferson County for designated rural village centers which provide for the needs of rural populations and travelers are largely defined by the built environment as it existed in 1990 or earlier. If impervious cover areas can be maintained at or within the 10% threshold, the lower population growth rate projections, along with protection and restoration measures, are expected to result in improved conditions for fish.

The co-managers have prepared a harvest management plan describing the harvest management guidelines for the Chinook of Puget Sound, including Hood Canal, for the 2004-2009 management years. The intent of the harvest management plan is to constrain harvest to the extent necessary to enable rebuilding of natural Chinook populations of Puget Sound, provided that habitat capacity and productivity are protected and restored. It includes explicit measures to conserve and rebuild abundance and to preserve diversity among all the Chinook populations. NOAA Fisheries has recently approved the co-manager harvest management plan.

The co-managers have prepared Resource Management Plans for hatchery operations affecting Puget Sound Chinook, including Hood Canal. The plans describe how hatchery programs are managed to help control potential hatchery impacts to natural Chinook populations and/or to recover the natural Chinook populations.

Significant Factors Limiting the Mid Hood Canal Chinook

The lower river and estuary are the most impacted by development and past logging practices in each of the three rivers inhabited by the Mid Hood Canal Chinook. Attributes related to habitat diversity, channel stability, key habitat quantities, flow, and sediment load emerged as the most important limiting factors per co-managers' ratings and the Ecosystem Diagnosis and Treatment (EDT) analysis. Habitat conditions related to successful egg incubation, fry colonization and, in some areas, pre-spawning holding were also identified as important limiting factors.

Significant habitat limiting factors which have prevented increased productivity of Chinook include the following:

Estuarine habitat loss and degradation associated with loss of eelgrass, bulkheads and revetments, and impaired riparian corridors have reduced the amount of rearing habitat in the estuarine and nearshore area as well as limited the amount of food for migrating juveniles.

Channel complexity and overall channel conditions have been impacted by dredging, removal of large woody debris (LWD) and lack of LWD recruitment. Logging has modified native riparian forests and has resulted in reduced LWD recruitment, increased water temperatures, reduced bank and floodplain stability, and impaired channel conditions, resulting in the loss of juvenile rearing and spawning habitat.

High water flows in the winter months cause scouring of salmon redds and, in association with unnatural man-made sediment sources (e.g. owing to forest practices), transport sediment loads downstream, potentially burying redds and reducing habitat quality. Summer low flows prevent or delay upstream passage and also reduce available spawning habitat.

Floodplain modifications and loss of freshwater wetlands that occurred largely due to the conversion of floodplains to pastureland and residential development have reduced the quantity and quality of habitat available for spawning and rearing and changes in instream flows.

Logging roads in the upper watersheds, as well as diking and channelization in the lower reaches has resulted in sediment aggradation, reducing spawning habitat and affecting incubation.

In addition to habitat limiting factors, there is evidence that harvest and hatchery activities have been limiting to Mid Hood Canal Chinook salmon. Mid Hood Canal natural Chinook were not protected from mixed stock fisheries within Hood Canal during the 1980s when these fisheries were at their peak. Also, fisheries outside Hood Canal would have been a factor. From 1990 through the present, fishing effects on the Chinook survival continue, primarily owing to pre-terminal (predominantly Canadian) fisheries. In recent years, the State and Tribes have severely reduced fisheries and their potential impact in Hood Canal and Washington State.

Hood Canal hatchery programs also have potentially impacted Mid Hood Canal natural Chinook. At one time, hatchery Chinook juveniles were planted in Mid Hood Canal streams, with possible negative effects on the natural populations; that practice was terminated in 1991. Today, there is still concern about hatchery released fish of Hood Canal affecting the abundance, productivity and diversity of

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Photo courtesy the Hood Canal Salmon Enhancement Group.

natural Chinook. However, the potential risks have been addressed by eliminating programs, reducing production, and timing hatchery releases to minimize interactions with the natural Chinook.

Future Threats

Climate change, ocean, estuarine, and freshwater effects (such as flows) and shifts related to human caused impacts that may negatively affect summer chum are also believed to affect Mid Hood Canal Chinook.

Dissolved oxygen levels are at historic low levels in the marine waters of Hood Canal. The problem is being addressed by the Hood Canal Coordinating Council and the Puget Sound Action Team through the Preliminary Assessment and Corrective Actions Plan and other programs.

Overall Approach to Recovery

Both Mid Hood Canal Chinook and summer chum salmon share the mid Hood Canal rivers and nearshore environment of Hood Canal. The Duckabush, Dosewallips, and Hamma Hamma river systems represent one of the six conservation units addressed in the summer chum recovery plan. For this reason, the Mid Hood Canal Chinook recovery strategy relies in part on close coordination and collaboration with the Hood Canal Summer Chum recovery planning processes and activities occurring under the auspices of the Hood Canal Coordinating Council. Habitat actions that will improve conditions for Chinook will also address limiting factors for summer chum in the Mid Hood canal watersheds.

Currently, this chapter does not address Skokomish Chinook recovery. The completion of the Skokomish recovery chapter will require continued work on all Hs-Habitat, Hydropower, Hatchery, Harvest. Co-managers are working together to develop a Skokomish Chinook recovery plan that could potentially be completed by December 2005.

The habitat protection and restoration strategy is to work cooperatively with current landowners on habitat stewardship and restoration projects. Acquisition will be pursued when no other practical alternatives exist to achieve some habitat goals. The existing regulatory protection tools are viewed as adequate for recovery "if watershed development occurs as expected and current regulations are maintained or improved and adequately implemented."

The Hood Canal Coordinating Council is the Lead Entity under HB2496 for the Hood Canal watershed. The Council's multi-species salmon habitat recovery strategy places Chinook and summer chum habitat in the Dosewallips, Duckabush and Hamma Hamma, and Skokomish rivers and their nearshore areas in the highest prioritization categories. The Lead Entity strategy is based on ecosystem restoration principles.

Key Strategies and Actions supporting the overall approach to recovery

Restoration actions in the Mid Hood Canal Chinook plan are organized by limiting factors. Examples are provided at right.

Ecosystem Diagnosis and Treatment (EDT) modeling results indicate that target recovery values would be close to being achieved for the Dosewallips River within 25 years, assuming that projects are implemented within the 10 year time frame if:

- Habitat protection and restoration projects of equal or better habitat value of the entire *High Implementation Potential* list are successfully implemented;
- Current development regulations are implemented and enforced;
- Habitat conditions do not degrade any more than is predicted for modeled potential build-out; and
- The assumptions and attribute ratings for EDT are correct.

Achieving target recovery goals in the Duckabush and Hamma Hamma watersheds requires intensive

Hamma Hamma River	
Factors limiting recovery	**Sample Actions within the next ten years**
• Loss of channel complexity and in-channel wood in lower river due to dredging, bank hardening and channelization • Bed instability and sedimentation (lower Johns Creek) at least partially as a result of landslides associated with road failures and clear cutting • Impaired connectivity and loss of tidal prism in the estuary from dredging and dikes • Restricted tidal action caused by the Highway 101 causeway, isolation of estuarine marsh	• Estuary: 34.5 km road decommissioning; 9.2 km road conversion to trail • Mainstem/Floodplain Restoration: Silviculture treatment of upland problem areas, with emphasis on Jefferson and Cabin Creek watersheds to increase hydrologic maturity • Assess, conserve and restore riparian conditions in anadromous zone and above anadromous zone as recommended in Watershed Analysis, and in lake riparian areas damaged by recreation

Duckabush River	
Factors limiting recovery	**Sample Actions within the next ten years**
• Loss of estuarine complexity and connectivity through highway construction • Loss of floodplain and side channel access due to development in lower river reaches • Loss of riparian vegetation in lower river; loss of in-channel wood; sedimentation	• North estuary restoration: remove dikes, improve tidal connectivity of two creeks • Evaluate SR101 across estuarine delta to restore tidal connectivity and native vegetation • Remove dike south side of estuary and upstream of SR101 • Reconnect northern distributary channel with the Duckabush River • USFS road decommissioning: 13 km of road decommissioning; 1.2 km of road conversion to trail • Plant and maintain riparian areas on public and private properties in lower mainstem in Murhut and Cliff sub-watersheds • Restore stream channel habitat complexity through key LWD and log jam addition in mainstem and through LWD addition in Murhut and Cliff sub-watersheds • Conserve remaining high quality riparian and floodplain habitat

Dosewallips River	
Factors limiting recovery	**Sample Actions within the next ten years**
• Loss of channel complexity, side channels, and floodway from levee construction, bank hardening, and splash dam • Loss of in-channel wood • Estuarine marsh affected by levees and filling	• Acquire 17 acres, • Placement of key wood or engineered log jams (ELJs) to improve channel and floodplain complexity • Mainstem – restore channel complexity below 6 Mile Bridge with full scale wood ELJ restoration; conifer under plantings • Restore channel complexity at Steelhead Campground through addition of key wood pieces, removal of sediment plug at top of enhancement pond, road bed and 200 meters of low riprap • Restore channel and floodplain complexity below washout with full scale wood/ELJ restoration • Restore riparian conditions RM 6 to RM 12 on USFS land • Remove low berms, dredge spoils, riprap, culverts, and restore vegetation in estuary • Remove bank protection/riprap below SR101 on lower river • Slough conservation: acquire 3 acres and restore vegetation • USFS 8 km road decommissioning • USFS 2.6 km road conversion to trail


Photo courtesy the Washington State Salmon Recovery Funding Board

habitat protection and restoration actions. The EDT analysis indicates that, unlike the Dosewallips, implementation of projects within ten years would not result in the achievement of target recovery values in 25 years in the Duckabush and Hamma Hamma watersheds, though significant progress would be possible.

The following issues and associated programs affect the entire watershed:

Instream Flows

Water Resource Inventory Areas within the Hood Canal watershed are in the process of developing Watershed Plans. The plans are expected to address Instream flow needs for fish.

Water Quality

The Hood Canal Coordinating Council is addressing water quality, including dissolved oxygen in marine areas, in concert with the Puget Sound Action Team.

Harvest Management Strategy

The management objective is to maintain and restore sustainable, locally adapted, natural-origin Chinook sub-populations. Fisheries are being restricted to accommodate the escapement objectives. Management strategies include the following (see Mid Hood Canal Recovery Plan, Chapter 39)

- Fisheries in southern U.S. areas, outside Hood Canal, are managed to achieve a pre-terminal rate of exploitation of no more than 15%.
- No fisheries specifically directed at Mid Hood Canal Chinook will occur until recovery is sufficient to support them.
- Fisheries on species other than Chinook are managed by limiting exploitation rates, using harvest time and area closures, to remove or minimize negative effects on Chinook salmon

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productivity, abundance, diversity and spatial distribution.

The co-managers' Chinook harvest management plan (PSIT and WDFW 2004) notes that performance of Chinook fishery management will be evaluated annually to assess whether management objectives were met and to identify factors affecting success or failure. The Mid Hood Canal Chinook recovery plan includes a table which describes harvest adaptive management assessments/tasks, rationale, monitoring tools required, time frames for implementation, and comments concerning funding. Tasks include assessing distribution of Mid Hood Canal Chinook throughout the watersheds, improving estimates of exploitation rates, and estimating a rebuilding exploitation rate (RER). Monitoring tools include coded wire tagging and sampling, spawner surveys, and modeling efforts (See Table 6.2, p. 49-52 of the Mid Hood Canal Recovery Plan chapter). A detailed description of Chinook harvest management practices is in Appendix F of the Mid Hood Canal Recovery Plan.

Hatchery Management Strategy

The co-managers studied HSRG recommendations for hatchery reform operations and implemented changes to Chinook programs, including:

- Termination of the Big Beef Creek Chinook program
- Reduction in size of several programs associated with the Hoodsport Hatchery program
- Modifications to hatchery facilities

(See Mid Hood Canal Chinook Recovery Plan chapter, P. 61-64)

The George Adams, Hoodsport and Rick's Pond Hatchery programs are operated to provide Chinook for harvest while minimizing adverse effects on ESA-listed fish. The Hamma Hamma River fall Chinook supplementation program is being managed to restore a healthy, natural, self-sustaining population to the Hamma Hamma River.

Hatchery programs supporting other species in Hood Canal are managed to minimize negative impacts on Chinook or summer chum salmon populations. The coho and steelhead programs include delaying release time until after April 15 to reduce potential predation on Chinook and summer chum. The fall chum and pink salmon programs also delay release to reduce competition and behavioral modifications to natural summer chum (Mid Hood Canal Chinook Recovery Plan chapter, p. 60).

The Mid Hood Canal Chinook Recovery Plan includes a table that describes hatchery adaptive management assessments/tasks, rationale, monitoring tools required, time frames for implementation, and comments concerning funding (See Table 7-2, p. 49-52). Tasks include assessing genetic, demographic and ecological characteristics of the Chinook population, evaluating non-Chinook hatchery program interactions with Chinook, assessing distribution of Mid Hood Canal Chinook throughout the watersheds, and measuring progress toward recovery goals. Monitoring tools include coded wire tagging and sampling, spawner surveys, juvenile trapping and snorkeling surveys.

H-Integration:

In addition to describing the application of the All-H Analyzer (AHA) model to the Hamma Hamma, the plan addresses several questions concerning the integration of habitat, harvest and hatcheries, including:

- Consistency of harvest rates with population productivity
- Consistency of harvest rates with providing necessary spatial structure
- Whether hatcheries are used effectively to reintroduce and maintain populations where habitat is degraded

- Whether hatchery structures are blocking access to important habitat
- Whether harvest augmentation programs are operated consistent with recovery of the ESU
- Whether production from hatchery harvest augmentation programs can be caught without excessive harvest of natural fish

Results

The watershed plan for the Mid Hood Canal Chinook population was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Shared Strategy staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan to some extent, but the reviewers felt they merited particular attention or additional effort to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

According to the TRT's ESU recovery criteria, the two Hood Canal Chinook populations (Mid Hood Canal and Skokomish) will need to achieve low risk status over time for Puget Sound ESU recovery. Since there was no plan submitted for the Skokomish population at the time of the review, there is no way to assess the certainty of achieving this outcome. The reviewers understand that the state and tribal co-managers are in the process of developing a plan for the Skokomish population that is expected to be available later in 2005.

The certainty of achieving this plan's outcomes and the resulting contribution to overall ESU recovery will increase if the following issues receive focused attention as described below.

The reviewers understand there is currently a lawsuit related to Cushman Dam in the Skokomish River basin that, until resolved, will limit the ability to develop specific recovery strategies and actions. In the meantime, it will be critical to preserve future options for the Skokomish Chinook populations and their habitat.

Several uncertainties exist surrounding the plan's hypotheses for what factors are most limiting recovery of the Mid Hood Canal Chinook population. The plan does not provide clear statements of the life stage-specific factors limiting overall population recovery and the likely habitat, hatchery or harvest factors contributing to these limitations. The EDT model results could be used to provide a basis for stating the hypotheses for where in the life cycle do bottlenecks occur for each stock, and how abundance, productivity, and diversity may be impaired relative to a low-risk condition. In addition, the plan considers the potential responses of the 3 Mid Hood Canal streams independently — how are their collective responses predicted to affect the risk status of the population (which includes Chinook in all 3 streams)?

Since this plan has some provisions that overlap with the Summer Chum Recovery Plan, it will be important to reconcile these two plans early in the first phase of implementation. It will be especially important to identify the specific protection and restoration strategies from the summer chum plan that are expected to help Chinook and link these to the four VSP parameters.

This plan largely relies upon existing land use regulatory and voluntary protection mechanisms. As such, it will be important to assess the biological results for fish that can be expected from these protection measures.

The TRT recommends using the adaptive management and monitoring program to assess the potential effects of competition among hatchery fish of all species in the Canal's nearshore. In addition,

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

the certainty of the plan will be increased if the authors clarify the EDT model predictions regarding the Hamma Hamma hatchery program. With the information provided, it is uncertain whether that program is necessary for population recovery, what its objective is, and whether the size of the program is consistent with what the habitat can support. There is a potential conflict between the objectives for the Hamma Hamma hatchery program: is it designed to be used as an indicator stock for estimating harvest rates, or a supplementation program for population recovery, or both? How the program will be managed to be consistent with harvest objectives and the capacity of the habitat to support fish over time is not clear.

In general, it will be important to assess the ecological effects of hatchery-wild interactions on VSP, for Chinook and other species (especially the steelhead and Coho hatcheries). This issue is most pressing if the goal is to develop a strategy for an "integrated" hatchery program that accounts for ecological interactions.

The harvest management strategy aims to make more population-specific estimates of harvest rates for the Skokomish and Mid Hood Canal Chinook populations, but this approach is still in the planning stages. In the early years of recovery plan implementation, it will be important to better integrate harvest objectives with hatchery and habitat objectives, consistent with recovery goals, and to begin implementing management actions accordingly.

This plan has a good start on developing strategies and using the AHA model to integrate habitat, harvest, and hatchery strategies. The AHA model does not cover ecological effects or the spatial context of hatchery effects and should therefore be only one of the tools used to strengthen the H-Integration strategies over time. In particular,

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

since the EDT modeling to date does not include the effects of hatchery or harvest management on Chinook population responses, the model results for specific abundance and productivities expected to occur in the 3 streams within 25 years are highly uncertain. The TRT encourages the planners to use the adaptive management and monitoring program to move H-Integration further down the integration continuum.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,

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- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the above uncertainties are addressed, the Hood Canal watershed will have the opportunity of making a significant contribution to overall Puget Sound Chinook ESU recovery.

Watershed Profile:

Dungeness

The Place and the People

Located on the northwest corner of the Olympic Peninsula, the Dungeness River is nestled in the dry rain shadow of the Olympic Mountains. The Dungeness River and its main tributary, the Gray Wolf, drain an 172,000 acre area. The river flows from steep mountains and deep-forested canyons, and in the lower ten miles through the broad, open Sequim-Dungeness valley, eventually emptying into the Dungeness Bay and the Strait of Juan de Fuca. Forming the southern boundary of the watershed, Mount Constance towers over the river and its 546 miles of streams and tributaries. The northern edges of the watershed are bound by 33 miles of shoreline along the Strait of Juan de Fuca.

Sedimentation is responsible for both the structure of the basin as well as the agricultural opportunities afforded to the people who live there. Ten thousand years ago, at the fullest extent of the ice age, glaciers extended across the Strait of Juan de Fuca and up the Dungeness valley. Lakes formed behind the ice dams, accumulating thick beds of coarse and fine sediments which are now largely responsible for the inherent instability of the upper watershed. As these sediments were transported out of the upper watershed they were deposited in a large alluvial fan. Channel migration occurred across the alluvial fan as the river continued to deposit sediments in the lower valley. As a result, all of the creeks have a floodplain which is larger than would be expected for streams in the lower valley.

Photo courtesy the Dungeness River Management Team.

The watershed contains a diverse array of land uses and cover types. Land uses include agricultural pasture, hay land and cropland on commercial and small farms, residential development scattered throughout the lower watershed, private and public forestland in the upper watershed, as well as a large portion of the Olympic National Park. Rural/ agricultural land occupies 21% of the watershed. Seventy to eighty percent of the agricultural land is irrigated from water diverted from the river, which flows through an extensive network of irrigation ditches.

The basin is part of a region that receives less rainfall and more sunshine than any place in Puget Sound. In the Dungeness Watershed, this drier climate is both a boon for sun-lovers and a bane for farmers in the Dungeness River Valley, who need to irrigate their fields, and for salmon which need sufficient flows in which to swim. In the lower basin, summers are warm but not usually hot, and are generally dry. The lower part of the watershed has cool and rainy winters, but snow and freezing conditions are uncommon. The upper basin is cooler and wetter in all seasons allowing for winters cold enough that snow is common.

The Dungeness River valley has a long history of human habitation. Evidence from an excavation near Sequim shows that people inhabited the region as early as 11,000 years ago--not long after the Vashon ice sheet had departed. In the late 1700s when the earliest European explorers came into the Strait of Juan de Fuca, they found native villages and camps along the shores and bays, indicating that bands of people moved between pre-established sites according to the seasons and availability of food resources. Based on archaeological reports, it is estimated that 400 to 2,100 native people were subsisting on salmon and other bountiful natural resources in the Dungeness River area prior to contact with European explorers and settlers.

European settlement began in the 1850s and proceeded rapidly in locations with good harbors. Logging and early sawmills produced lumber for export down the pacific coast. The local town of Dungeness developed around these activities. In 1855 the Treaty of Point No Point was intended to settle land ownership questions with the S'Klallams.

Key Facts

Most of this watershed is located in Clallam County.

■

The only major city is Sequim.

■

Projected population growth for Clallam County is 16% from 2000 to 2020, much of which is expected to occur in the Sequim area.

■

The planning area for the Dungeness Watershed under the state Watershed Management act is Watershed Resource Inventory Area (WRIA) 18 (Elwha-Dungeness).

■

A portion of the Quilcene Basin (WRIA 17), the Dungeness and Elwha River Basins (WRIA 18) and the Lyre-Hoko Basin (WRIA 19) represent one planning area under Shared Strategy, which includes the western Strait of Juan de Fuca to Neah Bay, the western most point of the continental United States.

However, many S'Klallams remained near their traditional bays and rivers. Threatened with relocation to a distant reservation in 1874, a band of S'Klallams pooled $500 in gold coins to purchase 200 acres of land along Dungeness Bay. In respect for their leader they named their community Jamestown, and their descendants comprise the membership of the modern Jamestown S'Klallam Tribe.

Today more than 16,000 people make their homes in the Dungeness River watershed. Clallam County has been rapidly developing as the mild climate and beautiful scenery attract retirees and others to the region. According to Peninsula Devel-

opment Association figures, the County population increased by over 75% between 1970 and 1992 and continues to grow today.

Property owners, farmers, and representatives of federal, tribal and state agencies are working together with local jurisdictions on the Dungeness River Management Team (DRMT) to address habitat protection and restoration opportunities on the Dungeness River for the people and salmon that live in and around it.

The Dungeness Salmon

Current fish populations in the Dungeness are a small fraction of what they are estimated to have been in the past. Historically, 11 populations or population components existed in the Dungeness. Currently, threatened early-run Chinook, threatened Hood Canal/Strait of Juan de Fuca summer chum, threatened bull trout, upper river "early" pink, lower river "late" pink, fall chum, coho, and winter and summer steelhead, along with sea-run cutthroat and resident rainbow trout live in the Dungeness along with native char.

Chinook return to the Dungeness in the late spring to mid summer with spawning occurring early August through early October. After emerging as fry in the early spring, most Chinook emigrate to rear in the estuary during their first year, while others will rear in the river for a year and emigrate as yearlings. Thus, estuarine habitat is very important for Dungeness Chinook, as the fish spend most of their first year in the estuary or nearshore area.

Summer chum enter the river in late August and spawn in the main channel through September. The young fish will then migrate to the estuary and nearshore area shortly after emerging from the gravel in late-spring.

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Preliminary results of studies suggest that bull trout can be found throughout the Dungeness River upstream to an impassable barrier at milestone 19, and also in the Gray Wolf tributary. They reproduce in colder water than other salmon (48° F or less). Some adults remain in fresh water all their lives, while others migrate to the estuary and may migrate to marine waters.

Recovery Goals

Members of the Dungeness River Management Team adopted an ecosystem approach to restore the physical and biological health of the watershed. Their general goals are to prevent loss of life and property from flooding; work towards the restoration of riparian and aquatic ecosystems within the Dungeness River watershed and estuary areas to mutually benefit wild and native salmonids and human residents; and to protect and enhance the water quality and quantity in the Dungeness Watershed Planning Area to support all beneficial uses including an adequate clean water supply for current and future human needs and a higher productive capacity of fish and wildlife habitats.

Chinook

The long term Chinook recovery goal is to achieve a naturally sustaining population at harvestable levels for residents and visitors. Recovery is expected to occur over a 100-year time period. To get to this point, short term goals (to be achieved within 25 years) have also been identified. The long term goals are reflected in the table below.

The Chinook planning targets are based upon the

Photo courtesy the Dungeness River Management Team. Photo by Bob Boekelheide.

Ecosystem Diagnostic and Treatment (EDT) Model and assume Properly Functioning Conditions (PFC) in the freshwater habitat and pristine conditions in the estuary. At the time the EDT modeling was completed, it was not possible to model PFC in the estuary. Therefore, it is understood by the participants that the planning targets may exceed the actual capacity of the watershed.

Goals for hatchery and harvest practices include providing for ceremonial, subsistence, commercial and recreational fisheries on a sustained basis. The Dungeness Chinook Hatchery Program established by co-managers is intended to maintain higher adult return rates until the habitat can support a productive and sustainable natural Chinook population. Currently, and for the short term, no recreational, subsistence or commercial fishing of Chinook in the bay and river is contemplated due to the decline in the Chinook population.

Bull Trout

The overall goal for recovery of the two bull trout populations in the Dungeness is to achieve and ensure the ongoing long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed across the species' native range so that the species can be delisted. The recovered abundance target is a minimum population size of between 500 and 1,000 adults in a core area (Rieman and Allendorf, 2001). Additional goals include maintaining or expanding the current distribution of bull trout while increasing the abundance of the fish.

Chinook Spawner Abundance Planning Targets for abundance (with productivity in parentheses)	
Low Productivity	**High Productivity**
4,700 (1.0)	1,200 (3.0)

The low productivity number represents one adult fish return per spawner, also called the equilibrium point of 1:1 (recruits per spawner). The high productivity number represents the number of spawners at the point where the population provides the highest sustainable yield for every spawner. The productivity ratio is in parentheses and represents the relationship of recruits per spawner.

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What is the current status of the Threatened Salmon populations?

Biologists estimate that about 8,000 Chinook entered the river annually before the 1850s. Dungeness Chinook, Hood Canal summer chum, and bull trout are considered to have fallen so dramatically, such that their low numbers "allow no room for further downward cycles" (McNulty, T. 2001). The Dungeness River Chinook especially is in jeopardy of being lost unless significant changes are made in the watershed.

Chinook

The Dungeness Chinook population is comprised of a single population of native origin fish with a spring/summer run timing. Run timing appears to be unchanged over time. However, a number of life-history pathways have been lost due to the loss of side-channel and estuarine habitat. It's estimated that only 70% of the historic pathways remain available.

Generally speaking, Dungeness River Chinook continue to have access to their historic geographic range of habitat and now spawn throughout the entire river, though all too often in the last 30 years only 200 spawners have returned. Estimates suggest that the Dungeness River currently is theoretically capable of supporting 699 spawners and that the Gray Wolf River, historically an important spawning area, is underutilized. Additionally, side channel habitat in the lower river, once available for spawning and rearing, has been lost due to diking and other channel changes.

Bull Trout

The U.S. Fish and Wildlife Service has identified two local populations of bull trout in the Dungeness watershed: one in the Dungeness River and one in the Gray Wolf tributary.

Bull trout distribution tends to be patchy, and sufficient information is not available for a precise estimate of abundance. Comprehensive surveys conducted in 2004 combining radio telemetry and walking surveys in the Dungeness and Gray Wolf Rivers documented only 52 redds. No information is available to describe historic or current productivity. Bull trout in the Dungeness are likely to have access to most of their historic geographic range of habitat in the basin, although availability of habitat at certain times of year may be limited due to low flows or warm water temperatures.

What are the key factors contributing to the current status of the populations?


Photo courtesy the Dungeness River Management Team.

Historically it is believed that Chinook swam far upstream and spawned in the upper Gray Wolf River and Gold Creek. Chinook were captured at a brood stock collection fence or "rack" that was put in the river at the hatchery at River Mile (RM) 10 in the early 1930s. The rack generally prevented Chinook from returning to the upper river for over 50 years. Efforts to produce sustainable runs with hatchery releases were largely unsuccessful. The effects from the hatchery programs and rack on

Photo courtesy the Dungeness River Management Team.

Major dikes are located on the east bank from RM 0 -2.6 (the "Corps" dike) as well as RM 7.6 - 8.4 (the Dungeness Meadows dike). Smaller dikes and embankments constructed by property owners are located throughout the lower ten miles of the river.

Five bridges currently cross the Dungeness River. Their design is such that they constrict the river to a narrower channel, which tends to increase water velocities and erosion potential.

Chinook spawning timing and location continue to be a hotly debated topic.

The main reasons for decline of Dungeness salmon can be attributed to the combined impact of a variety of land use activities that have occurred over several decades. During the 1890s settlers began irrigating their land with Dungeness River water, and a fish hatchery was built at Canyon Creek. Early settlers constructed dikes and drainage systems near the river mouth, converting tidal and estuarine areas into farmland. Both the upper and lower watersheds were logged, resulting in landslides in some areas. While areas of the headwaters were protected within Olympic National Park, other sections of the upper watershed in the Olympic National Forest were commercially logged. National Forest policies for upper watershed management are now geared toward the protection of fish and wildlife species.

Historically, dikes, levees and other actions to control the lower reaches of the river have degraded vital refuge for juvenile salmon, and truncated tributaries have degraded over-wintering habitat and contribute to scouring of redds. Diking along the river has constricted the natural process of stream channel formation and the transport of sediment.

With the increasing human population, the demand for water for irrigation, domestic, and business use has markedly increased. The source for this water is both the Dungeness River and groundwater. Most of the water is diverted from mid-April through September, the same time that Chinook return to the river and begin to spawn. Since the early 1990's, collaborative problem solving between the Dungeness River Agricultural Water Users Association, the Jamestown S'Klallam Tribe and others has resulted in water conservation measures which, along with changing water needs, have dramatically reduced diversion rates. Nonetheless, water withdrawals continue to affect salmon spawning and rearing habitat.

In addition to the increasing demand for fresh water, development is also adding contaminated run-off from lawns, driveways, parking lots, and other urban landscape features, and from farm animals, decaying irrigation ditches, leaky septic systems and other sources. The Jamestown S'Klallam Tribe was recently forced to abandon their commercial oyster farm in Dungeness Bay due to excessive bacteria levels from these sources.

Photo courtesy the Dungeness River Management Team.

Overall Approach to Recovery

Property owners, farmers, and representatives of federal, tribal and state agencies are working together with local jurisdictions on the Dungeness River Management Team (DRMT) to address habitat protection and restoration opportunities on the Dungeness River. Their work started over 16 years ago to bring disparate interests together in order to develop, support and promote protection, restoration and coordination among all levels of government and members of the public. By August 2003, representatives of local governments and tribal leaders, irrigators, landowners, key cooperating agencies and community members adopted a strategy to achieve salmon recovery goals. They identified ten "strategic elements" for habitat restoration and protection that help them work cooperatively toward--and measure--their progress.

Key Strategies and Actions Supporting the Overall Approach to Recovery

The ten strategic elements to achieve recovery are identified and described in Restoring the Dungeness as follows:

- Restoration of Lower River floodplain and delta to River Mile 2.6
- Protection of existing functional habitat through land purchase (RM 2.6 - 11.3)
- Floodplain Restoration/Constriction Abatement (RM 2.6 - 11.3)
- Water Conservation, Instream Flow Protection and Water Quality Improvement/Protection
- Restoration of Functional Riparian and Riverine Habitat
- Large Woody Debris Placement
- Nearshore Habitat Protection and Restoration
- Barrier Removal
- Stock Recovery/Rehabilitation/ Hatchery Reform
- Sediment Management/Source Control

(Restoring the Dungeness, 36)

The following key strategies and actions for habitat, harvest and hatchery are ten-year goals developed by the DRMT. Implementation of habitat restoration projects and management actions outside of the regulatory framework is dependent on adequate funding and land owner cooperation. For example, over the next ten years, 600 acres of land is targeted for purchase and conservation easements are being sought for an additional 250 acres. These goals cannot be achieved without adequate funding and landowner agreement.

1. Restoration of the lower river floodplain and delta to increase the quantity of essential rearing and salt/freshwater transition habitat

- Army Corps of Engineers and Beebe Dike set-back.

2. Protection of existing functional habitat within the watershed

- Riparian corridor protection/restoration to Highway 101 through land acquisition/easement
- Regulatory protection measures to be utilized include the Critical Areas Codes, Forests and

Fish rules, Department of Natural Resources Habitat Conservation Plan, the Federal Forest Plan, Shorelines Protection Act, the State Hydraulics Code, the WRIA 18 Watershed Plan, and Tribal land use regulations

3. Floodplain Restoration/Constriction Abatement (RM 2.6 - 11.3) to alleviate channel constrictions, thereby increasing corresponding channel meanders and reducing gradient, velocities, scour and bank erosion

- Removal of upper Haller Dike at the Weikal property
- Property will be purchased for the Corps Dike setback. The area will be re-vegetated and engineered log jams will be constructed

4. Water Conservation, Instream Flows, and Water Quality Improvement/ Protection to improve summer low flows and alleviate water quality concerns

- Implement such projects as piping and lining and other conservation strategies, re-regulating reservoir, water rights and leases and trusts, and reduce conveyance through river/creeks
- Implement other domestic/municipal water conservation projects identified in the WRIA 18 Watershed Plan

5. Restoration of Functional Riparian and Riverine Habitat to improve the quality of riparian habitat and function, including temperature moderation, long-term recruitment of Large Woody Debris (LWD), cover, food production, etc.

- Restore riparian corridor in Matriotti Creek
- Restore riparian corridor throughout the lower mainstem (numerous individual projects — see Recommended Land Protection Strategies for the Dungeness, 2003)
- River Riparian Area

6. Large Woody Debris Placement

- Lower river floodplain restoration, LWD between Schoolhouse Bridge and Woodcock Road
- Strategically placed LWD between Hurd Creek and Highway 101

7. Nearshore Habitat Protection and Restoration to improve the quantity and quality of estuarine and nearshore habitat

- Implement Dungeness Bay Cleanup Plan (Clean Water Workgroup, 2002)
- High priority restoration, protection and assessment projects along the Strait of Juan de Fuca

8. Barrier Removal to address passage conditions

- Improve fish screen/irrigation out-take alignments

9. Stock Recovery/Rehabilitation hatchery Reform (See Hatchery Strategy, below)

10. Sediment Management/Source Control

- Decommission and stabilize selected roads within the National Forest

Hatchery Management

The DRMT hypothesizes that habitat recovery will be sufficient to support a productive and sustain-

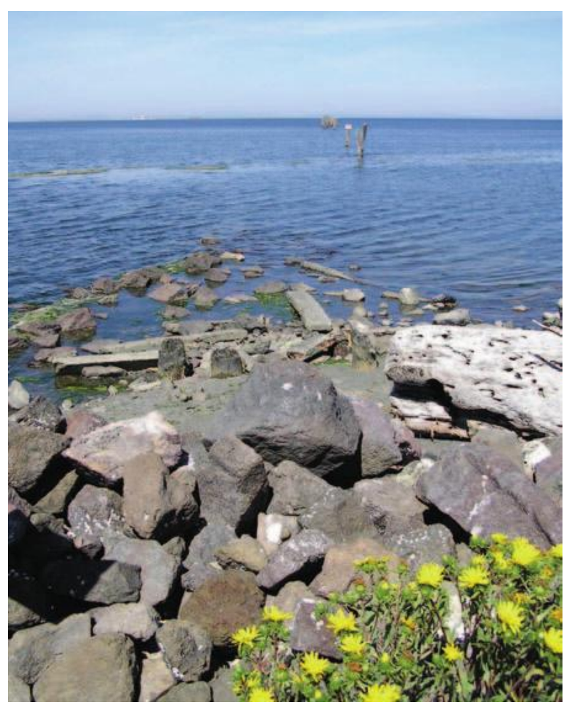

Photo courtesy the Dungeness River Management Team.

able natural Chinook population. Hatchery management strategies are designed to be consistent with recovery goals. A hatchery broodstock supplementation program is being utilized to bolster Chinook production in the watershed. The program will be conducted until the restored habitat can accommodate a robust, naturally sustainable Chinook population. Non-Chinook hatchery programs for coho and steelhead are managed to avoid negative impacts of predation on Chinook.

Harvest Management

Currently, there is no fishery for Chinook in the river or bay. The timing of coho fisheries is managed to minimize incidental capture of Chinook adults during the fall. The recreational trout fishery is timed to reduce the chance of intercepting juvenile Chinook salmon out-migrants.

Adaptive Management

The Adaptive Management Plan provides short term and long term monitoring parameters for the ten strategic elements identified above in the discussion of the overall approach to recovery. Monitoring activities in the Dungeness watershed are divided into four categories. The following table identifies the four categories and provides an example of a statement of purpose, example of

Photo courtesy the Dungeness River Management Team.

subtasks, and lead partners for each category. The Dungeness recovery plan also identifies a schedule and costs for each subtask. Some of the subtasks are performed on an ongoing basis. For others, costs have been calculated and funding sources are being sought. (The Tables can be found in Section D of the Recovery Plan, p. 4-7.)

Results

The watershed plan for the Dungeness was reviewed by the Puget Sound Technical Recovery Team (TRT: a group of seven scientists) and an interagency committee facilitated by the Strategy Shared staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan, but the reviewers felt they merited particular attention to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for

Summary of Dungeness Watershed Area Monitoring Program

Category	Purpose	Example of activity/ subtask	Lead Partners
Biological Processes	Attempt to determine success of physical or ecological restoration, e.g. adequate instream flows	Hydrology – baseline – measure instream flows	* USGS * Ecology
Habitat Conditions and Functions	Attempt to determine the current status of habitat conditions and functions, including LWD, solids and water quality	Large Woody Debris performance – 5 year analysis of LWD placement	*Jamestown S'Klallam Tribe
Biological Response	Measure current status of biological responses to restoration actions, e.g. abundance of salmon	Riparian Vegetation performance – annual air photos, project-specific monitoring of revegetation projects, report on land use strategies	* Jamestown S'Klallam Tribe * Conservation District * Clallam County Noxious Weed Board
Changes to Surrounding Land Use	Look at changes in land use that have the potential to affect watershed processes and conditions either positively or negatively	Land use performance – Critical Areas code compliance, build-out scenario based on zoning, county draft flood plan, annual monitoring of conservation easements	*Clallam County * Jamestown S'Klallam Tribe * WDFW * North Olympic Land Trust

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consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

Both the Dungeness River Management Team process and the example of the Jamestown S'Klallam Tribe and irrigators' water conservation agreement are a model of collaboration. Nowhere else in the region have irrigators and the agricultural community committed to a water conservation effort at the level that is being implemented in the Dungeness. Past successes and the clear level of commitment to implement plan actions increase the certainty that this watershed can meet its stated goals.

According to the TRT recovery criteria, along with the Elwha Chinook, the Dungeness Chinook are one of the two Chinook populations in this region needed to achieve low risk for ESU recovery.

The plan is founded on a sound technical analysis. It offers a new application of the EDT model in the harvest management plan that attempts to improve the plan's approach to address the spatial structure characteristics of a recovered population. This type of application may prove useful for overall H-Integration, not just in this watershed, but throughout the ESU. The reviewers encourage the DRMT to consider expanding this analysis to hatcheries and habitat and use it to help enhance H-Integration. Particular efforts on hatchery-habitat integration and reconciling harvest management objectives with recovery objectives are important next steps for increasing certainty in the plan's outcome for Chinook.

Even with the existing water conservation program, the low flow issues continue to be a major factor impacting fish in this watershed. As the plan is implemented, reviewers encourage continued efforts to identify opportunities to conserve water and increase flow in the Dungeness River system.

The nearshore and estuarine areas are a vital element for salmon recovery. The plan recognizes that protection of existing habitat and restoration actions are needed. The reviewers encourage close coordination with the lead entity group and regional efforts.

The TRT has expressed strong concerns about how the historic and potential future harvest levels under the existing Chinook annex of the Pacific Salmon Treaty (most of which could occur through interception in Canadian and Alaska fisheries) are inconsistent with assumptions about the ability of the habitat to support sufficient productivity of the

Photo courtesy the Dungeness River Management Team.

Dungeness population to allow recovery to proceed. Specifically, it appears from the information presented that potential harvest levels under the existing annex may exceed the productivity likely to be exhibited by the Dungeness population, given current and near-term habitat conditions. The TRT understands that the opportunity for change in the Pacific Salmon Treaty management process is not likely until the annex to the treaty is renewed and effective in 2009. While the negotiators should take advantage to renegotiate lower harvest in 2009, it is also important to develop a method to get population specific estimates of harvest impacts for the Dungeness so that effects of changes in habitat and harvest management can be monitored and assessed.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the proposals above are implemented, especially if flow issues and lower river functions and constrictions are addressed, this watershed and its Chinook population have the ability to achieve low risk status and will provide a critical contribution to the recovery of Puget Sound Chinook.

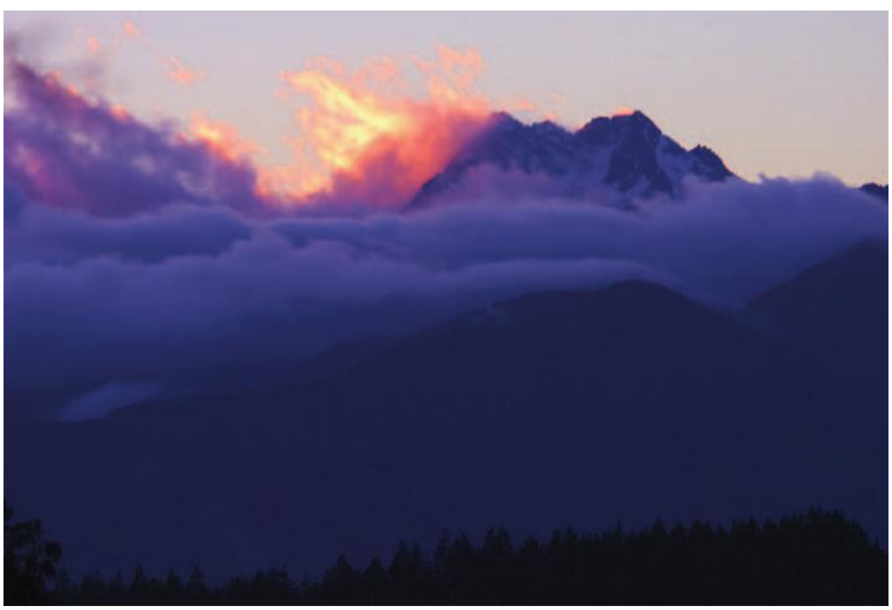
Watershed Profile:

Elwha

The Place and the People

The Elwha River originates from the Olympic Mountains, deep inside Olympic National Park. The river is one of the largest on the Olympic Peninsula, unique in that it supported all five species of Pacific salmon, along with steelhead, cutthroat trout, and native char. Scientists believe that some of the largest Chinook in the State, in excess of 100 pounds, used to swim there. The Elwha River watershed encompasses 321 square miles, the majority of which (267 square miles) are protected in perpetuity within the Olympic National Park.

Despite the rugged headwater terrain, the mainstem river maintains an alternating alluvial valley-and-canyon pattern with a moderate gradient throughout much of its length. The broad meandering valley sections offer excellent pool-riffle habitats and well-vegetated side channel complexes. The bedrock canyons are a mix of cascades, rapids, and long deep pools. The mainstem is about 45 miles in length with over 100 miles of tributary streams. Because the Elwha River is glacier-fed, river flows peak twice throughout the year — once during the winter and again in late spring or early summer from snowmelt.



The aging Elwha and Glines Canyon dams completely block access to 95 percent of the high quality spawning and rearing habitat for salmon and trout in the watershed. Their removal, scheduled to begin in 2008, will make available 70 miles of prime mainstem and tributary habitat, most of it in pristine condition thanks to its location within Olympic National Park. Approximately 75% of

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the funding needed to remove the dams has been awarded by the Federal Government. Remaining funds needed are expected to be appropriated over the next two years.

It required decades of dedicated, patient and painstaking efforts to develop a plan to restore an entire ecosystem by removing these two dams. Policy makers, scientists, and concerned citizens collaborated on the planning process to dismantle the two concrete structures, which entails periodically flushing downstream some of the tons of rock, gravel, sand, and silt that had been accumulating behind the structures for more than 70 years. While these sediments will be essential in order to reshape and restore the lower river and nearshore, it will also be necessary to maintain the quality of water upon which industrial and municipal water users in the watershed depend without eradicating the very fish populations that dam removal was intended to preserve and restore to historic numbers.

Driven by the 1992 Elwha River Ecosystem and Fisheries Restoration Act (P.L. 102-495), which predates the listings of Chinook, bull trout and summer chum as threatened species, the Elwha project cooperators began researching the possibility of removing the dams. They turned to notes written by settlers, early hatchery records, observations in other rivers, and tribal knowledge preserved for thousands of years to learn about the fish in their historic habitat: 100+ pound Chinook, bull trout, cutthroat trout and other fish that had used the naturally accessible mainstem and tributary habitats from the nearshore to the headwaters. Memories, early manuscripts, and records helped to reconstruct an understanding of how the various stocks of early and late run Chinook, coho, chum, sockeye and steelhead coursed up the mainstem into Little River, Indian Creek, and, further upstream to other important tributaries to spawn.

Scientists and policy folks spoke with members of the community about the way the shape of the lower river might change with dam removal and what restoration of the floodplain would mean to those living along side the river. Technical experts, fishermen, and landowners talked about the form of the nearshore, what would happen to clam beds and marine life, and the capacity of the water treatment plant to protect water quality for residents during the prolonged period of predicted turbulence. Ultimately, the decision was made to remove the dams over a period of 18 to 36 months and to implement the restoration goals and actions which were secured by the U.S. Congress through the Elwha Act.

Beyond dam removal, residents of the Elwha watershed know that protection and restoration of the lower reaches of the river, as well as water allocation and other issues not related to the dams,

Key Facts:

Most of the Elwha watershed is located in Clallam County (19% is in Jefferson County, within the boundaries of Olympic National Park)

▪

The only major city in the area is Port Angeles.

▪

Projected population growth for Clallam County is 16% from 2000 to 2020.

▪

A portion of WRIA 17 (Quilcene Basin), WRIA 18 (Dungeness and Elwha River Basins), and WRIA 19 (Lyre-Hoko Basin) represent one planning area under Shared Strategy which includes the western Strait of Juan de Fuca to Neah Bay, the westernmost point of the continental U.S.

▪

The planning area for the Elwha watershed under the state Watershed Management Act is Watershed Resource Inventory Area 18 (Elwha-Dungeness).

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will be critical for Elwha salmon restoration efforts to succeed. This commitment by those living and working in the Elwha watershed is reflected in the recently completed WRIA 18 Watershed Plan, which was adopted by Clallam County Commissioners in June, 2005.

The Elwha Salmon

The Elwha River supported legendary runs of salmon including summer/fall Chinook, spring Chinook, coho, winter steelhead, summer steelhead, pink, chum, sockeye, sea-run cutthroat, and native char. ESA-listed species within the Elwha River include Chinook and bull trout.

Chinook return to the Elwha River from late-spring through late-September and spawn from late-August through mid-October. Estuarine habitat is generally lacking in the Elwha River, so young Chinook migrate quickly into saltwater and likely spend most of their first year in the marine nearshore area. A small portion of the run may also spend a full year in fresh water before moving into the nearshore area, although freshwater habitat is currently limited due to the presence of the two dams. Chinook are mainstem spawners which make them vulnerable to high and low flow damage and to degraded river conditions in the lower part of the rivers.

Bull trout are found throughout the watershed. They reproduce in colder water than other salmonids (48° F or less), but can exhibit extensive migration behaviors. The bull trout living in the watershed above Glines Canyon Dam remain in fresh water all their lives, with some appearing to utilize Lake Mills as summer rearing habitat. Bull trout downstream from the dam likely migrate to salt water in the spring and summer, then returning upstream to spawn in the fall. A portion of the bull trout population above the dams may also migrate to salt water, but their return migration is blocked by the dams.

Recovery Goals

The goal of the Elwha River Ecosystem and Fisheries Restoration Act (the Elwha Act) is the full restoration of the Elwha River ecosystem. This includes:

- Re-establishing self-sustaining anadromous salmon populations and habitats to the Elwha River and its nearshore, and
- Restoring physical and biological processes of the overall ecosystem through dam removal and the return of viable salmon populations.

The removal of the two dams will have a short term adverse impact to the lower river system, while leading to restoration over the long-term. During the period of high impact, other key issues will be addressed, including:

- Protecting water quality for human consumption and other uses;
- Providing existing levels of flood protection to land owners on the river;
- Maintaining the health and vitality of fish populations during and after dam removal; and
- Preserving recreational opportunities.

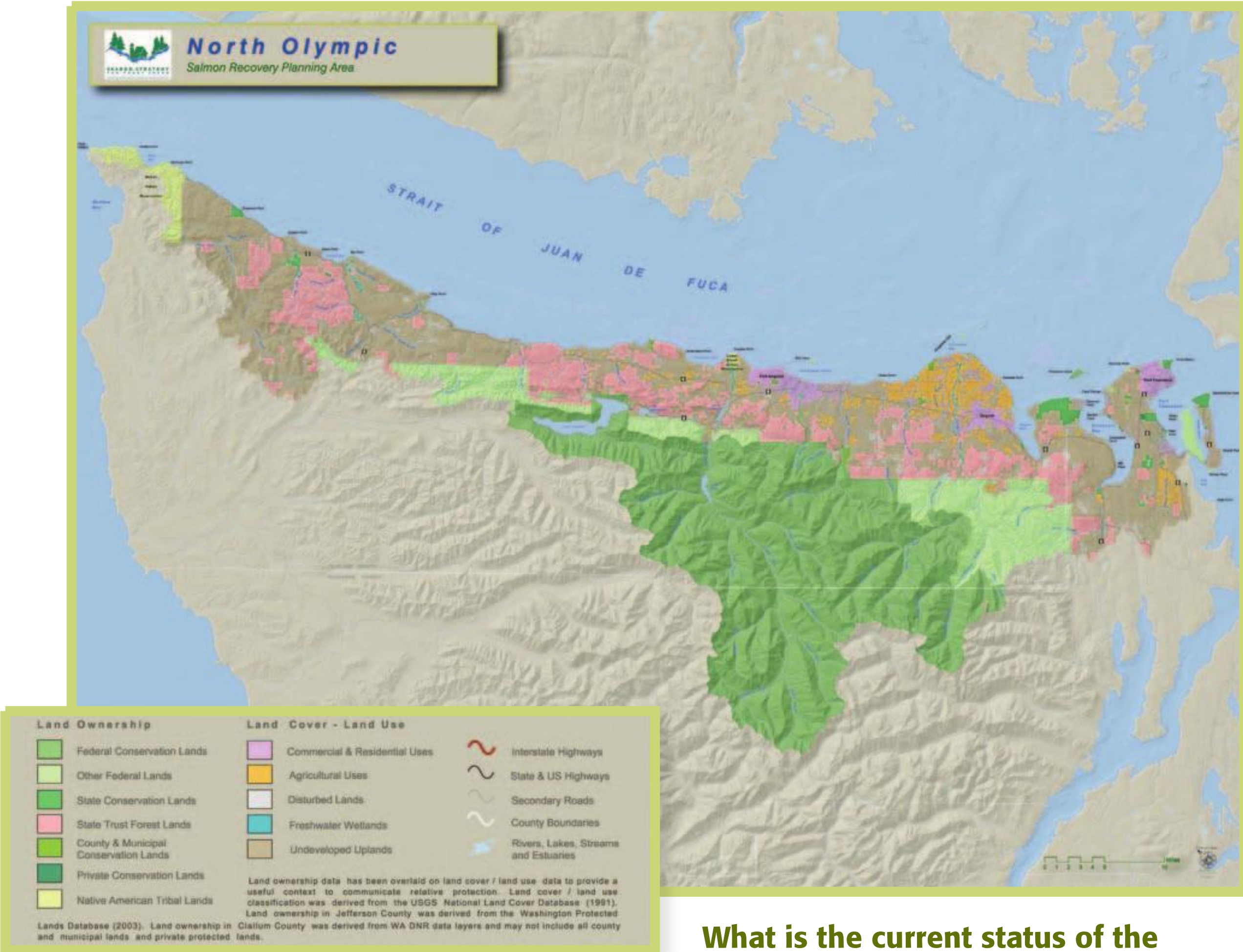
Chinook

The table below provides the 10 and 25 year planning targets for Chinook with productivity in parentheses. A high productivity is assumed due to the pristine habitat above the dams that will be available to returning adult spawners following dam removal.

Chinook Spawner Abundance Planning Targets for abundance
(with productivity in parentheses)

	Low Productivity	High Productivity
10 years		2,000 (>1.0)
25 years	17,000 (1.0)	6,900 (4.6)

FOOTNOTE: The low productivity number represents one adult fish return per spawner, also called the equilibrium point of 1:1 (recruits per spawner). The high productivity number represents the number of spawners at the point where the population provides the highest sustainable yield for every spawner. The productivity ratio is in parentheses and represents the relationship of recruits per spawner.



Bull Trout

The goal for the bull trout population in the Elwha is to ensure the ongoing long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed across the species' native range so that the species can be delisted. The following table provides 10 and 25 year planning targets for bull trout:

Bull Trout Spawner Abundance Planning Targets for abundance (with productivity in parentheses)		
	Low Productivity	High Productivity
10 years	To be determined	No decline from present (>1.0)
25 years	To be determined	>1,000 (To be Determined)

What is the current status of the Threatened Salmon populations?

Chinook

It is clear that the Elwha River Chinook populations are in jeopardy unless significant changes are made in the watershed. It is estimated that the river had as many as 30,000 Chinook salmon prior to the appearance of Europeans in North America. Construction of the Elwha Dam in the early 1900's immediately eliminated up-river production of early and late returning Chinook. Today, natural production of salmon is limited to just a few areas in the lower river. Population numbers have fallen to such low levels that hatcheries are now operated solely to maintain the Elwha Chinook salmon population while awaiting dam removal.

The Elwha Chinook population is believed to be comprised of two sub populations — an early and

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Photo of the Natures Enriched Rearing Environment Pond at the Lower Elwha Fish Hatchery. Photo courtesy Larry Ward, Fisheries Biologist.

a late returning run. Local residents recall that in the late 1940's and early 1950's, a significant run of fish arrived at the river prior to July 4th and a second run of fish arrived in mid-August.

An average of just over 1,350 fish is used each year for the hatchery program, while as many as 365 fish may die prior to spawning. This leaves about 1,300 fish to spawn naturally in the river. In recent years, total returns to the river and natural spawning escapements have fallen below normal levels, averaging just 2,050 fish and 740 fish respectively for the years 1999-2002.

Virtually no information is available to describe current or historical growth rate of the Chinook population in the Elwha River. However, it is known that the presence of hatchery-origin fish spawning in the wild can overwhelm any natural origin production in some years. In fact, the co-managers believe that the natural productivity of the river is variable-- that in some years, all fish returning to the river appear to be of hatchery origin, whereas in other years, tag data shows that as much as 50% of the returning fish could be of natural origin.

Bull trout

The upper and lower Elwha River bull trout populations represent 2 of the 34 subpopulations identified in the listing of the Coastal-Puget Sound population under the Endangered Species Act.

The Elwha River is considered a core area with one identified local population and a potential local population within the Little River. The lower Elwha River subpopulation of bull trout is rated "depressed" by USFWS. The status of the upper Elwha River subpopulation is unknown, though bull trout have been found in low numbers in Lake Aldwell, in several tributaries in the middle reaches of the Elwha River between the two dams, and in relatively high numbers above Lake Mills. Migratory bull trout are also believed to persist in the Elwha core area.

What are the key factors contributing to the current status of the populations?

Among the watershed's attributes that will contribute to recovery is the fact that about 83% of the Elwha River ecosystem is pristine and protected within the Olympic National Park's boundaries. Urban growth out of Port Angeles is not a major concern as the Urban Growth Area (UGA) is not being expanded. Where the population is likely to increase, mainly in the Little River and Indian Creek areas, the Clallam County Critical Areas Ordinance, other land use policies, and provisions contained in the WRIA 18 Watershed Plan are expected to protect critical habitat. Additionally, restoration activities are already occurring in the river below the Elwha Dam and are yielding positive results.

The largest factors limiting salmon recovery in the Elwha are the two dams blocking fish passage. Since 1911, the Elwha Dam has blocked anadromous fish passage to more than 70 miles of mainstem and tributary habitat in the watershed. In

1927, the Glines Canyon Dam was constructed 8.5 miles upstream of the Elwha Dam. Like the Elwha Dam, the Glines Canyon Dam was built without fish passage capability.

The construction of the Elwha Dam has blocked access of Elwha Chinook to 95% of their historic range. Further, it is believed that access to all areas previously utilized by the early run Chinook population has been eliminated. The habitat remaining below the dam is of generally poor quality, with only a small area of high quality habitat remaining.

In addition to blocking anadromous fish passage, the two dams on the Elwha River have interrupted the natural functions of the river ecosystem. Nearly 18 million cubic yards of sediment have been captured in the two reservoirs, affecting not only the lower river system but also the estuarine and nearshore environment both east and west of the river mouth. Recruitment of large woody debris has also been halted by the dams' restricting normal channel processes that create salmon habitat.

Finally, the two reservoirs serve as "heat sinks" during the summer, dramatically increasing water temperature downstream of the two hydroelectric projects. Consequently, the cumulative effects of the two dams have left the remaining accessible downstream habitat severely degraded.

In addition to the effects of the dams, development in the watershed has negatively impacted natural floodplain processes. Off channel habitat has been reduced through dikes, draining, tide gates, and bank hardening. Water diversions in the basin also contribute to low flow conditions that affect salmon spawning and rearing habitat, while high flow conditions cause scouring in mid-channel areas preferred by spawning Chinook, making conditions hazardous for newly deposited eggs. Water rights in the river currently exceed summer low flows, although the actual water use during the summer is only a small percentage of the water right claims. However, if these rights were fully utilized, it would have a devastating impact on the listed fish stocks in the river.

Overall Approach to Recovery

To recover Chinook to the Elwha River, efforts are primarily focused around the removal of the Elwha and Glines Canyon dams, which will restore salmon access to the upper watershed. Dam removal will not only allow for fish passage, but will also go a long way towards restoring the natural habitat-forming processes in the river.

Congress authorized removal of the dams in 1992, after the Elwha Klallam Tribe, local industry, environmental groups, and various agencies worked out a cooperative agreement for removing the hydroelectric dams. The decision came after several studies concluded that the removal of the dams offered the single best opportunity to restore salmon within the Elwha. Collaborative relationships at the agency/tribal policy and technical levels led to the development and formulation of environmental impact studies and plans to implement the restoration and recovery strategy. The agencies and tribes also worked to ensure the broader community understood and supported the protections offered during and pursuant to dam removal.

While dam removal and restoring access to the pristine habitat within the Olympic National Park is an important step in achieving salmon recovery, other strategies are needed to ensure that habitats outside the boundary of Olympic National Park are similarly protected and restored to maximize the benefits from dam removal.

The overall approach to recovery has been structured into six key habitat strategies and supporting actions for hatcheries and harvest detailed below. With the exception of the removal of the dams and associated actions occurring under the restoration act, habitat restoration projects identified below are funding dependent and/or rely on the cooperation of land owners.

Photo by Dan Kowalski

Key Strategies and Actions Supporting the Overall Approach to Recovery

Habitat Strategies

1. Restore access to the upper Elwha watershed

Fish access will be restored to the upper watershed by removing the Elwha and Glines Canyon Dams along the Elwha River. The dam removal actions are scheduled to begin in October, 2008. The removal of the two dams is the single most important step in restoring the Elwha Chinook population and will restore anadromous fish access to the upper watershed, allow for the natural habitat forming processes to occur through the natural accumulation and deposition of sediment and wood to the lower watershed and nearshore, and restore natural flow and temperature regimes to the river.

2. Protect existing functional habitat

Those areas of the river downstream of the Olympic National Park boundary are subjected to many deleterious habitat effects that need to be addressed in order for full restoration to occur. While the majority of the watershed is protected within Olympic National Park, the lower river is presently in poor shape for adult spawning and juvenile rearing.

It is intended that existing riparian corridors will be protected and/or restored, thus providing connectivity to Olympic National Park through land acquisitions, existing ownerships and/or private stewardship. A conservation-based land use management plan for Lake Aldwell properties will be implemented following dam removal. Existing regulatory protection measures will also be utilized, including Critical Areas Codes, the Forests and Fish Rules, the Department of Natural Resources Habitat Conservation Plan, the Federal Forest Plan, the Shorelines Protection Act, the State Hydraulics Code, the WRIA 18 Watershed Plan, and Tribal land use Regulations.

3. Restore the floodplain

Several constrictions exist between Olympic National Park and the river mouth. Seven features constrict the channel throughout this stretch of river and reduce the river's access to its floodplain. As

Photo courtesy the Washington State Salmon Recovery Funding Board

a result, the river channel is subjected to multiple sediment "scour and fill" events resulting in poor conditions for both adult spawning and juvenile fish rearing. To improve off channel habitat and flood-plain connectivity, it is recommended that dikes and gabions be removed or reconfigured.

4. Protect/restore estuaries and nearshore environments

Healthy estuarine and nearshore habitat is a critical component of the Chinook and bull trout life history. For Chinook, it is not unusual for newly emergent fry to migrate quickly downstream and take up residence within the estuary. When these fry vacate these areas in early June, the habitat is frequently utilized by fingerling Chinook smolts. These fry and smolts prefer tidal channels with low banks and many subtidal refugia.

Much of the Elwha estuary has been altered through diking and reduced sediment transport due to the construction of the Elwha dams. As the dams blocked sediments from moving down-stream, the river sediments coarsened and the delta at the river mouth was reduced. Additionally, the nearshore habitat east of the river mouth has steepened, and the sands and gravels have been replaced by cobbles and small boulders. The loss of sediment supply from the river has increased the need for bulk-heading and other hardening measures in order to protect human infrastructure from beach erosion.

Nearshore restoration/protection projects are expected to be implemented based on recommendations from the local Lead Entity (North Olympic Peninsula Lead Entity - NOPLE) Strategy and the Elwha Nearshore Workshop.

5. Conserve water and protect instream flow

Diversions from the river accentuate low flows, leading to less available functioning habitat. Although existing water rights in the Elwha watershed exceed summer low flows, the City of Port Angeles does not presently use the amount of water to which it is entitled under its water right. Were it to do so, instream flows would become a limiting factor. To address this, following dam removal and once the lower river stabilizes, a flow analysis will be conducted to establish those flows necessary to maintain fish production in the Elwha River. Additionally, other domestic and municipal water conservation projects and minimum stream flow requirements recommended in the WRIA 18 Watershed Plan are expected to be implemented.

6. Placement of Large Woody Debris

Large woody debris (LWD) provides a critical function in the river-forming processes necessary for healthy fish habitat. LWD helps maintain the distribution and frequency of flows, and provide shelter for fish. Without a healthy riparian forest in the lower river, large woody debris is typically not found naturally in the river. To remedy this, large woody debris will be strategically placed from the Elwha Dam to the river mouth, as well as in Indian Creek and Little River. Following dam removal, the mainstem channel above the Elwha Dam site will be evaluated to assess other large woody debris placement needs.

Hatchery Strategies

The hatchery program is focused on maintaining the integrity of the existing salmon gene pool during the dam removal period and through the subsequent periods of elevated sediment levels. It is anticipated that Chinook will immediately begin to recolonize the watershed at a predictable rate and that they will have fully recolonized the watershed in approximately 20-30 years. Following dam removal, the hatchery program will be managed to help maintain the population until there is sufficient habitat recovery to support healthy, natural production. The hatchery program is currently expected to phase out over a two cycle (~10 year) period following the removal of the dams.

Harvest Strategies

There are no fisheries currently targeting Elwha Chinook. The current moratorium will continue until monitoring data suggest that harvest can occur without impairing progress toward full recovery. Incidental harvest of Elwha Chinook from fisheries on other stocks and species is kept at an extremely low level (projected at less than 6% of the Elwha Chinook run within Washington and Oregon waters in 2004).

The timing of coho fisheries in the river and bay is currently managed to minimize incidental capture of Chinook adults during the fall. In the short term, during the period of dam removal (approximately 5 years), a moratorium on all in-river fisheries will be observed. In-river fisheries for any species will not reopen until it is clear through monitoring that the additional stress caused by fishing will not preclude recovery.

Adaptive Management

The National Park Service is the lead federal agency for implementation of the Elwha River Act. Following dam removal, federal, state and tribal policy and technical leads will continue to be engaged in monitoring and adaptive management activities.

The adaptive management plan identifies four monitoring objectives:

- Evaluate re-colonization by species (and/or genotype) and method of reintroduction through examination of rebuilding rates (production), and population size (abundance, spatial distribution and habitat utilization).
- Document the genetic structure and life history diversity of existing Elwha River fish populations - how it is affected by dam removal, sedimentation effects or hatchery practices through the life of the project, and how any changes affect the viability of the population
- Monitor fish health over time, space and method of reintroduction
- Document recovery of ecosystem processes over time and space. Ecosystem recovery includes freshwater, riparian, nearshore and terrestrial habitats.

A series of measurable hypotheses is provided for each monitoring objective, and research questions are provided for each hypothesis. A preliminary list of parameters, based on the hypotheses, is presented. The plan also includes a Monitoring Tool Kit to test the hypotheses. The Monitoring Tool Kit is portrayed in a table which identifies the tool, its applicability, area, and level of priority, i.e., the tool's importance to implementing the adaptive management component of the Fisheries Restoration Plan. Finally, a list of potential adaptive management actions for consideration has been developed for use should the monitoring effort indicate that the goals identified are not being achieved.

While monitoring efforts for the first three objectives focus on fish, the fourth objective-- ecosystem recovery -- follows changes in habitat from the reestablishment of dominant physical processes including sediment, woody debris, flow, nutrient transport and temperature regime in river habitats. Monitoring will include mainstem, side-channel and tributary sites grouped by similar physical features (gradient, confinement and location within the watershed). Nearshore and lower estuary habitat monitoring activities will include eroding and stable bluffs, sandy and rocky beaches, and pocket beaches that are grouped by geologic, biological parameters.

Results

The watershed plan for the Elwha was reviewed by the Puget Sound Technical Recovery Team (TRT: group of seven scientists) and an interagency committee facilitated by the Strategy Shared staff. The TRT reviewed the plan to determine the degree of certainty that the plan can achieve recovery goals. The conclusions of this analysis are below. For the most part, the issues identified below by the analysis are discussed in the watershed plan, but the reviewers felt they merited particular attention to increase the certainty of achieving plan outcomes. Where the analysis identified key uncertainties, proposals are included for consideration. If implemented along with the watershed plan's other actions, these proposals would increase the certainty of results and achieve the requirements for a recovery plan under the Endangered Species Act.

This plan represents a precedent-setting exercise for the nation and state in demonstrating such a strong commitment to restoring the quality of our environment at watershed scales. Removal of the two dams provides an important opportunity to understand and test ecosystem restoration and recovery. The most exciting prospect is the chance to bring back some of the biggest sized Chinook to the Puget Sound and to track the rate of salmon population responses to a major restoration project such as opening up pristine habitats behind dams.

The reviewers agree with the caution that the plan's authors and implementers express--to expect surprises. There is not much experience with these management actions at this scale, so there will undoubtedly be all kinds of results and consequences that no one could expect or anticipate. Describing how the hatchery supplementation program will be managed to hedge against uncertainties about how habitat recovery will proceed is key to the success of this plan.

Given the scope and size of this project, reviewers agree that a well crafted and implemented adaptive management and monitoring program is critical. The adaptive management and monitoring program outlined in the Elwha plan and technical feedback is an excellent step in the right direction; the plan's certainty will increase with further development of this piece into a full adaptive management and monitoring plan. Expectations for the development of the estuarine and nearshore habitats resulting from the removal of the dams are particularly uncertain, however, and need additional consideration.

The TRT has expressed strong concerns about how the historic and potential future harvest levels under the existing Chinook annex of the Pacific Salmon Treaty (most of which could occur through

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Photo courtesy the Washington State Salmon Recovery Funding Board

interception in Canadian and Alaska fisheries) are inconsistent with assumptions about the ability of the habitat to support sufficient productivity of the Elwha population to allow recovery to proceed. Specifically, it appears from the information presented that potential harvest levels under the existing annex may exceed the productivity likely to be exhibited by the Elwha population, given current and near-term habitat conditions. The TRT understands that the opportunity for change in the Pacific Salmon Treaty management process is not likely until the annex to the treaty is renewed and effective in 2009. While negotiators should take advantage to renegotiate lower harvest in 2009, it is also important to continue to evaluate population specific estimates of harvest impacts for the Elwha so that potential changes in migrational behavior and subsequent catch distribution resulting from dam removal can be monitored and assessed over time.

The Elwha Chinook population is a significant contribution to the overall viability of the ESU because of its geographic location at the edge of the ESU, and its historical structure and diversity types — the biggest Chinook this region has ever known.

It will be important to encourage local government involvement in protecting the lower river and estuarine habitats, since the existing plan focuses primarily on the ecological effects of dam removal and ecosystem restoration.

The review process also identified a number of issues and uncertainties that are common to many Puget Sound watersheds. Strategies to address these issues that are contained in this local watershed chapter are a good approach, based on the current state of scientific understanding. Nevertheless, because (1) these issues are very important to the success of watershed approaches to recovery and (2) the effects of some of these strategies on salmon populations at watershed scales are relatively untested, these issues deserve particular attention. Reducing the uncertainties in the issues below could come through local and/or regional inclusion in adaptive management and monitoring programs, regional or local pilot studies to explicitly test their effects, or through additional implementation actions. The complexities associated with these issues are discussed in the regional strategy section of this document or in the regional adaptive management and monitoring program. The "cross-watershed" issues identified are:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or, where they are included, to move them further along the integration continuum over time,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,
- The need to address water resources, both water quality and water quantity,
- The need to better link the effects of land use to habitat-forming processes and to habitat conditions. In turn, the effects of these changes in habitat, processes and landscapes on salmon populations need to be estimated,
- The need to develop or complete a robust adaptive management and monitoring program.

If the proposals above are implemented along with the watershed's proposed actions, this watershed and its Chinook population have the ability to achieve low risk status and will provide a critical contribution to the recovery of Puget Sound Chinook.

How does it all add up into one comprehensive plan?

The regional salmon recovery plan in Puget Sound represents a conservation effort whose scope and complexity are unparalleled for any listed species under the Endangered Species Act in the U.S. The magnitude and complexity of the issues facing the salmon in a region with 3.8 million people are magnified by the expected increase of 1.4 million additional people by 2020. However, the current scientific knowledge about the fish and environmental conditions they need, along with the many entities and governments working on habitat, hatcheries and harvest, make it possible to achieve recovery over time.

In the next ten years, measures to protect the fish and their habitats will be most important to reverse the declining trends. Habitat restoration, hatchery enhancements and developing strategies to integrate the "H's" is also needed to create significant gains in the productivity of the environment and the fish. This first implementation phase will also lead to more scientific understanding through adaptive management and monitoring. In the next phase, year eleven and beyond, responsible parties across the region will need to hone and improve their efforts for habitat restoration, H-Integration and other activities that can accelerate our ability to help the fish survive and thrive over the long term.

Due to the scope and complexity of designing recovery strategies for salmon in Puget Sound, there are significant uncertainties that need to be addressed to ultimately move the fish to a level where there is a negligible risk of extinction. The regional plan is designed to address the uncertainty inherent in such an endeavor in 3 important ways:

- Increase certainty in plan outcomes as much as possible.
- Acknowledge in a transparent way that some uncertainties remain — and identify approaches to address those uncertainties where possible.
- Design the regional strategy to hedge against inevitable surprises, preserve options, and make wise decisions in the face of uncertainty.

There are fourteen different watershed planning areas in Puget Sound plus the marine waters and they each are unique. Not surprisingly, different watershed planning groups identified different long-term and short-term goals and proposed different suites of actions to achieve those goals. Most watersheds presently containing

Chinook populations stated that they are striving over the long term to achieve low risk status for their listed fish. A key factor in evaluating the likelihood of recovery for the whole evolutionarily significant unit (ESU) in the Puget Sound region is the certainty that the strategies and actions in every watershed will be biologically effective in reversing declining trends and moving their populations toward recovery.

Consequently during the May 2005 review process, the Puget Sound Technical Recovery Team (TRT) and the Shared Strategy Work Group together discussed the level of certainty for achieving plan outcomes, identified issues that need to be dealt with in order to increase certainty, developed recommendations for how to address those issues, and assessed whether the combined local and regional plan elements will meet ESA recovery plan requirements.

The foundation for the review process was a technical analysis conducted by the TRT that focused on the scientific rationale underpinning strategies and actions identified in individual watershed plans (a written summary of the TRT technical rationale for the analyses and conclusions reached will be available later in the summer of 2005). The review assumed implementation — it did not evaluate the likelihood that strategies, actions or adaptive management would be implemented. Successful implementation will ultimately prove to be the most important determinant of success. Implementation commitments are not part of this regional plan, although there are several in the individual watershed chapters. Additional work on commitments will be carried out over the remainder of 2005.

The TRT and Work Group concluded that the Puget Sound Salmon Recovery Plan meets ESA section 4(f) requirements and the TRT recovery criteria (see below), and if implemented will put the region on a significant path toward recovery. The following summarizes the conclusions reached by the technical and policy reviewers.

How does this plan (combined watershed and regional components) meet ESA section 4(f) requirements?

In general, the Puget Sound Salmon Recovery Plan meets ESA §4(f) requirements as follows:

1. Objective, measurable criteria and goals are provided.
    a. The TRT developed ESU recovery criteria.
    b. All Puget Sound watersheds in this plan provided objective, measurable goals.
2. Site-specific strategies and suites of management actions tied to addressing key factors affecting the species are provided.
    a. Each watershed provided their own set of protection and restoration management strategies for specific sub-basins, river reaches, estuaries or nearshore areas tailored to the conditions of their watershed. As noted in the plan's watershed profiles (results and conclusions section), a regional review added recommendations to address specific issues to increase the certainty of achieving plan outcomes and contributing to overall ESU recovery.
    b. State and tribal co-managers provided management goals and actions for hatcheries and harvest in their respective watersheds. In most areas identified in the plan, there is more work to do to enhance or develop H-Integration strategies among the habitat, hatchery and harvest managers. A regional approach is recommended to enhance the integration at the individual watershed scale.
    c. There are a number of issues, like oil spills, that can only be effectively addressed at a regional scale. These are described in a regional strategy section of the plan. Regional strategies also address factors related to agriculture, forestry, and other land uses, the nearshore, water resource issues related to flows, assessing the effective-

ness of protection strategies and statewide co-manager strategies for harvest and hatchery management.

3. An implementation schedule is included in the regional plan. It describes strategies and actions most specifically for the first ten years of implementation. It identifies what will be needed beyond the first ten years in general terms but does not assign timeframes for specific actions over the longer term.
4. Cost estimates to carry out actions are provided in the financing strategy chapter of the regional document.
5. A chapter describing the key measures and elements of an adaptive management and monitoring program (AMM) is included in the regional document. Many watersheds have also included an AMM section in their plans. The implementation schedule calls for completing more detailed AMM frameworks at both local and regional levels by the end of 2005.

In general how does this plan, if implemented, increase the certainty that this region will start on a significant recovery path?

- By emphasizing the critical importance of protection strategies both to preserve existing ecological and biological functions, and to preserve options for restoration of habitat and salmon populations,
- By transparently identifying sources of uncertainty and recommending ways to reduce them,
- By highlighting the focus on actions needed early in the implementation phase to increase the certainty of their contribution to ESU recovery,
- Through the regional recovery criteria, which hedge against uncontrollable risks to populations by spreading the risk among five regions and where feasible, keeping options open at the outset for achieving long-term viability, and
- By developing an adaptive management and monitoring component that will track results and provide a path to modify the strategy as necessary (details of which are scheduled for completion by the end of this year).

How does this plan meet ESU recovery criteria?

As a reminder, the recovery criteria can be summarized as follows: The ESU will have a negligible risk of extinction if:

- All watersheds improve from current conditions, resulting in improving status for the fish.
- At least two to four Chinook populations in each of five bio-geographical regions of Puget Sound attain a low risk status over the long-term.
- At least one or more populations from major diversity groups historically present in each of the five Puget Sound regions attain a low risk status.

The May 2005 review by the TRT and Work Group of the Puget Sound watershed plans concluded that the plan meets the recovery criteria as follows:

All watersheds in all five regions need to improve from current conditions

All watershed plans contain strategies and actions that if implemented will improve the conditions in their basins.

Break-down by the five bio-geographical regions:

The five regions are the Nooksack, Whidbey Basin, Central/South Region, Hood Canal and the Elwha/Dungeness. To determine how well the plan meets ESU recovery criteria, the reviewers rolled up the analysis of the individual watershed plans into their respective regions. The conclusions from this roll-up analysis are summarized below.

Nooksack, Elwha/Dungeness and Hood Canal Regions

Three of the five bio-geographical regions have only two remaining Chinook populations within them. These are the Nooksack (includes the San Juan Islands), Elwha-Dungeness and Hood Canal regions. Both populations in each of these areas need to achieve low risk status over time to meet the ESU recovery criteria. Based on the materials provided by the watershed groups in these areas, the certainty of achieving low risk status in these areas is currently low because of the magnitude of change needed.

To increase the certainty of achieving ESU recovery criteria, the TRT and Work Group recommend that each watershed within these three regions of Puget Sound consider prioritizing or sequencing specific strategies within the next couple of years in their plans as described below. The reviewers assumed that each watershed's entire plan would be implemented over the long-term and that they would address recommendations from the review. However, certain priorities rose to the top for these three regions that the reviewers believe deserve early and focused attention:

- In the Nooksack, the proposed hatchery broodstock program for South Fork Chinook needs to be implemented immediately. Other priorities to address are habitat protection strategies and harvest by Canadian and Alaskan fisheries.
- In the Hood Canal, it is important to preserve future options for the Skokomish population, more fully integrate habitat, harvest and hatchery management for both Hood Canal populations, and coordinate the Chinook and summer chum plans.
- In the Dungeness basin, the priorities are to address high and low flows, and to integrate the hatchery and habitat actions. In the Elwha basin, the top priority is to develop and implement a robust adaptive management and monitoring program. In both the Elwha and Dungeness basins, harvest by Canadian and Alaskan fisheries needs to be addressed.

The Whidbey Basin and Central/South Regions

Two of the bio-geographical regions have multiple Chinook populations. The Whidbey Basin region, which includes the Skagit, Stillaguamish, Island and Snohomish watersheds, has ten remaining populations. The Central/South region, which includes the Lake Washington/Cedar/Sammamish, the Green/Duwamish, the Nisqually, East Kitsap, South Sound and the Puyallup/White watersheds, has six populations remaining. These two regions, therefore, have more choices (with the exception of the remaining early-run Chinook in the White river basin) as to which populations ultimately need to achieve a low risk status in order to meet ESU recovery criteria. The role these populations will play in ESU recovery will clarify after the first ten-year implementation phase, and will depend upon how well the first ten years of actions are implemented and on execution of a solid adaptive management and monitoring program.

The Whidbey Basin Region

In the Whidbey Basin region (Skagit, Island, Stillaguamish and Snohomish watersheds), the actions taken in the next ten years are likely to be the same whether the long-term watershed goals are aimed at improving from current conditions or achieving low risk status. Ultimately, at least one of the early returning Skagit populations plus at least one late run population from within the region will be needed to achieve low risk in order to meet ESU recovery objectives.

The Whidbey Basin needs to keep all its options open at this time to hedge against uncertainties in the other regions for achieving low risk populations such as the Nooksack, Hood Canal, Elwha/Dungeness and the White River populations. It is also

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likely that the Whidbey Basin populations historically were a core production area for the whole ESU. The TRT believes that restoring ecological processes in all four of the Whidbey Basin watersheds--as planned in the first ten years--will benefit all Puget Sound Chinook populations. From an ESU perspective, all of the watershed plans in this region will provide improved anadromous fish functioning in both fresh and salt water and improved estuarine and nearshore functions.

The reviewers identified priorities for Whidbey Basin watersheds to consider in the next ten years to make the most of this first phase to help their area and assist the ESU in getting on an aggressive recovery path. Again, as previously stated for the other regions, the assumption is that the entire suite of strategies and actions identified in the plans will be implemented, but that some issues, identified below, deserve a special focus.

- In the Skagit, there are six Chinook populations which each have an opportunity to achieve low risk status over time because of this watershed's relatively good ecological integrity and the chance to restore habitat-forming processes at the watershed scale. While all six populations are likely to benefit from the ten-year plan, the early-run populations are particularly important for ESU recovery. In the near term, the priority for the Skagit watershed is to ensure protection of existing habitat functions and initiate restoration efforts for the benefit of all Skagit populations.
- The Stillaguamish has two populations-the North Fork and South Fork. The watershed's goal is to achieve low risk for both populations, but there is low certainty, especially for the South Fork, of being able to achieve this status. This is due to the magnitude of changes needed to restore habitat-forming processes in the watershed. There is slightly more certainty for the North Fork population because of its somewhat better status and the likelihood that early habitat actions will produce the needed improvements. The populations in the Stillaguamish watershed provide connectivity and if the plan is implemented as stated, the improved watershed functions will help preserve recovery options for the Whidbey Basin. The top priorities for this watershed in the near-term are to address flows and to improve the connection with forest managers to address hydrology and sedimentation issues.
- The Snohomish provides the ESU with an opportunity to test the possibility of achieving low risk status for two populations in an urban and urbanizing area. One of the most important priorities for this watershed is to determine the results for fish from habitat protection actions. Aggressive habitat restoration planned in the next ten years will also increase the certainty in the plan's outcomes. For these reasons, the watershed is encouraged to rapidly implement their plan as described.

The Central/South Basin Region

The Central/South Basin (Lake Washington/Cedar/Sammamish, Green/Duwamish, East Kitsap, Nisqually, South Sound and the Puyallup/White watersheds) has the widest range of conditions compared to any of the other geographic regions in Puget Sound. The conditions range from the largely intact Nisqually River basin to the dramatically altered hydrology of the Lake Washington system. There is also a wide range within the more urban watersheds--conditions range from the nearly pristine upper areas of the Cedar and Green rivers to the most intense urban conditions of the lower Duwamish and Puyallup rivers through Seattle and Tacoma.

Each watershed in this region needs to make significant decisions as identified in their plans and from the May 2005 analysis before it will be possible to evaluate the likelihood of achieving long-term goals for this region's populations. In the meantime, to meet ESU criteria, all populations in this region have to at least improve from current conditions. From an ESU perspective, the watershed plans in this region will provide improved anadromous fish functioning in both fresh and salt water and improved estuarine and nearshore functions.

As with the other regions, the TRT and Work Group highlighted a near-term focus for each of the South/Central watersheds to increase the certainty of achieving their plan outcomes and fulfilling their contributions to the ESU.

- The Lake Washington/Cedar/Sammamish watershed has the largest human population in the state and the most altered "plumbing" system. From an ESU perspective, improving current conditions within the constraints of this watershed as planned will provide important ecological benefits to the ESU by increasing the ecological functions provided by anadromous fish. It also has the opportunity to preserve a lake-rearing Chinook diversity type, and provides a chance to test re-colonization as a recovery approach above the Landsburg Diversion dam.

  The near-term priorities for this watershed are to integrate the "H's" as soon as possible (agree on goals and address the Issaquah hatchery and Sammamish Basin and Cedar habitat issues). Also protection of the remaining habitat, and restoration efforts to protect the Cedar River Chinook population, as stated as a priority in their plan.

- The Green/Duwamish watershed is another highly altered river system in the Puget Sound region. It is dominated by a hatchery system whose main objective is to provide harvest opportunities. Currently the habitat conservation plan and hatchery and harvest management plans have not been integrated to increase the likelihood of recovery. This creates high uncertainty for the watershed's ability to achieve a low risk status for its Chinook population.

  The recommended near-term focus for this watershed is to protect and improve spawning and rearing in the middle watershed and reduce harm as the fish migrate through the lower reaches of the Duwamish River. In addition, to increase the chances of recovery, the watershed's managers will need to agree on goals and develop an H-Integration strategy. Meanwhile, improvement from current conditions will provide ecological services to the ESU by improving anadromous fish functions and contributing to the health of freshwater, estuarine and nearshore ecosystems.

- The White River Chinook is the only remaining early-run population in the South/Central region, and as such it needs to achieve low risk status over time to meet ESU recovery criteria. The certainty of achieving this status is low. Improving the current status of the Puyallup population will provide ecological services to the ESU by improving anadromous fish functions and contributing to the health of freshwater, estuarine and nearshore ecosystems. To increase certainty of achieving plan outcomes and ESU contributions, the identified priorities for both populations in this watershed include the need for habitat planners and co-managers to agree on goals, develop an H-Integration strategy, address flows, and secure restoration opportunities in the lower river and estuary.

- The Nisqually watershed has the best remaining ecological integrity relative to the other watersheds in this region, and their plan articulated the clearest path in this region for achieving low risk status for their population. For this reason, it has the greatest chance of achieving low risk for its population if the hatchery and harvest management strategies are managed in conjunction with the habitat strategy.

Watersheds without independent spawning populations

The remaining four watersheds not yet discussed (although they also reside within the above regions as indicated), do not have independent spawning populations. These watersheds are the San Juan Islands, Island County, East Kitsap and the South Sound. They support Chinook during several life stages. Their primary contribution to ESU recovery is to support current ecosystem functions and processes in their freshwater tributaries, and estuarine and nearshore environments.

The main priority for all four of these watersheds is to protect current habitat functions through existing strategies and to improve protection over time as more is learned about how fish use their waters and how ecosystem processes are supported by key estuarine and nearshore habitats. East Kitsap and South Sound watersheds, because of the hatcheries in those areas, would also improve the chances of ESU recovery by developing regional H-Integration strategies.

Conclusion

Upon completing their review of all the local watershed plans and regional (cross-watershed) elements, the TRT and Work Group concluded that the Puget Sound Salmon Recovery Plan is solid and credible. The reviewers are confident that the work done to date (combined local and regional) sits on a solid scientific foundation. Work scheduled for the next six months (completion of the local and regional adaptive management and monitoring plan and adding to implementation commitments,) and addressing the priorities identified above in the early implementation stages will increase the certainty of achieving desired results. If implemented, the policy and technical reviewers believe that this plan (combined local and regional elements) will put the region on a significant path towards salmon recovery.

CHAPTER 6

Regional Salmon Recovery Strategies

Regional Recovery Strategies: Introduction

"We are all in this boat, in the same watershed, together and the sooner we realize it the more progress we will make...we must work together across Puget Sound to make sure our efforts will add up to meet the biological goals set by the federal government for the ESU."

William D. Ruckelshaus

Site-specific strategies and suites of management actions to recover listed Chinook salmon in the Puget Sound Evolutionarily Significant Unit (ESU) are provided in the individual watershed chapters. These are summarized in the watershed profiles section of this document, and included in their entirety as submitted by local watershed groups in Volume II of this plan.

A key strength of this plan is that each watershed chapter is tailored to the particular conditions and needs of its area. Another key strength of this plan is that the 15 watershed and nearshore chapters create a composite result that meets the criteria for ESU recovery provided by the Puget Sound Technical Recovery Team (TRT).

In some cases as noted in the watershed profiles, the TRT identified additional factors or conditions that merit particular attention or additional effort to increase the certainty of achieving a watershed plan's outcomes and contribution to overall ESU recovery. A number of these issues, even if appropriately addressed at an individual watershed scale, are common to multiple watersheds and need both regional and local attention to resolve. Where a regional approach is needed in addition to a local approach to address these items, they are discussed in the regional strategies in this chapter or in the adaptive management and monitoring section (Chapter 7).

The strategies discussed in this chapter are not intended to replace actions or strategies identified within individual watershed plans. Together with the additional factors and conditions identified by the TRT, the watershed plans are considered to be based on the best available science for recovery in the individual watershed. The strategies in this chapter are intended to bolster and support watershed efforts by adding appropriate regional scale approaches or guidance. If there is a conflict between the recommendations of the regional strategies and the individual watershed chapters, the individual watershed chapters shall take precedence.

This chapter is organized as follows:

1. Regional habitat strategies

- Habitat protection
- Nearshore
- Water quality
- In-stream flows
- Forests and fish
- Farms and fish

2. Regional harvest management strategies

3. Regional hatchery management strategies

4. Integration of Habitat, Harvest and Hatchery Strategies and Actions

The essence of each strategy is summarized below for reference purposes, but the full discussion should be read to help understand the context and details of each approach:

Protection of Existing Physical Habitat and Habitat Forming Processes:

The regional approach to habitat protection is three-pronged. It capitalizes on existing resources and seeks to reduce known areas of uncertainty.

1. Improve certainty of results of the various protection efforts by conducting an analysis of the effects of existing programs on habitats and fish.
2. Improve existing regulatory and voluntary protection programs and continue implementation at the local, state and federal levels of government.
3. Coordinate regulatory and voluntary protection actions at the appropriate scale to ensure protection objectives are met.

Nearshore: Estuaries, Puget Sound and the Pacific Ocean Supporting Salmon Recovery:

The importance of the estuarine and marine environments are highlighted in this section. It presents a regional approach to protect and restore the Sound and shows the connection between watershed and regional efforts. There are major results, strategies, and actions for seven key factors. These are:

A. Protect key fresh- and saltwater processes and habitats from physical or biological disruptions.

B. Restore estuarine processes and habitat.

C. Restore marine shorelines (including freshwater inputs) outside major deltas.

D. Protect and restore fresh- and saltwater quality.

E. Protect and restore freshwater quantity.

F. Reduce the risk and damage from catastrophic events.

G. Reduce risk and damage from non-indigenous species and other changes to food webs.

Key ocean strategies are also included.

In-Stream Flow Protection and Enhancement:

There is a three part strategy to ensuring instream flows that support salmon recovery. This section describes:

- The schedule and approach for setting flows;
- The need and approach for improving the science that connects flows to salmon needs; and
- A ten year timeframe to achieve flows that support recovery.

Forests and Fish and Salmon Recovery:

The regional strategy for addressing forest factors related to salmon recovery seeks to increase coordination between forest managers and salmon recovery managers within existing regulatory frameworks by:

- Sharing lessons learned from monitoring and research activities.
- Requesting specific and strategic adaptive management projects for consideration by the Forest Practices Board.
- Communicating monitoring and research needs and the studies underway for habitat functions covered by Forests and Fish, and communicating about monitoring and research needs and programs that will be covered by others.

- Coordinating restoration efforts such as sequencing of fish passage barrier projects from the lower to the upper watershed.
- Working together on legislation and fundraising where mutually beneficial.
- Coordinating public education and outreach where mutually beneficial.
- Working together to help small forest land owners implement fish-friendly practices without undue economic hardship.

Proposal for the Prosperity of Farming and Salmon:

This proposal focuses on three initiatives, each with its own set of tools:

- Protecting & restoring fish habitat;
- Keeping farmland in farming; and
- Improving farming's bottom line.

The regional strategy assumes that existing regulatory protection mechanisms will continue to be applied and so this section focuses on bolstering the incentive-based approaches to help farmers help fish.

Regional harvest management strategy:

This section summarizes the overall harvest management strategy to ensure that fishery-related mortality will not impede the rebuilding of natural Puget Sound Chinook salmon populations, while maintaining consistency with treaty-reserved fishing rights and international agreements. The Harvest Management Component of the Comprehensive Chinook Management Plan (PSTT and WDFW, 2004) sets limits on annual fishery-related mortality through the establishment of harvest rate ceilings and thresholds of low Chinook abundance that trigger additional conservation measures.

Regional hatchery management strategy:

Strategies to reform hatchery programs have been underway for decades. The Puget Sound Salmon Management Plan in 1985 between state and tribal co-managers and the development of new stock transfer policies in 1991 fostered the use of local brood stocks and reduced the transfer of eggs and juveniles between watersheds. Recent reform efforts to modify hatchery structures and operations, and to emphasize the maintenance of genetic flow and diversity for natural populations are largely outlined in the Comprehensive Puget Sound Chinook resource Management Plan - Hatchery Component (WDFW and PSTT, 2004) and the associated 42 Hatchery Genetic Management Plans. This section summarizes these existing approaches.

Integration of Habitat, Harvest and Hatchery Strategies and Actions:

This section summarizes the need, guidance and existing approaches for developing strategies to integrate the three H's, and recommends next steps to move further down the integration continuum over time.

Habitat:

Protecting Existing Physical Habitat and Habitat Forming Processes

The purpose of this regional strategy on protection is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team. This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

"Puget Sound is like a large water bucket, full of habitat and life. Habitat losses are the holes in the bucket, and many small holes can eventually drain it. Restoration is the process of plugging the holes while protection is to prevent new holes from being formed, allowing the bucket to fill once again through natural processes."

Jacques White, The Nature Conservancy

Introduction

In the face of increased human population growth (projected at 1.4 million people by 2020) and the impact of ongoing land use activities, the ability to recover Chinook salmon can only occur through a combination of habitat restoration and protection. This recovery plan proposes substantial increases in the abundance, productivity, spatial distribution and diversity of existing Chinook populations to recover their health and ensure their long-term sustainability. Habitat restoration will ultimately be required to increase fish populations to naturally sustainable levels, but without protecting existing habitat functions, restoration will only stem or slow the decline.

Today's remaining Chinook populations depend on existing quality and quantity of salmon habitat in the Sound's fresh and marine waters. Any further reductions in habitat quality and quantity will require more restoration to achieve recovery goals. In other words, if the 'Puget Sound bucket' keeps on getting new holes, even while we plug old holes, we won't get very far toward achieving recovery goals. And eventually, given how ecosystems work, there can come a point when there are so many holes that the system can no longer be restored. Protection is needed at the individual habitat site as well as at the ecosystem scale to ensure the processes that create habitat continue to function.

tools through these efforts. However, the region is facing increased pressures from human population growth, escalating the urgency to protect habitat.

Protecting existing habitats is an on-going effort and will require coordinated action by many: governments that update and enforce environmental laws and issue land-use permits, individual property owners and other land managers. In the past couple of decades the focus has largely been on regulations. Enforcing and improving regulations is important, but it is also critical that all three tools — regulation, incentives and education — be used in a coordinated fashion to improve the overall results for fish and increase overall public and property owner support.

In their local plans, watersheds identified the various regulatory, conservation, incentive and educational programs in their areas to protect salmon habitats and the processes that create them. What is not clear is how these different tools combine to provide the level of protection needed for salmon recovery — that is, what are the expected results for fish from these programs?

As other parts of this plan point out, there have already been substantial reductions in the types, quality and amounts of salmon habitat, and this is one of the main factors affecting fish populations. The Puget Sound Technical Recovery Team finds that protecting existing habitat and the ecological processes that create it is the most important action needed in the short-term to increase the certainty of achieving plan outcomes. Protection must occur in both urban and rural areas if we are to ensure the long-term persistence of salmon in Puget Sound.

The Federal Government, Tribes, State of Washington and many local governments as well as private parties in Puget Sound have worked hard over the last three decades to protect the natural environment, including salmon habitat. There have been significant advances in the types of protection

Existing Protection Efforts

When one looks closely at a map of the Puget Sound region it shows the enormous effort over the last century to protect some of the unique and spectacular parts of this place. To preserve their ecological function, huge tracts of land were designated as national and state wilderness areas, parks and forest lands. These past actions have protected many of the upper elevations of the watersheds in Puget Sound, but there are also islands in the San Juan archipelago and important lowland areas in the same protected status.

In more recent times, this region has been fortunate to have many land trusts and private individuals take an active interest in conserving lands that provide key salmon habitat functions. Groups like The Nature Conservancy and Cascade Land Conservancy have purchased large tracts of forests, streams and marine shorelines to ensure permanent protection. As an example, Cascade Land Conservancy recently developed an innovative program to preserve working forest lands and increase salmon habitat protection for several thousand acres in the urban counties of King, Snohomish and Pierce. This kind of program is not a substitute for effective regulations but it has the potential to dramatically increase the long-term certainty of protecting resources in rural areas as well as protecting property rights and economic prosperity.

To address the impacts to salmon habitat from land development, the State, Tribes and local governments have developed and refined their regulatory programs since the early 1970's. Major environmental laws were enacted in the 1970's--the Growth Management Act, the Shorelines Management Act, the Water Resources Act and the Forest Practices Act (amended per the Forests and Fish agreement in 2002). These — combined with the State Hydraulics Code and local government regulatory programs — have improved many land and water use practices and reduced impacts on salmon habitat over the last several decades.

One of the primary tenets of the State's Growth Management Act and local regulatory programs is to encourage high density development in urban areas and protect the remaining environmental functions in rural areas through low density land use. Consequently, in most counties, 95% of future growth is planned to occur in the urban areas.

One protection element that is often overlooked is the contribution by private citizens as the land stewards. There are still many areas in Puget Sound along streams, rivers and marine shores that support salmon due in significant part to the care and action of these individuals. Many of these folks have a strong ethic for preserving both private property rights and taking responsibility for caring for their land — a responsibility they take seriously and often pass on from one generation to the next. Understanding these citizens' interests and concerns is a critical component of a successful protection strategy.

"Property owners have a lot at stake when it comes to protecting salmon in Puget Sound and we feel like we should be part of the process, but the only way we're going to get the biggest advantage is if government works closely together, cooperatively with property owners. The big stick of regulation will not take us where we want to go. Salmon are very important in our lives and so are property rights, and the long lived American dream of home ownership needs protecting."

Vivian Henderson, Executive Director,
Kitsap Alliance of Property Owners

Challenges and Results

The combined actions by private landowners, educators, conservation groups and governments have given the region a base of high quality habitat to build on for salmon recovery. The intended results from the combination of regulations, incentives and education is better protection of existing habitat but it is highly uncertain whether the results are sufficient. Many watersheds listed their regulatory programs and new protection proposals which will likely reduce impacts to the environment, but none of the watersheds were able to provide enough information to evaluate the level of protection that is being achieved in relationship to the habitat needed by salmon. This is understandably a difficult task because it requires an evaluation of the adequacy of the regulations as well as how they are administered and enforced.

Not knowing the degree to which protection mechanisms are effective is a key weakness. This is especially true given that scientists identified the protection of existing working habitat as an immediate short-term need to preserve options and increase the chance of success.

Under the Growth Management Act, the State requires local areas to protect existing ecological function as counties and cities permit new developments. To assist local governments, the State developed a best management practices manual and guidance document. However, there is no requirement for local governments to use the guidance document and most local governments find the recommendations too stringent to achieve public support. Even in the most restrictive local ordinances they are not achieving the state recommendations for elements like buffer widths on streams and wetlands.

It is clear from the region's experience with Growth Management and environmental regulations that these are highly controversial issues. Cumulative actions by many people in a watershed can add up to significant impacts. People working on these issues understand from science the interconnectedness of watershed systems and their susceptibility to land use changes throughout the entire watershed. It is insufficient to protect only to the stream's edge, for example, when the entire stream system needs to be taken into account. But while the science is clear about the impacts, it is less clear how they can be mitigated when land and water resources are developed.

Managing at a level that will protect habitat throughout a watershed from the headwaters to the Sound is politically difficult. Recent local government actions required by state law have left many property owners and developers and others trying to support our growing population, the people we need to be good stewards, angry and frustrated. Many property owners and developers manage their property in a way that does protect the greater good on their own.

Regulations are not intending to "punish" good land stewards, rather they are intended to provide certainty that in the future, if and when land ownership changes hands or owners change their use, the land will continue to be managed in a manner that does not adversely impact the environment.

The line between private property rights and the rights of the public trust is difficult to draw, and often seems to be as interconnected as the watershed

system itself. But perhaps this is exactly the place to start – asking: *How much burden on landowners is too much? How much impact on public resources is too much?* To complicate these questions, Native American Tribes in the Puget Sound region have property rights to the salmon themselves, and the right to harvest fish guaranteed by treaties with the United States government.

Protecting private property rights must be balanced with the need to protect public resources. Both are important. A dialogue that begins to bridge the needs of private property owners with the needs of the public resources, and moves beyond the mostly polarized responses of recent times, would help interested parties find solutions not otherwise apparent.

Conservation groups, environmental organizations and government agencies have tried to address some of the challenges posed for private property owners and developers through financial compensation and education initiatives. Incentives like the Public Benefit Rating System provide property owners with tax breaks for conservation efforts. Educating land owners helps them understand how to take care of and use their property in a manner that reduces or eliminates environmental harm. All of these programs are helpful and important. But as with regulatory programs, it is unclear whether or not they provide results sufficient to protect existing salmon habitat, especially given the intensive growth pressure in the next twenty years.

Finding the appropriate balance for using all the available tools, both voluntary and regulatory, may be one of the greatest challenges in securing the protection needed. If we all assume that most people in the region generally desire to take care of the natural environment, what sort of education would be most effective and useful? What incentives would encourage landowners and developers to take good care of the environment we enjoy? What types of regulation are needed? Where is regulation the most appropriate and the most effective? How can these tools be applied across landscapes, political boundaries, land uses, and habitats so that they make sense to the individual property owner and address the cumulative impact of many actions in a watershed?

"...one of the things in terms of salmon recovery, and being smart about conservation is that you engage folks that live here in dialogue.... Starting at the grassroots, with people living in their neighborhoods and their communities, along the Cedar, in Bear Creek around Lake Washington...We found they were ready to respond, that they did care about this place and the more they learned about what was happening to salmon the more they wanted to step up and do something about it."

Larry Phillips, Chair, King County Council (D)

"As Larry says ....if citizens are with you and they understand what is going on, then that is what empowers people who have the responsibility for deciding how much money to spend and where to spend it, that empowers them to go ahead and say yes we can do this... but you wouldn't get anywhere without the citizens with you."

Louise Miller,
former King County Councilmember (R)

Principles for Protection

To achieve salmon recovery we need a common level of certainty for protection across the region. In each situation, decisions must be made as to whether to protect through regulatory or non-regulatory means, and how this protection is to be implemented.

In considering how to balance the variety of regulatory and incentive-based tools to increase the level of protection and public support, the following principles are recommended as this plan is implemented:

1. Protect existing environmental functions in both urban and rural areas using the array of protection tools available.

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2. All governments and property owners share in the responsibility of protecting existing environmental functions.
3. Environmental regulations should provide a basic level of protection for habitat but also be flexible to adjust to local environmental conditions based on science.
4. Property owners should be recognized for good stewardship. Land values, taxes and incentives should support good stewardship and appropriately recognize the economic limitations created by regulations.
5. Focus landowner education programs specifically on the need for protection in their area.
6. To the extent feasible and practical, involve individuals, groups and entities with a stake in the outcome when developing environmental regulations.

Regional Strategy for Increasing the Certainty and Level of Protection

The regional approach to habitat protection is three-pronged. It capitalizes on existing resources and seeks to reduce known areas of uncertainty.

1. Improve certainty of results of the various protection efforts by conducting an analysis of the effects of existing programs on habitats and fish.
2. Improve existing regulatory and voluntary protection programs and continue implementation at the local, state and federal levels of government.
3. Coordinate regulatory and voluntary protection actions at the appropriate scale to ensure protection objectives are met.

Assess the effectiveness of combined protection efforts on habitats and fish results

Currently there is much uncertainty at the local and regional levels as to whether current regulatory and incentive programs adequately protect existing salmon habitats and habitat functions. No one has yet done an analysis to specifically determine the effect of protection measures on habitat and Viable Salmon Population (VSP) parameters (Are there gaps in the predicted and observed effects?) Reasons for this uncertainty include:

1. Many of the regulatory programs are relatively new or recently improved.
2. Most regulations take a blanket approach to protection and are not often tailored to the unique characteristics of an individual parcel or the broader cumulative needs of the watershed.
3. Variances are granted and mitigated at a site-specific scale, which has the potential to cause, over time, significant losses to habitats and the processes that support salmon.
4. Areas in Puget Sound were platted prior to existing regulations, which limits their ability to meet new standards.

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5. Incentive, voluntary and educational programs have not always been intentionally designed to complement regulatory programs.

Current programs must be assessed for their individual and combined results. This strategy recommends a pilot study in several counties or cities that clarifies expected long-term results of the suite of protection programs and identifies any gaps relative to salmon population and ESU recovery needs. Specifically, the pilot programs would explore the certainty with which the combination of protection programs:

1. Prevent negative cumulative impacts,
2. Protects both habitats and the processes that create and maintain them,
3. Links fresh and saltwater processes,
4. Addresses impacts from recreation in already protected areas, and
5. Ensures unique salmon needs (e.g., timing variation or life-stages served) are protected as described in the watershed chapters.

If gaps are identified in the protection needed for salmon, responsible parties and interested groups in the pilot study areas would determine and recommend a combination of locally-agreed-to voluntary, incentive and regulatory solutions. Scientists and permitting agencies would likely need to collaborate to develop new tools to indicate the level of protection needed in specific areas.

An analysis of the pilot studies should determine if any of the identified gaps appear to be similar across Puget Sound. It will be important to ensure that the scale of analysis is consistent with ecological needs in addition to jurisdictional responsibilities.

Improve and implement existing protection programs.

A strong set of regulatory and voluntary protection programs have to be consistently implemented, improved and updated based on new information and ideas on how to address the threats from human population growth, re-development and on-going land-use activities and practices.

Implement existing educational and incentive-based programs; seek new voluntary approaches

A large percentage of Puget Sound shorelines are in private ownership. Thus, protection efforts rely upon the knowledge and good stewardship of individuals taking individual actions. Education of government people by private landowners and developers can create an understanding of the constraints and opportunities for stewardship. Education of landowners about the salmon needs specifically in their area can help them see how their actions affect the fish. Education and voluntary/incentive-based programs should be continued and improved to target specific areas for protecting existing habitats and processes important for salmon recovery. New information from this recovery plan and subsequent improvements to the watershed strategies should be incorporated over time to set protection priorities.

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Unique Opportunity to Coordinate Salmon Recovery and Growth Management

Currently in the Puget Sound, there is a unique opportunity for counties and cities to refine protective measures for wetlands, critical aquifer recharge areas, frequently flooded areas, geologically hazardous areas, and fish and wildlife conservation areas that are consistent with our science to date. As required by state law, all Puget Sound counties and cities planning under GMA will be required to update their Critical Areas Ordinances (CAO) by December 2005. Some were due December 2004, but to date, only 9% of the entities that were required to complete their update in 2004 have done so. Many of them are moving forward to take action this year.

In addition, cities and counties in the Puget Sound region will be updating their Shoreline Management Master Programs (SMP) between now and 2012 to incorporate the new state Shoreline Guidelines.

This timing provides an unparalleled opportunity to coordinate SMP and CAO updates with salmon recovery. The recovery plan (especially the local watershed chapters) can serve as the Best Available Science for these updates. Local governments simultaneously have the opportunity to coordinate their stormwater manual, clearing and grading, and zoning programs with these updates. CAO's provide a minimum level of certainty that key habitats are protected throughout the entire region. Such regulations lessen the cumulative negative impacts from multiple developments and land management actions across an entire watershed.

Coordinate voluntary and regulatory protection actions at the appropriate scale

Success for salmon recovery requires that all of the interests work efficiently and effectively to produce a collective result for salmon and people. There needs to be a regional effort working with all the different parties involved with both voluntary and regulatory habitat protection to better develop ways to integrate all efforts in each watershed for a cumulative result. For example, for key habitat areas identified in a watershed plan that need protection, a coordinated plan could be put together among local government entities, conservation organizations, and affected citizens. Such a plan would clearly identify what is already in protected status, what more is needed and the best balance of protection tools to achieve the desired level of protection in priority areas. To succeed, developing this coordinated approach will require the parties involved to share information, learn from each other, and be willing to engage in a search for creative solutions.

In summary

The Puget Sound region is growing. We need to advance and build upon our successes, and create a dialogue to forge new solutions to the challenging problems related to environmental protection. The land use structure that we put in place now can ensure that people and salmon coexist into the future. The timing now is crucial - Critical Area Ordinance updates, Shoreline Master Program updates, conservation, incentive and education programs have the potential to all come together and provide effective and fair protections for salmon habitats, our watersheds, and our future.

Habitat:

Estuaries, Puget Sound and the Pacific Ocean: Supporting Salmon Recovery

The purpose of this regional strategy on estuaries and the marine environment is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team. This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

"My tribe has not fished for Skagit Spring Chinook for over 30 years. I hope some Memorial Day in the future I can stop at my farmer friend Dave Hedlin's home, and trade stories about who caught the biggest fish for the family dinner."

Brian Cladoosby, Chairman, Swinomish Tribe.

I. Introduction and context

Salmon are born in freshwater, migrate thousands of miles to the northern Pacific ocean, then return to the same stream where they were born. All twenty-two populations of Chinook salmon remaining in Puget Sound, fourteen core populations of bull trout, and Hood Canal summer chum use saltwater environments for their growth and survival. In fact the majority of their lives are spent in these places.

However, people and organizations working on salmon recovery only recently have focused on the needs of the fish in these marine environments. It is imperative that the estuaries, Puget Sound, and the ocean be treated together with freshwater environments as one interconnected system that must be protected and restored. Salmon populations mix in these environments and the fish depend on each part of the ecosystem to function successfully for their survival.

Compared to the marine environments, rivers are simpler and more contained. In the freshwater, it is relatively easier to measure where the fish go, the number that survive, and the conditions that support their health. All of these things are more complex and complicated in Puget Sound and the Pacific Ocean. Those planning in the freshwater systems are unable to ensure the viability of their populations unless the impacts on the health and function of Puget Sound and the ocean are also addressed.

People in this region care about the health of the marine environment. Government organizations like the Puget Sound Action Team and private groups like People for Puget Sound have invested several decades of time and money in actions for the health of the Sound. It has been known for a while that estuaries, shorelines and the deeper waters of the Sound play a role in the lives of salmon. More recently scientists at the federal, tribal, state and local level have discovered more about which places salmon prefer, when they are in these special places, and how the fish are affected by the quality of those habitats. The amount of such information has been growing, and now it is starting to find its way to groups working to restore salmon runs. We can now better answer the questions: Are we protecting the right places? Are we restoring enough habitats to achieve the recovery goals for the Puget Sound salmon?

Photo by Dan Kowalski

This section of the plan provides answers to these questions to the extent possible at this point and identifies where more information is needed. It identifies the factors affecting the current status of Chinook populations as well as the results, strategies and major actions needed in the marine environment for the fish. The information in this section complements the work by local watershed groups and the Nearshore chapter of this plan prepared by the Puget Sound Action Team.

The watershed chapters provide additional information on local protection efforts and initial restoration ideas in estuarine and nearshore habitats. The Nearshore chapter written by PSAT provides the scientific foundation for how salmon use the marine environment of Puget Sound. The Nearshore Chapter also divides the marine environment into eleven sub-basins because a consistent set of objectives and strategies at the sub-basin scale are needed as well as more specific ideas for recovery actions. In the near future, the specific ideas for protection and restoration in the watershed and Nearshore Chapters need to be refined to be consistent with the regional strategies in this section. This will increase the certainty of investments and results for the fish.

The following sections are organized to define the critical components needed in the marine environment for Chinook. The first sections-The People and The Place, Goals, Status of the Populations, and Factors Contributing to the Current Status-paint a picture of the situation at hand. This section also includes discussion of the overall approach, strategies and actions that build on the opportunities and challenges delineated before. The next section lays out the significant changes that can be implemented immediately, and the last section describes the results that can be expected from the implementation of these strategies and actions.

II. The People, The Place

As long as human beings have lived in the Puget Sound region, people have lived along the shorelines where rivers meet the saltwater. The first peoples of this place chose well. They inhabited the

Photo by Dan Kowalski

the decades, there has been a mental shift in how the Sound is viewed---in addition to seeing it as a place for industry, it is also appreciated for its special beauty, recreation and living. Where else can one leave a city of 500,000 people, board a ferry and see Orcas, porpoises, and bald eagles? A place where people go crabbing in the San Juans, fishing for salmon off of Whidbey Island, clamming in South Sound and kayaking along timbered shorelines?

rich deltas of the major river systems, the shorelines for valuable food sources, and the protected bays and inlets, which sheltered them from harsh winter storms. For thousands of years, these people lived here, with the salmon, in a dance of seasonal survival. Like the salmon they revere, the Native Americans of this region chose the places that allowed them to thrive, rather than merely survive.

200 years ago, explorers and traders came to this bountiful place. They were also drawn to the broad, flat expanses of the major deltas of Puget Sound, where rivers and tides collided, and rich soil formed from flooding. Crops grew and farm animals thrived. People found refuge in the calm waters of protected bays. The shoreline edge was a place to be tamed for commerce. Estuaries were diked and drained, ports were developed, and industries used the edge of the land and sea to move goods as well as get rid of their waste products. For many years the marine shorelines and deeper waters of Puget Sound were viewed as places to serve the industry and less for their environmental value and natural beauty.

Now, almost four million people live in this region. Our interaction with the 2,500 miles of beach and cliff edges that ring Puget Sound is more dramatic than the twenty-foot tides that rise and fall naturally. With the influx of more people over

Sadly, many of the salmon species who course the marine waters are no longer thriving. In fact, several are struggling to survive. This place of bounty and beauty is changing. We must work together to determine the future of Puget Sound. What will the shorelines, the deltas, and marine waters look like in the future? Will we be able to create a place that meets the needs of both fish and people?

We propose that it is possible with the recommendations that follow and a commitment to implement them.

III. Status and Goals for Salmon in the Marine Environment

Puget Sound Chinook have suffered from the changes in their environment as well as from past harvest and hatchery management. As mentioned in Chapter 2, one third of the over 30 original populations of Chinook have been lost. Of the 22 remaining, several are mixed with hatchery fish. The healthiest of the remaining populations, those in the Skagit River basin, are only at 50% of their historical abundance. Most of the others are less than 10 % of their historical numbers, and some have less than two hundred fish returning annually. Historic records indicate there may have been as

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many as 600,000 wild Chinook returning annually to Puget Sound rivers in the late 1800s.

The salmon recovery goal for the marine environment is the same as that for the whole Puget Sound ecosystem: naturally self- sustaining populations at harvestable levels. It is also the goal to support recovered populations of bull trout. This plan is focused on Chinook recovery. Specific actions needed for summer Chum and bull trout are addressed in their separate recovery plans. In reaching for these goals, attention must be given to the other species of salmon using the marine environment, of both wild and hatchery origin. It is also important to ensure that efforts for salmon fit into the larger, ecosystem restoration needed for the marine environment to support all species of life indigenous to the Sound.

IV. Key Factors Contributing to the Current Status of the Populations

Despite the goodwill and resources put into Puget Sound over the last three decades, estuaries, shorelines and marine waters remain significantly changed from their historic conditions. The loss of habitat functions for fish associated with these changes is believed to be one of the major causes for the decline of Chinook populations. There are other signs that these alterations are a significant concern. Declines in bird populations, the "dead zones" in Hood Canal and the recent listing of Orcas, in addition to salmon, are all signs that recovery actions are necessary in Puget Sound. It will take more than the current efforts to restore the health of salmon and other species.

One of the most significant changes to saltwater areas has occurred in the major river deltas of Puget Sound. Seventy-three percent of the estuarine wetland habitats in these deltas have been eliminated. The Green-Duwamish for example has suffered the greatest losses, with over 99% of their estuarine habitats lost. This loss of habitats is often so extensive that it has resulted in degradation of what little ecological function is provided in the remaining estuarine landscape.

Alteration of flows in major rivers compounds the physical losses of estuarine habitat. Lower flows reaching the remaining estuary habitats can contribute to high temperatures that are not tolerable for estuarine inhabitants. Also, upstream changes alter the amount and timing of water, sediment and wood delivery--processes that are critical to the function of the downstream estuary and nearby shorelines. Dams like those on the Green, Skokomish, Elwha, and Skagit rivers hold back sediment important to processes downstream and nourishment of shoreline beaches. One of the most dramatic alterations to rivers occurred early in the 1900's, when Lake Washington and its tributaries were diverted from the Green River and redirected out the newly created Ship Canal and the Ballard Locks. The Black River disappeared as a result of this major re-plumbing.

The marine shorelines have also seen changes over the last two hundred years. Hardening of shoreline beaches and bluffs, filling of wetland and tidal marsh areas, addition of over-water structures such as docks and marinas, and loss of marine riparian vegetation are but a few examples of the modifications that have occurred.

A significant portion of shoreline trees and vegetation has been removed, which once provided shade and habitat for insects eaten by juvenile fish. Approximately thirty-three percent of Puget Sound shorelines have been filled and armored by concrete or rocks, mostly to protect single family homes. There are over 3,500 docks and piers, 29,000 small boat slips, and 700 large ship slips. These structures change how the ecosystem functions. Combined, these changes affect migration corridors, transition of the fish from fresh to salt water, their eating habitats, and their ability to forage and seek refuge from predators.

In addition to the importance of physical habitat, water quality plays a big role in the robustness of salmon populations. Contamination of water and sediments can be harmful and in extreme cases, lethal for the fish. There have been tremendous improvements to the treatment of urban wastewater, and some of the most toxic marine sediments have been cleaned up. Improvements for septic tanks are starting to be addressed which is important as there are an estimated 500,000 on-site sewage systems in Puget Sound that vary greatly in the quality of the effluent they are discharging.

In addition to commonly known water quality concerns there are new concerns about chemicals--like caffeine--that are not treated by wastewater facilities and have even less understood impacts on the ecosystem. Nutrient loading contributed by the Skagit and Snohomish rivers contributes 50% of the total load in Puget Sound. While functioning marine systems require a balance of nutrients and sediment loads, such nutrient loadings may, combined with other factors, lead to low dissolved oxygen levels and increased stress on nearshore organisms. In addition to added nutrients, the number of gallons of oil spilled in Puget Sound has increased since 2001.

Hatchery releases, harvest activities, fish aquaculture, shellfish aquaculture and introduction of exotic species have also altered salmon populations and marine communities. Changes to salmon and the marine communities of which they are a part may affect the availability of food, opportunities for rearing, and exposure to predation.

Approximately 100 state, tribal and federal hatcheries exist in Puget Sound and release millions of juvenile Pacific salmon and steelhead into Puget Sound. The impact of these releases on wild populations of salmon in Puget Sound is currently not known. In 2001, ten commercial net-pen salmon farms were identified in Puget Sound. Concerns associated with net pens are the potential release of non-native species and water quality impacts. Shellfish operations also have the potential to impact eelgrass meadows and water quality.

Tributaries that drain directly into Puget Sound are an important component of salmon recovery as they can provide freshwater inputs that assist in the transition from freshwater to saltwater and provide additional rearing areas, food inputs, and refuge for salmon. Urbanization of the watersheds containing these tributaries affects the hydrologic, riparian, and sediment functions they provide. These changes have the potential to affect salmon viability across the ESU.

Non-native plants and animals have been introduced to Puget Sound and have the potential to significantly alter habitats and biological communities in a manner that may impact salmon. Loss of mudflats, eelgrass meadows and macroalgae negatively impacts fish foraging and rearing in these areas.

Even with all the changes to the estuaries, shorelines and marine waters, Puget Sound still supports significant numbers of salmon. There are many areas, like Vashon-Murray Islands and the San Juans, which still retain most of their original ecological function intact. There are over 400 miles of shoreline containing trees and overhanging vegetation, and stretches of beaches that are not armored and support spawning herring and other food fish for salmon.

As in the freshwater basins, the challenge facing those designing recovery strategies for Puget Sound is how to build upon what ecological function remains and bolster the ecological services the ecosystem provides through well-conceived protection and restoration approaches.

V. Overall Approach To Salmon Recovery In Puget Sound And Ocean

Providing for the long-term persistence of salmon species requires we complement the needs of salmon and the environmental processes that form their habitat with our human needs. This is no simple task when dealing with environments as complex as Puget Sound. Fortunately, we understand many of the environmental processes as well as what maintains their functions, and we have an existing social infrastructure to build on for protection and restoration of these habitats. We also continue to learn more about how salmon use estuarine and marine habitats For instance, we

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Photo by Dan Kowalski

are still learning about the overall capacity of Puget Sound to support its food web. Continued learning will increase our certainty of how salmon might respond to some actions. We must act now where we do have certainty of results and where we are uncertain we must be aggressive in preserving options.

The basic approach to marine habitat issues for salmon is to answer three questions: (1) Are we protecting the right places? (2) Are we restoring enough habitats to achieve the recovery goals for the Puget Sound salmon? and (3) Since people are responsible for the major impacts to habitat, how can we act in a manner that works for the needs of both fish and people?

"Are we protecting the right places?"

To answer the first question it is necessary to define the "right" places and then understand if "enough" of them exist or can be restored. "The right places" are a combination of key habitats that provide important functions to fish, and the processes that create and maintain those habitat types. For example, in some cases key habitats might serve to provide migratory pathways for salmon moving from early rearing estuaries to feeding grounds further away from their home river basins.

Part of identifying the 'right' places is understanding how salmon use different habitats at different times in their life cycle. Chinook salmon are incredibly diverse in how they navigate freshwater, estuarine and marine waters throughout their lives. One way this diversity is represented is in the multiple ways in which salmon transition from the freshwater environment to saltwater. These transition strategies are important because there is a strong correlation between the size of a fish and the types of habitats that it can access and use.

Chinook move downstream from their spawning areas anytime from shortly after emerging from the gravel to over a year later. Some fish rear for extended periods in the delta of their birth river, and others move rapidly through the estuary into either deeper marine waters or to pocket estuaries situated close to the delta of origin. Small fish tend to stay in shallower waters and travel shorter distances than larger fish that can inhabit both shallow and deeper waters.

It is not enough, however, to simply identify specific habitats for protection and restoration. Habitats are reliant upon a larger infrastructure for their success. Scientists call this larger infrastructure 'ecosystem processes'. Habitats are maintained by processes that deliver sediments, water or organic

Photo by Dan Kowalski

material at the right time, in the right quantity, and of the right quality. Puget Sound salmon need estuarine, marine and shoreline habitats and processes that support them in locations that allow for the full representation of their historic diversity. This means habitats must support the full range of fish sizes and needs as they swim into the saltwater.

The following list identifies those habitats and processes where (based on what we now know) it is critical to support salmon recovery.

Key Habitats:

- shallow, low gradient regions along marine shorelines including eelgrass meadows and pocket estuaries in close proximity to natal deltas
- marine and estuarine riparian areas
- natal estuaries
- spawning areas and critical rearing and migration habitats for forage fish
- freshwater inputs where the quantity and quality of freshwater sources have a direct effect on nearshore habitats and processes

Key Processes:

Area-wide

- biological processes (riparian areas, large wood, food web)

Nearshore littoral habitats

- drift cell processes (including sediment supply, transport and deposition) that create and maintain nearshore habitat features such as spits, lagoons, bays and beaches
- oceanographic water transport processes (freshwater, tidal, wave and physio-chemical properties)

Estuarine habitats (for all scales of estuary sub-systems from major river deltas to micro-estuaries)

- fluvial process inputs (including water, LWD, and sediment supply, transport and deposition) that help create and maintain estuarine habitat

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features such as distributary and dendritic channels, mudflats, and emergent marshes.

- physio-chemical processes that also help create and maintain estuarine habitat features such as salinity gradients and turbidity maxima.
- water transport processes (freshwater, tidal, wave)

In addition to this general list of habitats and processes, the Nearshore Chapter divides Puget Sound, the Georgia Straits and the Straits of Juan de Fuca into eleven sub-basins based on marine topography, terrestrial eco-regions and the major diversity units of Puget Sound Chinook. In each sub-basin, there is information on key habitats and processes and more specific recommendations for protection and restoration.

How do we know what is "enough" habitat to recover salmon in the marine environment?

Ocean cycles and marine and freshwater ecosystems change naturally with time. It is well documented that the functions of Puget Sound and the oceans have changed significantly from historical conditions. However, understanding what is enough to support salmon viability is a complex task. Interactions between hatchery and wild fish, competition with other species of salmon, changes in survival rates as communities of predators and prey rise and fall, and food web complexities are but a few of the components that must be explored to determine how much habitat function is needed in the marine environment for salmon recovery. Although it is important to ask this question and continue working to refine the answers, waiting for a complete answer is not an approach that preserves options for the fish. We have sufficient information now to begin improving conditions for fish.

Implementing the recommendations in the following sections significantly increases salmon habitat in a number of the major estuaries of Puget Sound, improvements to water quality, and other results that will enhance the chances that salmon in Puget Sound will recover. Monitoring the results of these actions will help us to understand where to continue or how to adjust our efforts to achieve recovery.

"How do we develop and implement solutions that work for fish and people?"

Much of the marine shoreline (and tidelands) in Puget Sound is owned by private citizens. Both protection and restoration actions will require the support of these land owners to be successful. Gaining certainty for the actions needed and landowner support will require a suite of regulatory, voluntary, educational, and incentive programs that act in concert. It will require a tailored approach to each community that is best implemented by local and watershed groups.

There are other human-caused impacts on the Puget Sound ecosystem. These include maintenance and further development of commercial and recreational marine transportation facilities and associated vessel traffic, harvest of salmon and other marine species, hatchery practices, delivery of freshwater flows, public access to marine shorelines and estuaries, land-uses on publicly and privately owned aquatic lands and discharge of wastewater and stormwater. These activities need to be balanced with the degree of ecological function that the estuarine and nearshore environments need to provide for salmon recovery.

"I think there is a connection between salmon and people; if we can't take care of our environment then we can't take care of ourselves"

Julia Kowalski,
Bainbridge Island High School Student.

VI Necessary Results For Recovery: Strategies And Actions

The following section describes seven key results this recovery plan must provide for Puget Sound's marine environments to support recovery of the

Chinook ESU. Strategies and actions, including timeframes for their implementation are described below each result. The results needed for Puget Sound marine environments are:

A. Protection of key habitats and freshwater and saltwater processes from physical or biological disruptions

B. Creation of additional estuarine habitat and processes in the major river deltas

C. Restoration of marine shorelines (including freshwater inputs) outside of major deltas where there is a significant benefit for population/ESU viability

D. Protection and restoration of fresh- and saltwater quality

E. Protection and restoration of freshwater quantity

F. Reduction of the risk and damage from catastrophic events

G. Reduction of the risk and damage from non-indigenous species and other alterations to food webs.

To achieve these necessary results, the strategies and actions below must ensure that protection and restoration programs (regulatory, educational, voluntary) match the value, desired function and sensitivity of an area to threats. The existing management programs in Puget Sound were not designed with salmon recovery in mind, and as a result, they do not easily accommodate analyses of effects at an appropriate scale. For this reason, additional analyses at broader geographic scales, and technical work to estimate the effects of these strategies and actions on salmon will likely be a necessary component of implementing most actions.

A. Protection of key habitats and freshwater and saltwater processes from physical or biological disruptions.

Puget Sound still has acres of eelgrass meadows and kelp forests, stretches of forage fish spawning beaches, over 400 miles of forested shorelines, and a number of estuarine habitats with productive tidal marshes and distributary channels. Where these areas exist, they support a functioning system for fish. The main threat to these existing habitats is impacts from land development and on-going human activities, which are discussed in this section. Catastrophic events, water quality, water quantity and non-indigenous species and other food web alterations are covered under separate strategies.

There have been significant protection programs developed at the local, state, tribal and federal levels that reduce the impacts from development. These programs include regulatory as well as voluntary and incentive-based approaches. Each watershed chapter describes the local efforts for protection. The Nearshore Chapter of this Plan summarizes the important regional and federal programs. Despite all the past efforts, there is uncertainty whether the results of the protection programs meet the needs of the fish. The reasons for this conclusion about uncertainty are discussed in the protection section of this chapter. The strategies presented below are consistent with the strategies in the protection section.

There are four strategies for protection that capitalize on existing resources and seek to reduce known areas of uncertainty.

Strategy A1: Improve existing protection programs and continue implementation through local, state, tribal and federal governments.

Strategy A2: Evaluate the effects of existing protection programs and their contribution to salmon recovery.

Strategy A3: Coordinate protection actions at the sub-basin or appropriate scale to ensure levels of protection needed for salmon recovery are met.

Strategy A4: Implement, evaluate and change strategies and actions where necessary.

Strategy A1: ***Improve existing protection programs and continue implementation at the local, state and federal levels of government.***

Achieving the level of protection needed for salmon along the marine shoreline is complicated. A large percentage of Puget Sound shorelines and tidelands are in private ownership, and many of the properties are small lots created before today's environmental standards. Thus, protection efforts rely upon the knowledge and good stewardship of individuals taking action. Education and incentives need to be key on-going elements of a strong program for protection so property owners can easily know how to prevent significant impacts.

A strong protection program also will rely upon the continued implementation of regulatory programs and updates to existing programs based on new information. Implementation of existing and improved regulatory programs is a significant and necessary step towards addressing threats from growth, re-development and on-going activities and practices.

Both voluntary and regulatory programs can provide increased benefits for salmon recovery by applying the regional, watershed and sub-basin specific information from this plan.

There already have been improvements in some parts of Puget Sound. Whatcom, Snohomish, and Island counties, are using local watershed chapter information as best available science in their 2005 Critical Areas Ordinance updates under Growth Management.

Washington State Department of Ecology's adoption of new shoreline master program (SMP) guidelines in 2003 initiated a new generation of shoreline planning in Washington. The guidelines were developed as part of a year-long negotiated settlement that also led to adoption of shoreline legislation (effective July 2003) establishing a new schedule for updating SMPs, and a biennial appropriation of $2 million to fund local SMP development. These updates of local SMPs will also be able to use the salmon specific information in the Nearshore and Watershed Chapters.

The actions below identify local and regional programs that should continue and be enhanced with the information in this Plan.

Actions

Key actions important to take in the next 10 years are:

- Local regulatory programs: The twelve counties and the numerous cities in Puget Sound review, evaluate, and adopt needed amendments to comprehensive plans and development regulations to increase protections based on the factors and conditions identified in this recovery plan. These include potential amendments to Comprehensive Plans, Critical Area Ordinances and Shoreline Master Programs consistent with salmon recovery needs.
- Regional and Watershed Education and Incentive Programs: There a number of programs, local and Puget Sound wide, to encourage private landowners to provide good stewardship of their land along the marine shorelines. It is essential that these programs continue. It is especially important that these programs focus on areas that are intact and providing significant benefits for salmon at the present time. The information in the watershed and Nearshore Chapters can be used to focus the voluntary efforts and provide landowners about their specific area and its special importance.

Timeframe for Comprehensive plans and Development regulations:

Clallam, Jefferson, King, Kitsap, Pierce, Snohomish, Thurston, and Whatcom counties and the cities within those counties review, evaluate and update their comprehensive plans and development regulations on or before December 1, 2004.

Island, Mason, San Juan, and Skagit counties and the cities within those counties review, evaluate and update their comprehensive plans and development regulations on or before

December 1, 2005, and every seven years thereafter.

Timeframe for early-adopters of Shoreline Master Programs:

December 1, 2005, for the city of Port Townsend, the city of Bellingham, the city of Everett, Snohomish county, and Whatcom county; December 1, 2009, for King county and the cities within King county greater in population than ten thousand;

Except for the early adopters (above), updated SMPs are due on or before December 1 of the following years. This will be consistent with Growth Management Act requirements.

2011, for Clallam, Jefferson, King, Kitsap, Pierce, Snohomish, Thurston, and Whatcom counties and the cities within those counties;

2012, for Island, Mason, San Juan, and Skagit counties and the cities within those counties;

- Washington State Department of Fish and Wildlife Permits: Hydraulic Project Approvals (HPA), issued by the Department of Fish and Wildlife and consistent with the federal program actions below, should grant permits in the context of processes, ecosystems and the population specific viability needs noted in this recovery plan (including the Nearshore and other watershed chapters).
- Washington State Department of Natural Resources Management of Aquatic Lands: The state manages approximately 2 million acres of aquatic lands in Puget Sound. There are several on-going programs that provide management opportunities for salmon recovery. These are described in the Nearshore chapter. In addition, a Habitat Conservation Plan is currently under development and should develop actions and programs consistent with salmon recovery needs. Timeframe: Prior to HCP issuance.
- Washington State Departments of Health, Fish and Wildlife and Natural Resources: There are several on-going programs supporting aquacultural practices that provide management opportunities for salmon recovery. The programs should be conducted in the context of processes, ecosystems and the population specific viability needs noted in this recovery plan (including the Nearshore and other watershed chapters).
- Federal Regulatory Programs: Permits issued by the U.S. Army Corps of Engineers under the Clean Water Act and Rivers and Harbors Act should be granted in the context of processes and ecosystems and the population specific viability needs noted in the Nearshore chapter of this Plan. Permits should prevent against cumulative loss of habitat function for salmon. Timeframe: Within 5 years.

Strategy A2: ***Evaluate the effects of existing protection programs and their contribution to salmon recovery.***

Currently there is debate and uncertainty between interested parties at the local and regional levels as to whether current regulatory and incentive programs adequately protect existing habitats for salmon. There are six main reasons for the lack of agreement and uncertainty about current protection efforts.

1. Many of the regulatory programs are relatively new or recently improved.
2. There are many protection programs in place that are administered differently by a large number of local entities and they have never been reconciled.
3. Most regulations focus on the individual parcel and are not easily tailored to the unique characteristics of a reach or region of the marine shore.
4. Variances are granted and mitigated at a site-specific scale which has the potential to cause,

over time, significant losses to habitats and the processes that support salmon.

5. Areas in Puget Sound were platted prior to existing regulations, which limits their ability to meet new standards.
6. Incentive, voluntary and educational programs have not been intentionally designed to complement regulatory programs.

Actions

Implementation of the following action takes into account the six factors stated above and will increase the certainty that existing habitats, processes and functions will be protected into the future.

- In all areas of Puget Sound, programs for protection need to be assessed to determine the extent these protection measures are being implemented, and what is the predicted or observed effect on habitat and salmon Viable Salmonid Population (VSP) parameters. Identify gaps in the protection programs and develop and implement locally-acceptable solutions. Timeframe: Completed for all of Puget Sound within five years/ complete case study by 2006.

  The first proposed step to completing this action is to conduct a case study in several counties or a city that clarifies expected long-term results of the suite of protection programs and identifies any gaps relative to salmon population and ESU recovery needs. Specifically, explore the certainty with which the combination of protection programs:

  - prevents against cumulative negative impacts of threats,
  - protects both habitats and the process that create and maintain them,
  - links fresh- and saltwater processes,

- addresses impacts from allowed activities and facilities in already protected areas (e.g. public access for recreation), and
- ensures unique salmon needs (e.g. timing variation or life-stages served) are protected as described in the sub-basin strategy.

If gaps are identified, determine and implement

Photo by Dan Kowalski

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solutions based on locally agreed-to actions through a combination of voluntary, incentive and regulatory programs. It is likely new tools may need to be developed in collaboration with regional scientists that provide permitting agencies and others with indicators of habitat conditions and processes that function to promote salmon recovery. Timeframe: 2006

Once a better understanding is gained about the effectiveness of existing programs, regional and local resources (non-profit groups, state and federal agency staff and resources, and dollars allocated to nearshore in the salmon recovery financing plan) can be encouraged to focus protection efforts where necessary. Timeframe: 2006

Results from the case study can then be examined to determine if the gaps identified are likely to be similar across Puget Sound. Where necessary further analysis must be conducted to determine what, if any, gaps exist in other parts of Puget Sound. Each additional case study should be conducted at a scale that is consistent with ecological needs and jurisdictional responsibilities. Timeframe: Completed within 5 years

Strategy A3: Coordinate protection actions at the sub-basin or appropriate scale to ensure levels of protection needed for salmon recovery are met.

In each of the eleven sub-basins of Puget Sound identified in the Nearshore Chapter, there are a number of people in different levels of government and the private sector working to protect existing resources. Success for salmon recovery requires that all of these interests work efficiently to produce a collective result for protection. Workshops and on-going communication will be important in each sub-basin to ensure success. Timeframe: On-going

Strategy A4: Implement, evaluate and change strategies and actions where necessary.

The first steps of this strategy focus on implementation of existing regulations, improvements and changes based on new information. As the case study is completed and additional changes are made to the suite of protection programs it will be necessary to continue to cycle through these elements and use tools which assist us in monitoring the results of protection efforts and adapting our approach where necessary.

Actions

- Develop an adaptive management and monitoring program. See Chapter 7 of this plan for more detailed information
- Develop a shared, publicly available database and/or mapping system that helps land managers, non-governmental organizations and others determine how they can contribute to protection objectives in each sub-basin. Timeframe: Within 5 years.

B. Restore processes and habitats in and near estuarine deltas where salmon populations first encounter tides and saltwater.

Salmon spawn in freshwater. As the juveniles mature in freshwater they eventually move downstream. This is the start of their long ocean migration. As they move downstream, they eventually reach a point where the rising tides and saltwater of Puget Sound push up into the river system. This tidal influence and the mixing of salt and freshwater are called an estuary and the structure of the landscape in this region is called a delta. The tides and saltwater from the tides can push upstream as far as 10-15 miles in Puget Sound river systems.

These delta areas are critical to salmon. The biological change fish must undergo to shift from freshwater to saltwater living is immense. Estuaries provide good food sources, enable transitions from freshwater to saltwater, offer places to hide from predators, and provide a migratory pathway. The eleven major areas like this in Puget Sound are: Elwha, Dungeness, Skokomish, Mid-Hood Canal, Nisqually, Puyallup/White, Green/Duwamish, Snohomish, Stillaguamish, Skagit and Nooksack. Lake Washington is a unique case because of the locks and other human developments that have changed the whole manner in which the freshwater connects with the marine environment.

Salmon also use shorelines adjacent to the major deltas. One rationale for prioritizing protection and restoration strategies is to consider shorelines and features within a day's swim for a juvenile Chinook. Scientists studying Chinook in the nearshore are telling us this is roughly five to ten miles depending on currents, the flow of the river and other conditions.

Loss of estuarine function in the natal deltas of Puget Sound has been dramatic over the last two centuries. Our understanding of how salmon viability relates to habitats, processes and salmon use of estuarine areas is increasing rapidly. In particular, significant progress has been made in understanding how these areas contribute to juvenile use, residence time and growth rates. Local salmon-recovery groups have further refined this existing body of knowledge by conducting additional research, analysis and/or modeling specific to their independent populations and local habitat conditions.

The high value these areas have for salmon populations, coupled with the significant loss of estuarine habitats, has placed the protection and restoration of the major river deltas as a top priority for recovery of salmon in the next ten years. These same areas so critical to salmon also support productive farmlands, bustling ports, major cities, private shoreline residences and industrial complexes. This makes restoration of these areas both a critical component of salmon recovery, and one that requires finding solutions that work for people too.

As more has been learned about how fish use and move through these estuaries, research has extended out into the shorelines adjacent to them. Research is beginning to show the importance of key habitats, such as pocket estuaries, to salmon viability. We also have learned that key habitat features cannot support Chinook salmon if they are not connected in a manner that supports movement between habitats, or if these habitats are not supported by the processes that create and maintain them. Few watershed planning areas have yet conducted such a detailed analysis, but watersheds such as Skagit are providing valuable information that can be applied to other areas or used as a model for establishing similar research programs.

Given the importance of these areas to ESU viability, it is important to invest soon in actions where our confidence in outcomes is greatest and where there is local support. In areas where restoration priorities are not yet determined, near-term investments should focus on how to improve our knowledge. In areas lacking local support, near-term investments should be used to develop solutions that work for fish and people. Preserving future options is a critical near-term component for every major delta area. The following categories of strategies and actions are based on the overall understanding of individual river deltas and local support.

There are three strategies to restore processes and habitats in and near estuarine deltas where salmon populations first encounter tides and saltwater.

Strategy B1: Add significant new estuarine habitat and restore processes in and near estuarine deltas where salmon populations first encounter tides and saltwater.

Strategy B2: Conduct further technical assessments and/or build public support where local communities are not ready for restoration.

Strategy B3: In highly urbanized deltas, target short-term investments in actions that support ESU recovery by providing migratory corridors. Determine long-term restoration goal and subsequent strategies.

Strategy B4: Preserve future opportunities in all major river deltas.

Strategy B1: Add significant new estuarine habitat and restore processes in and near estuarine deltas where salmon populations first encounter tides and saltwater.

Photo by Dan Kowalski

Where a scientifically founded locally supported proposal is provided, implement the restoration plans.

Action

- Implement the Elwha, Dungeness, Snohomish, Nisqually, Skagit and Stillaguamish watershed proposals. Timeframe: Within 10 years implement near-term actions and further refine restoration program beyond 10 years. Beyond 10 years implement actions necessary to reach salmon recovery targets.

Strategy B2: ***Conduct further technical assessments and/or build public support where local communities are not ready for restoration.***

Puget Sound has areas where there is likely a need for restoration, but there are not significant restoration proposals in the local watershed chapters. This is due to two reasons. First, a strategic approach has not yet been described. Second, there is not yet public support for project implementation. Regional assistance will focus on the development of a restoration strategy consistent with ESU objectives or efforts directed at finding solutions that work for fish and people.

Action

- Conduct further technical assessments and/or build public support where necessary in South Sound, Island, Nooksack, Skokomish, and mid-Hood Canal. Timeframe: Within 10 years establish and initiate implementation of a restoration program. Beyond 10 years implement actions necessary to reach salmon recovery targets.

Strategy B3: ***In highly urbanized deltas, target short-term investments in actions that support ESU recovery by providing migratory corridors. Determine long-term restoration goal and subsequent strategies.***

Puget Sound has two major deltas and shoreline areas where the primary support to the ESU is largely as a migratory corridor. This is because the underlying structure of the natal delta and shorelines has been lost or never existed (in the case of

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the current Lake Washington/Cedar/Sammamish watershed). There is also great technical uncertainty that processes could be restored or created, given the extent of the losses. Additionally, the cost to the region of fully recovering these estuaries, both in terms of restoration dollars and economic loss, is dramatic. Nevertheless, improvements in these areas are critical to move the Chinook populations that use these areas out of a high risk situation and to support other salmon populations that use the areas.

Action

- Critical near-term actions in the Sammamish/Cedar and Green/Duwamish watersheds, are to preserve future opportunities, as they are very limited, and to develop a restoration strategy and set of actions in light of long-term goals. Over the longer term, implement actions consistent with the restoration strategy and overall goal.

Strategy B4: ***Define the potential of the Puyallup/White delta and nearby shorelines to support a low risk White River and an improving Puyallup population. Preserve future opportunities.***

The current ESU strategy is to ensure that the White River Chinook population (one of two populations in the Puyallup/White watershed) obtains a low risk status and that the Puyallup population moves out of high risk. The White River population is important to the ESU as it represents the only remaining early run in the South/Central Puget Sound region, and therefore it must be at low risk to meet the ESU recovery criteria. The Puyallup/White delta has experienced considerable loss of function due to industrialization, development and degradation of water quality and quantity. The underlying structure of the delta has been largely lost, making the restoration of processes and habitats a significant financial and technical undertaking.

Action

- Within ten years it is necessary to define the potential of the delta and shorelines to support recovery goals for the two populations. Then feasibility analysis should be conducted to determine the ability to achieve the potential for the delta. Immediate focus should be on preserving future opportunities in the lower river and estuary, given the high likelihood of needing significant restoration of both habitats and the processes that support them. In the long-term restore habitats and processes necessary to reach recovery targets or determine if alternative ESU strategy is necessary.

Strategy B5: ***Use new scientific information to improve restoration strategies in the deltas and adjacent shorelines.***

As we have seen, estuaries and adjacent shorelines are an important component of the regional recovery strategy in Puget Sound. Developing a collaborative research and monitoring program focused on filling common data gaps and learning from project implementation will increase the likelihood of adaptively managing the plan to reach recovery targets. Similar to creating a regional approach to research and monitoring for the freshwater environments, it will be necessary to develop a comprehensive adaptive management, monitoring and research program for saltwater environments.

Action

- Develop an adaptive management, research and monitoring program. It is important to increase the certainty of proposed restoration strategies for the delta and adjacent shoreline areas given the expense and human cost of actions and the importance that projects produce significant results for salmon. Regional monitoring of actions and testing of strategies and hypotheses will ensure that they are producing the desired result for the population and the ESU and addressing other community interests.
- Listed below are some already identified short-term gaps in our scientific understanding.

Prioritization of these questions, with others surrounding salmon recovery, is necessary to target research to those issues most needing early attention at the ESU scale.

- Improve understanding of how juveniles move within and between habitats of natal deltas and shorelines.
- Support the Salmon Recovery Funding Board's designation of the Skagit estuary as an intensively monitored area. Actions implemented in this watershed will contribute to the overall understanding of how hypotheses, strategies and actions in estuarine areas support viability of salmon.
- Support the Salmon Recovery Funding Board in designating a shoreline area and sub-basin as an intensively monitored area. Actions implemented in this watershed will contribute to the overall understanding of how hypotheses, strategies and actions in estuarine areas support viability of salmon.

C. Restoration of marine shorelines (including freshwater inputs) outside of major deltas where there is a significant benefit for population/ESU viability.

Puget Sound is a migratory corridor for juvenile, resident and adult Chinook. Fish depend upon shoreline habitats and the prey they produce to survive. While it is considered important to protect all remaining habitats and functions that remain in Puget Sound, the quantity and location of habitats necessary to restore to support salmon recovery is less certain. In some cases, watershed chapters provide information and recommendations for restoration of marine shorelines. However, across Puget Sound as a whole there is currently no restoration strategy for these areas. As restoration strategies are developed, at a minimum they must consider the appropriate scale for restoration, connectivity between habitats, functions and processes, the ability of fish to access and use the habitat, and the needs of all populations likely using the area at different life stages.

There are two strategies for restoring marine shorelines outside of major deltas.

Strategy C1: Improve our understanding of what are 'enough' places and the 'right' places to restore outside of major deltas in order to support ESU viability.

Strategy C2: Restore habitats (where processes are intact) or key processes where such restoration is linked to a likely population response.

Strategy C1: ***Improve our understanding of what are 'enough' places and the 'right' places to restore outside of major deltas in order to support ESU viability.***

The following actions will create a technical foundation for developing a more comprehensive approach to restoration in the shoreline areas outside of major deltas.

Actions

- Develop a regional research and monitoring program that increases the understanding of how Chinook use shoreline habitats.
- Refine and improve hypotheses developed by the Puget Sound Action Team on how multiple populations use habitats and functions within a sub-basin.
- Develop and apply analytical tools to more fully incorporate spatial structure and diversity viability characteristics into recovery planning and implementation. Incorporation of diversity and spatial structure will better inform the relationships between nearshore habitat and population responses.

Strategy C2: ***Restore habitats (where processes are intact) or key processes (where habitats are intact) where benefits to salmon are expected.***

Action

- Salmon recovery groups work with regional experts to finalize a prioritized list of restoration actions based on local analyses and the

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regional chapter sub-basin analysis. By 2015, small but strategic improvements to functions provided by habitats and processes will be achieved. Beyond 2015, significant actions will need to be implemented to improve functions provided by habitats and processes. This will be based on the increased technical foundation developed in the first strategy.

D. Protect and restore fresh- and saltwater quality where there is a significant benefit for population/ESU viability

Clean water is important to protect and restore for many reasons broader than salmon. This plan directs water quality actions to those areas where improvements in certain water quality perameters would show a benefit to salmon (e.g. increases in smolt production). There are several elements important to salmon viability. These include dissolved oxygen, proper nutrient levels, temperature, and toxics.

Over time toxic chemicals introduced into the water column settle into marine sediments. Activities such as aquatic marine construction can reintroduce these contaminants into the water column. Dissolved oxygen, temperature, toxics and contaminated sediments all occur in lethal and sub-lethal levels in some areas of Puget Sound. However, low levels of dissolved oxygen, high nutrient loadings and stormwater inputs have been observed across the greatest scales and have the potential to negatively impact multiple populations. Nevertheless, all of these water quality attributes can reduce fitness and pose significant barriers to salmon migration. Their pervasiveness in multiple sub-basins indicates that they could be threatening ESU viability.

There are three strategies for protecting and restoring water quality in Puget Sound.

Strategy D1: Implement protection and restoration strategies in areas prone to low dissolved oxygen levels.

Strategy D2: Implement protection and restoration strategies in areas prone to high temperatures.

Strategy D3: Implement strategies that prevent toxic chemicals, including those borne in stormwater, from entering Puget Sound, and restore contaminated areas.

Strategy D1: ***Implement protection and restoration strategies in areas prone to low dissolved oxygen levels and where benefits to salmon are expected.***

Some areas of Puget Sound are impaired by low levels of dissolved oxygen or are susceptible to degradation (due to combinations of low flushing rates, shallow waters, warm temperatures, nutrient inputs and/or minimal freshwater inputs). This is of particular concern where low dissolved oxygen disrupts key functions provided to salmon. Actions are supported where increases in dissolved oxygen would provide benefits to salmon, such as increased access to habitat or increases in fish densities. Low dissolved oxygen levels may threaten either population or whole ESU viability, depending on the extent, location and scale of the problem.

Actions

- Implement programs or projects that maintain appropriate levels of dissolved oxygen by limiting the discharge of oxygen-demanding substances and nutrients in all areas of Puget Sound.
- Establish permit limitations, best management practices for nutrient loading and a monitoring program in sub-basins susceptible to low dissolved oxygen. Set early warning triggers that further limit nutrient loading if dissolved oxygen objectives are not being met. These sub-basins include, but are not limited to: Carr-Nisqually Inlet, Hood Canal, and Padilla Bay.
- Develop and implement spatially explicit restoration strategies (i.e. water quality clean-up plans or TMDL programs) where areas are limiting or on the path to limiting population viability, such as in Hood Canal, South Sound and Whidbey Basin.

Strategy D2: ***Implement protection and restoration strategies in areas prone to high temperatures and where benefits to salmon are expected.***

High temperatures in estuaries and shallow shoreline areas are naturally occurring phenomena. Nevertheless, in some instances human activities have reduced riparian areas and changed the quantity and timing of cool water inputs. This means high temperatures may be starting earlier and lasting longer than under natural conditions and are occurring in areas that historically would not have had high temperatures.

High temperatures may threaten either population or whole ESU viability, depending on the extent, location and scale of the problem. Actions are supported where lowering the water temperature would provide benefits to salmon such as increased access to habitat or increases in fish densities.

Actions

- Watershed chapters provide strategies, actions and timeframes to protect temperatures through riparian restoration and flow in the natal deltas. Monitor results of actions on temperatures.
- Focus restoration actions in basins where the temperature in the estuaries limits natal population productivity, abundance, spatial structure or diversity. Watersheds where this is likely to be the case include:
  - Stillaguamish
  - Duwamish
  - Others may exist that have not been documented or reported.

Strategy D3: ***Implement strategies that prevent toxic chemicals, including those borne in stormwater, from entering Puget Sound and restore contaminated areas where benefits to salmon are expected.***

Toxic chemicals affect Chinook salmon health, but it is not certain the extent to which they currently affect ESU viability. Impacts of toxics and contaminants on salmon are influenced by tidal flushing, location and depth. Actions are supported where addressing toxic chemicals would reduce adverse impacts to salmon such as changes in growth patterns, disease resistance, and behavior.

Actions

- Support existing sediment remediation projects, determine results expected from these efforts, and timeframes for achieving those results. Such projects currently exist in Puyallup/Commencement Bay, Nooksack/Bellingham Bay, Snohomish/Everett Harbor, Duwamish/Harbor Island and Elliot Bay, and Sinclair Inlet.
- Continue programs which set discharge limitations and develop best management practices to protect salmon from harmful contaminants.
- Continue and improve stormwater programs which protect fish against harmful contaminants. Ensure that Phase I and Phase II Municipal Stormwater Permits consider regional salmon recovery plan needs in the update process.
- Develop clean-up plans to reduce levels of contamination and prevent cumulative impacts from exposure to toxic contaminants in subbasins currently affected by and/or susceptible to water quality degradation. Improve controls on toxic discharges and clean up efforts by determining thresholds where toxic chemicals (including legacy sediment contaminants) potentially impact the food web and Chinook VSP parameters.

E. Protect and restore water quantity where there is a significant benefit for population/ ESU viability

The timing, rate and quantity of freshwater inputs to Puget Sound are critical components for maintaining the habitats and processes that support salmon recovery in the estuarine and marine areas. Timing, rate and quantity of freshwater flows are affected by changes in impervious surfaces caused

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Photo by Dan Kowalski

by development, forest and vegetative cover, water diversions, inputs and climate. Dam operations also alter the timing, rate and quantity of freshwater flows delivered to Puget Sound. There is one strategy to achieve the desired result.

Strategy E1: ***Use Department of Ecology's Instream Flow program and other processes to protect and restore freshwater quantity***

Department of Ecology has a rigorous process for setting instream flows which is summarized in this chapter under the section on Instream Flow. Most of the watersheds in Puget Sound have instream flow levels that were set in the 1970's or 1980's and for the most part did not consider the impacts to estuarine and marine environments.

Actions

- Department of Ecology has set a schedule to ensure all watersheds in Puget Sound have instream flows set by the end of 2006.
- As instream flows are set and updated, salmon recovery needs in estuarine and nearshore areas should be addressed.
- Federal Energy Regulatory Commission (FERC) licenses should consider impacts to estuarine and nearshore functions and processes specific to salmon recovery needs.
- Implement strategies and actions (forest retention, minimization of impervious surface, etc.) proposed by the individual planning areas that protect and restore the flows designed to create and maintain estuarine and shoreline functions for salmon.
- Actions may include development of alternative approaches to National Pollution Discharge Elimination System (NPDES) outfalls and stormwater treatment systems, such as beneficial reuse to augment stream flows through lower rivers and estuaries.
- Department of Ecology's flow enhancement program, which is discussed in the Instream Flow section of this chapter, should include actions for estuaries and nearshore where flow is a significant limiting factor.

- Develop tools that improve the understanding of the relationship between viable salmon populations and water quantity. Tools should take into consideration the relationship between water quantity and estuarine and adjacent shoreline function.

F. Prevent, prepare for and respond to catastrophic events

Catastrophic events have the potential to significantly reduce the likelihood of persistence of salmon in Puget Sound. These major events, both natural and human caused, can encompass large areas and affect multiple populations. The overall approach to salmon recovery in Puget Sound is designed to protect the species by ensuring we have healthy fish across a variety of river, estuarine and marine systems.

Nevertheless, Chinook populations mix in Puget Sound; thus it is important to consider what additional measures can be taken to ensure the likelihood of catastrophic events is minimized where possible. In addition, contingencies need to be established where there are remaining risks to catastrophic losses of salmon or their habitats. Human-caused catastrophic events in the marine environment are predominantly spills. Spills can be of a variety of substances including oil, chemicals, or hazardous waste. Natural catastrophic events are occurrences such as tsunamis, volcanic activities, landslides or other disasters.

There are four strategies to address catastrophic events.

Strategy F1: Prevent Oil Spills

Strategy F2: Prepare for Oil Spills

Strategy F3: Response to Oil Spills

Strategy F4: Determine expected results from existing efforts for hazardous waste and non-human catastrophic event response.

There is already an infrastructure in place to prevent, prepare for and respond to human catastrophes. Department of Ecology actions are described below.

Strategy F1: *Prevent Oil Spills*

There are four core activities that the Department of Ecology's Spill Preparedness and Response Program carries out to minimize the threat of oil spills in Washington. These are:

- vessel screening, inspection, and oil transfer oversight.
- review and approval of facilities' oil spill prevention plans and operation manuals.
- minimize vessel casualties and oil spills in bad weather through Neah Bay tug.
- Investigate near-miss incidents and accidents to prevent future problems.

Two oil spills of significance occurred in Puget Sound during 2004-2005. In response to these spills, an independent citizen's advisory council was created through legislation and signed into law by the Governor. The purpose of the Oil Spill Council is to improve efforts to prevent oil spills. The Governor will appoint Members of the Council during the summer of 2005. Others in Puget Sound are also working to prevent oil spills from occurring.

Actions

- The Oil Spill Council should consider salmon recovery needs in their efforts to improve prevention programs and provide information on the expected results of their efforts for fish.

Strategy F2: *Prepare for Oil Spills*

Department of Ecology requires that operators of large commercial vessels and oil handling facilities maintain state approved oil spill contingency plans. These plans help assure that when major oil spills occur, the responsible party is able to rapidly mount an effective response. Once agency staff have reviewed and approved an oil spill contingency plan, the contingency plan holders and spill response contractors maintain their readiness through required spill drills. The agency also partners with the U.S. Coast Guard and Environmental Protection Agency to maintain a single, overarching policy document (the Northwest Area Contingency Plan) that guides how spills are managed in the Northwest.

The Department of Ecology has also created Geographic Response Plans. These plans identify and rank oil spill protection strategies for sensitive natural resources in a geographical area. By using these plans, first responders to a spill can best protect resources. The strategy for containing oil spills (booming) itself underwent an ESA Section 7 consultation through NOAA fisheries to ensure this strategy did not unwittingly cause harm to salmon in and of itself.

Actions

- Department of Ecology Geographic Response Plans prioritize natural resource areas for response actions. These plans are updated yearly and are scheduled for a major revision in 2005. Salmon recovery plan information should be included in revisions with a statement of expected results of implementation for fish.

Strategy F3: ***Respond to Oil Spills***

Department of Ecology provides round-the-clock response (from four regional offices) to oil spills. The agency ensures that the damage from these spills are contained within the smallest area possible and cleaned up as quickly as possible with minimum damage to public health, safety, natural resources, and private property.

Actions:

- Provide staff and resources necessary to respond to oil spills quickly that threaten population or ESU viability.
- Respond to Oil Spill Council recommendations that are important for salmon recovery.

Strategy F4: ***Determine expected results from existing efforts for hazardous waste and non-human catastrophic event response.***

G. Non-indigenous species and other alterations to food webs

Much of the focus for salmon recovery has been on the habitat part of the ecosystem. The biotic part of the ecosystem is equally important to manage if salmon recovery is going to be successful. There have been a number of significant changes to the Puget Sound ecosystem that affect biological interactions. For the most part the effect of these changes on salmon and the limitations they pose for recovery are unknown. Changes to the marine communities may affect the availability of food, opportunities for rearing, and exposure to predation for salmon. Below is a list of issues that should be studied scientifically over time to determine their impact on recovery. With that information, appropriate management strategies can then be developed and implemented. In the long-term we will need to better understand ecological functions to integrate recovery for the Puget Sound chinook ESU and salmon recovery with other Puget Sound ecosystem restoration efforts.

Issues necessary for further study:

- Non-native species impact on habitats and food webs used by salmon.
- Hatchery fish inputs that impact salmon through competition, predation, and alterations in community structures
- Relationship between key food web species and salmon
- Fish and shellfish harvest effects on community structures that affect salmon.

VII. Key Ocean Strategies And Actions

There are two strategies to link ocean environments to the fate of Puget Sound salmon populations and a recovery strategy. The first is the overall improvement of ocean ecosystems — such protection and restoration strategies are coordinated at the national level. The second is to determine the impact ocean conditions have on salmon populations in Puget Sound and design strategies and actions that complement the availability of the ocean to support recovery.

Overall Improvement of Ocean Ecosystems

In late 2004, the U.S. Commission on Ocean Policy submitted recommendations for a coordinated and comprehensive national ocean policy to the President and Congress. The Commission's final report, "An Ocean Blueprint for the 21st Century," contains 212 recommendations addressing all aspects of ocean and coastal policy. These recommendations, if implemented, are expected to halt the steady decline of natural resources within our nation's oceans and along its coasts.

In response to the Commission's findings and recommendations, the President issued an executive order establishing a Committee on Ocean Policy as part of the Council on Environmental Quality. The U.S. Ocean Action Plan was also released. Following the White House announcement of these actions, the Commission responded with a preliminary assessment of the Ocean Action Plan, calling it a promising first step toward the implementation of a comprehensive national ocean policy.

Action

- Determine the results expected for salmon recovery from the implementation of the U.S. Ocean Action Plan. NOAA Administrator's office and appropriate divisions of NOAA will coordinate with local recovery efforts on the expected results from implementation of this plan. A schedule will be set for these updates by NOAA Fisheries by 2006.

Develop Puget Sound Strategies Based on Ocean Conditions

Puget Sound strategies should be developed with an understanding of marine survival on salmon viability.

Actions

- Use population ocean survival information from harvest management and marked wild fish (e.g., in Skagit studies) to refine Puget Sound strategies and actions based on what we can count on for survival during the ocean phase of the Chinook life cycle.
- Analyze the robustness of restoration strategies under different assumptions of ocean conditions. Adjust the strategies to be successful, regardless of what is assumed for ocean survival.

VIII. CONCLUSIONS AND NEXT STEPS

The strategies described above summarize what is most important to accomplish in estuaries, Puget Sound and the Pacific Ocean in the next ten years to support salmon recovery. They also describe the results necessary to support recovery in the long-term. One of the most important next steps to increase the certainty of salmon recovery is to develop consistent sub-basin objectives and strategies between the regional Nearshore chapter ideas and the local watershed chapters. It will also be important to develop monitoring plans and indicators for each desired result.

In conclusion, the following steps are necessary to set the region on the path to recovery.

Within the ten year timeframe it is important to increase the certainty that our protection efforts are effective for salmon. This includes:

- Gaining a better understanding of how protection programs protect identified key habitats and processes into the future;
- Specifically understanding the results that can be expected from existing land-use programs and identifying and resolving gaps;
- Encouraging management at the scale of the processes that support key habitats (sub-basin, drift cell, etc.);
- Protecting water quality in areas susceptible to degradation and where there is high population use;
- Integrating information generated through the salmon recovery planning process into oil response plans, CAO, SMP and instream flow updates;
- Ensuring an adequate quantity of freshwater exists to support nearshore and marine systems;

- Containing existing invasive species and preventing introductions of new species.

Salmon recovery requires restored productivity in the marine environment. In ten years improvements are needed in:

- Areas where water quality is degraded and high population use occurs;
- Deltas of the rivers where spawning populations occur;
- Shorelines adjacent to major river deltas; and
- Water quantity where linked to temperature or degradation of estuarine functions.

Research and analysis is an important component for improving the certainty of our marine strategy and actions. Examples of high priority needs are:

- Increasing the scientific documentation for salmon recovery efforts in the marine and estuarine environments;
- Reconciling the strategies and actions proposed in the local recovery chapters with the Nearshore chapter and refining the ESU strategies based on the new information;
- Developing a strategy for restoration of shorelines further from major river deltas;
- Identifying properly functioning conditions (or a set of indicators) to support protection efforts and to identify areas for restoration/enhancement;
- Developing estuarine strategies in areas where increased understanding is necessary;
- Better understanding of how fish move within and between deltas and shoreline features;
- Improved understanding of hatchery-wild fish interactions in the nearshore; and
- Improved understanding of food-web and its ability to support existing and recovered populations.

These early steps need to be accomplished in an improved context for coordinating both the scientific and policy aspects of local and regional efforts. If the above strategies and actions are implemented, the nearshore environment will significantly contribute to salmon viability and long-term persistence.

"The essence of this work boils down to a few uniquely human capacities:

Care and respect,
hope and creativity,
and stubborn determination."

Carol MacIlroy, Shared Strategy Staff

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Habitat:

Water Quality

The purpose of this regional strategy on water quality is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team. This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

" Ironically, as we work to save the salmon, it may turn out that the salmon save us."

Paul Schell, former Seattle Mayor.

Background

Both people and salmon depend on clean water to survive and many of the watershed salmon recovery plans recognize the importance of water quality. Ensuring the quality of the water in Puget Sound involves a variety of tools, largely regulated by the Washington Department of Ecology (Ecology) and the US Environmental Protection Agency (EPA). However actions to address water quality rely heavily on the implementation of activities at a local and individual level. Collectively, these entities carry out an approach for addressing water quality by establishing standards for water bodies, issuing permits, cleaning up areas that exceed standards, and monitoring. Water quality requirements are contained in the state Water Pollution Control Act and the Clean Water Act.

The Water Pollution Control Act sets the state's policy for clean water: to "...maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment...the propagation and protection of wildlife, birds, game, fish and other aquatic life, and the industrial development of the state."

The Clean Water Act (CWA), passed in 1972, sets the national policy for clean water: to "...restore and maintain the chemical, physical, and biological integrity of the Nation's waters." To accomplish this, section 303(d) of the act specifically requires the states to:

1. Establish and periodically review and revise water quality standards;
2. Perform water quality assessments to identify waterbodies that are not meeting the standards, and to list such waterbodies every two years; and
3. Develop cleanup plans ("total maximum daily loads", or TMDLs) for listed water bodies.

These steps provide the foundation for Washington's approach to ensuring safe water quality.

The water quality standards established by the state reflect current science, but as our knowledge of biology, aquatic systems, and pollutants improves, these standards and the scale at which they are applied can change to reflect advances in science and the needs for salmon recovery. After standards are set, actions are taken to both prevent the degradation of water and to clean up water bodies that are already impaired from pollution.

Primarily, preventive action to protect water quality is taken through the issuance of permits. Permits are applied to pollution dischargers for both point source pollution (where the source of a pollutant is known and originates from a distinct point) and non-point source pollution (where the source of a pollutant is either unknown or where the origin of the pollutant is from a diffuse source). Point source pollution is regulated throughout Puget Sound through National Pollutant Discharge Elimination System (NPDES) permits. Pollution that originates from urban runoff from streets, roofs, lawns, and construction sites is called stormwater and is also addressed through NPDES permits. Typically NPDES permits require the application of technology-based and water quality-based limits so that the discharge does not cause or contribute to a violation of water quality standards.

To ensure that water meets the water quality standards, available data is collected on water bodies and assessed every two years (the state only has data on 5% of the water bodies). If water bodies do not meet the standards, cleanup plans or "total maximum daily loads" (TMDLs) must be developed. These involve identifying what the pollutant is and how to reduce it to target levels.

Together these measures, established by the federal government and implemented by the state, comprise Washington's approach to ensuring that waters throughout the Puget Sound and across the state are safe for people and for fish.

Water Quality Standards

The state has had *Surface Water Quality Standards* to protect aquatic life and human health since 1975. The CWA also requires states to periodically review and update their water quality standards in order to comply with new or revised federal guidance, to incorporate new state programs, and to respond to new understandings of aquatic ecosystems and new scientific information. Such reviews must take place at least every three years, and are known as "triennial reviews." This review process ensures that new information about aquatic systems and their pollutants is reflected in the standards.

The state's surface water quality standards set limits on pollution in our lakes, rivers and marine


Photo by Dan Kowalski

standards and prohibit additional pollution of waters that violate water quality standards.

Updated rules also set a framework to address the protection of salmon and other temperature-sensitive fish, such as bull trout and Dolly Varden, from temperatures that could harm their populations.

Point Source Pollution

When the sources of pollutants are discrete, known entities, permits are issued so that, collectively, discharges do not exceed the established standards. The Department of Ecology regulates discharges of pollutants to surface and ground waters by writing wastewater discharge permits for sewage treatment plants, industrial facilities, and other general categories of wastewater dischargers. A permit is a set of limits, monitoring requirements, and management practices which are designed to ensure that a facility can meet treatment requirements and water quality standards. The Department of Ecology prepares permits, conducts inspections, and provides assistance for more than 2,300 permit holders.

This permitting strategy becomes more difficult when the origins of pollutants are unknown, unquantifiable, and from diffuse sources.

Nonpoint Source Pollution

Nonpoint source pollution (or polluted runoff) is considered to be any water pollution without a distinct source. It is the leading cause of water pollution in Washington and poses a major health and economic threat. Nonpoint pollution can include fecal coliform bacteria, elevated water temperature, pesticides, sediments, and nutrients. Sources of pollution include agriculture, forestry, urban and rural growth, habitat alteration and recreation. In general, the Department of Ecology addresses

waters in order to protect water quality. The Clean Water Act requires that the water quality standards protect beneficial uses, such as swimming, fishing, aquatic life habitat, and agricultural and drinking water supplies.

The State of Washington Sediment Cleanup Standards also address contaminated marine sediments which are important for salmon because a wide range of adverse impacts on the health and survival of juvenile salmonids and other marine species are associated with exposure to contaminated sediments. There are no standards for freshwater sediments.

In 2003, the Department of Ecology completed the first major overhaul of Washington's water quality standards in a decade. The Environmental Protection Agency has only partially approved the revised standards. The state will use the 2003 rule for the sections that EPA has approved, but will use the 1997 rule for the sections that EPA has not approved.

Updates to the water quality standards achieve two important goals: pollution prevention and protection of threatened fish species. New approaches allow Washington State to preserve pristine waters when there is broad public support to do so. There are also new tools to prevent increased pollution of water bodies that are already meeting water quality these problems by raising awareness, encouraging community action, providing funding, and supporting local decision makers. Working with local governments and providing assistance is key to resolving many nonpoint problems. In addition Ecology coordinates with other agencies through the Washington State Nonpoint Workgroup; Forest Practices Technical Assistance (working with the Department of Natural Resources); and Agricultural Technical Assistance (working with the Conservation Commission). Ecology also develops and coordinates implementation of the State's Nonpoint Pollution Management Plan which highlights nonpoint issues needing attention in the state.

Stormwater

One type of nonpoint source pollution is runoff from urban areas, or stormwater. As land development changes the natural hydrologic cycle by stripping vegetation cover, removing and destroying native soil, modifying surface drainage patterns, and adding impervious surfaces, our streams, lakes, estuaries, and marine waters are becoming degraded. The large impervious surfaces in urban areas reduce the amount of water that goes into the ground and, as a result, decreases summer base flow and increases the quantity and peak flow of runoff during the wet season. This development allows contaminated waters to flow unobstructed into water bodies from our rooftops, paved streets, highways, and parking lots as well as hard grassy surfaces like lawns and playing fields.

In general, untreated stormwater is unsafe for people and for fish. It contains toxic metals, organic compounds, and bacterial and viral pathogens. Urban stormwater also harms and pollutes streams that provide salmon habitat. Virtually all of our urban embankments, creeks, streams, rivers, and marine waters are harmed by urban stormwater, making stormwater the leading contributor to water quality pollution of urban waterways.

NPDES Stormwater Permits

Because the sources of stormwater are diffuse, the control of this runoff does not fit very well with traditional wastewater discharge permit requirements. In 1987, Congress changed the federal Clean Water Act to include stormwater under the National Pollutant Discharge Elimination System (NPDES) permitting program. As a regulatory tool under the Clean Water Act, NPDES requires permits for urbanized areas to reduce the discharge of pollutants to the maximum extent practicable, protect water quality and effectively prohibit all non-stormwater discharges. Therefore, not all salmon habitat objectives can be addressed through these permits. In Washington State, the EPA delegated its authority to administer the federal wastewater discharge permit program to the Department of Ecology.

The EPA stormwater regulations establish two phases for the stormwater permitting program. In 1990, EPA issued NPDES Phase I rules that apply to stormwater discharges from certain industries,

Photo courtesy King County Department of Natural Resources and Parks construction sites involving five or more acres, and storm sewer systems owned or operated by cities and counties with populations greater than 100,000. Washington has six Phase I jurisdictions: Snohomish, King, Pierce, and Clark counties, and the cities of Seattle and Tacoma. Discharges from Washington Department of Transportation (WSDOT) facilities within those jurisdictions are also regulated.


Photo courtesy King County Department of Natural Resources and Parks

On October 29, 1999, the final Phase II stormwater regulations were signed into rule by EPA. The Phase II regulations expand the requirement for stormwater permits to all municipalities located in urbanized areas, and to construction sites between one and five acres. The rule also requires an evaluation of cities outside of urbanized areas that are more than 10,000 in population to determine if a permit is necessary for some or all of these cities. Under the new rule up to 90 additional municipalities in Washington may need municipal stormwater permits.

The Department of Ecology is issuing a separate Phase II general permit for Western and Eastern Washington. Only the Western Washington permit has been announced. The Washington Phase II draft permit is still under development. The Phase II general permit for Western Washington applies to approximately 80 jurisdictions located within the 2000 Census-defined urban areas. Another five Western Washington cities have been evaluated and are proposed for inclusion in the Phase II permit.

These municipal stormwater permits require the implementation of a Stormwater Management Program. The Stormwater Management Program is a set of actions to be implemented during the term of the permit to reduce the discharge of pollutants to the Maximum Extent Practicable, protect water quality, eliminate illicit discharges, and make progress towards compliance with surface water, ground water and sediment standards. EPA Phase II municipal stormwater permit rules require stormwater management programs that address the following elements:

- Public Education and Outreach
- Illicit Discharge Detection and Elimination
- Post-Construction Runoff Control
- Public Participation/Involvement
- Construction Site Runoff Control
- Pollution Prevention/Good Housekeeping
- Implement applicable provisions in TMDLs
- Evaluation and Reporting

Schedule for permits:

Preliminary drafts of the Phase I and Phase II Municipal Stormwater Permits for Western Washington have been posted for public comment. The preliminary drafts Ecology is issuing at this time are considered works in progress and Ecology will be accepting comments through August 19, 2005. The final permit for Western Washington is scheduled to be issued by March 2006. The proposed date to issue the Phase II permit for Eastern Washington is June 2006.

Stormwater Management Manuals

Stormwater Management Manuals are used to provide guidance on the measures necessary to control the flow rate and quality of stormwater produced by new development and redevelopment. Local governments use the manual to set stormwater requirements for new development and redevelopment projects. Land developers and devel-

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opment engineers use the manual to help design site plans and determine stormwater infrastructure. Businesses use the manual to help design their stormwater pollution prevention plans. There are separate manuals for Eastern and Western Washington due to the difference in climate and hydrology of these regions. Both manuals have been recently updated (the Eastern Washington manual was updated in September 2004 and the Western Washington manual was updated in April 2005). Ecology is proposing implementing the manuals through all the stormwater general permits.

Water Quality Assessments

The Department of Ecology compiles and assesses available water quality data on a statewide basis in order to get a better picture of the overall status of water quality in Washington's waters and to determine if water quality standards are being met. The results of the assessment are submitted to the Environmental Protection Agency (EPA) as an "integrated report" to satisfy federal Clean Water Act requirements of sections 303(d) and 305(b). The assessment includes the list of known polluted waters in the state, sometimes referred to as the 303(d) list.

Washington's Water Quality Assessment for 2004 has been submitted to EPA as an "integrated report" to meet the Clean Water Act requirements of sections 305(b) and 303(d). Of the total statewide river miles, approximately 4000 stream miles were assessed, representing about 5% of all streams.

This integrated report consists of 5 new categories of waters.

Category 1: Meets tested standards is for clean waters.

Category 2: Waters of concern is for waters where there is some evidence of a water quality problem, but not enough to require production of a TMDL at this time.

Category 3: No data is a category that will be largely empty. Water bodies that have not been tested will not be individually listed here.

Category 4: Polluted waters that do not require a TMDL is for waters that have pollution problems that are being solved in one of three ways.

> **Category 4a has a TMDL** and is for water bodies that have an approved TMDL in place and are actively being implemented.
>
> **Category 4b has a pollution control plan** and is for water bodies that have a plan in place that is expected to solve the pollution problems.
>
> **Category 4c is impaired by a non-pollutant.** This category is for water bodies impaired by causes that cannot be addressed through a TMDL. These impairments include low water flow, stream channelization, and dams. These problems require complex solutions to help restore streams to more natural conditions.

Category 5: Polluted waters that require a TMDL. The 303(d) list is the traditional list of impaired water bodies. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. TMDLs are required for the water bodies in this category.

This categorization provides the Department of Ecology with a more thorough picture of the status of Washington's waters.

The TMDL or Water Cleanup Plan

For waters determined to be in the state's Category 5 (or on the 303(d) list), clean up plans must be created and implemented. Total maximum daily loads (TMDLs or water cleanup plans) are a process established by Section 303(d) of the Clean Water Act (CWA). Based on the water quality standards described above, TMDLs describe the type, amount, and sources of water pollution in a

Photo courtesy Whatcom Conservation District

Best management practices on farms can limit non-point source pollution.

particular water body; analyze how much the pollution needs to be reduced to achieve clean water; and provide strategies to control pollution. TMDLs establish limits on pollutants that can be discharged to the water body and still allow state standards to be met. The state monitors the effectiveness of TMDLs after the actions identified in the Water Cleanup Plan have been put in place.

All TMDLs/Water Cleanup Plans have these main components:

1. Identification of the type, amount, and sources of water pollution in a particular water body.
2. Targets for how much the pollution needs to be reduced or eliminated to achieve clean water.
3. Actions for reducing the pollution to target levels.
4. A monitoring plan to assess effectiveness.

All water bodies identified on the list must attain water quality standards within a reasonable period, either through a water cleanup plan or other pollution control mechanisms. If at the end of this timeframe the water is still polluted then more stringent pollution controls will probably be required.

The schedule for Washington's cleanup plans

In 1996, the EPA was sued because it was not requiring Ecology to produce TMDLS at a quicker pace. As a result, the Department of Ecology was given a deadline of 2013 to develop and implement plans to clean up about 650 polluted water bodies throughout the state. The list represents all of the water bodies on the 1996 303(d) list. A schedule was established for completing the required water cleanup plans which includes interim targets at five-year intervals. The first five-year target required 249 cleanup plans completed by June 30, 2003. This deadline was met.

As part of the settlement, the EPA and the Department of Ecology agreed on a five year, five step process for prioritizing TMDLs in Washington. This process is part of a larger new managerial framework that emphasizes watershed management that Ecology is undertaking to improve the protection of water quality.

1. **Year 1.** Water quality issues will be identified and prioritized by assembling information from community involvement and reports, including the 303(d) list.
2. **Year 2/3.** Data will be collected and analyzed through monitoring, facility inspections and other general research.
3. **Year 4.** A Plan of Action will be developed in coordination with the watershed community that addresses the priority problems identified in Year 1. Draft TMDLs will be issued for public comment and subsequent submittal to EPA. Strategies and management activities will be developed to implement TMDLs, issue or reissue waste discharge permits, form partnerships, and address funding issues.
4. **Year 5.** TMDLs will be implemented, waste discharge permits will be issued or reissued, and Ecology will work with local, state and federal programs, and partners to implement nonpoint pollution prevention and control activities.

As part of Ecology's watershed approach, watershed resource inventory areas (WRIAs) were prioritized and divided into three groups for a staged approach to beginning the process. The TMDL process for first group of WRIAs began in 2003. The second began in 2004 and the third began in 2005. Each group is scheduled to be completed within five years.

Puget Sound WRIAs scheduled to begin the TMDL process in 2003

WRIA 8- Cedar-Sammamish
WRIA 9- Duwamish-Green
WRIA 13- Deschutes
WRIA 14- Kennedy Goldsborough
WRIA 16- Skokomish- Dosewallips
WRIA 17- Quilcene- Snow
WRIA 18- Elwha- Dungeness
WRIA 19- Lyre-Hoko

Puget Sound WRIAs scheduled to begin the TMDL process in 2004

WRIA 3 - Lower Skagit
WRIA 4 -Upper Skagit
WRIA 5 - Stilliguamish

Puget Sound WRIAs scheduled to begin the TMDL process in 2005

WRIA 6 - Island WRIA 7 Snohomish
WRIA 10 - Puyallup-White
WRIA 11 - Nisqually
WRIA 12 - Chambers-Clover

Ecology is working with many local, state, and federal agencies to meet the water cleanup plan schedule and improve the health of Washington's waters. Ecology is partnering with the EPA, U.S. Forest Service, U.S. Navy, King County Department of Natural Resources, and numerous local governments to clean up specific water bodies of special interest to those agencies. The Department of Ecology is also exploring internal efficiencies and actively seeking additional partnerships with local governments and citizens to help complete water cleanup plans and attain better water quality statewide.

Clean Water Act/ Endangered Species Act Integration

Although the Endangered Species Act and the Clean Water Act were developed independently and for the most part have not been jointly administered, in this case there are several compelling reasons to link our clean water and salmon recovery efforts to the extent possible within the legal authority granted under each Act.

- The physical and biological integrity of our watersheds need to be restored.
- The resources that need to be protected are inextricably linked.
- There are common elements between basic programs.
- Neither program alone can protect resources at a satisfactory level.
- A joint program that meets the requirement of both Acts reduces the risk of future legal challenges that could jeopardize individual programs and decisions.
- The state is federally mandated to implement the Clean Water Act requirements and comply with ESA requirements.
- There is a clear desire among elected officials and the public for "one stop shopping" versus repetitive and potentially conflicting or duplicative requirements.

As the Puget Sound Chinook Recovery Plan is implemented, federal and state agencies will continue to work closely with local governments, tribes, and planning groups to ensure that the Clean Water Act and the Endangered Species Act are carried out consistently and in complement to one another.

Habitat:

Instream Flow

The purpose of this regional strategy on instream flow is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team. This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

"Salmon recovery is a symbol for Washington's future because it is a story of people learning to live with nature. We have the ability to save some of the world's greatest salmon runs, it is in our control. The question is whether we will do what we need to do fast enough.... We need to ensure there is enough water in our streams. We need to protect and restore important habitat."

Joan Crooks, Executive Director, Washington Environmental Council

This recovery plan proposes a three-part strategy to ensure adequate water for listed Chinook salmon, bull trout and summer chum in the rivers and streams of the Puget Sound Chinook Evolutionarily Significant Unit. The three parts are:

- Establish fish-protective instream flows in the ESU to prevent future degradation;
- Advance the science to better define instream flow limits for recovery; and,
- Implement programs over the next ten years to achieve the flows necessary for recovery.

I. Establish Fish-Protective Instream Flows

First and foremost is a schedule for completing instream flow setting in Puget Sound watersheds. Establishing instream flows is a critical step to prevent future degradation of stream flows by providing a "water right" for fish. However, an instream flow, as a water right, will have a junior priority date and does not guarantee water in a stream. Rather the instream flow, in part, sets a floor below which flows will not be impaired by subsequent junior rights. Where flow is a limiting factor for salmon, a program will be implemented to enhance and protect stream flows (see Part III). As indicated in the table below, instream flows have been set for the majority of the major rivers in Puget Sound.

The State of Washington and its partners completed eleven Instream Resource Protection Programs within the ESU between the years 1971 and 2003. The programs are:

173-501	Nooksack River - Water Resource Inventory Area (WRIA 1)*
173-503	Upper Skagit (WRIA 4)
173-507	Snohomish River (WRIA 7)
173-508	Cedar - Sammamish (WRIA 8)
173-509	Green - Duwamish (WRIA 9)
173-510	Puyallup River (WRIA 10)
173-511	Nisqually River (WRIA 11)
173-512	Chambers - Clover Creek (WRIA 12)*
173-513	Deschutes River (WRIA 13)*
173-514	Kennedy - Goldsborough (WRIA 14)
173-515	Kitsap (WRIA 15)*

The following programs do not have administrative rules adopted to establish in-stream flows as a water right:

173-503	Lower Skagit (WRIA 3)
173-505	Stillaguamish (WRIA 5)
173-516	Skokomish-Dosewallips (WRIA 16)*
173-517	Quilcene-Snow (WRIA 17)*
173-518	Elwha-Dungeness (WRIA 18)*

The WRIAs with an asterisk are conducting watershed planning pursuant to chapter 98.82 RCW and conducting instream flow work.

The following WRIAs are proposing new instream flows and/or reevaluating existing flows: WRIA 1 in 2006-2007; WRIA 3 (Samish) in 2006; WRIA 5 in August, 2005; WRIA 16 in 2006; WRIA 17 in 2005; WRIA 18 in 2005; and WRIA 19 in 2006.

Additional watershed specific information and schedules for instream flow rule-making are at http://www.ecy.wa.gov/programs/wr/instream-flows/isfhm.html.

In the past seven years, about $33 million in grants, state wide, were awarded to local jurisdictions to assist with the watershed planning process. This investment supported extensive technical work, healthy debate around instream flows and water for future growth, and significant public involvement. In 2004, as the first set of watershed plans and instream flow recommendations came due, Ecology and Department of Fish and Wildlife developed the *"Action Plan for Setting, Achieving, and Protecting Stream Flows."* The Action Plan is focused on priority watersheds, including fish critical basins, where instream flow recommendations were either due in 2003 and 2004, or coming due in 2005. In addition, Ecology developed draft and final guidance to watershed planning units regarding instream flows entitled *"A Guide to Instream Flow Setting in Washington State."* In September 2004, Ecology provided a general guidance document entitled *"Guidance for Setting Instream Flows and Allocating Water for Future Out-of-stream Uses"*, that

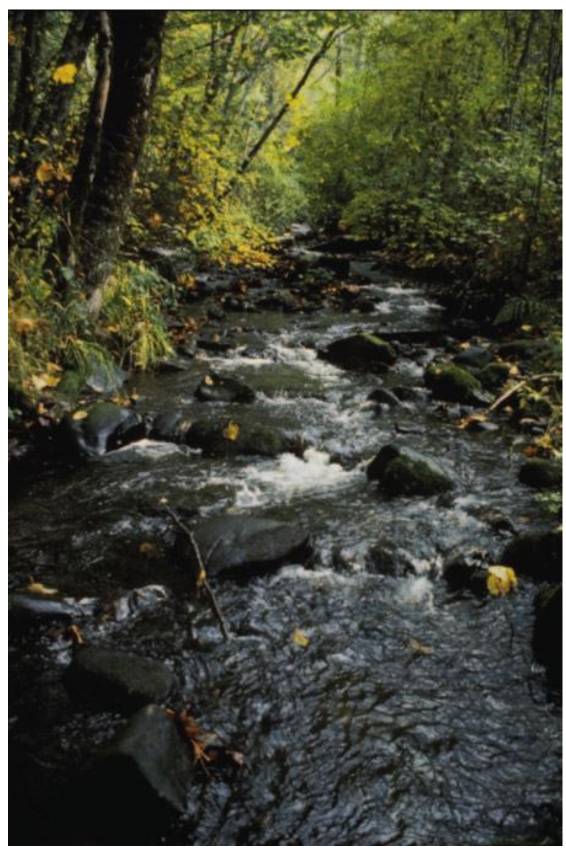

Photo courtesy King County Department of Natural Resources and Parks identifies technical and rulemaking considerations for developing rules, setting instream flows and allocating water for future domestic uses.

Ecology recommends that instream flow levels set in rules consider and address fish flow needs that vary in volume, frequency, season and duration. Salmonids need habitat flows that provide "living space" referred to as useable habitat. They also need ecological flows that provide essential functions, such as fish migration flows, flushing flows that remove sediments, and channel and riparian maintenance flows. Each analysis is basin specific and may be performed in conjunction with watershed planning. The State is committed to ensuring instream flow rules that support salmon recovery by using sound science to guide the instream flows established. In most cases, the Instream Flow Incremental Methodology and or toe-width methods are used to determine instream habitat needs. Ecological flows are being addressed at this time in rulemaking by limiting total withdrawals in a basin, including that for future reserves, to 10 percent of the 50 percent exceedance hydrograph. Other methods that scientifically determine ecological flows are being investigated.

In addition to establishing instream flows, the State is working with local partners to establish effective instream flow monitoring and compliance programs for the watersheds with rule-making. Ecology, in partnership with local communities, is developing effective water conservation and reuse programs in the state's critical basins and working to obtain flow improvements to support recovery through other processes, such as Federal Energy Regulatory Commisssion (FERC) license renewals and Habitat Consenation Plan (HCP) adaptive management studies while respecting existing water rights.

Ecology regulates water withdrawals from surface waters and groundwater within the ESU. Ecology must approve requests for withdrawals and use of water for all uses, except small uses exempt from permit requirements. The projected population growth in the ESU will undoubtedly result in increased municipal water use demands. The change in land use patterns and resource demands, including water use, will need to be managed in order to protect salmon and their habitat. Consequently, the decisions of other entities are increasingly affecting water management and instream flows.


Photo by Dan Kowalski

Part II. Advancing the Science Relating Instream Flow to Salmon Recovery

While much work has been done to identify the importance of instream flow conditions to salmon recovery, there remain significant unknowns about how these flow conditions influence the health of salmon populations and what flow conditions and habitat conditions are needed to ensure recovery of salmon to harvestable and sustainable levels. In the context of this Recovery Plan, there also are uncertainties about how to establish priorities in addressing human activities that affect instream flow conditions within a watershed.

To improve our understanding of the effects of land use and water withdrawals on instream flow conditions and to learn more about the relationship between flow conditions and salmon health, an instream flow assessment pilot project is advancing the science under the partnership of the Shared Strategy. A group of state, local and tribal participants are involved.

Intent/Purpose

The primary intent and purpose of the pilot is to create a cost effective tool for evaluating how current and future land and water management actions relate to instream flow conditions and their influence on achieving watershed plan salmon goals. This new tool will support decision-makers in considering and implementing land and water management actions that affect instream flow conditions and salmon recovery.

The pilot focuses on the effects of water diversions and land use changes, two major and fairly common flow-affecting management actions in the Puget Sound region. The pilot is being conducted in the Stillaguamish basin and applies directly to that watershed. However, it is designed to be applicable to other watersheds attempting to address similar instream flow issues. After completion, the pilot will undergo a peer review to be evaluated for scientific merit.

Modeling Tools

To analyze hydrologic conditions in the project area, the pilot employs a hydrologic model, Hydrological Simulation Program-Fortran (HSPF). The purpose of this model is to synthesize hourly stream flow records on a reach by reach basis for several combined land use and water management scenarios. To analyze fish population response across scenarios, the pilot uses Ecosystem Diagnosis and Treatment (EDT), a salmon response model. Both of these models are used widely throughout the region and should facilitate understanding and acceptance of the pilot approach and its potential transfer to other watershed areas in the Puget Sound region. The pilot is also exploring ways to connect the HSPF model to another salmon response model, Salmon Habitat Integrated Analysis (SHIRAZ), being applied in some Puget Sound watersheds.

Management Implications

The results of the pilot study will be used to evaluate the model created, and to determine whether other runs of the model would add useful information to the development of management options and the description of the likely implications of those options for flow related impacts on salmon. Initial evaluation of the project indicates that further refinement and use of the model will be a valuable tool in assessing the relationship between individual management actions and changes in flow conditions and the expected salmon responses. The independent peer review will be a critical next step prior to drawing any management or other conclusions from the pilot project. The peer review is anticipated to clearly outline the assumptions, limitations, and forward progress that has occurred as a result of the pilot and identify the additional efforts that would add to the viability of the tool. Ultimately, management options that should be thus evaluated include, but are not limited to, enhanced stormwater best management practices requirements, impervious area and clearing limit restrictions, instream flow recommendations, enhanced water conservation, water supply storage, or water source substitution. The pilot is being funded through the Department of Ecology at a cost of $170,000 and is scheduled for completion in August of 2005. Subsequent funding will be sought to address any issues or additional progress that can be made as a result of the independent scientific review.

Other Science Actions

In addition to the Shared Strategy flow project, the entire ESU will benefit from other studies ongoing, such as Chinook juvenile rearing habitat work being done in the Cedar River basin or the recent publication of "Protecting Aquatic Resources Using Landscape Characterizations: A Guide for Puget Sound Planners" (see http://www.ecy.wa.gov/programs/sea/landscape-tool/home/reviewers.html)

Part III: Implement Programs to Ensure In-stream Flows Support Salmon Recovery in Each Watershed and the Nearshore

The third part of the approach is to develop and implement a ten-year effort to improve instream flows that limit salmon recovery. These strategies can be referred to as Instream Flow Protection and Enhancement Program (PEP). A collaborative effort is needed between state and federal agencies, tribes, local governments and watersheds to achieve the necessary flows.

Within the first years of the ten-year effort, several actions are needed to improve flows. These actions fall into two categories:

Photo by Dan Kowalski

- Identification of flow related problems that limit salmon recovery and identification of "recovery flows" to support salmon recovery; and,
- Implementation of instream flow Protection and Enhancement Programs to prioritize, fund and solve instream flow deficiencies.

The above actions are not sequential; rather, flow protection and enhancement actions will be implemented as identified and/or prioritized.

The overall approach will be supported by two components: regional guidance and actions and individual watershed-based programs, consistent with existing laws and processes. The regional component of in-stream flows should be an element of the overall effort and structure for implementation of the Puget Sound Salmon Recovery Plan. The regional group will develop guidance and provide support to both better identify flow deficiencies and to help develop watershed PEPs.

Identify Flow Related Problems and Salmon Recovery Flows

Many of the 14 Puget Sound watershed planning areas identified flow as a limiting factor for salmon recovery. However, few watershed plans provide specific remedies to address flow deficiencies.

The Conservation Commission's Limiting Factors Analysis, WDFW's Central Puget Sound Low Flow Survey, and other local research identify flow related problems. Agencies, tribes, and watersheds will build on these earlier efforts to better identify flow related problems. This may take the form of specific field work and/or the application of emerging scientific research, such as Shared Strategy's Stillaguamish pilot project, to identify flows that support salmon recovery.

While identification of flow related problems and remedies can occur relatively quickly, identifying specific recovery flows may take time. Additional research is likely in many watersheds and management options need to be determined. The lack of specific recovery flow targets, however, will not impede progress where problems are known.

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Photo by Dan Kowalski

Develop Instream Flow Protection and Enhancement Program

To support salmon recovery, watershed PEPs need to identify and implement actions necessary to protect and achieve adequate flows. These action programs can follow a basic template that includes both process and substantive elements. Process elements may include:

- Schedule for actions;
- Research;
- Responsible parties;
- Monitoring;
- Funding strategies;
- Incentives;
- Compliance; and,
- Adaptive management.

A wide variety of tools are needed to support flow protection and enhancement. PEPs will describe how these tools address flow as a limiting factor and include actions to achieve recovery flows. The state will support development of PEPs and take actions to achieve flows commensurate with salmon recovery. PEP elements are likely to consist of the following:

- Strategies to address the adverse flow effects where existing or future land use negatively impact fish habitat;
- Instream flow monitoring;
- Water rights compliance programs;
- The measuring and reporting of water use;
- Water conservation and reuse programs;
- Stormwater management programs;
- Implementation of the Municipal Water Law consistent with required linkages with watershed plans and conserved water provisions;
- Flow improvements through processes such as FERC license renewals and Habitat Conservation Plans;
- Multipurpose storage through new reservoirs or improvements to existing facilities;
- Aquifer recharge and recovery;

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- Infrastructure improvements in irrigation systems;
- Implementation of the trust water-right program and water banking;
- Water management techniques such as conjunctive use of surface and ground water sources; and
- Placing conditions on new water right permits to protect instream flows.

For the watersheds planning under the Watershed Planning Act some of the ideas for a PEP are proposed or in place. In those cases, implementation would be done through plan implementation. For watersheds not planning under the Watershed Planning Act, the State will take a more active role to work with tribes, local communities and other interested parties to develop the PEP programs.

Next Steps

Protecting and achieving in-stream flows for recovery will require an aggressive and coordinated effort among all interested parties. Within the next year the program to achieve flows will need to be designed in detail. Responsibilities will need to be defined and the parties to the program will need to commit to carry it out successfully to achieve in-stream flows in the next ten years. A critical initial step in the development of the program will be an estimate of the costs for implementation and how to secure funds for actions necessary to achieve the desired flows.

Habitat:

Forest Management and Puget Sound Salmon Recovery

The purpose of this regional strategy on forest practices is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team (TRT). This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

"We (the timber industry) know that we are an environmental factor in every one your watersheds. We are connected to two Northwest icons – we are the evergreen state and we love and adore salmon."

Bill Wilkerson, Executive Director, Washington Forest Protection Association

Large woody debris log jams are important features of healthy salmon habitat on the North Fork Nooksack River. Photo courtesy the Washington State Salmon Recovery Funding Board.

Many of the watershed chapters in this Puget Sound Salmon Recovery Plan identify damage from past forest practices among the factors that contributed to salmon declines. Every watershed in Puget Sound has forest lands in the uplands and in some cases down into the lowlands as well. How these forests are managed has a direct bearing on salmon survival and persistence, affecting such factors as stream temperature, sediment loads, hydrology, riparian buffers, and large woody debris.

Under federal law, all forest lands in Washington State have to be managed to standards that comply with the Endangered Species Act including federal forest plans, state rules, and various Habitat Conservation Plans. There are five major categories of ownership that manage forest lands in the Puget Sound region: federal agencies, Washington State Department of Natural Resources, Tribes, private timber owners of large landholdings and small forest land owners. This distinction in ownership is important because several of the federal and state laws covering forest practices are tailored to these different ownerships. Federal forest lands are covered by the Federal Forest Plan. State and large private ownerships are covered by the Forests and Fish Rules as well as the Federal Clean Water Act and Endangered Species Act. Small land owners are governed under the same laws but by different standards than large land owners under the Forest and Fish Law. Tribal lands are governed by Federal Indian law.

Two important issues for salmon recovery that spans all ownerships are the maturity of the forest cover in a watershed and the status of riparian conditions along salmon streams. Several watersheds in Puget Sound are susceptible to significant changes in hydrology based on the percentage of mature forest cover. These changes to hydrology from the collective rate of timber harvest in a watershed can significantly affect salmon habitat. The cumulative result from harvest on different land ownerships needs to be addressed in watersheds that are sensitive to these changes and is identified in the individual watershed chapters. Addressing this issue of forest cover will require a regional effort in partnership with local watershed groups, the Forest Service, the Department of Natural Resources, the Washington Forest Practices Board, timberland owners and others. This effort needs to be initiated early in the implementation of this recovery plan.

Riparian forest management is widely divergent depending upon land ownership. A consistent, although not identifical approach that recognizes the habitat needs of fish independent of ownership is necessary to promote and sustain the long term health of listed fish species.

Northwest Forest Plan

The management of federal forest lands is a key factor for salmon recovery in many of the fifteen watersheds of Puget Sound. Litigation over the management of federal forests in the Northwest, in combination with broad public demand for change, led to a 1993 Forest Conference convened by then-President Bill Clinton who declared a mandate to develop an ecology based forest management scheme. The effort produced the Northwest Forest Plan (NWFP), the first ecosystem management plan for public lands.

While the plan was initially prompted by the conflict over the spotted owl, its implementation has important implications for salmon conservation. The Northwest Forest Plan is an overall vision for the federal forests of the Pacific Northwest that would produce timber products while protecting and managing impacted species. The Plan focuses on five key principles:

- Consider human and economic dimensions of the problem solution;
- Protect long-term health of forests, wildlife, and waterways;
- Focus on scientifically sound, ecologically credible, and legally responsible strategies and actions;
- Produce a predictable and sustainable level of timber sales and non-timber resources;
- Ensure that Federal agencies work together.

The mission of the NWFP is to adopt coordinated management direction for the lands administered by the US Department of Agriculture (USDA) Forest Service and the US Department of Interior (USDI) Bureau of Land Management and to adopt complementary approaches by other Federal agencies within the range of the northern spotted owl. The management of these public lands must meet dual needs: the need for forest habitat and the need for forest products.

The Northwest Forest Plan covers 24.5 million acres in Oregon, Washington, and California that are managed by a variety of Federal agencies. Since its implementation, logging in the affected area has dropped by more than 80 percent.

The Aquatic Conservation Strategy (ACS) is part of the Northwest Forest Plan that specifically addresses salmon and their habitat. The ACS recognizes the destructive impacts of bad logging practices – especially clear-cutting on steep slopes, fragile soils, and in streamside corridors. This strategy was intended to ensure that logging and road building would not damage salmon bearing watersheds, and to "maintain or restore" habitat for salmon and other aquatic species. In March of 2004 the Bureau of Land Management and the Forest Service completed an overhaul of the Aquatic Conservation Strategy, and the environmental results of these changes are being debated.

The health of Puget Sound watersheds and the success of salmon recovery depend in part on the ability of the Federal Forest Plan to achieve its intended objectives. As the Puget Sound Salmon Recovery Plan is implemented over the next ten years, it will be important to forge a strong partnership between the Forest Service and other federal agencies to ensure recovery efforts in each watershed of Puget Sound are successful.

Scientest measuring stream temperature on forestland. Photo by Keith W. Wood, courtesy the Washington Forest Protection Association.

Washington State Forests and Fish Rules

The focus of this section is on the state's Forests and Fish Law and its connection to Puget Sound salmon recovery planning efforts. The Forests and Fish Law standards are applied mostly to private owners of large landholdings and the Department of Natural Resource timber lands. Small landowners are provided specific exemptions from the standards in the Forests and Fish Law. These exemptions may be important for the long-term future of small timberland owners. However, in some watersheds the number of small landowners is a significant portion of a watershed and collectively the management of these lands can have a significant effect on salmon recovery. In these watersheds there needs to be an effort to work with the small landowners to support their needs and the needs for salmon recovery or revise current forest practices rules.

The Forests and Fish Law, a product of the Forests and Fish Agreement (F&F) was enacted in 1999 with rules to implement it adopted in 2001 by the Forest Practices Board. It is one of the regulatory programs included in this salmon recovery plan and its successful implementation is a key element for the overall recovery of salmon.

The updated rules changed how non-federal and non-tribal forest lands in Washington State will be managed to protect key habitat functions and maintain an economically viable timber industry. There is general acknowledgement that it will take many years to see some of the effects of those changes.

The monitoring and adaptive management program is therefore a critical mechanism in the rules for making adjustments if needed based on scientific research.

Specifically, F&F's stated purpose is to provide protection for fish habitat and water quality on non-federal and non-tribal forest lands by changing the way forest managers build and maintain roads, protect riparian habitat and unstable slopes, and conduct other forest practice activities, and by changing the way forest managers monitor the effects of on-the-ground forest management activities.

Specific to F&F, the important questions for the Puget Sound recovery program to answer are:

- How will the forests and fish rules and compliance activities on non-federal and non-Tribal forest lands contribute to recovery?
- How can the results of forests and fish actions be quantified and integrated with the results of other habitat actions in the recovery plan?

The first question may be answered in a general way by citing the F&F rules and how they are structured to contribute. The challenge for local planners in individual Puget Sound river basins is how to answer this question specifically in their recovery chapter. This is particularly true for watersheds with large land areas covered by forests where they have specific questions unique to their watershed about how F&F compliance actions contribute to recovery. As this section discusses later, F&F is not structured to answer detailed questions for individual watersheds. It is through the Forest Practices Board adaptive management program or through the Courts that watershed organizations have the opportunity to influence changes in the forest practices rules affecting salmon survival and persistence in their local areas.

The second question about quantifying and integrating F&F results with those of other habitat actions is being addressed in part through the

Vantage of the Cedar River watershed. Photo courtesy Department of Natural Resources and Parks.

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"Intensively Monitored Watersheds for Effectiveness Monitoring (IMW)," a partnership between the Washington Department of Fish and Wildlife, Department of Ecology, and Forests and Fish. F&F's Cooperative Monitoring, Evaluation and Research committee (CMER) has allocated $2.3M to this program in their work plan to 2010.

The idea behind IMW is that the complex relationships controlling salmon response to habitat conditions can be understood by concentrating and integrating monitoring and research efforts at a few locations. IMW is intended as an efficient method of achieving the level of sampling intensity necessary to determine the response of salmon to a set of management actions, including those in F&F. It is hoped that the information from this research can be applied to many watersheds. In those cases where the information is not readily transferable, local watersheds may need to develop their own research and monitoring plans to answer the integration question over time.

Over time, through a combination of monitoring and research by F&F and by salmon recovery groups, the above questions will be answered. However, this will require forging a long-term relationship between people working on F&F and Puget Sound salmon recovery.

F&F and salmon recovery groups

A long-term relationship is desirable for both F&F and salmon recovery groups because they share a common interest in:

- Increasing certainty and confidence that the investments being made both upstream and downstream in Puget Sound watersheds will pay off.
- Developing a workable approach for forestry interests and watershed interests to communicate both about what is being learned through research and monitoring and about other topics of mutual concern.
- Identifying specific areas, in addition to monitoring and adaptive management, where coordination, engagement and integration are mutually beneficial and practical.

The above statements can serve as general goals on which to focus the relationship, and when achieved, will help answer the above questions for the salmon recovery program.

Common strengths and interests

At the Shared Strategy 2005 Summit, F&F and Puget Sound salmon recovery representatives agreed that they share common strengths and interests to support building a good working relationship and to support each other in meeting desired habitat improvement goals for salmon.

- **Both programs recognized as strongest of their kind**
  F&F is recognized by many as having the most rigorous regulations of its kind in the country with the commitment of the federal and state agencies, most Tribes, local governments, and private forest landowners to implement it. The Puget Sound recovery plan is unique in building the strongest commitments from local forest product related communities for implementation for any listed species (with more commitments expected to be solidified in the next months). Both F&F and the recovery plan emphasize implementing actions on-the-ground, testing the effectiveness of those actions against goals and targets, and making changes as new information is learned over time.

- **Commitment to both salmon and economic vitality**
  Both F&F and the Puget Sound salmon recovery approach recognize the value of vibrant natural resource economies, the importance of preserving working lands, and the necessity of protecting and restoring ecosystems. Both have stated goals that commit to actions and solu-

tions that address the needs for both salmon and economic vitality.

- **Mutual desire for investments to pay off**

Both F&F and watershed recovery groups want to be sure that investments being made upstream and downstream in Puget Sound watersheds will pay off. For example, F&F leaders are interested in coordinating restoration activities such as sequencing the removal of fish passage barriers and other improvements where it makes sense.

Conversely, watershed groups are interested in sharing information collected in their watershed that would also benefit the forested parts of the watershed. Both efforts recognize that they would gain from knowing more about each other's plans and from understanding better what information each needs to have from the other to help them maximize their respective investments.

- **Opportunity to learn from each other and coordinate activities**

Both forestry and salmon recovery representatives (as confirmed at the 2005 Summit) agree that it is in everyone's best interest to develop a practical approach for forestry and watershed interests to communicate about what is being learned through their respective adaptive management programs and about topics of mutual concern. There are also opportunities where coordination of certain activities might be mutually beneficial and practical such as coordinating barrier removals up and down stream, fundraising for small forest landowner incentives, fundraising to carry out research and monitoring projects, and working together to build needed political and public support. It should be possible to save costs by sharing monitoring and research information and by coordinating activities of mutual interest.

Roads on working forestlands are being repaired and maintained to prevent sediment from entering streams. Photo by Keith W. Wood, courtesy the Washington Forest Protection Association.

Constraints, pressures and concerns

It is important to acknowledge, understand and respect the issues that can make it difficult or challenging for the two efforts to connect effectively. These can be addressed once people agree on common goals, clarify roles to achieve them and remain committed to working through or respecting constraints and areas of difference.

- **Concerns about future results on both sides**

One of the challenges to effectively connect F&F and watershed recovery groups stems from the history of their development. The development of the Forests and Fish agreement and the Shared Strategy recovery planning process have occurred on separate tracks, along slightly different time frames, have involved different people, and have experienced limited communication between them. In addition,

	Forest and Fish	Puget Sound Recovery Plan
Geographic scale	State-wide, sub-divided into East and West Washington	Watershed-based, rolled up into Puget Sound basin
Scope	--Habitat only --Multi-species (fish--listed and not, and specific amphibians)	--All 4 H's: habitat, fish harvest, hatchery and hydro management ---listed salmon species (although some local chapters include non-listed salmon species as well)
Goals	Regulatory compliance on non-federal, non-tribal forest lands to meet ESA & CWA requirements; restore & maintain riparian habitat to support harvestable supply of fish; keep timber industry economically viable	Recover and maintain an abundance of naturally spawning salmon at harvestable levels; support viability of natural resource economies in context of recovery
Roles	Manage habitat functions	Recover salmon populations
Results tracking, measuring	By resource objectives (e.g. water temperature) and performance targets for East or West Washington	By fish objectives--salmon population viability parameters (VSP): abundance, productivity, spatial distribution and diversity

Figure 6.1

Forests and Fish is a state-based plan while watershed planning is done on a local and regional basis. This means that the respective needs and goals of the two efforts were not correlated early on, contributing to some of the questions about effectiveness and adequacy expressed about both.

Groups involved in both F&F and salmon recovery continue to have concerns about the long-term effectiveness respectively of both the F&F rules and the salmon recovery plan. Since both recognize the inter-dependent effects various land-use activities have on the ecosystem, they want some level of certainty that their respective investments pay off. For example, some forestry representatives worry about the effectiveness of local land use regulations' ability to protect salmon habitat in developing areas. Some watershed and tribal representatives worry that the F&F rules are not structured to address ecosystem level issues such as the rate of timber harvest, landscape effects on watershed hydrology, cumulative effects, riparian management and interactions of forestry related effects with the impacts of climate change, especially on watershed hydrology. Both are concerned about the availability of adequate funding to implement needed actions.

Some watershed groups and tribes have also expressed concern that the F&F adaptive management program has yet to consider changes to forestry practices in light of new scientific information. They fear that once the F&F agreement is accepted as an HCP, there will no longer be an incentive for industry to change management practices. F&F representatives counter that the program is still new and that it will take time for the positive effects of restoration actions to manifest.

To date, groups in the two efforts have had limited and sometimes unsatisfactory interactions that would help them understand each other's needs and constraints better and build confidence in each other's programs.

"Interested parties are encouraged to participate through the cooperative monitoring evaluation and research committee. The forest practices board will consider research requests directly from the public as well."

Joseph Pavel, Co-Chair, Forest and Fish Policy Group and Northwest Indian Fisheries Commission

Summit 2005 participants agreed that it is to everyone's mutual interest for F&F and Puget Sound salmon recovery to forge a productive relationship. They agreed that while we may have differences or worries about each other's efforts, we can work together and should turn the focus to: what can the two efforts work on together to the mutual interests of both?

- **Differences in scale, scope goals, roles and results tracking**

Some of the challenges for connecting F&F with watershed recovery stem from differences in geographic scale, scope, goals, roles and how results are tracked and measured. These differences make it particularly difficult to answer the question: how can the effects of forests and fish compliance actions be quantified and integrated with the effects of other habitat actions in the recovery plan?

Both F&F and the salmon recovery plan aim to have harvestable populations of salmon back. The main challenge in the above differences lies in the fact that tracking and measuring results occur at different scales and focus on related but different objectives.

F&F is focused on habitat management as the key forest practices contribution toward salmon recovery. Monitoring information tracks the effectiveness of forest practices toward achieving habitat suitable for the protection and recovery of fish populations. The Puget Sound Recovery Plan, on the other hand, intends to track recovery through monitoring results of actions on fish populations. This approach must eventually take into account the broader cumulative effects of harvest management, hatchery influence, ocean conditions and freshwater and nearshore habitat in order to identify factors contributing to salmon population growth or decline.

Once these differences and their implications for connecting the two programs are better understood, it should be easier to figure out how to work effectively together, to determine what types of data are readily available, what types may be harder to collect, what types are better gathered and provided by others outside the F&F program, and so on.

Strengthening the relationships

Anyone involved with salmon recovery knows that it will take decades before this important economic and cultural icon is once again hale and hearty. While much is already known to start us moving toward a positive trajectory, most scientists and planners also agree that we still have a great deal to learn about what will help bring the salmon back. More to the point, we have much to learn about how to bring the salmon back while meeting other human land use needs, and about how to understand and achieve the balance that is best for both people and fish.

Monitoring and research closely tied to adaptive management programs are key to the ongoing learning process necessary to achieve recovery goals and enjoy economic prosperity. F&F and

Photo by Keith W. Wood, courtesy the Washington Forest Protection Association.

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Photo by Keith W. Wood, courtesy the Washington Forest Protection Association.

salmon recovery groups can help each other over time by sharing what they learn from their respective monitoring and research efforts.

There will be informational needs that F&F does not or should not be expected to provide, due to the differences in figure 6.1 related to the upper portions of individual watersheds, and to direct fish results. Additionally, since F&F does not apply to all forest ownerships, cumulative result from harvest on different land ownerships will need to be addressed in a coordinated way. Others, at the state, tribal, regional or watershed levels will need to craft adaptive management programs to address informational needs unique to specific geographic areas and to evaluating the results of actions on fish populations.

Work continues to refine and complete the adaptive management programs for both local watershed chapters and the regional plan, and questions about who is best positioned to gather needed information not covered by F&F or other programs, for that matter, is one of the questions that needs to be resolved. How to achieve economies of scale by allocating and coordinating monitoring and adaptive management activities is another question that will be considered.

F&F adaptive management program

The Forest and Fish Rules are designed to meet specific biological goals and objectives for water quality and fish habitat within a context of maintaining the sustainable economic viability of the timber industry. The Rules recognize that current scientific knowledge lacks the certainty to answer all pertinent questions associated with the forest practices rules. To gain the answers that allow the dynamic nature of the science to evolve, F&F envisioned an Adaptive Management Program to address the effectiveness of forest practices rules in aiding the State's salmon recovery effort, and to provide recommendations to the Forest Practices Board on proposed changes to forest practices rules to meet timber industry viability and salmon recovery.

The adaptive management program must also provide "assurances that rules and guidance not meeting aquatic resource objectives will be modified in a streamlined and timely manner (WAC 22-08-035)."

Specifically, the adaptive management program's purpose is: "to provide science-based recommendations and technical information to assist the board in determining if and when it is necessary or advisable to adjust rules and guidance for aquatic resources to achieve resource goals and objectives. The board may also use this program to adjust other rules and guidance. The goal of the program is to affect change when it is necessary or advisable to adjust rules and guidance to achieve the goals of the forests and fish report or other goals identified by the board. There are three desired outcomes:

1. Certainty of change as needed to protect targeted resources;

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2. Predictability and stability of the process of change so that landowners, regulators and interested members of the public can anticipate and prepare for change;
3. Application and quality controls to study design and execution to the interpreted results" (WAC 222-12-045).

The Forest Practices Board has established monitoring and research objectives and performance targets for "key aquatic habitat functions" fish need for survival. Initial areas of study and monitoring include: temperature, large woody debris, sediment, hydrology, chemicals, stream-typing and fish passage.

The Forest Practices Rules further provides for the general public to propose adaptive management projects to the Forest Practices Board. This allows salmon recovery groups to engage with the process. It is also entirely possible that certain types of research and monitoring will need to be conducted by others outside the F&F adaptive management program. One of the proposals in this plan is to have the salmon recovery implementation organization (TBD as of this writing) coordinate the appropriate linkages between specific watershed groups and the F&F adaptive management program.

Long-term Partnership between Forest and Fish and Salmon Recovery

To take advantage of potential synergies between F&F and salmon recovery efforts, it is necessary to establish ongoing coordination and communication linkages.

An on-going linkage can most efficiently and effectively occur between the existing F&F policy group and the Puget Sound recovery implementation organization (TBD). The future salmon recovery implementation organization can serve as a bridge between local watersheds and F&F. The groups would continue to refine the ongoing relationship and coordinate activities that emerge as desirable and offering mutual benefit.

A starter list of opportunities to coordinate various activities to the mutual benefit of both F&F and salmon recovery interests includes:

- Sharing lessons learned from monitoring and research activities.
- Requesting specific and strategic adaptive management projects for consideration by the Forest Practices Board.
- Communicating monitoring and research needs and the studies underway for habitat functions covered by F&F, and communicating about monitoring and research needs and programs that will be covered by others.
- Coordinating restoration efforts such as sequencing of fish passage barrier projects from the lower to the upper watershed.
- Working together on legislation and fundraising where mutually beneficial.
- Coordinating public education and outreach where mutually beneficial.
- Working together to help small forest land owners implement fish-friendly practices without undue economic hardship.

Habitat:

Proposal for the Prosperity of Farming and Salmon

The purpose of this regional strategy on farming and salmon is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team. This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

"This work takes many leaps of faith and a bucket full of optimism, but we are making progress."

Dave Hedlin, Skagit Farmer

Farm at Parson's Creek. Photo courtesy the Washington State Salmon Recovery Funding Board.

Moving Beyond Past Conflicts to a New Future

Agricultural land use is one of the identified factors affecting salmon populations. This strategy focuses on creative solutions that address opportunities for salmon recovery on agricultural and small family forest lands by working with farmers and small family forest landowners to pursue both the future of farming and the future of salmon. There are many federal, state and local laws governing farming and forestry practices. This strategy is not intended to change those requirements but to provide a more effective program for incentives that encourages farmers and small family forest landowners to actively participate in the recovery of salmon.

Both farmers and small family forest landowners face many of the same challenges and pressures in terms of conversion due to development and have similar opportunities for restoration and conservation activities. In addition, many of the salmon-bearing rivers in the region are bordered by farmland and forestland, and effective strategies for promoting conservation and restoration on these lands is a vital element of the recovery strategy. This parallels other efforts to improve habitat conditions in urban, suburban and forested areas and to operate effective harvest and hatchery programs for the Puget Sound region. Please note: farming as referred to in this paper refers to both agricultural and small family forest operations.

Farm and fish advocates have often had opposing interests over the last several decades, particularly in 1999 following the listing of salmon in Puget Sound. Those groups advocating for fish have seen farmers as helping to cause the environmental decline in local waterways, while farmers have seen fish advocates as causes of increased regulations that limit their ability to farm and maintain small family forest operations. In the past, fish and farms have been pitted against each other in the political process at both the local and state level. However, many people now believe that choosing farms over fish or fish over farms is a false choice. In reality we need both to flourish in a manner that complements the other. In Puget Sound watersheds where farmers, tribes, local governments and environmental groups have started working together, there have been significant strides for both fish and farms.

"Over the last year we continued to look for ways to put aside differences in search of common ground. This accord (a farmer/tribal accord) provides a solid foundation for building trust and finding real solutions to some of the biggest challenges that we face."

Steve Sakuma, Board Member of Skagitonians to Preserve Farmland and Western Washington Agricultural Association.

The premise of this strategy is that farming that is done in an environmentally sensitive manner is a good neighbor for fish and incentives should be provided to those farmers and for those farms where operations are conducted in ways that protect and restore Puget Sound Chinook. Inherent in this premise is the connection between the preservation of salmon friendly farming, farmland and the preservation of salmon habitat. Given the impacts to water quality and habitat associated with urban development and the fact that many farms border salmon bearing streams, it is clear that efforts are needed to protect and preserve these farm lands. The presence of too many blanket regulations on farming limits the farmers' ability to make a profit. This increases the pressure on the farmer to sell to development interests where the land will provide less benefit to the environment.

Moving to a new future means finding ways to understand and support the needs of the farming community in Puget Sound; finding ways to improve the certainty that farmers will protect fish habitat and providing incentives for creating new habitat in a manner that supports farms too. The ultimate hope is that farming and fish advocates working side by side will create a future where protecting salmon is part of the daily business of farmers and supporting the prosperity of farms is a daily concern of fish advocates.

The Challenge

For more than a century, farmers have raised food for local tables, supported the growth of rural communities, and tended a vast landscape of fields and pastures in the river valleys of the Puget Sound region. Farming is vital to the economy of the state and the wellbeing of rural communities. It also contributes greatly to the environment of the region. Farms provide a rural edge next to developing communities, preventing urban sprawl into river floodplains. In the early part of the past century, the land adjacent to many Puget Sound rivers and streams was altered to improve the

productivity of farming and many of these changes had significant impacts on fish habitat. Today, many farmers understand the practical advantages of good conservation practices, and many are already protecting and restoring stream corridors, wetlands, and other natural features on their farms.

Farming in many parts of the region faces an uncertain future. Competition in the international markets for agricultural commodities has reduced prices for Puget Sound farm products while costs of land and raw materials continue to rise. Low profit margins have forced many farmers out of business and farmland is being converted to other uses at an alarming rate. For example, more than 20% of the farmland in the region, greater than 100,000 acres, was lost to other uses in the fifteen years between 1982 and 1997.

The future of salmon will depend in large part on the future of farming. If farming remains viable in the region and farmers expand their commitment to conservation, a major part of the salmon landscape (approximately 20% of the land along salmon streams in the Sound is in agricultural uses) will be protected. If farms are lost and replaced by sprawling suburban communities, a host of urban environmental problems will follow and a major opportunity for preservation and restoration will be lost. Put another way, if salmon recovery is possible in the Puget Sound region, it will be with the help of farms, not in spite of them.

A strong, healthy agricultural community is profitable, is viewed as a permanent part of the landscape and is fully integrated with the surrounding community. If the recommendations outlined in this paper become reality, we will have an agricultural industry whose practices are directly benefiting the health of salmon while also increasing the presence of local agriculture in the marketplace and surrounding community.

The following sections identify a set of projects and programs to promote an integrated set of farming and conservation actions on farms. Some of the actions can be implemented quickly through budget appropriations or program administration. Others may take a longer commitment. All have been recommended by farmers, small family foresters, as key actions to improve the viability and conservation potential of Puget Sound farms and family forests. To achieve success, a broad-based group of leaders at federal, state and local levels will need to support the funding and implementation of these recommendations.

The Tools

This proposal focuses on three initiatives, each with its own set of tools:

- Protecting & restoring fish habitat;
- Keeping salmon friendly farmland in farming; and
- Improving farming's bottom line.

Tools for Protecting & Restoring Fish Habitat

Many farms and small family forest lands border and impact salmon habitat. Our goal is to ensure that any impacts are positive and contribute to recovery goals. Using local science, fish and farm advocates should work together to determine goals for recovery, associated actions and projects, and jointly monitor for continued success. Providing the resources for programs and efforts to this end is crucial for salmon recovery on these lands.

Develop joint farm/watershed groups to identify goals and means for habitat enhancement and restoration projects.

The goals for salmon recovery within each watershed for the most part are currently defined through collaboration between local watershed groups, interested community members (including farmers in some cases), tribes, state and federal agencies. Local watershed groups identify the means and actions necessary to achieve the goals created through this collaborative process.

"The plan embraces a rural ethic of working together to achieve a common goal. Salmon and farmers have survived side by side for years; I have come to believe that the types of protections offered to fish in this plan can also benefit farmers."

Farmer Bill Knutsen, Carnation, WA

Andy Werkhoven of the Skykomish Valley speaks to farmers, biologists and planners during a planning meeting. Photo courtesy Snohomish County.

To ensure that the actions outlined in this paper are in line with the goals developed at the watershed level, the farm community needs to be involved with local watershed groups in a working partnership. Such is already the case in a number of local efforts and could serve as models for other watershed groups.

A partnership is the best means to define the role of the farm community in achieving recovery goals and to determine if the necessary actions are being implemented. A complimentary monitoring plan, with specific target milestones, that is based on local, available science (e.g., Limiting Factors Analyses) would help ensure that habitat improvements are occurring on local farmlands and provide a means to measure progress. This watershed/farming partnership is recommended to mutually identify:

- Objectives for the farm community contribution (in terms of acres restored, enrolled in easements, etc.) based on local science and recovery needs.
- A means for jointly identifying priority areas where projects are needed to protect or restore habitat functions and provide support to individual landowners who take the initiative to implement specific projects.
- A series of milestones to measure progress and identify areas for revised planning (i.e., here's where we all want to be and here's how we will track it).

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This partnership will help increase accountability that meaningful goals are set and achieved by both groups and allow opportunities for changes in practices as needed. The farming community's commitment to this type of watershed management, tracking, and evaluation program that has objectives specific to riparian areas, and is incentive-based, will help increase the certainty that these actions are undertaken and contribute to recovery goals. Providing support for this local dialogue and representation by the farming community in these discussions in a manner that does not create a hardship for individual farmers could be achieved by the development of a strong watershed/farm liaison to represent the local farming community consistently at meetings. This representative would also be involved in tracking and monitoring success as identified above. In addition, watershed representatives should attend regularly scheduled farm association meetings at times to reach a broader group of farmers when needed.

Provide more flexibility for farmers that want to engage in salmon recovery actions.

Although a number of federal incentive programs are available for Washington farmers and small forest landowners, the diversity of cropland, combined with eligibility and program requirements, may not allow for full participation. For farmers that want to participate in conservation activities, a program that offers state-level technical assistance and cost-share approaches for conservation practices is needed. Such a program could provide payments to farmers who undertake water quality and habitat improvements, provide technical assistance to help farmers identify what/how conservation activities can take place on their lands, and provide financial assistance for practices related to the presence of fish.

Newly planted Conservation Reserve Enhancement Program (CREP) buffer on Mary & Roy Anderson's farm in the Skagit Valley. Photo by Jagoda Perich-Anderson.

Providing an option for farmers who engage in these programs to also enroll in an easement program would help extend the effectiveness and investment in conservation practices over the long-term. The Conservation Commission, working through local conservation districts, should take the lead role in providing coordinated outreach and education to ensure all conservation programs are available in an easily accessible format. The primary goal of this exercise should be to assist in meeting the needs for salmon recovery as well as ensure that all programs create positive experiences for landowners that engage in conservation efforts, that these efforts take minimal time to participate in and that they enhance the farm's profitability.

Increase state funding for programs to lease land and share the costs of restoration activities.

One important incentive program currently available to local farmers is the Conservation Reserve Enhancement Program (CREP), which provides cost-share payments to farmers to set aside and restore natural areas. Washington State is currently participating in the program and every state dollar is matched with approximately ten federal dollars in assistance to farmers, making this one of the most attractive programs to engage in from a fiscal standpoint. Despite these very favorable terms, the state has recently had difficulties providing sufficient funding for the program. Ensuring a state commitment to fund CREP is a critical component of a highly utilized and successful program. In addition, the CREP program currently operates under an incidental take permit authorized by the Services. The CREP program should be reviewed to ensure that it is adequate to support recovery needs.

"Both farm and tribal communities share the same goals – a future in the Skagit Valley that fosters our cultural and social vitality, and assures our economic prosperity."

Brian Cladoosby,
Chairman of the Swinomish Tribe.

Broaden the WA State CREP program to cost-share a wider range of environmental projects.

Part of the state/federal deal to offer CREP in Washington State was an agreement identifying which farm conservation practices were eligible for cost-sharing. The state program is currently available only for stream buffers (CP 391). It would be desirable to open CREP to other practices, such as hedgerows, grass filter strips, wetlands and other water quality projects when the deal is renegotiated in 2007 and to insure that this program expansion is consistent with recovery needs. In addition, an option to enroll in a conservation easement program should be available to all CREP participants at the end of their lease contracts. Other states have already negotiated this type of agreement for their CREP contracts.

Promote conservation and restoration programs for small family forestlands.

There are a number of programs targeted at small family forest landowners to remove fish barriers, improve water quality, purchase easements, and enhance wildlife habitat. However, many landowners either are not aware of opportunities or do not have the time or resources to engage in these programs. Developing a brokerage program that serves as an intermediary between landowners with conservation/enhancement opportunities and government financial assistance programs may serve as a means to increase landowner participation in these programs.

Increase funding for the Forest Land Enhancement Program.

The Forest Land Enhancement Program (FLEP) is a federally funded program that provides education, technical assistance, and cost-share assistance to help non-industrial private forest landowners develop Forest Stewardship Plans and implement a variety of forest stewardship practices on their lands. Washington State currently receives around $400,000 per year for this program to work with close to 100,000 small family foresters. This is a very popular program that currently has a large backlog of programs due to insufficient funding. Supplementing the available federal funding for FLEP with state, private or other federal funds would help ensure increased opportunities for salmon habitat enhancement.

Encourage the development & implementation of stewardship plans on all Puget Sound farms and small family forest lands.

Many local government ordinances rely on voluntary stewardship plans to define practical conservation measures that are tailored to individual properties for environmental protection while still maintaining their function as working lands. Stewardship plans outline long term management objectives that are designed to conserve natural resources while maintaining economically viable forests and farms. Most government sponsored financial assistance programs require a landowner to have a stewardship plan in order to be eligible for funding. Providing additional financial and technical assistance to landowners to develop stewardship plans that are in line with priorities for habitat protection and restoration would result in an increase in the participation of farmers in conservation programs and lead to healthier watersheds. Currently, the Department of Natural Resources Forest Stewardship Program, WSU Extension and local Conservation Districts are the primary technical assistance providers to landowners who are interested in developing stewardship plans. Increased financial support to these agencies to promote stewardship plan development on small forest and farmlands is recommended.

Careful planning is required to allow for continued urban and residential growth and development, while preserving farmland and preventing incompatible development in agricultural communities.

Tools for Keeping Farmland in Farming

Preserving farmland is a key component of the salmon recovery plan. Incentives are needed to keep farmers farming and discourage conversion of farms to other uses. Further loss of agricultural lands will jeopardize the economic future of remaining farmers and foreclose options for a partnership between farming and salmon recovery that could serve both interests successfully.

Provide more state and federal funding for programs to purchase development rights.

As residential development encroaches into farm communities, the value of farmland can rise abruptly to the point where farmers can't expand their operations or continue to pay rising taxes. The increase in land value is also a powerful inducement to sell farmland for residential or commercial use. One very effective tool to keep farmland in farm use is to provide the opportunity for farmers to sell development rights - the rights to develop the land for residential and commercial use – while leaving the underlying farm and rights to continue farming to the farmer. Funds for the purchase of development rights should have as their highest priority those farms where activities are conducted in ways that promote salmon recovery and are threatened by development.

Prioritize the allocation of funds for best effect.

Funding for programs to purchase development rights (PDR) is in short supply and it is important to allocate these dollars where they will do the most good. Agricultural commissions (where available) should work with watershed groups to develop a prioritization scheme for funding local PDR programs based on their specific needs and conditions.

Ensure that local planning efforts work to preserve salmon friendly farmland and forestland.

Emphasizing farmland and non-industrial forestland preservation in any planning decisions taking place at the local or state level can have a significant impact on the effectiveness of preservation programs and the ease with which they can be run. Agricultural commissions, where available, and local governments should strategize about how to use existing local government programs and ordinances to achieve the desired goal of preserving farmland and preventing incompatible development in agricultural communities. This work should be included as an element of the model ordinance program proposed in the economic development section noted previously as well. The development of Comprehensive Irrigation District Management Plans (CIDMPs) should also be encouraged to ensure that farm and fish compatible goals are set and achieved.

Ensure that farmers can undertake ditch maintenance activities that protect drainage and salmon.

Providing for ditch maintenance to occur on farms is an essential component of a preservation strategy. Some farmland can't be farmed if the fields can't be drained. Impediments to drainage are a major contributing factor to the uncertainty facing farmers in the future, which in turn translates into increased pressure for the conversion of farmland to other purposes. Refining state administrative requirements surrounding ditch maintenance practices that are designed to protect salmonids is a key element of farmland preservation that should be undertaken by relevant agencies.

Tools for Improving Farming's Bottom Line

Working to ensure the sustainability of agriculture in the region is important both economically and environmentally. The creation of a market demand for goods produced with an eye towards salmon recovery will naturally increase the number of farmers engaging in conservation practices. In addition, the development of market forces promoting local, environmentally sound agriculture will help ensure the sustainability of the industry overall.

Provide economic development support for the agricultural community.

Increase the state commitment to enhance economic development for Puget Sound agriculture. A comprehensive economic development strategy includes: increased state purchasing of local agricultural products (purchasing local agriculture for state institutions whenever possible), financing economic development strategies for farming communities and individual farms, and providing access to capital to support sustained economic development plans. Both commodity and specialty farms should be targeted as part of this effort to help sustain agriculture as an industry overall, with a different menu of tools available for each. In terms of economic development, emphasis should be placed on commodity farms that traditionally support the overall infrastructure of agriculture, accompanied by complimentary efforts to target smaller niche farms.

Remove current, fiscally based regulatory impediments for agriculture.

Develop a model agricultural ordinance that supports a strong, healthy agricultural industry while providing for the protection and/or restoration of salmon habitat. The Shared Strategy will work with local farm communities and fish interest to develop recommendations to local governments regarding legal and regulatory frameworks that can help promote the economic vitality of agriculture. Working with local officials, these model standards will be incorporated into local ordinances to remove unnecessary impediments to modernizing agricultural production and marketing, and ensure that local programs and policies support economically viable farming and the preservation of farmland.

Components of a model ordinance would provide for the protection and restoration of habitat, strengthen right-to-farm laws and allow for on-site processing and agri-tourism in a manner that does not conflict with other critical community objectives. In addition, Washington State Department of Community, Trade and Economic Development (CTED) should revise the model agricultural ordinance in conjunction with agricultural and environmental groups, tribes, the Washington State Department of Agriculture, the Washington Department of Fish and Wildlife and the Conservation Commission to ensure that local ordinances do not hinder healthy agriculture and promote protection and restoration of fish habitat.

Promote local, fish-friendly agricultural and forestry products in the marketplace.

Work with farmers to develop a regional branding strategy that fulfills both the desire to increase market value for local goods and contribute to healthy salmon runs in the development of a "buy local, save salmon" marketing campaign. There are two types of programs available to farmers to help

Photo by Dan Kowalski.

Jason VanderVeen at his Whatcom County Dairy Farm.

meet this goal: local marketing/branding programs (such as Puget Sound Fresh) and environmental certification and recognition programs (such as Salmon Safe Certification). These programs have similar missions aimed at adding value to products by promoting sense of place, quality, variety, and environmental stewardship. These programs can be linked to further enhance the development of a farming community and marketplace that values local goods produced in an environmentally sound way, particularly in regard to water quality and habitat protection, and ensures the promotion of both local farms and specific practices that contribute to salmon recovery.

A unified certification/marketing effort will strengthen both program approaches by integrating salmon conservation and healthy watersheds into the regional branding and marketing identity in a way that will further promote the goals of the Shared Strategy. Shared Strategy could bring regional marketing and certification groups together to identify a common "buy local, save salmon" goal and promote opportunities for collaborative program partnerships.

The Opportunity

In the coming year, the focus of the Puget Sound salmon recovery effort will shift from development of the recovery plan to the first steps of implementation. One major task will be to secure the commitments from federal, state, and local officials, tribal leaders, and other key stakeholders to follow through on funding and other responsibilities under the plan. Although the Shared Strategy can provide support for the initiatives suggested in this paper, it will be up to groups and individuals at the local level who are best in tune with their needs and interests to make this effort successful. The implementation of these recommendations for farms and fish need to be developed at a community or watershed scale to ensure the local characteristics of the farms and the fish needs are met.

Regional Harvest Management Strategies

The purpose of this regional strategy on Harvest Management is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team (TRT). This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence. The strategy on harvest management described in this section relies upon the Comprehensive Chinook Harvest Management Plan developed by the state and tribal co-managers and adopted by NOAA-Fisheries as the Resource Management Plan (RMP) under Limit 6 of the 4(d) Rule. If there is a conflict between the regional strategy or watershed chapter and the RMP in implementation, monitoring or adaptive management, the RMP shall take precedence. In addition, the reporting requirements of the Plan and the RMP should be aligned to be consistent with data availability and efficient in use of resources.

"We all must work together for the benefit of the salmon-as tribes, as citizens, as Americans, and as Canadians. It's everyone's responsibility and duty to make sure these precious stocks don't deteriorate further and are restored to stable healthy conditions."

W. Ron Allen; Jamestown S'Klallam Tribal Chairman and Commissioner on the US/Canada Pacific Salmon Commission


Tribal fish trap. From the collection of the Washington State Archives.

Harvest management strategies that would ensure the return of a portion of the salmon runs to their home spawning grounds have been implemented for thousands of years in the Pacific Northwest. Until the mid-19th century, aboriginal people spread their harvest patterns across different locations and times, sometimes using weekly closure periods to pass salmon upstream. These measures, combined with pristine habitat, allowed salmon runs to flourish over many millennia. Without exception, early European explorers marveled at the abundance of salmon in Pacific Northwest rivers.

The combination of accelerated habitat modification and the advent of industrial fishing methods in the late 19th century resulted in an almost immediate decline in salmon abundance. Early hatchery operators in Puget Sound were optimistic that they could stem this decline with massive hatchery programs. As the runs of salmon dwindled further in the late-20th century, fisheries managers struggled to protect remaining runs and accommodate the ability of fishers to catch salmon for their livelihood, sustenance and recreation. Eventually it was recognized that more focus was needed on wild fish within the complex legal and biological structure of harvest management in Puget Sound. (Taylor and Cronon, 1999).

Conservation principles were explicitly recognized in the legal proceedings of *US v. Washington* in the 1970s. Following this decision and that of the US Supreme Court upholding it, the co-managers (the treaty tribes and the State of Washington) grouped all Puget Sound salmon runs into management units with separate conservation objectives. In 1985 the US District Court adopted the current version of the Puget Sound Salmon Management Plan, which establishes the principles and legal guidelines under which harvest and hatchery management are conducted by the co-managers.

As noted in chapter 3, fisheries affecting Puget Sound Chinook are implemented under the principles of the Pacific Salmon Treaty, the Magnuson-Stevens Act, *US v. Washington*, and associated legal and policy forums. This structure involves a wide variety of jurisdictions including Canada, the states of Alaska, Washington, Oregon and California, and approximately 25 treaty tribes. Fisheries managers at all of the forums fully recognize the necessity of providing productive spawning salmon in the rivers and streams that constitute the home of Puget Sound Chinook. At the same time, they seek to provide meaningful fishing opportunities in the ocean, Puget Sound marine areas and river systems that target abundant natural and hatchery populations.

Although harvest strategies for protecting and rebuilding Puget Sound Chinook will continue to be implemented through all three of the primary harvest management forums, the near-term focus of the regional harvest strategy for recovery falls within the co-managers' forum under *US v. Washington*. It is within these fisheries that the bulk of harvest adjustment for the majority of Puget Sound Chinook stocks must be made on a year-to-year basis to meet the conservation and rebuilding needs of Puget Sound Chinook. Puget Sound treaty tribes and the State of Washington developed the "Comprehensive Resource Management Plan for Puget Sound Chinook: Harvest Management Component" (hereafter referred to as the Chinook Harvest Plan) in 2004 to establish harvest and recovery objectives and actions for the 2004-2009 fishing years.

In addition to the provisions of the Chinook Harvest Plan, harvest management activities including monitoring, assessment, enforcement and research will occur in all of the management forums. Co-managers working in coordination with local watershed groups have also developed watershed-specific harvest management measures to contribute to the recovery plan.

Comprehensive Chinook Harvest Management Plan

The Endangered Species Act prohibits the take of threatened and endangered species by harming or harassing the listed species. However, a Resource Management Plan (RMP) prepared under Limit 6 of the 4(d) rule ensures that the co-managers are not subject to the prohibition on "take" under the Endangered Species Act while conducting harvest of Puget Sound salmon under the terms of the RMP. The Chinook harvest plan serves as an RMP under the Act, and was designed to:

- Ensure sufficient spawners to maintain population stability, given current habitat productivity.
- Set maximum limits on exploitation rates during recovery.

- Allow populations to expand as habitat improves.

Goals and Objectives

The Chinook Harvest Plan states the fundamental intent of the co-managers to:

Ensure that fishery-related mortality will not impede rebuilding of natural Puget Sound Chinook salmon populations, to levels that will sustain fisheries, enable ecological functions, and are consistent with treaty-reserved fishing rights.
(PSIT & WDFW, 2004)

Several objectives that address catch accounting, management of risk in the conduct of fisheries, and adhering to the principles of existing salmon management plans and the Pacific Salmon Treaty are included in the Plan as follows:

- Conserve the productivity, abundance and diversity of the Chinook populations in the Puget Sound Evolutionarily Significant Unit.
- Manage the fisheries to account for the uncertainty and risk in estimating population sizes and the impacts of harvest.
- Meet the standards of the Endangered Species Act to insure that harvest does not, "appreciably reduce the likelihood of survival and recovery" of the ESU.
- Provide opportunity to harvest surplus production from other species/populations.
- Account for all sources of fishery-related mortality.
- Adhere to the principles of the Puget Sound Management Plan and legal mandates of U.S. v. Washington to ensure equitable sharing of harvest opportunity among tribes and among treaty and non-treaty fishers.
- Achieve allocation guidelines and conservation benefits defined by the 1999 Chinook Chapter of Annex IV to the Pacific Salmon Treaty.

Key conservation provisions of the Chinook Harvest Plan include:

Low Abundance Threshold (LAT): When the number of spawners falls to a very low level, there is a significant risk of biological instability and extinction. A Low Abundance Threshold has been established for each population well above the level of instability, and the threshold triggers additional conservation measures in intercepting fisheries.

Rebuilding Exploitation Rates (RER): Exploitation rates are calculated as the percentage of the total return that is caught in fisheries. Rebuilding Exploitation Rates are set at levels that have a low probability that harvest will reduce abundance to unstable levels, and high probability that escapement will increase. The rebuilding exploitation rates serve as a constraint on fisheries to allow populations to grow, if appropriate habitat conditions are present.

- Ensure the exercise of Indian treaty rights in "usual and accustomed" areas.

Puget Sound treaty tribes have noted their opinion that the opportunity to exercise treaty rights, while stated as an objective in the plan, is not currently being achieved due to the degradation of the abundance and productivity of Puget Sound Chinook. The Chinook Harvest Plan indicates that harvest curtailment alone cannot correct that situation without significant habitat restoration and recovery of Puget Sound Chinook populations.

"Harvest constraint can only maintain escapement at the optimum level associated with current habitat quality." (PSIT & WDFW, 2004)

The Chinook Harvest Plan does not eliminate all harvest on Puget Sound Chinook populations. A portion of the populations are still taken in Washington Coastal, Alaskan, Canadian and some

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Puget Sound fisheries. However, the intent of the Plan is, "to enable harvest of strong, productive stocks of Chinook and other salmon species, and to minimize harvest of weak or critically depressed Chinook stocks." (PSIT & WDFW, 2004)

Provisions of the Plan

The protective measures contained in the Chinook Harvest Plan are considered by the co-managers to be conservative, and contain buffers for uncertainty and management error. The harvest actions are directly linked to salmon abundance and productivity.

"Objectives and conservation measures contained in this Plan were developed with specific intent to maintain all populations at their current status and allow them to rebuild as other constraining factors are alleviated." (PSIT & WDFW, 2004)

The Chinook Harvest Plan generally utilizes the delineation of the 22 independent populations of Puget Sound Chinook identified by the Puget Sound Technical Recovery Team (PSTRT, 2005) for the basis of harvest management. However, for river basins containing multiple populations it is difficult to achieve a level of precision at the single population level; thus these basins are combined into a management unit. The plan includes measures to conserve the viability of all individual populations. However, it does not require that harvest be managed separately for each population.

Conservation measures contained in the plan rely on two interlinked constraints on the fisheries when setting up an annual fishing regime -- the projected size of the annual run in individual populations, and the cumulative rate of harvest on groups of populations. If pre-season computer simulation models predict that harvest impacts would drive down abundance to severely depressed levels in individual populations, or if cumulative rates of harvest are projected to exceed defined ceilings, then additional constraints on harvest are implemented. Conversely, as population abundance and productivity improve with the implementation of habitat restoration, the rates enable harvest to adjust to additional harvestable surpluses (figure 6.2).

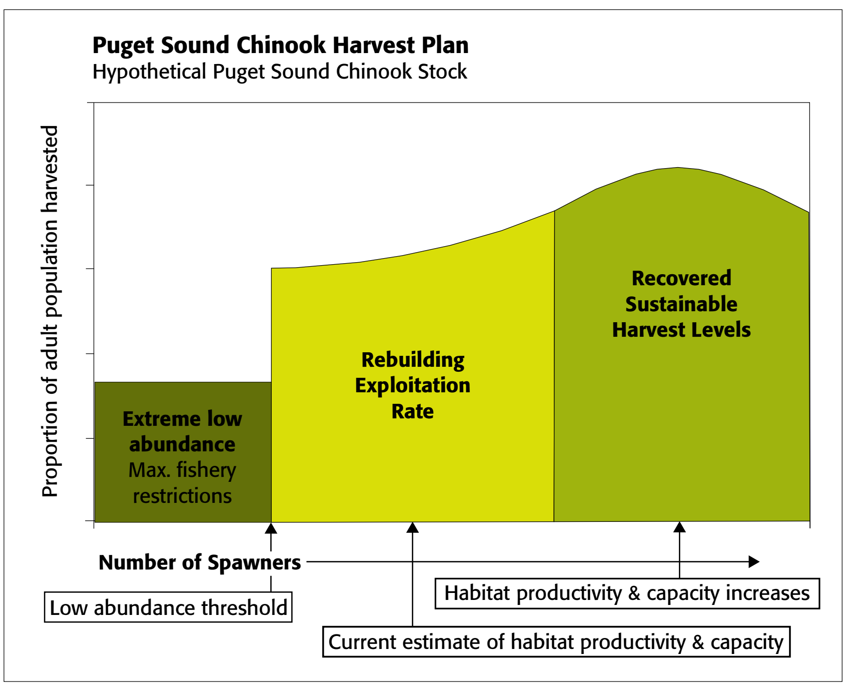

Figure 6.2 Conceptual relationship of harvest and spawning abundance during recovery under the Puget Sound Chinook Harvest Plan

Low Abundance Thresholds

The Chinook Harvest Plan recognizes the importance of meeting goals for naturally spawning Chinook populations. Low Abundance Thresholds are established as a safeguard against extremely low numbers of spawners that would cause biological instability in a natural population. Harvest must be adjusted to allow the population to meet or exceed the threshold. Since the Pacific Salmon Treaty sets the fisheries in Alaska and Canada, harvest adjustments to meet the LAT must come entirely from fisheries in Washington, Oregon and California. In Washington, no directed commercial or recreational harvest is allowed on populations that do not meet the threshold, and additional constraints to meet LAT levels may include the elimination of test fisheries and incidental catch. Escapement levels below LAT levels trigger a Critical Exploitation Rate Ceiling that cannot be exceeded when establishing an annual harvest regime for Chinook populations.

Of the Puget Sound Chinook populations, only the North and South Fork Nooksack and the Dungeness are consistently below LAT levels, and some hatchery supplementation programs have been implemented to avoid extinction of these populations. Lake Washington and Mid-Hood Canal populations are below LAT levels in some years. Hatchery supplementation is maintaining the Stillaguamish, White and Elwha populations above LAT levels, but natural productivity is chronically depressed. All other Puget Sound Chinook populations are consistently above the Low Abundance Threshold. (PSIT & WDFW, 2004)

Upper Management Thresholds

The co-managers have established an "upper management threshold" that is the level for determining whether a population or management unit has a harvestable surplus. Consistent with the Puget Sound Salmon Management Plan (WDFW & PSIT, 1985), this threshold is generally intended to be the level of escapement associated with optimum productivity. However, the available data for calculating capacity and productivity in a given watershed is limited, which has resulted in setting an upper management threshold in different

Management Unit Population	**Rebuilding Exploitation Rate**	**Low Abundance Threshold**	**Upper Management Threshold**	**Critical Exploitation Rate Ceiling**
Nooksack North Fork South Fork	Under development	 1,000[1] 1,000[1]	4,000 2,000 2,000	7%/9% SUS[2]
Skagit summer/ fall Upper Skagit summer Sauk summer Lower Skagit fall	50%	4,800 2,200 400 900	14,500 8,434 1,926 4,140	15% SUS even-years 17% SUS odd-years
Skagit spring Upper Sauk Upper Cascade Suiattle	38%	576 130 170 170	2,000 986 440 574	18% SUS
Stillaguamish North Fork Summer South Fk & MS Fall	25%	650[1] 500[1] N/A	900 600 300	15% SUS
Snohomish Skykomish Snoqualmie	21%	2,800[1] 521[1] 1,745[1]	4,600 3,600 1,000	15% SUS
Lake Washington Cedar River	15% PT SUS	200[1]	1,200	12% PT SUS
Green	15% PT SUS	1,800	5,800	12% PT SUS
White River Spring	20%	200	1,000	15% PT SUS
Puyallup fall South Prairie Creek	50%	500	500	12% PT SUS
Nisqually	Terminal fishery managed to achieve 1,100 natural spawners.			
Skokomish	15% PT SUS	1,300[3]	3,650 aggregate 1,650 natural	12% PT SUS
Mid-Hood Canal	15% PT SUS	400	750	12% PT SUS
Dungeness	10% PT SUS	500	925	6 % SUS
Elwha	10% PT SUS	1,000	2,900	6% SUS

PT refers to Pre-Terminal
SUS refers to Southern United States, and is used to refer to West Coast US fisheries south of AK, including Puget Sound fisheries.
Rebuilding Exploitation Rate (RER) as used here refers to the co-managers' use of the term in the Chinook Harvest Resource Management Plan. NMFS uses a different definition, and the NMFS-derived RER for individual populations may not be the same.

(Footnotes)
[1] Natural-origin spawners
[2] Expected SUS rate will not exceed 7% in 4 out of 5 years
[3] The threshold is escapement of 800 natural and/or 500 hatchery

Figure 6.3 Puget Sound Chinook populations, management units and associated exploitation rates and thresholds. (PSIT & WDFW, 2004)

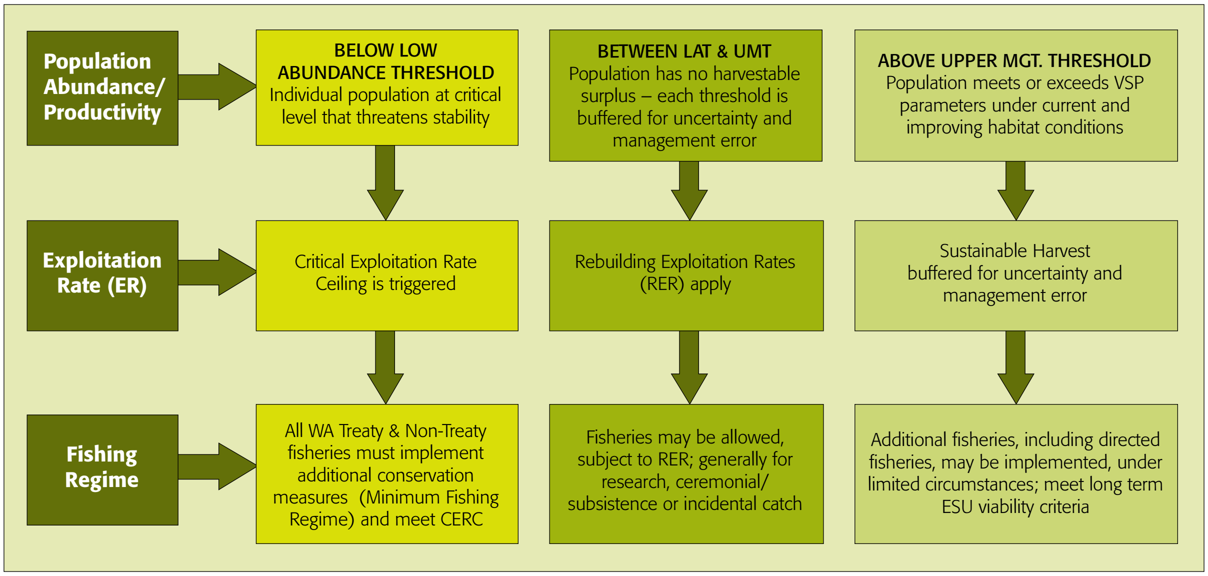

Figure 6.4 Hierarchy of Population Status and Fishing Regimes under the Comprehensive Chinook Harvest Plan

ways for different populations. Managers have established upper management thresholds with buffers to provide a conservative standard for determining harvestable surplus.

Rebuilding Exploitation Rates

Salmon populations vary from year to year, thus fishing regimes must adjust annually to reflect the changes in projected levels of abundance and allow an appropriate portion of the run to "escape" all fisheries to spawn. The harvest limits established in the Plan are set as ceiling rates which are used to determine annual catch limits and other restrictions. Recognizing that Puget Sound Chinook populations need to rebuild to viable levels, the rates are set as "Rebuilding Exploitation Rates." For many Puget Sound Chinook populations, RERs constrain harvest beyond the escapement level needed for populations to replace themselves at their current levels. This strategy allows more fish to spawn in an effort to build abundance and productivity in tandem with habitat restoration. Figure 6.3 identifies the management units, populations, exploitation rates and low abundance thresholds and upper management thresholds established by the Chinook Harvest Plan.

Application of conservation measures in establishing fishing regimes:

Annual fishing regimes are established on a hierarchy of population abundance, exploitation rates and harvest constraints (figure 6.4). Prior to the fishing season, computer simulation models make projections of the exploitation rates of the proposed fisheries and the expected spawning escapement for each population or management unit..

If the spawning abundance of a listed population is predicted to fall below the Low Abundance Threshold, the harvest of all treaty and non-treaty fisheries in Washington must be further constrained until the LAT is met, or the CERC is not exceeded, and provisions of the US/Canada treaty are met as well.

If the listed populations exceed the minimum threshold (LAT), but the populations do not have a harvestable surplus, fishing regimes may be established to provide for test fisheries, treaty ceremonial and subsistence needs, and incidental catch of healthier Chinook populations or other species. Cumulatively, harvest impacts must fall below Rebuilding Exploitation Rates or achieve escapement goals, depending on the objective .

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The use of the Rebuilding Exploitation Rate allows the managers to adjust fishing regimes to coincide with habitat improvements over time, but serves as a brake on harvest so that populations can grow.

If a population exceeds an upper threshold and has a harvestable surplus, additional fisheries may be implemented, including directed fisheries, as long as they stay within the ceiling exploitation rates defined for all fisheries by the RER or for southern U.S. fisheries by the Critical Exploitation Rate Ceilings. Upper management thresholds are related to the optimum productivity under current habitat conditions and recent levels of escapement. This approach to harvest supports an integrated approach to recovery by continuing to test assumptions about habitat capacity and productivity and ensure additional spawners are available to take advantage of improved habitat conditions. The Chinook Harvest Plan contains rules that apply to protect weak stocks (while implementing fisheries above the upper management threshold), but this situation is expected to be experienced only in a few areas within the 2004-2009 timeframe of the Plan.

Ultimately, managers are working toward the achievement of viable salmon populations. Harvest regimes at this level would likely be based on the maximum sustainable harvest, accompanied by monitoring and adjustment for conditions throughout the Puget Sound Chinook Evolutionarily Significant Unit. Attainment of this level is considered highly unlikely without substantial habitat improvements, and cannot be achieved through harvest curtailment alone.

Summary of conservation measures in the Chinook Harvest Plan:

- Rates of harvest have been substantially reduced and will remain at low levels under the Plan consistent with rebuilding needs. In many cases, this has resulted in foregoing harvest on stronger hatchery Chinook stocks or other salmon species.
- Rates of harvest have been established that will allow populations to grow as habitat conditions and marine survival allow.
- Rebuilding exploitation rates are ceilings, not targets and it is not the intent of the co-managers to harvest up to the maximum level of the rate.
- Where harvestable surpluses are available, the surplus can be harvested only if the conservation needs of co-mingled weaker populations are addressed.
- In any event, if a population is forecast to fall below the low abundance threshold, fisheries under the co-managers' jurisdiction will be further reduced to achieve the critical exploitation rate ceiling. It is noted that LAT levels are conservatively set with a buffer for uncertainty and management error. Again, the thresholds are triggers for sets of actions, not objectives – it is not the intent of the co-managers to fish down to the lowest level.
- High rates of harvest in the past may have

A researcher surveys for salmon redds in the Stillaguamish River. Photo courtesy the Washington State Salmon Recovery Funding Board.

Researchers on the Puyallup River count and measure juvenile Chinook outmigrants that have been trapped in this "smolt trap". Photo by Dan Kowalski.

selected against larger, older spawners, thereby affecting population diversity. The reduction in exploitation rates of the Chinook Harvest Plan are expected to increase the proportion of larger and older spawners.

- Harvest constraints under this strategy may increase the number of fish carcasses on the spawning grounds in river systems, and those nutrients could further contribute to population productivity.
- Co-managers retain the right to implement more restrictive conservation measures than the ceilings stated in the Chinook Harvest Plan.

Monitoring and Adaptive Management

The performance of the annual fishing regime is assessed annually to determine whether harvest expectations were met and what factors contributed to the success or failure of management. To the extent information is available, the managers determine whether deviations from what was expected were due to the natural unpredictability of salmon abundance and timing, inaccuracies in computer simulation models or other assessment tools, or the failure of regulations or enforcement to constrain harvest. Several monitoring and assessment programs are operated by WDFW and Washington treaty tribes, many of which were mandated by the 1985 Puget Sound Salmon Management Plan (PSIT & WDFW, 1985).

Commercial catch by treaty and non-treaty fishers, treaty ceremonial and subsistence catch, and fish retained for personal consumption are recorded on fish tickets and entered into a joint database. Recreational catch is estimated in-season through field sampling programs, as well as catch record cards. Other studies are conducted periodically to estimate non-landed mortality (for example, fish that are hooked and released, etc.).

Spawning escapement is estimated from surveys in each river system, and to collect biological data from salmon carcasses. Surveys also describe the annual variation in return and spawning timing. In some river systems, the location of Chinook redds (nests) are mapped and contribute to information for habitat protection and restoration programs.

An additional tool for evaluating productivity is "smolt-trapping." During the period from January to August, traps are installed in the river to temporarily trap the outmigrating Chinook before they leave the freshwater environment. The juvenile fish are counted and measured before their release, and the data provides useful information about freshwater survival and productivity.

Coded wire tag recovery enables managers to estimate the proportion of Chinook from various populations in fisheries harvested throughout the Pacific Northwest, and provides information on abundance and incidental catch. Several hatchery produced "indicator stocks" with characteristics similar to specific wild populations are marked and released to determine harvest distribution and exploitation rates.

Review of the Plan under the National Environmental Policy Act

Following the preparation of the Chinook Harvest Plan by the co-managers, NMFS prepared a Draft Environmental Impact Statement (EIS) for the implementation of the plan in April 2004. The EIS process was related to the determination by NMFS under Limit 6 of the ESA 4(d) rule that the activities described by the Plan, "would not appreciably reduce the likelihood of survival and recovery of the Puget Sound Chinook Evolutionarily Significant Unit." The Draft EIS analyzed three alternatives to the fishing regime. The Chinook Harvest Plan was the Preferred Alternative selected by NMFS. A final determination was issued by NMFS in the Federal Register of March 11, 2005 (70FR12194), subsequent to the issuance of a Final EIS the same month. In addition to the protections of the Endangered Species Act, each of the alternatives was evaluated against providing for the exercise of treaty fishing rights and sustainable fishing opportunity, two of the primary goals of the harvest plan.

Additional Harvest Management Recovery Strategies

Ocean, Alaskan and Canadian Fisheries

NOAA Fisheries has released its "Final Programmatic Environmental Impact Statement (FPEIS) for Pacific Salmon Fisheries Management off the Coasts of Southeast Alaska, Washington, Oregon, California, and in the Columbia River Basin." This EIS covers the harvest in ocean fisheries off the coast of Washington under the purview of the Pacific Fisheries Management Council, and in the Columbia River as managed through the Columbia River Compact. NMFS indicated the need to look regionally at the relationship between the various fisheries since changes in harvest that could benefit natural populations of one ESU could act to the detriment of other listed ESUs. The preferred alternative is generally to, "reduce impacts to natural origin fish through a variety of selective harvest methods, while maintaining or enhancing the fishery" (NMFS, 2005). This alternative would lead in the direction of greater reliance on fisheries targeting marked hatchery fish and reducing the retention of unmarked fish in hook-and-line fisheries.

As noted in Chapter 3 on harvest factors, fisheries harvest in Alaskan and Canadian waters is regulated under the terms of the Pacific Salmon Treaty. Each year, US and Canadian managers implement the treaty to conserve US and Canadian salmon populations and work together to find opportunities for harvest reductions beyond those provided in the treaty that would provide additional benefits for Puget Sound Chinook populations. Because of the US concerns, the impact of Canadian fisheries on Puget Sound Chinook has been a primary focus of negotiations with Canada. Information about the impact of these fisheries on Puget Sound Chinook populations will again be discussed in the development of a new Chinook regime for fisheries after 2008.

Individual Watershed Plans

State and tribal co-managers have identified numerous harvest measures to protect populations of Puget Sound Chinook in terminal marine areas (near river mouths) and in-river fisheries while providing opportunity for both commercial and recreational fisheries. These measures may include test fisheries and surveys to determine the presence of adult Chinook prior to opening other fisheries. Regulations that include requirements to monitor commercial net gear 24 hours a day or to release Chinook during fishing for other species have been issued locally by the relevant management entity. Some recreational fisheries in-river have had delayed openings to ensure that Chinook spawning has been completed and the redds have "hardened" so that the presence of fishermen will not disturb the eggs. All these actions are taken in concert with similar actions in marine fisheries to minimize harvest on weaker Chinook populations and ensure management objectives are met. More information on these specific measures is contained in the watershed chapters.

Regional Hatchery Management Strategies

The purpose of this regional strategy on hatchery management is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team (TRT). This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

"Hatcheries can be useful as part of an integrated comprehensive approach to restoring sustainable runs of salmon, but by themselves they are not an effective technological solution to the salmon problem."

National Research Council, 1996

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

Hatchery management has continually changed in the face of advances in scientific information and husbandry practices, evolving community goals, and realization of the long term impacts that the hatcheries themselves may engender. Chapter 3 on hatchery factors described the history of hatchery management in the Puget Sound region, the ways that hatcheries have been used to attempt to mitigate for habitat loss in some watersheds, and the growing awareness of threats as well as benefits. Hatcheries may be used to promote community economic and cultural goals for harvest and as a tool to conserve and recover threatened populations of salmon and steelhead. However, long term awareness of issues such as loss of fitness and genetic diversity, ecological impacts to naturally spawning populations through predation and competition, disease transfer, and the habitat disruption of the facilities themselves have led to a number of hatchery reform efforts in recent decades.

Institutional and operational changes to hatchery management have occurred over the last 20 years in response to declining populations and growing awareness of risks. Hatchery production, wild stock management needs and harvest objectives were central issues in the 1985 Puget Sound Salmon Management Plan (PSSMP) between WDF and Puget Sound tribes. Several other co-manager initiatives have advanced such as disease control policies and procedures, wild salmonid policies and a systematic analysis of the benefits and risks of hatchery programs.

The Puget Sound and Coastal Washington Hatchery Reform Project was launched in 2000 by the U.S. Congress and created an independent review panel, the Hatchery Scientific Review Group. The Project reviewed all Puget Sound hatchery programs, made recommendations for reform, created scientific tools to help implement recommendations, and created principles to make hatchery reform operational and ongoing. It also provided funding for related studies, hatchery operational changes, and some funding for modifications to facilities where appropriate. (www.hatcheryreform.org)

In 2004, WDFW and Puget Sound treaty tribes completed the hatchery component of the Comprehensive Chinook Resource Management Plan (RMP), building upon other assessments submitted to NMFS in response to the listing of Puget Sound Chinook under the Endangered Species Act. The Hatchery RMP contains 42 specific Hatchery Genetic Management Plans designed to limit adverse impacts to threatened populations of salmon from hatchery programs and operations.

The next segment of this paper describes principles and strategies for hatchery management that have evolved from the series of hatchery reviews and reforms that were conducted in recent decades. The last segment describes the Hatchery RMP, expressing the commitment that state and tribal co-managers have made to utilize hatcheries as a tool for rebuilding salmon populations to sustainable harvestable levels, and to ensure that hatchery production is not a threat in itself. Additionally the watershed chapters contain information provided by local watershed groups and hatchery managers relevant to proposed recovery actions.

Guiding Principles for Hatchery Management

Hatchery reform is the ongoing, systematic application of scientific principles to improve hatcheries for recovering and conserving naturally spawning populations and supporting sustainable fisheries (HSRG, 2004). Several common principles for hatchery management have evolved from scientific reviews and discussions between state and tribal co-managers, federal agencies and independent science panels in recent years. These principles generally reflect the shift in perspective away from viewing hatcheries primarily in terms of production objectives, to a broader view of the role of hatcheries within the larger ecosystem and their function in supporting multiple community and ecosystem goals. The principles are also intended to gear hatchery operations to reduce the risk to threatened populations of salmon, and to be responsive to specific watershed conditions and needs.

Productive natural habitat is essential for healthy, harvestable salmon populations and successful hatchery programs.

Healthy habitat provides the greatest biological certainty, as it contains the core functions that sustain salmon populations over the long term. When habitat strategies are designed to protect existing intact ecological functions, they have a greater certainty of maintaining or restoring viable salmon populations than strategies that rely on artificial substitutions (NRC, 1996). However, habitat conditions in some watersheds are already substantially degraded, and restoring and protecting habitat to the extent necessary to achieve population restoration and harvest may take several decades.

While natural populations are recovering, hatchery programs will provide important opportunities for rebuilding and harvest.

Social, economic or funding constraints may make it infeasible for some salmon populations to be provided with the necessary habitat conditions to meet biological and social objectives. In watersheds where these constraints severely limit conservation and harvest objectives, hatchery programs that use careful operational strategies and complementary habitat actions may be appropriate. Scientific decision support tools developed by the co-managers, Hatchery Scientific Review Group, and others can help identify scientifically defensible combinations of habitat improvements, harvest constraints, and hatchery program types and sizes that are consistent with policy objectives and limitations, and are coupled with consistent, long-term monitoring, evaluation and adaptive management programs.

Despite the improvements in hatchery management, hatchery production can never fully replace the benefits of natural production. Healthy, abundant habitat is also essential to the success of hatchery programs. The size and health of natural populations and the habitat on which they depend controls what hatcheries can do to boost natural spawning and meet harvest objectives (WDFW & PSTT, 2004; HSRG, 2004).

Hatchery programs must operate under the legal framework defined by U.S. v Washington.

Providing harvest opportunities consistent with treaty fishing rights and conservation is an important, legally defined role for hatcheries. Hatchery programs are managed by the state, tribes, and federal government under the Puget Sound Salmon Management Plan and other plans and agreements prepared under the legal umbrella of U.S. v Washington. The PSSMP identifies tools for making changes to hatchery programs including, 1) descriptions of operational modes such as goals, production objectives, description of facilities, species cultured, broodstock source, hatchery protocols, and contingency plans; 2) annual review of operational plans; 3) regional coordination of co-manager activities and priorities; 4) information systems for the exchange of technical information and analyses; and 5) dispute resolution. (WDF & PSIT, 1985)

The harvest of salmon is intrinsically linked to the identity of Pacific Northwest tribes, but fishermen cannot presently rely on naturally spawning populations to fulfill their cultural, subsistence and economic needs. It is through hatchery fish that the tribal communities can likely retain the knowledge of how to fish during the years it will take to restore natural production.

"The hatchery program at the Stillaguamish Tribe was created to help provide current tribal members and future generations with the opportunity to continue their spiritual and cultural connections to salmon through fishing. However, even with this program in place, tribal members and their children will lose the legacy of Chinook without the commitment and dedication of the community to salmon habitat recovery."

Kip Killebrew, Stillaguamish Tribal Fisheries Biologist

Hatcheries designed, operated, and evaluated in an ecosystem perspective are more likely to provide harvest and conservation benefits with reduced risks to natural populations.

Rather than viewing a hatchery as an isolated fish production factory, numerous scientific reviews have recommended that hatchery programs should be integrated and evaluated as part of the environmental and ecological systems in which they operate (NRC, 1996; Brannon et al., 1999; HSRG, 2004). Managers have been encouraged to view hatcheries in a manner similar to an additional watershed tributary, and examine their fish culture practices as a broad investigation of demographic, ecological, evolutionary and fishery interactions (Williams, et al., 2003).

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A hatchery program is "successful" when it provides a more favorable balance of benefits to risks when evaluated relative to watershed-specific objectives.

"Hatcheries are by their nature a compromise, a balancing of benefits and risks to the target stock, other stocks, and the environment affected by the hatchery program. A hatchery program is the right solution only if it is better, in a benefit/risk sense, than alternative means for achieving the same or similar goals." (HSRG, 2004)

Hatchery programs can provide substantial economic, cultural and conservation benefits, but potentially they can also pose risks to natural populations of salmon. The risks and benefits of a hatchery program should be evaluated relative to the ability of the habitat in that watershed to support viable natural populations and other policy objectives. Consequently, the characteristics of a successful program will differ among watersheds because of the varying status of natural populations and policy decisions regarding the rapidity and extent of habitat protection and recovery. As habitat is restored and populations approach their recovery goals, the benefits of a hatchery program are lower relative to the potential genetic, ecological and demographic risks. A plan with successful integration of strategies across management sectors will result in the concomitant modification of hatchery programs to reduce their potential risks. The hatchery program may be visualized as following a trajectory from the current operation to the expected operation at recovery, with the level of acceptable risk declining as the population approaches recovery (figure 6.5).

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

Hama Hama Hatchery.

■ represents a spawning population of salmon

*Risk tolerance must be evaluated for the unique spatial and diversity characteristics of a given population as well as population abundance and productivity.

Figure 6.5 Conceptual relationship between habitat quality and quantity, population abundance and productivity, and risk tolerance for hatchery programs. (Adapted from Currens & Busack, 2005)

Integrated programs are designed and operated with the intent that fish of natural and hatchery origin will become fully reproductively integrated as a single population. The selection of this strategy will always require that natural origin adults are incorporated into the broodstock for the hatchery program. Isolated programs intend for the hatchery population to represent a distinct population that is reproductively isolated from naturally-spawning populations (figure 6.6).

The selection and management of an integrated or isolated production strategy is intended to prevent the negative effects of gene flow, which can lead to the loss of population identity or fitness over time. Integrated programs

The design of a successful program begins with the identification of a program goal and the careful selection of either an integrated or an isolated hatchery strategy.

The selection of goals for each hatchery program drives the protocols for program design and operation. The primary management goals of hatchery programs are: 1) to promote rebuilding and recovery of populations at risk; and 2) to provide opportunities for harvest. Selection of goals depends on the conditions specific to each watershed, such as the status of the natural population and habitat. Strategy selection is program and watershed specific, and depends on the status of the natural population and habitat, the ability to collect natural-origin broodstock, the ability to control the number of hatchery-origin adults in natural spawning areas, and other factors.

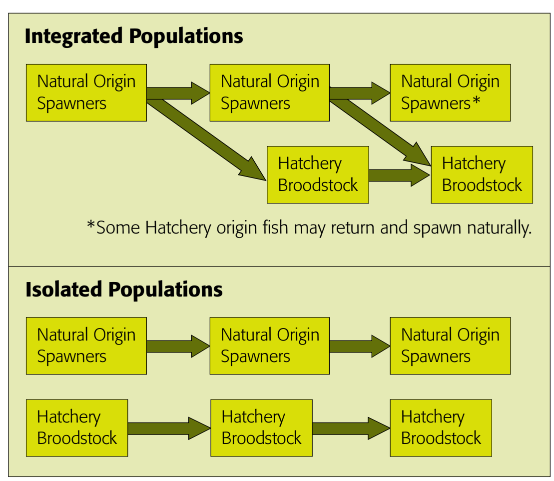


Figure 6.6 Conceptual representation of the extent of reproductive interaction in integrated and isolated hatchery programs.

ultimately need sufficient numbers of natural origin spawners that can be incorporated into the hatchery broodstock. The intent of an integrated program is for the genetic make-up of hatchery-origin fish to be the same as that of the underlying natural population, and that natural selection in the wild drives the fitness of both components of the population (HSRG, 2005).

Habitat is of critical importance to any type of hatchery operation, as hatchery programs can only be successful if habitat conditions are conducive to the survival of salmon throughout their entire life cycle. However, this is particularly true for programs relying on an integrated strategy, since natural-origin broodstock must be incorporated into the hatchery in each generation.

In general, integrated hatchery programs can be operated to increase the number and distribution of natural spawners, increase the productivity of the composite population, and provide fishing opportunities. Isolated hatchery programs can be operated to provide fishing opportunities while minimizing interactions with natural populations (Figure 6.7).

Hatchery operating protocols should be consistent with the management objective and the strategy. The protocols describe the daily operation of the hatchery program, and include the program size, broodstock source and collection procedures, rearing conditions, and time, size and location of release. Guidelines for hatchery protocols are described in the findings and recommendations of the Hatchery Scientific Review Group (2004) and in the co-manager Hatchery Resource Management Plan (RMP) (PSTT & WDFW, 2004). The Hatchery RMP contains lists of hatchery programs in Puget Sound, their objectives (recovery, harvest, research) and their program type (isolated, integrated).

Primary Management Objective	Demographic Relationship to Natural Population(s) in Watershed	
	Integrated Production	Isolated Production
Recovery	• Prevent extinction • Increase natural origin recruits using the local stock • Reintroduction • Research	• Prevent extinction • Create 'reserve' population in case other recovery options fail • Gene banking until reintroduction • Research
Harvest	• When isolated approach is not feasible • Maintaining local stocks • During rebuilding • Mitigation • Research	• Create new or enhance existing fishing opportunities • Mitigation • Allocation • Research

Figure 6.7 Artificial production strategies and their primary uses (from PSTT & WDFW, 2004).

Successful hatchery programs are characterized by clear goals and operational plans.

During their review of hatcheries in Puget Sound in 2002-2004, the HSRG found several examples of Puget Sound hatchery Chinook programs that are presently: 1) helping to recover and conserve naturally spawning populations; or 2) supporting sustainable fisheries. Such programs were generally characterized by key principles of successful hatchery operation, including, "clear goals, scientifically defensible programs, and informed decision-making" that can be monitored and adapted over time. (HSRG, 2004).

Principles of Successful Hatchery Programs:

- **Well-defined goals:** If the goals for each hatchery population are well defined, quantified where possible, and expressed in terms of community objectives (harvest, conservation, research, etc.) the ability of hatchery managers to evaluate the benefits and risks of a program are greatly improved.
- **Scientifically Defensible Programs:** A clearly articulated scientific rationale for a hatchery program provides the foundation for decision making and strategies for the achievement of goals. Hatchery strategies must be consistent with current scientific knowledge at the initial planning and operational stages. Assumptions, hypotheses and uncer-

tainties should be spelled out in a comprehensive management and operational plan.

- **Informed Decision Making:** Management decisions must be informed and modified by continued evaluation of existing programs and assimilation of new information. Communication across regional hatchery programs and the relationship of hatchery management actions to habitat and harvest are essential elements of successful adaptive management.

The HSRG found that, while a given individual hatchery program may be successful in broodstock collection and other operational considerations, it might not be adequately taking into account the risks to other stocks or the environment, benefits to the target population, or the relationship of hatchery production to habitat availability over time. During the review of individual watershed recovery plans in 2004-2005, the Puget Sound Technical Recovery Team observed that substantial progress has been made, but identified additional steps that are needed to integrate hatchery programs with habitat and harvest.

Hatchery strategies must be integrated with harvest and habitat.

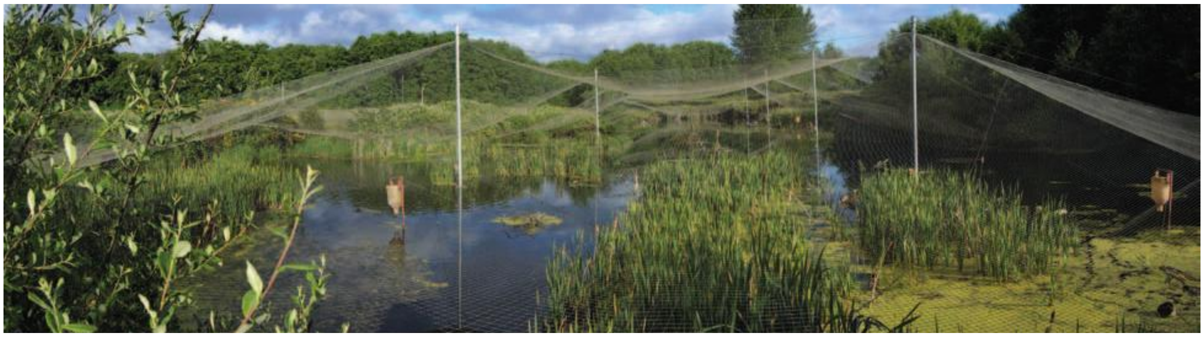
While natural populations are recovering, hatchery programs will provide important harvest opportunities. This allows all groups to maintain the knowledge and culture of fishing and, in particular, provides treaty tribes with the ability to retain a portion of the treaty-reserved fishing rights in the face of habitat degradation. Because harvest opportunities on hatchery fish are only available in restricted times and places, they cannot fully make up for the harvest that would be available from restored natural populations. Hatcheries will provide a necessary source of harvest opportunity while natural populations recover, but restoration of habitat function is required to restore natural production, which in turn is necessary for harvest and other benefits.

Clear consistent communication is also needed across the hatchery, harvest and habitat sectors. Hatchery programs must be designed and operated to consider the availability of habitat quality and quantity, with appropriate timing and sequencing as habitat conditions are improved. Harvest programs must consider the production objectives, capabilities and needs of hatchery programs. More information on all H-Integration is included in the next section of this chapter.

Puget Sound Chinook Salmon Hatcheries, a Component of the Comprehensive Chinook Salmon Resource Management Plan (Hatchery Resource Management Plan (RMP))

State and tribal co-managers have indicated their commitment to implement hatchery management strategies that will assist in the recovery of Puget Sound Chinook, consistent with all measures and actions described in the Hatchery Resource

Gene Enick, Tulalip Hatchery technician, collects Chinook eggs at the Samish WDFW hatchery. Photo by Steve Young, Tulalip Hatchery Manager.



The Natures Rearing Pond at the Lower Elwha Tribal Hatchery: Hatchery managers have developed new techniques to improve hatchery productivity by integrating elements of natural ecosystems into hatchery operations.

Management Plan (WDFW & PSTT, 2004). This Plan defers to and relies upon the hatchery management strategies and actions described in the Chinook Hatchery Resource Management Plan and in the individual Chinook salmon Hatchery and Genetic Management Plans proposed by the co-managers in 2004 and 2005 for implementation through the NMFS ESA 4(d) Rule limit 6 evaluation and determination process. The general principles of the plan are directed at minimizing the risks to natural populations while rebuilding weak and threatened populations and providing opportunities for harvest. Protocols are described to manage risks associated with fish health, broodstock collection, spawning, rearing, and release of juveniles; disposition of adults; and catastrophes within the hatchery. The Hatchery RMP was completed in response to the Endangered Species Act, and was an expansion of the biological assessment of tribal hatchery programs submitted by the Bureau of Indian Affairs as a requirement of Section 7 of the ESA. The Hatchery RMP also incorporates management alternatives developed by the tribes and the National Marine Fisheries Service, and draws from the recommendations of the Hatchery Scientific Review Group.

"The overall strategy for managing hatcheries at the ESU [Evolutionarily Significant Unit] scale is based on the observation that the risk of extinction to ESU and potential for recovery are different in different watersheds of the Puget Sound. The Puget Sound includes areas where the habitat can still support some sustainable natural production, areas where habitat for natural production has been irrevocably lost, and areas where Chinook salmon were never self-sustaining, independent populations." (WDFW & PSTT, 2004)

Operational Changes to Hatchery Management in Puget Sound

Operational changes have already been implemented that emphasize rebuilding wild populations and reducing negative impacts with wild fish. These actions are described in the Hatchery RMP as follows:

- "Reduction of cross-basin transfers of salmon stocks: Once a common practice, this management method has been dramatically reduced to protect local genetic adaptations and to reduce the risk of disease."
- "Reduction of fry plants: Until the 1960s, fry plants were the primary release strategy but they are used today only where it is ecologically and genetically appropriate."
- "Establishment of fish health programs: Building on the fish disease policy, WDFW and the tribes have developed extensive fish health monitoring and treatment programs to ensure the health of hatchery fish."
- "Development of improved release strategies: Improved release strategies focus on increasing survival by releasing fish at physiologically

appropriate stages and minimizing competition and predation on wild fish."

- "Reduction in total releases of Chinook: Releases of Chinook salmon increased during the late 1970s and 1980s, with the peak of approximately 76 million Chinook occurring in 1990... Recent annual release levels have been about 50 million Chinook. Further reductions are being considered."
- "Implementation of recovery programs using hatcheries: Beginning with the White River program in 1977, geneticists and fish culturists have been improving techniques for using artificial propagation to prevent extinction and to maintain genetic diversity."
- "Development of genetic baselines to distinguish specific stocks: During the 1980s and 1990s, and continuing to the present, genetic profiles for most Chinook stocks have been developed, providing specific information useful for harvest analysis and hatchery operations."
- "Development of the coded wire tag and resultant data: This has allowed fishery managers to acquire information pertaining to stock contribution and distribution in fisheries in marine and freshwaters areas." (WDFW & PSTT, 2004)

Hatchery operations will undergo a transitional period for the next several years as new information comes in. Chinook salmon released from hatcheries may take up to six years to return, and modifications to program facilities depend on funding. Although key strategies to minimize the risk to wild populations will be applied across the ESU, programs and objectives will vary in different watersheds.

The specific details for each Chinook hatchery program are contained in 42 Hatchery Genetic and Management Plans developed by state and tribal fisheries managers. (see the Puget Sound Chinook Hatchery RMP (WDFW and PSTT 2004) and individual HGMPs.) Additionally, nearly all of the watershed chapters attached to this recovery plan carry forth information provided in the HGMPs and RMP regarding specific aspects of hatchery management that are relevant to ESU recovery. For those watersheds where proposed hatchery management strategies and actions have not been described in the Plan, the Plan defers to the individual HGMPs proposed to operate within each watershed, as well as the Chinook Hatchery RMP, for descriptions of proposed hatchery actions.

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

Juvenile hatchery Chinook.

Adaptive Management

Hatchery reform is a continuing process, with program modifications occurring in response to research, monitoring, and evaluation results and funding availability. The adaptive management framework developed by the co-managers for Puget Sound hatchery plan implementation and modification combines passive adaptive management and evolutionary problem solving. The approach proposed will help reduce uncertainty regarding future hatchery responses. New data available through the research, monitoring, and evaluation programs included in the co-manager hatchery plans will be used as the basis for making adjustments in hatchery actions. These adjustments will be made in concert with local watershed plan implementation under this Plan. The intent is to ensure that hatchery program modifications are based on the best available science, and that any modifications made are consistent with habitat and harvest management actions taken for population and/or ESU recovery purposes. The adaptive management framework for Puget Sound hatcheries has seven key elements:

- An integrated strategy for the ESU
- Defined goals and objectives for hatchery programs
- A framework of artificial production strategies for reaching goals and objectives
- Strategy-specific guidelines for operating hatchery programs
- Scientific tools for evaluating hatchery operations, including statistical analyses, risk-benefit assessments, and independent scientific review
- A decision-making framework for considering in-season, annual, and long-term changes in hatchery objectives and standard operating modes described in HGMPs and resolving disputes
- Implementation using available resources

Scientists from WDFW and Puget Sound tribes are working with the HSRG and NMFS on research, monitoring and evaluation tools to guide the future changes of hatchery programs. Plans call for additional research in the Puget Sound region that will help indicate the genetic, ecological, and demographic effects of hatchery programs on the survival and productivity of listed and non-listed salmonid populations at various life stages. The integration of hatchery, harvest and habitat recovery activities will be the focus of additional work in individual watersheds and across the ESU. These efforts support the goal of the 1997 Wild Salmonid Policy adopted by the Washington Fish and Wildlife Commission and several Puget Sound tribes to:

....protect, restore and enhance the productivity, production and diversity of wild salmonids and their ecosystems to sustain ceremonial, subsistence, commercial, recreational fisheries, non-consumptive fish benefits, and other related cultural and ecological values.

Final Joint WDFW/ Tribal
Wild Salmonid Policy, 1997

Integration of Habitat, Harvest and Hatchery Strategies and Actions

The purpose of this regional strategy on the integration of habitat, harvest, and hatchery strategies and actions is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team (TRT). This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

"Considering the effects of one factor at a time (e.g. harvest, habitat, or hatchery management actions) on salmon population characteristics is more tractable from a technical standpoint, but such estimates of effects are sure to be wrong in most instances. Managers [are asked] to consider suites of habitat, harvest, and hatchery actions together, especially with a view towards how these factors interact..."

Puget Sound Technical Recovery Team (2003)

Salmon recovery faces enormous challenges in tying together actions across all watersheds, jurisdictions and decision-making forums affecting the Puget Sound Chinook Evolutionarily Significant Unit (ESU). The major factors that affect the abundance, productivity, spatial structure and diversity of salmon populations are often lumped into the "H Factors" of harvest, hatcheries and habitat (including hydropower). Each of these factors independently affects the status of salmon populations, but they also have cumulative and synergistic effects throughout the salmon life cycle. The achievement of viability at the population and ESU level depends on the concerted effort of all three factors working together, not canceling each other out, and adjusting over time as population conditions change.

The preparation of the recovery plan has provided an opportunity for all Puget Sound communities, watershed groups and fisheries managers to bring their recovery proposals to the table at one time within respective watersheds and as a region, and take a look at the way

"Integrate:" To make something whole or complete by bringing together the parts….

"Synergy:" The simultaneous action of separate parts which, together, have a greater total result than the sum of their individual effects.

Webster's New World Dictionary

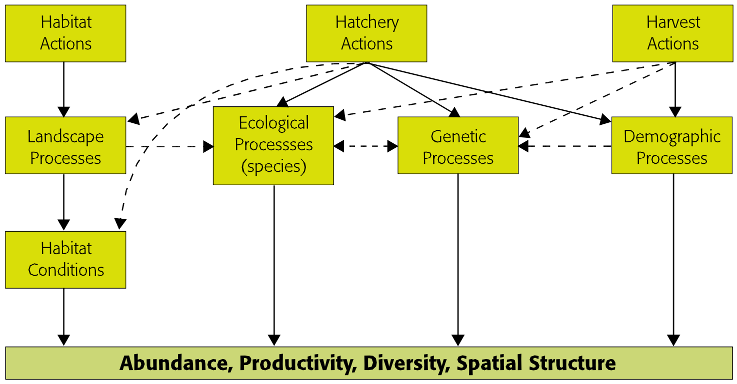


Figure 6.8 Example of the interactions among habitat, hatchery, and harvest management actions and their potential effects on the VSP parameters of a population. (PSTRT, 2003) page 37

these efforts will interact over the coming decades. This broad perspective has highlighted the need for more work in the watershed plans and regional strategies to further develop strategies that integrate the "H Factors" and increase the certainty that the plan outcomes will provide the needed benefits to salmon and the Puget Sound community as a whole.

Definition of an Integrated Salmon Recovery Strategy

An integrated strategy for salmon recovery describes a set of inter-related objectives and actions that have a logical sequence and are predicted to achieve population and ESU viability. Elements of an integrated approach include considerations of temporal and spatial scales, the positive or negative outcomes of actions that are linked across the H factors, and the ability to manage and adapt to uncertainty and change.

Temporal considerations evaluate whether actions are working in the right order, and how differing time scales are incorporated into recovery. For example, habitat restoration activities may take over a century to be effective, while hatchery actions will have an impact on the next generation, and harvest management affects the current year's return. If hatchery rebuilding programs are to be effective in restoring naturally spawning populations, they need to be linked to the quantity and quality of available habitat. As habitat improvements begin to be effective, hatchery supplementation programs need to change to allow improvement of salmon productivity, diversity, spatial structure and abundance. Projects and activities in an integrated strategy should reflect the progressive improvement in VSP parameters over time.

Spatial elements of H-integration consider how habitat, hatchery or harvest actions interact in particular locations. For example, are habitat restoration projects aimed at bolstering capacity of wild juvenile Chinook in a lower watershed coordinated with hatchery release locations so that those habitats are used primarily by wild (instead of hatchery-origin) juveniles?

An integrated salmon recovery strategy should have the following elements:

- Consistency among the recovery goals for the population, the hypotheses about what is limiting the population, and the recovery actions that are proposed.
- Strategies and actions are interrelated in their predicted effects on VSP parameters.
- Strategies and actions produce no long lasting damaging or contrary effects in the population parameters.
- The strategies are designed to be biologically efficient - they can achieve VSP outcomes before irreversible harm is done to the population.
- The strategy contains actions across all three H sectors.
- The timing and sequence of projects and activities reflect changing long-term improvements in VSP parameters.

Contradictory	Non-aligned	Integrated
Actions across the Hs are inconsistent and mutually detrimental.	Actions across the Hs do not conflict, nor do they enhance each other.	H Actions work in concert and are progressively sequenced in time and space.
C-1: A new area of habitat is restored before the population is sufficiently large to make use of it. In very small populations, the distribution could become so thin that productivity actually declines due to low reproductive success.	**N-1:** Habitat actions are mainly focused on a single activity, such as placement of large woody debris. This may improve overall habitat quality, but if the population is very low in abundance, initial negative population responses to this activity may drive the population close to extinction unless appropriate harvest and/or hatchery actions are undertaken concurrently.	**I-1:** Habitat restoration is phased and sequenced in parallel with expected population growth due to harvest rate reductions and hatchery supplementation (where applicable).
C-2: Harvest may negatively impact diversity by selectively harvesting larger spawners. The remaining smaller females cannot dig redds in areas of larger rocks that were the preferred habitat when average size was higher.	**N-2:** Harvest management includes measures to assure that mortality is evenly distributed across the size and timing characteristics of the run, thus not selectively impacting any one component.	**I-2:** Harvest management and hatchery supplementation (where applicable) is specifically designed to produce a diversity pattern of spawning and rearing life histories that will fit in with current and restored habitat conditions.
C-3: Harvest management guidelines are based on the escapement needs of hatchery fish. Commingled wild fish may or may not achieve escapement numbers appropriate for available habitat.	**N-3:** Harvest management guidelines are set to provide sufficient natural spawners for current habitat conditions. However, spawner numbers may not increase when habitat improves due to plan actions or when marine survival conditions are favorable.	**I-3:** Harvest rates are established that allow spawner numbers to increase to take advantage of favorable marine survival conditions and improving habitat. Carcasses from increasing escapements provide additional marine-derived nutrients to the upper watershed, which in turn enhances natural productivity.
C-4: The size of hatchery releases overwhelms a habitat that has recently been restored, increasing competition and negating the benefit to wild fish.	**N-4:** Hatchery supplementation programs are underway, but the watershed lacks protection strategies for the limited amount of productive habitat that remains.	**I-4:** Monitoring programs look at escapement estimates, proportions of natural and hatchery origin spawners, genetic profiles and juvenile distribution and abundance. Information feeds back into management actions for adjusting harvest rates, hatchery production and release timing, and locations for habitat restoration focus.

Figure 6.9 Continuum of H-Integration Strategies — examples

Contradictory and Integrated Salmon Recovery Strategies

Management actions in one H sector may have positive or negative effects on salmon depending on actions in the other H areas. The intent of an integrated recovery strategy is to ensure that actions have no permanent or long-lasting contrary effects, and to advance the ability of these actions to work together. Figure 6.9 is a conceptual diagram of the continuum of H integration strategies from a dysfunctional situation where the factors work against each other, to the development of an effective and progressive set of actions where the actions in the Hs work synergistically.

Actions should not move population parameters away from viability unless the effects of such actions can be shown to be of short duration and necessary to the long-term achievement of population viability. Even then, such actions should not cause irreversible declines in any VSP attribute. Moreover, it may be necessary to implement actions from one H before actions are taken under any of the others. Example N-1 from the table illustrates the need to undertake an immediate rescue of an imperiled population through harvest or hatchery actions, since habitat actions will not be effective for a longer time period. Long-term viability still requires habitat actions to be undertaken, but the timing and proper sequence of such actions must be well-conceived.

Key Questions to Identify Issues for Harvest, Habitat and Hatchery Interactions

Members of the Puget Sound Technical Recovery Team have identified a set of example questions to help illustrate how cross-H issues in a watershed or region can be considered.

1. Given the VSP attributes of a population, what role has each H played in the condition of the population?
2. Has any VSP attribute been irretrievably altered? (Generally applies more to diversity and spatial structure)
3. Is the population imperiled by changes in any particular VSP attribute or combination of attributes in the short or long term?
4. What H strategies have the greatest probability for addressing this change?
5. Given the strategies, what actions are necessary to implement them successfully?
6. How do the actions interact and complement one another towards achieving objectives for the population?
7. What is the effect of each action and the cumulative effects of all actions on the VSP attributes?

Puget Sound watershed groups and local co-managers have identified examples of cross-H issues for watershed level evaluation such as:

- Harvest and habitat: Are harvest rates consistent with population productivity and spatial structure? How do different fishing regimes differentially affect VSP parameters in a given population? Is the productivity of the habitat consistent with maintaining VSP levels and sustainable harvest levels?
- Hatcheries and habitat: Are hatcheries used effectively to reintroduce and maintain populations where habitat is degraded? Are hatchery structures blocking access to important habitat? Are hatchery programs designed to ensure that the use of habitat by hatchery-reared fish is consistent with the achievement of VSP levels in naturally-spawning populations?
- Harvest and hatcheries: Are those hatchery programs that are intended to produce fish to augment harvest operated consistently with the recovery of the ESU? Can the production from these programs be harvested without increasing the harvest rate on natural populations as they rebuild? Is the harvest management plan designed to allow sufficient escapement so that supplementation programs assist the watershed's ability to meet population recovery goals?

Steps in the Development of an Integrated Salmon Recovery Strategy

In order to achieve integration of salmon recovery strategies, it is necessary to meld scientific analysis with decision-making by the appropriate management entities in order to:

- Understand or predict the combined effects of the individual H actions on VSP parameters over the life of the actions
- Compare the effects of the H actions on VSP parameters for their directionality (+ or -), magnitude, time lag and persistence
- Choose actions that are complementary in their effects
- Time the actions appropriately keeping in mind the state of the VSP attributes and salmon population goals
- Sequence the actions appropriately to achieve the desired VSP effects in time to avoid the loss of VSP integrity (the "first things first" principle)
- Utilize monitoring and adaptive management to address probabilities and uncertainties

The end result of the development of an integrated strategy should be to identify a suite of actions that are consistent and predicted to move salmon populations towards short, moderate, and long-term recovery goals. An integrated strategy should describe the relative uncertainty of the suite of actions, and how uncertainties will be reduced through an adaptive management and monitoring program.

Communication

Participation and communication must occur on a technical, policy and implementation/action level. Each viewpoint must be considered along with participants' ability to implement change. It is essential that managers and participants in one H sector communicate and understand the relationship of their actions to those in the other sectors.

"In a well-run fishery, all of the key players (fishermen, biologists, and managers) should be able to state in unambiguous terms what harvest strategy is used for the fishery." (Hilborn and Walters, 1992)

An integrated structure for salmon recovery applies within and across the habitat and hatchery sectors as well, and is characterized by informed groups who understand how each other's activities are arranged to maintain and restore the salmon populations. Additionally, management must occur in coordination, so that decision-making in one of the H sectors is not usurped or preempted by decisions occurring in another sector.

Technical Assessment

Models may provide managers with an opportunity to work together to document goals, identify important variables and data sources, and discuss what assumptions are unknown or untested. Several watersheds have utilized computer models to begin evaluating the relationship of proposed habitat, harvest and hatchery actions together. Each of these tools is designed to address specific questions, and no one tool is perfectly suited to answer all of the questions associated with developing an H-integration strategy. A number of modeling tools for this purpose are described in the *"Technical Guidance for Watershed Groups in Puget Sound"* (PSTRT, 2003). Two of the commonly used models in the Puget Sound region are the Ecosystem Diagnostic Treatment (EDT) model (Mobrand Biometrics) and the SHIRAZ model (Sharma et al. 2002). While both models were originally developed to predict the effectiveness of habitat conditions and processes on salmon throughout a watershed, they can also be used to explore interactions among hatchery, harvest and habitat management on salmon populations.

Recently another integrative modeling tool known as "AHA" (All H Analyzer) was developed by the Hatchery Scientific Review Group based on theoretical work from scientists from WDFW, NOAA, USFWS and tribes. An overview of AHA is available at the hatchery reform website (www.hatcheryreform.org) and in the HSRG's 2005 Report to Congress (HSRG 2005). Under AHA, actual or theoretical data about habitat productivity and capacity, harvest rates, and hatchery operations in a watershed are entered. AHA allows managers to consider some of the effects of habitat, harvest and hatchery management choices together as the factors are changed in a series of model runs. These runs inform management decisions by describing current conditions, goals for the long-term future of a salmonid population, and one or more scenarios for achieving or moving toward those goals in the short-term. AHA is a good illustration of the potential value that models can provide in demonstrating how management among the H's can be coordinated. Additional factors important for designing integrated all-H strategies, such as the spatial locations in which habitat, hatchery and harvest actions are implemented, cannot be explored with this tool, and should be included in strategy development.

Status of H Integration at the Regional and Watershed Level

On the continuum of H Integration Strategies (figure 6.9), some of the watersheds in Puget Sound have eliminated actions that are contradictory and have achieved at least "non-aligned" status in that the proposed sets of actions do no harm to each other. A few have moved further down the continuum toward an integrated approach. The Puget Sound Technical Recovery Team has identified questions and uncertainties about the interaction of "H Factors" in some cases and offered suggestions for furthering this work to these watershed area groups.

The development of a recovery plan for the entire Puget Sound Chinook Evolutionarily Significant Unit has necessitated a comprehensive review of the relationship between habitat, harvest and hatchery programs. The Comprehensive Resource Management Plans for Chinook (harvest and hatchery components) incorporate provisions to integrate their activities with improvement to VSP parameters at the watershed and regional level, such as:

- The Co-managers have established rates of harvest and thresholds that are directly tied to abundance and rebuilding in each watershed. Population levels that fall below low abundance thresholds trigger severe restrictions in the fisheries that potentially intercept these populations before they return to their spawning ground.
- Hatchery programs that are directed toward the recovery of threatened populations of Chinook, such as captive broodstock programs, are being evaluated in the development of local and regional harvest regimes at the Pacific Fisheries Management Council and North of Falcon forums.
- Harvest management forums, such as the Pacific Fishery management Council, have established habitat committees because they recognize that habitat quality affects the performance of the salmon stocks they manage.
- Hatchery reform initiatives have reviewed the relationship of hatchery facilities to habitat conditions, both to evaluate the impacts of the facilities themselves, and to determine whether hatchery programs have looked at habitat capacity in their operational planning.

Additional issues that have been identified for further work on H Integration at the regional level include, but are not limited to:

- Substantial uncertainties exist regarding the interaction of hatchery and wild populations in habitats throughout their life cycle, and how those interactions affect VSP parameters over the long term. These hatchery-wild fish interactions that could affect a population's progress towards recovery include hatchery fish of all salmonid species. This is an important question to address because of the need to ensure that hatchery management is consistent with the habitat protection and restoration strategy towards achieving recovery objectives.
- The capacity of the nearshore to sustain natural- and hatchery-origin populations of all salmonids in Puget Sound requires further evaluation. Local studies of the competition and predation in nearshore areas, such as those underway in the Skagit system, will contribute to regional understanding of this issue.
- More information is needed to analyze the effect of harvest on diversity and spatial structure.
- Resources for monitoring and data analysis are limited, thus the development of regional monitoring and adaptive management plans and the establishment of research and monitoring priorities at a regional scale are important to developing and tracking the effects of H integration actions.

WDFW has indicated their commitment to use their resources, working with tribes as co-managers and local watershed recovery groups, to further the work on H integration strategies in 2005-2006.

AR057379

References:

Harvest:

70 Federal Register 12194, March 11, 2005. Notice of Final Determination and Discussion of Underlying Biological Analysis [of the joint RMP for Puget Sound Chinook Harvest]

Koenings, J., 2004. Remarks for Salmon Homecoming Alliance. http://wdfw.wa.gov/depinfo/director/sep1504.htm

National Marine Fisheries Service, 2004. Puget Sound Chinook Harvest Resource Management Plan Draft Environmental Impact Statement. USDA/NOAA, Northwest Office. Seattle, WA (Final EIS, 2005) http://www.nwr.noaa.gov/1sustfsh/salmon/SharvEIS.htm

National Marine Fisheries Service, 2005. Final Programmatic Environmental Impact Statement (FPEIS) for Pacific Salmon Fisheries Management off the Coasts of Southeast Alaska, Washington, Oregon, California, and in the Columbia River Basin. USDA/NOAA, Northwest Office. Seattle, WA. http://www.nwr.noaa.gov/1sustfsh/salmon/FPEIS_coastwide_salmon/

Puget Sound Indian Tribes and the Washington Department of Fish and Wildlife, 2004. Comprehensive Resource Management Plan for Puget Sound Chinook: Harvest Management Component.

Puget Sound Indian Tribes and the Washington Department of Fisheries, 1985. Puget Sound Salmon Management Plan. Filed with U.S. District Court, Western Washington, October 17, 1985 in relation to U.S. v. Washington, F. Supp. 1606:1405

Taylor, J.E. III and W. Cronon. 1999. Making Salmon: An Environmental History of the Northwest Fisheries Crisis. University of Washington Press.

Hatchery:

70 Federal Register 12194, March 11, 2005. Notice of Final Determination and Discussion of Underlying Biological Analysis [of the joint RMP for Puget Sound Chinook Harvest]

Brannon, E.L., K.P. Currens, D. Goodman, J.A. Lichatowich, W.E. McConnaha, B.E. Riddell, and R.N. Williams. 1999. Review of Salmonid Artificial Production Programs in the Columbia River Basin as a Scientific Basis for Columbia River Production Programs. Northwest Power Planning Council. Portland, OR.

Currens, K.P. and C.A. Busack. 2005. Practical Approaches for Assessing Risks of Hatchery Programs. American Fisheries Society Symposium 44: 279-289.

Hatchery Scientific Review Group (HSRG)-Lars Mobrand (chair), John Barr, Lee Blankenship, Don Campton, Trevor Evelyn, Tom Flagg, Conrad Mahnken, Robert Piper, Paul Seidel, Lisa Seeb and Bill Smoker. April 2004. Hatchery Reform: Principles and Recommendations of the HSRG. Long Live the Kings, 1305 Fourth Avenue, Suite 810, Seattle, WA 98101 (available from www.hatcheryreform.org).

Hatchery Scientific Review Group (HSRG) - Lars Mobrand (chair), John Barr, H. Lee Blankenship, Donald Campton, Trevor Evelyn, Tom Flagg, Conrad Mahnken, Paul Seidel, Lisa Seeb and Bill Smoker. April 2005. Puget Sound and Coastal Washington Hatchery Reform Project: Progress Report to Congress. Long Live the Kings, 1326 Fifth Avenue, Suite 450, Seattle, WA 98101 (available from www.hatcheryreform.org).

Mobrand, L., 2005. Remarks at the Shared Strategy Summit, January 26, 2005. Tacoma, WA.

Mobrand, L. E., J. Barr, L. Blankenship, D. E. Campton, T. T. P. Evelyn, T. A. Flagg, C. V. W. Mahnken, L. W. Seeb, P. Seidel, and W. W. Smoker. 2005. Hatchery reform in Washington State: Principles and emerging issues. Fisheries 30(6):11-23.

National Research Council, 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academy Press. Washington, D.C.

Northwest Indian Fisheries Commission and Washington Department of Fish and Wildlife, 1998. Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State. www.nwifc.gov/pdf_public/Disease_Policy_1998.pdf

Puget Sound Indian Tribes and the Washington Department of Fisheries, 1985. Puget Sound Salmon Management Plan. Filed with U.S. District Court, Western Washington, October 17, 1985 in relation to U.S. v. Washington, F. Supp. 1606:1405

Puget Sound Treaty Tribes and Washington Department of Fish and Wildlife, 2004. Puget Sound Hatchery Strategies for Steelhead, Coho Salmon, Chum Salmon, Sockeye Salmon, and Pink Salmon. Unpublished report available from the Northwest Indian Fisheries Commission. Olympia, WA.

Washington Department of Fish and Wildlife, 1997. Policy of WDFW and Western Washington Treaty Tribes Concerning Wild Salmon. [note: The policy was not adopted by all western Washington treaty tribes. More information on the policy and adoption is located at www.wdfw.wa.gov/fish/wsp/joint/final/fwsptoc.htm]

Washington Department of Fish and Wildlife and the Puget Sound Treaty Tribes, 2004. Puget Sound Chinook Salmon Hatcheries, a Component of the Comprehensive Chinook Salmon Resource Management Plan, draft.

Williams, R.N., J.A. Lichatowich, P.R. Munday, and M. Powell. 2003. Integrating Artificial Production with Salmonid Life History, Genetic, and Ecosystem Diversity: A Landscape Perspective. Issue Paper for Trout Unlimited, West Coast Conservation Office. Portland, OR.

Integration:

Hilborn, R., and C.J. Walters, 1992. Quantitative Fisheries Stock Assessment: Choice, Dynamics, and Uncertainty. Chapman and Hall, NY.

Hatchery Scientific Review Group (HSRG) - Lars Mobrand (chair), John Barr, H. Lee Blankenship, Donald Campton, Trevor Evelyn, Tom Flagg, Conrad Mahnken, Paul Seidel, Lisa Seeb and Bill Smoker. April 2005. Puget Sound and Coastal Washington Hatchery Reform Project: Progress Report to Congress. Long Live the Kings, 1326 Fifth Avenue, Suite 450, Seattle, WA 98101 (available from www.hatcheryreform.org).

Puget Sound Technical Recovery Team. 2003. Integrated Recovery Planning for Listed Salmon: Technical Guidance for Watershed Groups in Puget Sound. Draft report available from the Northwest Fisheries Science Center; Seattle, Washington.

Sharma, R., A. B. Cooper, and R. Hilborn. 1997. A Quantitative Framework for Analysis of Habitat and Hatchery Practices on Pacific Salmon. Columbia River Inter-Tribal Fish Commission, Scientific. Seattle, 58 pages.

CHAPTER 7

Adaptive Management and Monitoring for the Puget Sound Salmon Recovery Plan

Adaptive Management for the Puget Sound Salmon Recovery Plan

Purpose and Need

The Draft Puget Sound Salmon Recovery Plan represents an unprecedented effort to construct a recovery plan for a culturally and commercially important species listed under the Endangered Species Act across a large urban and urbanizing region. The geographic area is vast; the legal, biological, and political issues are complex and interdependent; the information is incomplete; and the recovery planning process is new in some places, and evolving.

Despite these challenges, the plan represents thousands of hours of technical and policy work by watershed and regional planning groups. As a result of these efforts, the plan is based on the best available scientific information about salmon and their freshwater and marine habitats within the Puget Sound. With this foundation, strategies and specific actions to recover Chinook salmon have been carefully outlined. Additionally, the plan reflects the different legal authorities and management organizations able to take actions to recover salmon.

Puget Sound watershed and regional salmon recovery groups can proceed with confidence based on the above characteristics. Adding to this confidence is the explicit recognition that the plan's key political and biological assumptions, which are unproven, can be tested as recovery moves forward. The plan calls for us to check assumptions, improve our knowledge, monitor our progress, and adjust our plans and our actions as we go. This will be accomplished through adaptive management.

Adaptive Management

Adaptive management is the process of making decisions, implementing them, learning from the results of implementation, and adjusting decisions as necessary. In so doing, the certainty of achieving society's goals improves.

Adaptive management provides the ability to:

- Integrate science and policy in making decisions;
- Use systematic processes for improving future management actions by learning from the outcomes of implemented actions;
- Use rigorous, transparent processes to set and assess goals and timeframes;
- Reduce uncertainty over time;

- Increase accountability and reduce risk of insufficient investment and misdirection of funding;
- Take action in the face of uncertainty;
- Communicate information to the public in order to build understanding;
- Learn from unexpected events and capitalize on "crisis;"
- Distinguish mistakes from failures.

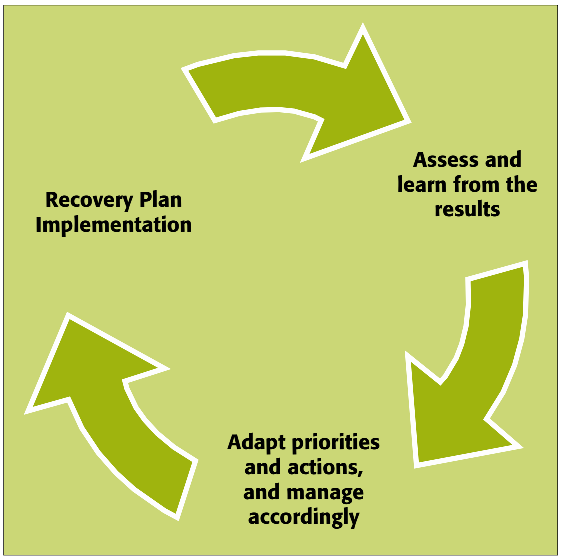


Figure 7.1 Adaptive Management: A framework for learning and adjusting during plan implementation.

Adaptive Management and Salmon Recovery

Adaptive management for salmon recovery has many elements in common with the way adaptive management is applied in other natural resource management issues. For example, collection of environmental data in salmon habitats, research on habitat function, monitoring clean water and flows, access to analyses and data, allocation of sufficient resources, and many elements of decision making structures already exist. Adapting these to assess the goals and measures of success for achieving viable salmon populations and ESU recovery, however, is unique to salmon recovery. The key distinguishing factor of salmon recovery is that success is determined by the overall status of populations in the ESU, which is a reflection of the individual abundances, population growth rates and trends, diversity characteristics, and habitat distributions of the different salmon populations.

The multifaceted recovery requirements for salmon mean that adaptive management must be applied at multiple geographic levels. As a result, there are three obvious levels at which adaptive management must occur:

- **Watersheds and populations.** The recovery plan builds on watershed specific action plans to protect and recover specific populations within each watershed. Each population has separate goals, assumptions, actions, and expected results.
- **The Evolutionarily Significant Unit (ESU).** The status of the ESU depends on the status of the individual populations across the Puget Sound as they relate to ESU recovery goals, the assumptions that those goals are based upon, actions, and expected results. In addition, certain recovery actions lend themselves to regional or ESU-wide solutions.
- **Multiple ESUs.** Some factors affecting Chinook populations occur or are managed at geographic scales larger than the Puget Sound. Harvest management of Puget Sound Chinook salmon, for example, involves monitoring, analysis, and negotiations between different states and countries.

Key questions that an Adaptive Management Program must Address

The implementation and design of this recovery plan raises a number of key questions that must be addressed in order for the recovery plan to be successful at the population and ESU levels. Adapted management programs for all three levels listed above will need to address each of the following questions:

1. *Who are the key decision makers with the authority to affect the implementation of recovery strategies and actions?* These are the groups to whom information should be provided (at the population or ESU scale), and whose decisions can be adjusted as necessary to adapt the plan over time.
2. *What are the salmon goals the plan aims to achieve?* These goals at the population scale are expressed as abundance, productivity, diversity and spatial structure targets or as objectives for the ecological functions and habitat conditions or processes a watershed will provide. At the ESU scale, the plan aims to achieve a negligible risk of extinction of the ESU and sustainable harvest.
3. *What are the key hypotheses for which salmon life stages and habitat, hatchery or harvest factors ("H" factors) are limiting recovery?*
4. *How are individual actions for each H factor and their cumulative effects addressing the key life stage(s) and H factors limiting recovery?*
   - How are specific and combined effects of actions contributing to achieving changes in H factors?
   - How in turn are changes in H factors contributing to achieving the VSP goals?
   - What measures best assess the overall effectiveness of the actions?
5. *How does data collection support the measures to assess effectiveness?*
6. *How does communication occur at all levels about the results of actions to improve knowledge?*
7. *Are there sufficient resources to carry out each element over the necessary time period and geographic area?*
8. *What is the organizational (decision-making) structure that defines roles and responsibilities for each element?*
9. *What are the commitments to implement the plan and its actions?*

A Strategic Focus

Because the list of questions that an adaptive management program must address is long, issues should be strategically prioritized and tracked. Examples of priorities are: the key life stages or H factors limiting recovery within watersheds, actions that will have the most uncertain effects on key factors or life stages, or the populations within the Puget Sound ESU whose improvements in status are critical to ESU recovery.

In addition to determining priorities, adaptive management must also be applied to the solutions that have been proposed to address "gaps" across watersheds. These gaps are key uncertainties in the plan that could not be addressed by individual watersheds during the planning period. Gaps occurred because 1) legal or policy issues affecting salmon recovery in a key population could not be resolved during this timeframe, but can be resolved over longer periods and 2) building the regional plan solely on individual watershed recovery plans would have ignored issues that need cross-watershed coordination to fully address. Because these gaps reflect important regional issues, the ultimate success of the plan depends on how well adaptive management will succeed in filling these gaps.

The "cross-watershed" issues include:

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or where they are included to move them further down the integration continuum over time,
- The need to develop or complete a robust adaptive management and monitoring program,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,

- The need to address water resources, both water quality and water quantity,
- The need to link the effects of land use to habitat-forming processes and to habitat conditions.

Gathering Information

Gathering and analyzing information on the success of various strategies and decisions is an essential component of adaptive management. Strategies and decisions affecting salmon recovery almost always involve the need to balance policy and scientific considerations — in other words, deciding what we want for fish and people given what is scientifically effective and politically tolerable.

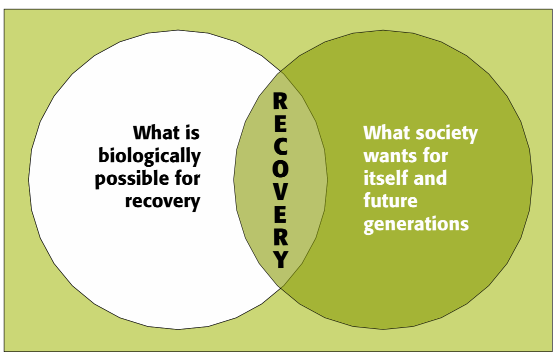


FIGURE 7.2

This means that if adaptive management is to be applied to learn what works for salmon recovery, it must encompass two objectives: understanding what is biologically possible, and understanding how to implement strategies to recover salmon that are politically feasible. Understanding what is biologically possible for recovery requires improving scientific knowledge, such as assessments of habitat status, the key processes affecting habitat status, the biological response of salmon in different habitats, and the effects and efficiency of restoration efforts. Understanding what society wants for itself and future generations, given what is biologically possible for recovery, means gathering better information on how to gain public support for habitat protection, restoration and rehabilitation.

Monitoring efforts for salmon recovery should correlate the scale and precision of monitoring with the purposes and uses of the information (2003 Washington Comprehensive Monitoring Strategy and Action Plan for Watershed Health and Salmon Recovery). Monitoring for adaptive management and salmon recovery purposes will require a multi-tiered approach, addressing monitoring needs both within respective watersheds and across the ESU.

At all levels (watershed and population, ESU, multiple ESU's) for which information is collected and analyzed it generally needs to address four types of questions:

- Implementation monitoring — Were the proposed actions implemented? If not, why not?
- Effectiveness monitoring — are the recovery actions, such as regulatory programs or restoration projects, having the desired effect?
- Validation monitoring — were our assumptions used in developing the recovery plan correct?
- Trend/status monitoring — What are the status and trends of important indicators (i.e. habitat quality, habitat quantity, water quality, VSP parameters, etc...) at a watershed level?

Watershed Level adaptive management

The Draft Puget Sound Salmon Recovery Plan is based largely upon watershed specific plans that have been developed over the past several years by local watershed groups. Each plan varies in terms of its content, scientific basis and background, level of certainty, analysis tools used to develop the plan, level of participation and commitment by watershed stakeholders, as well as other factors.

While many factors affecting Chinook are common across watersheds (habitat loss and degradation, harvest impacts, hatchery effects), there are many differences in how these factors have manifested themselves within each watershed and how they interact with the particular fish populations in each watershed. Thus, each watershed plan will have a slightly different set of specific questions and uncertainties to address through adaptive management.

Examples of general watershed level questions include:

- What goals do we want to achieve within the watershed?
  - Biological goals
  - Habitat goals
  - Policy goals
  - Funding goals
- What effects do we want to see from our actions and what effects do we actually see (effectiveness monitoring)?
  - Restoration projects
  - Protection actions
  - Policy actions
- What are the critical uncertainties in the watershed plan and how should they be filled or tested? Have we taken the actions we proposed in the plan (implementation monitoring)?
- Are the effects occurring fast enough and are they significant enough to lead to recovery and accomplishment of goals (trend/resource monitoring)?
- Were the assumptions used to develop the plan good ones (validation monitoring)? Were the right factors of decline identified and the right actions to address them?
- What changes are needed to assure adequate progress to plan implementation and resource recovery?

Watershed level adaptive management must ask these questions in the context of specific fish populations, critical habitat types, conditions within that particular watershed. The questions must be applied to each of the H's (hatchery, harvest, habitat and hydro).

In addition, there are H-Integration questions in each watershed. These questions relate to understanding the interactions between harvest, hatcheries, and habitat in each watershed for each population. These are among the most important sets of questions to answer through adaptive management, both at the watershed and ESU levels. To date, scientific tools for understanding these interactions are relatively new and still being developed. Furthermore, the interactions are complex, resulting in high uncertainty of planned management actions to integrate the H-factors.

The watershed level adaptive management programs must have some common elements across watersheds to allow "rolling up" information to the ESU level. Watershed level monitoring could include some common elements across watersheds to address ESU adaptive management questions.

ESU Level Adaptive Management

Many of the same basic questions asked at the watershed level also apply at the ESU level; however answering these questions requires information from all of the watersheds.

Example questions include:

- What goals do we want to achieve at the ESU level?
  - Biological goals (e.g., how many low-risk populations and how many are improving in status but not yet at low risk for all 4 VSP parameters?)
  - Habitat goals
  - Policy goals
  - Funding goals
- What effects do we want to see from our actions and what effects do we actually see at the ESU level (effectiveness monitoring)?
  - Restoration projects
  - Protection actions
  - Policy actions

- What are the critical uncertainties in the ESU Plan and how do we fill them or test them?
- Have we taken the actions we proposed in the plan (implementation monitoring)?
- Are the effects occurring fast enough and are they significant enough to lead to recovery and accomplishment of goals (trend/resource monitoring)?
- Were the assumptions we used to develop the plan good ones (validation monitoring)? Did we identify the right recovery criteria (the number of fish needed for viability and VSP)? Did we identify the right Factors of Decline and the right actions to address them?
- What changes are needed to assure adequate progress to plan implementation and resource recovery?

There are a number of "cross watershed" issues that may be best addressed at the ESU level, including but not limited to:

- Nearshore habitat protection and restoration — what is the role of nearshore habitats for multiple watersheds and stocks?
- Instream flow protection (state program).
- The effect of protection mechanisms on fish populations and VSP parameters.
- Puget Sound water quality issues such as Hood Canal and South Puget Sound.
- Integration of all the H's between watersheds.

Beyond the ESU

There are a number of technical and policy issues that also must be addressed at a scale larger than either the watershed or ESU level. For example:

- Harvest management goals and actions are developed in the context of a complex management scheme that encompasses the entire West Coast of the United States and Canada. Adaptive management at this broad scale will need to be integrated into the management system for Puget Sound Chinook recovery efforts.
- Treaty Trust Responsibilities involve a special relationship between the United States and Treaty Indian Tribes. This relationship cannot be comprehensively defined at the watershed or ESU levels.
- Many factors affecting the salmon are linked to statewide issues, such as water management, shoreline management, water quality protection, critical areas protection, and growth management that are largely defined by state law and actions.

As the adaptive management program is further developed and implemented, it will need to be synchronized with other management and monitoring programs that extend beyond the Puget Sound ESU.

Next Steps

During the first phase of implementation of the Draft Puget Sound Salmon Recovery Plan, it will be necessary for watersheds to refine and give further definition to watershed and regional adaptive management programs. In addition, a parallel regional approach will also need to be detailed.

During the first year of implementation, participants in the Puget Sound Recovery Plan will:

1. *Convene watersheds to confirm, refine or develop an adaptive management program that allows them to make scientifically and politically defensible decisions that lead to salmon recovery in the watersheds.*
2. *Convene a regional group to identify regional adaptive management issues that cross watersheds and develop a plan. The regional group should involve representatives from each of the watershed groups.*
3. *Watershed and regional groups will use ESU goals to identify metrics, performance standards for ESU roll up and the decision-making*

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Photo courtesy the WAshington State Salmon Recovery Funding Board.

Fish biologists monitor salmon in the Stillaguamish River.

feedback to individual watersheds or regional adaptive management processes.

4. The groups will conduct a gap analysis that identifies existing monitoring programs, provides habitat, population, or policy information and identifies where data collection or monitoring are not occurring.

5. The groups will secure commitments to prioritize key monitoring needs to fill existing gaps and implement those programs.

During the May 2005 review of watershed chapters and regional plan elements, the Technical Recovery Team and an interagency committee identified a preliminary list of issues that have high uncertainty and need to be incorporated into the adaptive management plan.

Technical issues identified include:

- **Interactions between hatchery and wild fish in certain watersheds, estuaries, and Puget Sound.** General interactions such as competition, interbreeding, straying, and disease transmission are well known; however, the specific interactions in a particular watershed or habitat are less well documented in many cases. Improving our understanding of these interactions, quantitatively and qualitatively, is essential for "H integration" over time.
- **Juvenile Chinook use/survival in different freshwater, estuarine and marine habitat types.** While general habitat requirements and use by Chinook are known, the specific importance of specific habitats is not well understood. Increasing our knowledge of the use and survival of specific habitats is necessary to help validate models such as EDT that were used in some watersheds and could be applied in other watersheds in the future.
- **Effects of freshwater and marine water quality on VSP parameters.** The role of water quality on Chinook production and survival is poorly understood. Significant water quality problems exist in the region in both fresh and marine waters, however the importance of these relative to salmon recovery needs further research and assessment.
- **Lack of a robust landscape based process model for determining land use effects on freshwater habitat and VSP parameters.** Future patterns of human population growth

and development in the Puget Sound region could have profound effects on the survival and recovery of Chinook and other salmonids. The impacts of this growth and development within watersheds and the region are not well monitored or assessed. This is a major source of uncertainty in the Recovery Plan and must be addressed in the detailed adaptive management plan.

- **H-Integration in each watershed and within Puget Sound.** A variety of questions related to interactions among the 'H-factors" need to be addressed in the adaptive management program. Questions range from the need to understand how these interactions affect VSP parameters over the long term to the effect of harvest on diversity and spatial structure. The adaptive management program needs to improve our quantitative understanding of these interactions in order to adjust management over time.
- **Water quantity and instream flows.** This is an important issue in every salmon watershed. Identifying instream flows, or flow regimes, that will support salmon recovery in each watershed represents a difficult technical challenge. There are numerous scientific tools to help identify these flows but there is significant scientific uncertainty of the efficacy of these tools. There is also a growing scientific consensus that we need to move away from identifying "minimum flows" and move towards identifying flow regimes that will support not only the biological needs of salmon, but also support the habitat forming processes necessary to maintain habitat quality and quantity over time.
- **Nearshore protection.** Scientists are recognizing the role and importance of nearshore marine habitats to Chinook salmon recovery. Because salmon are part of an ecologically complex web and different authorities and regulations affect these habitats, it is difficult to predict precisely the effects of different protection and restoration actions.
- **Effectiveness of regulatory habitat protection.** All watersheds identified provisions of the Shoreline Management Act and Growth Management Act as mechanisms for protecting habitat, but no watersheds proposed evaluating the implementation and effectiveness of these regulations, or other habitat protection measures, for salmon. The adaptive management plan needs to identify a program for assessing the effectiveness of protection measures in each watershed and within the region.
- **The potential impacts of climate change on salmon recovery.** Climate change, both natural and induced, could have significant effects on Chinook salmon and other salmonids in the Puget Sound region and beyond. Possible effects include alteration of the hydrologic cycle resulting in changes in low and high flow patterns, changes to habitat forming processes, changes in terrestrial and riparian vegetation that affect habitat forming processes, changes in erosion patterns, and impacts to water quality. Significant research on this topic is being conducted in the region, however none of the watershed plans have proposed means of monitoring climate change or its impacts. This is a significant uncertainty in the Puget Sound Recovery Plan and should be addressed through the detailed watershed and regional adaptive management plan.
- **Nearshore.** Uncertainties surrounding the habitat processes, conditions, population and ESU responses in the nearshore result in significant uncertainties regarding the effectiveness of the entire ESU recovery plan. There needs to be an increased scientific understanding of the relationships between the viability of salmon and bull trout populations, nearshore and marine habitat conditions, and habitat management actions. This might be measured over a 10 year timeframe to develop and use quantitative models of the effects of habitat alterations on salmon population viability.

Photo courtesy the WAshington State Salmon Recovery Funding Board.

Biologists from the Stillaguamish Tribe gather smolts from a smolt trap.

Policy issues that have been identified include:

- **Identification of key decision makers and responsible parties for implementing actions.**
- **The need to describe the implementation process beyond the first 10 years.**
- **Implementation monitoring of habitat protection measures.** There is currently no monitoring or evaluation system in place in the region for tracking the implementation and effectiveness of habitat protection measures for salmon recovery. It will be important to conduct an assessment to learn how effective various protection mechanisms are for achieving results for fish.
- **Achieving instream flows within Puget Sound watersheds.** There are significant policy and legal hurdles to achieving instream flows, once these are set or identified. A variety of approaches, from voluntary to regulatory, are being pursued in the region. The adaptive management program should track these approaches and inform changes to them to achieve the goal of providing instream flow regimes that will support salmon recovery.

Identifying research needs in support of salmon recovery in Puget Sound

As exemplified in this plan, recovering salmon in Puget Sound will involve implementation of actions and a well-designed adaptive management and monitoring program to track outcomes and make adjustments when needed. The proposed recovery strategies in habitat, hatchery and harvest management are based on our best understanding of the integrative effects of actions in each of these sectors. The process of designing recovery strategies has illuminated some key gaps in our scientific understanding that, if addressed, will greatly improve our ability to target recovery actions where their benefits will be greatest.

Key scientific uncertainties identified in individual watershed plans range from insufficient understanding of where juvenile salmon rear in lower rivers, estuaries, and in the nearshore to uncertainties in the cumulative effects of protection measures on habitat, and in turn, on salmon. Similarly, important gaps in biological information at the regional scale include the relative importance of different nearshore habitats to specific salmon populations and how many salmon can be supported by nearshore and marine habitats.

The individual watershed, nearshore and regional plans identified important gaps in our scientific knowledge, as illustrated in the previous paragraph. Prioritizing these research needs is a critical next step that is being initiated for Puget Sound by a group of scientists and policy-makers. A draft of a research needs document for ecosystem-based management in Puget Sound will be available for public comment later in the fall of 2005. Such a broadly agreed-upon research plan will help guide funding for research such that our scientific focus is strategically geared towards providing information that will improve the likelihood of salmon recovery.

CHAPTER 8

Financing Puget Sound Salmon Recovery

Financing Puget Sound Salmon Recovery

"We want to recover salmon not just because of the ESA, but because it is our responsibility to take this on and restore it for the sake of our cultural, social, industrial and economic future."

U.S. Senator Patty Murray

People from all fifteen Puget Sound watersheds, in one of the most populous regions of the state, came together to save a species from extinction. The sheer size of this effort and number of communities involved is unprecedented in the history of the Endangered Species Act: fifteen local communities, both rural and urban, developed a regional recovery plan intended to do the most good for people and salmon. Critical to the implementation of this plan is the ability to fund its programs and actions and so Shared Strategy leaders developed a strong financing strategy to enable local and regional leaders to work together to raise the needed funds.

This chapter describes the financing strategy, developed over a two-year period by the Shared Strategy Development Committee (DC). The financing strategy's concepts, principles and approach were recently supported and affirmed by a Leadership Group composed of city and county elected officials from throughout the Puget Sound region, government agency representatives, tribes, conservation organizations, and private industry.

In addition, this chapter is intended to fulfill the requirements of section 4(f)(1) of the Endangered Species Act that requires that the recovery plan include "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" (16 U.S.C 1531-1544, as amended).

What are the financing strategy's goals and objectives?

The primary goal of the financing strategy is to facilitate the implementation of this recovery plan over the next ten years. Doing so will improve conditions for the remaining 22 Puget Sound Chinook populations, core populations of bull trout and Hood Canal Summer Chum and place them on a recovery path.

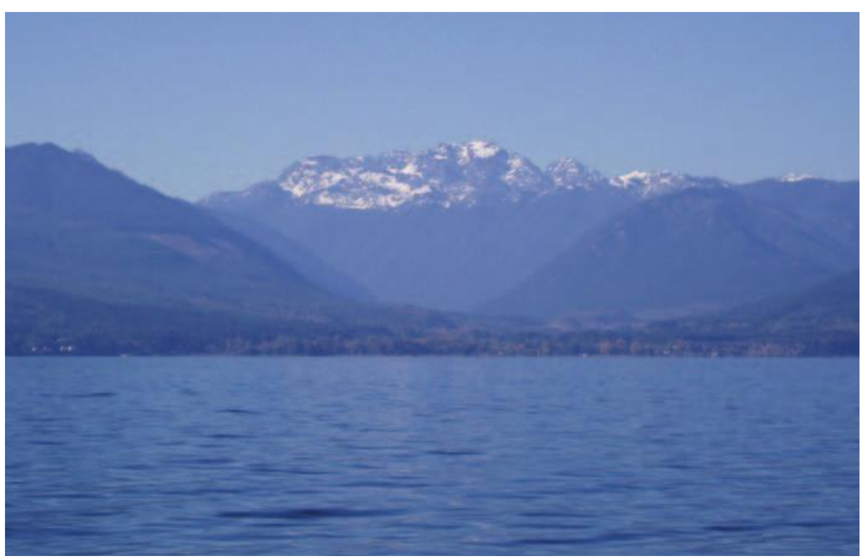

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

Additional objectives of the financing strategy include:

- Create public support for a long-term investment and commitment to action,
- Provide for dependable sources of salmon funds,
- Use public and private funds effectively on the highest priority salmon recovery actions based on science and local interests, and
- Improve the overall health of the Puget Sound ecosystem by helping salmon.

What period of time does the financing strategy cover?

The financing approach focuses on the first ten years of plan implementation. While it is generally accepted that full recovery will take several decades, financing this first phase is expected to result in improved conditions for all Puget Sound Chinook populations and is expected to put the region on an aggressive recovery path. Ten years is a reasonable period of time during which to implement and evaluate the set of short-term strategies and priority actions identified in the plan, to gain a preliminary view of the status and trends of important recovery indicators, and to make mid-course corrections as needed. In ten years, regional leaders will decide how to finance the next phase of recovery based on the conditions and needs at that time.

How were cost estimates developed?

The recovery plan recommends hundreds of different actions to protect and restore salmon populations, including protecting habitat through a combination of regulations, incentives and education. There are also restoration projects ranging from several thousand to several million dollars to improve fresh and salt water salmon habitats.

In addition, efforts will be necessary to integrate habitat, harvest and hatchery management to work in concert with recovery goals, as well as efforts to administer major long term responsibilities of public agencies related to plan implementation.

To address the costs of implementation, watersheds provided ten-year cost estimates based on their priority actions, assumed to be the period 2006-2015. Most watersheds used cost estimation models from the Shared Strategy publication *A Primer on Habitat Project Costs* and a companion spreadsheet model for non-capital costs (Evergreen Funding Consultants, 2003). While the precision of cost estimates varies somewhat from watershed to watershed, they are equivalent to pre-design or planning estimates for other public works programs.

In addition to the watershed-specific work to identify and estimate costs for priority actions, the Shared Strategy staff developed estimates for three programs that span multiple watersheds: hatchery improvements, nearshore and marine habitat protection and restoration, and incentive programs aimed at conservation on private farms and small forest parcels.

It is useful to note that the cost estimates are more accurate in the aggregate, when high and low estimates are expected to offset each other, than they are for individual projects. Therefore, costs of individual projects used to develop the watershed estimates should be viewed as approximations, likely to change significantly as projects proceed into and through design phases and finally to construction.

Cost modeling is based on average circumstances. Anything out of the ordinary, such as particularly challenging site conditions or access to low-cost labor, can result in significant changes in project costs. Again, it seems likely that these offset one another when applied across the hundreds of projects identified in the watershed strategies.

All costs are in 2005 dollars, with no inflation anticipated in the ten-year estimates. The actual sequencing of projects and specific funding needs over the ten year period will be addressed later by the middle of 2006.

What are the cost estimates for watershed projects and programs?

The attached figure (figure 8.1) shows total costs (capital and some operating) for the initial ten years of implementation for ten of 14 watersheds in the Puget Sound basin. The remaining four watersheds (South Sound, Whidbey/Camano Islands, the San Juan Islands, and the east side of the Kitsap Peninsula) are making an important contribution to salmon recovery through their nearshore protection and restoration efforts. Consequently, these four were estimated as part of a group in the nearshore category discussed later in this chapter.

As noted on the figure, all but two of the costs estimates (for the Skagit and Hood Canal watersheds) were developed by local watershed planners. The Hood Canal basin provided costs for summer chum. Additional costs for Hood Canal Chinook recovery actions will be completed later in 2005. Since the actions benefiting Hood Canal summer chum are also expected to benefit Chinook in that basin, the additions of Chinook specific projects should not significantly change the magnitude of the need in Hood Canal. The Skagit costs are assumed to be comparable to the Snohomish watershed.

The total cost (mostly capital projects) of watershed actions identified for the ten watersheds is roughly $1.1 billion for the ten-year period from 2006 to 2015. These costs are principally for habitat protection and restoration, the orientation of most of the watershed plans.

Estimates for regional projects and programs

Note that there are three bars to the right of figure 8.1 that are not watershed-specific. These costs-for nearshore, hatcheries, and farm and forest programs- are estimates for regional programs that will span the watersheds of the Puget Sound region. Like the watershed-specific costs, they are assumed for the first ten years of plan implementation. These costs and the proposed distribution of funding will be

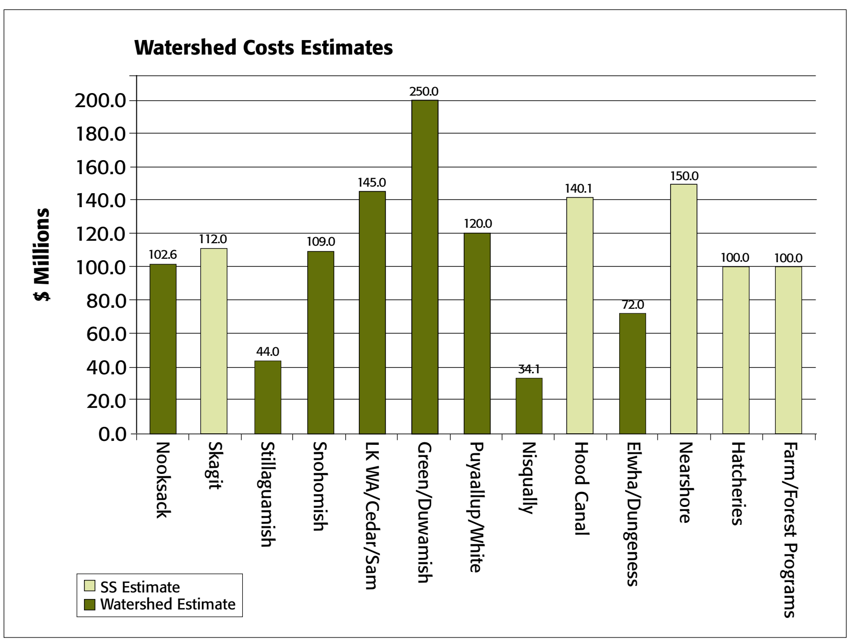

Figure 8.1 Ten-year Cost Estimates for Puget Sound Watersheds

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subject to additional consultation, planning and decision processes for each of the three programs.

Nearshore: The financing strategy assumes that funding for the nearshore program would be allocated across all 14 Puget Sound watersheds in accord with regional nearshore priorities and shoreline assessments currently underway (including the Puget Sound Nearshore Ecosystem Restoration Program). Estuarine restoration projects are already captured in the watershed's ten-year costs. The estimate of $150 million for the nearshore program is similar to the level of effort in a moderate-to-large watershed program.

Hatchery Improvements: The $100 million assumed for the hatchery effort is in keeping with initial priorities for capital improvements identified in the Hatchery Scientific Review, a congressionally authorized assessment of hatchery improvements in Puget Sound and coastal waters. Like the nearshore funding, it is assumed that hatchery funding would be spread among the 15 Puget Sound watersheds in accordance with priorities that are consistent with recovery goals and agreed to by state and tribal co-managers.

Farm and Forest Incentives: The farm and forest funding is assumed to be allocated among Puget Sound watersheds to provide incentives to farmers and small forest landowners for salmon conservation work on their lands and to preserve these working lands. The $100 million estimated from this work is based on the costs of comparable programs in individual jurisdictions.

Of the total watershed and regional costs, 85% or slightly more than $1.2 billion is projected to be needed for capital projects – largely habitat-related – and the remaining 15% (or $222 million) is proposed for key non-capital activities such as adaptive management and monitoring.

Other costs of the recovery effort not covered by these estimates

The costs above are primarily for efforts central to the recovery effort. There is a broader universe of programs whose goals and applications are not directed solely at salmon recovery, but that do or could have some benefit to salmon. They include:

- Development and enforcement of land use regulations
- Enforcement of water pollution controls
- Hatchery operations and maintenance
- Development and enforcement of fishing regulations
- Restoration of in-stream flows to support salmon recovery
- Water quality clean-up costs
- Public outreach
- Protection and enforcement of regulations regarding instream flows
- Monitoring and enforcement of ESA compliance

Costs of these activities have not been quantified for two reasons. First, the compilation of costs of activities that are spread among hundreds of jurisdictions, such as land use enforcement, is impractical. Second, it is challenging to determine how to allocate the costs of these activities between salmon recovery and other benefits such as water quality or fisheries management. Suffice it to say that there are substantial additional costs associated with the accomplishment of the recovery strategy, many of which are borne by local, state, and tribal governments in the region.

How will the cost estimates be refined?

Costs for the recovery plan will be refined in phases as additional information is gathered. Those elements of the plan that are addressed in regional actions with gross cost estimates – nearshore, hatchery, and farm and forest activities – are expected to be fleshed out and estimated for costs by the first annual review of the recovery plan in late 2006, and costs will be modified accordingly. Finally, all costs of the plan are expected to be updated as projects proceed through further design and development, with each phase of the design process resulting in more reliable cost estimates.

Summary of cost information

The costs of the recovery plan can therefore be summarized as such:

1. The costs of habitat actions and some hatchery and adaptive management work identified in 10 of the 14 watersheds in the region sum to $1.2 billion, the majority of which is needed as capital funding in the next ten years.
2. Costs of regional programs to address near-shore, hatchery, and farm and forest conservation needs are estimated at $350 million for the next ten years.
3. Many activities that are ancillary to but supportive of the recovery effort have not been quantified.
4. Costs will be refined as regional studies continue and as individual projects proceed through the design and development process.

What is the financing strategy?

One of the objectives of the financing strategy is to provide dependable sources of funds needed to address the highest priority actions identified in the regional recovery plan. This will be pursued through the following strategy:

- Maximize the use of existing salmon funding sources.
- Draw on additional existing sources that could be, but have not been, used for salmon recovery priorities (e.g. mitigation, federal farm bill, public and private grant programs).
- If sources fall short of goals, explore alternative sources or change the scope or pace of recovery plan implementation.

What are existing sources of salmon funds?

In the aggregate, spending for salmon recovery has been divided fairly evenly among federal, state, and local governments in recent years, although each (and other contributors) have had different emphases:

- Capital funding for habitat projects has come principally from federal and local sources, with tribes also contributing significantly;
- Funding for hatchery and harvest activities has been raised and spent principally by state and tribal governments;
- Watershed and regional recovery planning has been funded by local governments, tribes, and private organizations, although the federal and state governments have contributed cash and technical assistance to the effort.

In the five years since the ESA listings, annual spending from sources that are expressly for salmon projects and programs — such as the Salmon Recovery Funding Board (SRFB) and the National Fish and Wildlife Foundation's Community Salmon Fund (CSF) — have crested at more than $25 million annually within the Puget Sound region. Sources that are not salmon-focused but have been used extensively for salmon projects in recent years (including funding from local surface water management programs, Corps of Engineers restoration programs, and a wide variety of local, state, and federal environmental grant programs) have contributed at least another $40 million per year. For the purposes of this financing approach, the current level of funding is assumed to be $60 million per year in Puget Sound.

How can we maximize existing sources?

Existing funding comes principally from targeted federal and state appropriations, competitive grants, and local (with tribal and private) matching funds. This financing approach assumes continued success at current levels from local contributions and with the federal portion of SRFB funding. The financing strategy calls for an increase in state SRFB funding, and concerted efforts in Washington DC and Olympia to diversify federal and state funding sources.

The approach also calls for a higher rate of activity and success with competitive grant programs that are relevant to salmon recovery activities. There are dozens of appropriate grant sources and existing efforts that could be greatly improved by employing a more strategic approach to identifying promising grant sources and coordinating proposal writing. Together, these efforts to maintain and improve fundraising from existing sources are anticipated to result in an increase in annual funding for Puget Sound salmon recovery activities from $60 to $80 million annually.

What is the principal untapped source that could be used for salmon?

The principal untapped source identified in the financing approach is mitigation funding provided as compensation for environmental impacts of public and private construction projects. The financing strategy proposes to use existing, not new or increased, mitigation funds more effectively. Currently, projects requiring environmental mitigation spend anywhere from 5% to 60% of the project cost on mitigation with an average of 10%. The approach anticipates that a small portion of mitigation money (one tenth) could be redirected to salmon habitat projects through banking and other alternative mitigation strategies. The purpose would be to mitigate a project's impacts on salmon off-site where restoration could be expected to make a bigger difference than on-site.

There are a number of administrative and policy issues that need to be addressed to use mitigation funds for salmon recovery. Mitigation program details will be developed later this year and expected to be completed by mid 2006.

In addition to mitigation, the financing approach incorporates a very small amount of funding from the increased use of existing local funding authorities such as the Conservation District assessments and Conservation Futures taxes in some communities that are not currently using these programs. These sources are forecasted to add an additional $40 million per year in funding for Puget Sound salmon recovery.

How will funds be distributed?

It is worth noting that only about a third of the sources identified in the financing strategy are available for distribution across the region. These are primarily the SRFB state and federal sources and some grants. Local appropriations are confined to the jurisdiction in which they are raised. Mitigation funding can rarely be spent beyond the watershed in which environmental impacts occur. This means that urban watersheds with the largest population size have the potential to raise the most money.

The financing strategy compensates for this inequity by distributing funds that are not geographically constrained (portable) according to priorities in the regional recovery criteria. That is, each of the five bio-geographical regions would receive an equal amount of portable funds with a 10% bump to the Skagit watershed because of its unique role. Each sub-region then divides the money evenly among its watersheds. Initially, until planned fund sources roll in, watersheds with independent spawning populations would continue to receive comparable levels of SRFB funds according to current averages. Watersheds without spawning populations would receive a portion of the nearshore funds. Once the entire suite of planned sources begin coming in, the full financing strategy will be implemented.

What is the total funding level and what can it achieve?

The financing strategy is expected to sustain the $60 million currently available for salmon recovery and raise an additional $60 million per year for a total average of $120 million per year over ten years. This funding level will support significant progress toward recovery based on local watershed scientific work and the TRT's regional recovery criteria. Based on the assumptions in the finance strategy, it will do so at a cost that can reasonably be borne by the governments and taxpayers of the region without tax increases. It does not, however fund the entire suite of priorities on which the watersheds based their estimates.

The Puget Sound Technical Recovery Team's conclusions about the certainty of achieving plan outcomes (as described in other chapters of this plan) assume implementation of the entire 10-year suite of priority actions. If the ten-year program cannot be fully implemented, the certainty of achieving plan outcomes and achieving ESU recovery is reduced. It is incumbent on regional leaders to address this issue as results and progress become apparent in the next ten years. They may need to re-evaluate the funding strategy to determine if the fund raising goal will need to be adjusted.

Review and adaptation of the financing strategy

An annual review process is recommended to ensure that tasks are executed as planned and, in time, that the strategy is reaping the funding levels expected. It is recommended that this occur in the late fall of each year to make the necessary mid-course corrections before the state and federal budget processes begin in January. The reviews for years one and two (in the fall of 2005 and 2006) should focus principally on whether the proposed tasks have been implemented. Thereafter, the focus should shift to whether the tasks have succeeded in raising the money anticipated, with the first full evaluation of program performance in the fall of 2007 when all programs should be fully underway.

Summary of the financing strategy and schedule

The approach can be summarized as follows:

1. Existing federal, state, and local sources of funding for salmon recovery now contribute an average of $60 million per year.
2. Through an active lobbying and grant writing effort, this could grow to $80 million dollars.
3. An additional $40 million per year - to a total of $120 million per year over the next ten years - may be available largely from redirecting money that is currently spent on mitigation to higher priority restoration sites.
4. Executing this approach will require a strong commitment to a joint communications, lobbying, grant writing, and mitigation banking campaign.
5. This campaign will take two years to reach full strength and should be evaluated and fine-tuned on a regular basis through the initial ten-year implementation period.
6. In the meantime, watersheds will receive comparable funds according to current averages from either the SRFB or the nearshore portion, depending on whether or not they have independent spawning populations.

Conclusions

The financing approach discussed in this chapter is ambitious but achievable. Since 1999, the governments, community organizations, tribes, and business community have demonstrated that when they all pull together to support funding programs, the money flows. There are hundreds of completed habitat projects on Puget Sound rivers and

Photo by Levi Sheckler, courtesy the Washington State Department of Community, Trade and Economic Development.

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shorelines that demonstrate the resolve and power of this partnership.

The next ten years will test this resolve and power. The financing approach counts on redoubled efforts in DC and Olympia, a regional grant-seeking compact, and pioneering work to redirect mitigation funding. It will require all of the effort put in the last few years and a good bit more. The partners in the Shared Strategy have demonstrated that it can be done - that the financing approach, while properly ambitious, can be achieved.

CHAPTER 9

Implementation

Federal Assurances

I. ESA Requirements and Potential for Regulatory Certainty

When species are listed under the Endangered Species Act (ESA), federal agencies are required to ensure that any actions they fund, permit or carry out are not likely to jeopardize the species' continued existence or destroy or adversely modify its critical habitat. Federal agencies must consult with the listing agency (NOAA Fisheries or U.S. Fish and Wildlife Service) regarding actions they take that "may affect" the listed species or its critical habitat. Actions that may affect but are "not likely to adversely affect" the species undergo an informal consultation, while those that are likely to adversely affect the species or its critical habitat must undergo more lengthy formal consultation. The ESA also prohibits the "take" of listed species, either through section 9 (for endangered species) or through section 4(d) (for threatened species). The take of a listed species can occur as a result of many of the everyday activities carried out in a watershed, resulting in an ESA violation.

Although there is no requirement to implement recovery actions, there are risks if actions are not taken promptly to improve the conditions for salmon. For example, if habitat continues to degrade and the status of salmon continues to decline, the species could be downgraded to an endangered status which could result in more restrictions on current activities and more costs for recovery.

Private citizens, landowners, businesses and local governments can all be affected by the federal consultation requirement or the ESA prohibition of take. For example, ESA consultations can affect the time it takes to issue a permit, fund a project, or complete an action when a federal agency is involved. Consultation might also affect the conditions on a permit or funding, or the manner in which a project is completed.

In Puget Sound, a consortium of watershed groups, local, state, tribal and federal governments developed this draft recovery plan for ESA-listed salmon and bull trout. Commitments to implement the plan will be developed by the end of 2005. In exchange for those commitments, local, state, tribal and other interested parties want to know what support they can expect from NOAA Fisheries and the U.S. Fish and Wildlife Service. The extent to which a party might receive regulatory relief, or assurances against take liability, will depend on the extent to which that party commits to taking certain specific actions.

II. Interests for Federal Certainty and Regulatory Relief

Addressing the uncertainty and legal liability created by the ESA mandates is important to the future of many activities ranging from farming to forest management, rural and urban development, and road maintenance and other community improvements. Interested parties want to know that the development of, and most importantly, implementation of a salmon recovery plan will achieve salmon recovery, and help reduce the legal and regulatory uncertainty for activities necessary to support our human population. They also hope that effective plan implementation will lead to a reduction in the cost of ESA compliance and the risk of third party lawsuits.

People working across Puget Sound share the perspective that the money provided from the federal and state governments while important will be inadequate to recover salmon without resources committed from local governments, business, and other private parties. Without incentives for working on recovery, local governments and the private sector will find it difficult to do more than just comply with the law.

III. Ability to Provide Federal Certainty

The ability of the federal agencies to provide certainty and regulatory relief is based on several factors:

1. The comprehensiveness, level of detail and scientific certainty of results proposed in a recovery plan,
2. Comprehensiveness and certainty of commitments for implementation,
3. Demonstrated progress in implementation of actions called for in the plan, and
4. Improved status/trends for populations listed under the ESA.

Like climbing the rungs on a ladder, the more progress that is made toward achieving the four criteria, the higher the level of certainty or regulatory relief that could be offered. At the time of the anticipated adoption of the plan by the federal agencies, the factors mentioned above will only be partially met. It is anticipated that the plan will actively evolve over time and that substantial progress could be made on all four factors over the first years of implementing the plan.

IV. Initial Steps for Federal Certainty

The general recommendation is to provide a staged progress review and the provision of assurances over the next ten years for the whole region, individual watersheds and specific sectors of the region. Some individual sectors or watersheds may be further along then others in their understanding and commitment to address the threats to the salmon and they should be rewarded with additional assurances. This proposal includes a conservation agreement for the whole region and individual watershed/sector assurances.

Regional Conservation Agreement

Upon the adoption of the Puget Sound recovery plan by the federal services, an agreement is recommended between the federal agencies and the State of Washington for the conservation and recovery of the salmon. "Conservation agreements" are not specific to the ESA but provide a means to formalize commitments that could support implementation of the plan.

The conservation agreement would acknowledge that the Puget Sound recovery plan with its implementation commitments is the agreed upon approach for achieving recovery by the State and the Federal Services. The conservation agreement would identify key measures that would be monitored for success, the process for adapting to new information and the initial milestones over a ten-year period where progress and results would be evaluated. The agreement would also state the intention of the state and federal agencies to jointly pursue funding for local communities if a watershed or sector is implementing the plan. They will also consider how their enforcement powers and other tools can be used to provide incentives for implementing the plan. The agreement could be used in the event of third party lawsuits by identifying the recovery plan as the recommended approach to recovery in the case of legal action.

The conservation agreement would identify review points at specific time intervals; three, five and ten years. At each review point, progress would be evaluated for each watershed, fish population and the evolutionarily significant unit. Based on the four factors mentioned in the previous section, the federal agencies would determine if additional assurances or regulatory relief could be provided.

Watershed and Sector Specific Assurances

Federal assurances can provide a significant benefit to local watershed interests and individual sectors of the community by streamlining the permit process and providing upfront certainty for permit requirements. Currently the actions that may require consultation under the Endangered Species Act, that are important for participating local jurisdictions include:

a. Erosion control bank protection

b. Dike and levee maintenance

c. Fish passage projects, e.g., culvert replacements

d. In-stream restoration, e.g., engineered log jams, side channel restoration

e. Riparian restoration

f. Docks and piers in fresh and marine waters

g. Installation of watercraft lifts

Once the recovery plan is adopted, the federal services could formally initiate a process to evaluate the potential for general programmatic permits to cover as many of the above actions as possible. The conditions for favorable consideration of a general programmatic permit would be compliance with the implementation schedule for the watershed plan, adoption of regulations consistent with the plan and an on-going monitoring program.

Implementation Schedule

Puget Sound Salmon Recovery Plan Draft Implementation Schedule		
Near-term (July 2005 to July 2007)		
Watershed Groups/Entities	Watershed Groups work with Shared Strategy, TRT and others to develop an adaptive management and monitoring program that is integrated at the watershed and regional scale.	July 05-Dec 05
Watershed Groups/Entities	Obtain and confirm commitments by decision makers and responsible entities to implement actions consistent with their authority and responsibility.	July 05-Dec 06
Watershed Groups/Entities	Preserve future options for restoration in priority areas where needed.	July 05-July 06
Co-Managers and Watershed Groups/Entities	Work together to develop and refine integration of habitat, harvest and hatchery goals and strategies.	Jul 05-Jul 06
Puget Sound Counties and Cities planning under GMA	Update CAO's, (local watershed chapters and recovery plan can serve as best available science); coordinate with stormwater manual, clearing and grading, and zoning programs.	Jul 05-June 06
Shared Strategy*	Develop, refine, and complete regional (Puget Sound ESU-scale) adaptive management and monitoring program; coordinate with watershed AMM programs and the regional nearshore strategy.	July 05-Dec 05
Shared Strategy and its successor*	Coordinate the design and implementation of a regional communication and fundraising campaign to build support for salmon recovery efforts and enable implementation.	July 05-Dec 06 and ongoing
Shared Strategy and its successor*	Coordinate a pilot project in cities or counties to evaluate the effects of existing protection programs and their contribution to salmon recovery; identify gaps in programs, and develop and implement locally acceptable solutions based on a combination of voluntary, incentive and regulatory programs.	Jul 05-Dec 06
Shared Strategy/Regional Finance Leadership Group*	Refine and complete detailed salmon recovery funding plan; begin fundraising according to the current strategy.	July 05-Dec 06
Forests and Fish Policy Group and Shared Strategy successor*	Establish regular communication structure to coordinate activities between forestry managers and watershed habitat managers.	Jan 06-Jul 06
WA Dept. of Ecology	Integrate the recommendations in this Plan with the Oil Spill Response Program.	2005
WA Dept. of Ecology	Design program to establish flows for salmon recovery.	July 05-July 06
WA Dept. of Ecology	Issue Phase I and II Municipal stormwater permits consistent with this Plan.	Jul 05-June 06
WA Dept. of Ecology	Implement protection and restoration strategies in nearshore-marine areas prone to low dissolved oxygen levels, high water temperatures, and contamination.	Jul 05 and ongoing
NOAA	Coordinate the development of a multiple ESU-scale adaptive management and monitoring program that integrates the Puget Sound approach.	Dec 05-Dec 07
NOAA	Determine results expected for salmon recovery from the implementation of the U.S. Ocean Action Plan	2006

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Puget Sound Salmon Recovery Plan Draft Implementation Schedule		
Midterm (2005 to 2015)		
Watershed Groups/Entities and other responsible agencies	Evaluate the effects of existing protection programs and their contribution to salmon recovery; identify gaps in programs and develop and implement locally acceptable solutions based on a combination of voluntary, incentive and regulatory programs; coordinate protection actions at the sub-basin or appropriate scale to ensure levels of protection needed for salmon recovery are met.	2005-2010
Watershed Groups/Entities	Implement watershed 10-year fresh and marine water strategies, actions, and adaptive management and monitoring programs	2005-2015
Watershed Groups/Entities and regional nearshore experts	Conduct further technical assessments as needed to help determine nearshore-marine restoration priorities and actions; build public support for nearshore restoration actions.	2005-2015
Watershed Groups/Entities and regional nearshore experts	Develop prioritized list of nearshore restoration actions based on local analysis and the regional nearshore chapter's sub-basin analysis.	2005-2015
Watershed Groups/Entities and regional nearshore experts	Refine Puget Sound strategies and actions based on different assumptions for ocean conditions.	2005-2015
Watershed Habitat Managers	Coordinate and sequence habitat restoration actions consistent with H-Integration strategy.	ongoing
Co-managers	Implement provisions of CRMP for Chinook (harvest and hatchery components) to integrate activities with improvements to VSP parameters at watershed and regional scale.	ongoing
Co-managers and Watershed Habitat Managers	Continue to enhance H-integration strategies and move further down the H-Integration continuum over time.	2005 and ongoing
Co-managers and Watershed Habitat Managers	Monitor H-Integration results; adjust strategies and management practices according to new information.	ongoing
Puget Sound Counties and Cities	Update Shoreline Masters Program to incorporate new state shoreline guidelines; local watershed chapters and recovery plan can serve as best available science; coordinate with stormwater manual, clearing and grading, and zoning programs.	2005-2012
Shared Strategy and its successor*	Encourage local, state, tribal and federal agencies to grant permits, and develop and manage programs and actions in the context of processes, ecosystems and population specific viability needs noted in the plan (e.g. granting or developing hydraulic project approvals, habitat conservation plans, programs that support aquacultural practices, and granting permits under the CWA and Rivers and Harbors Act)	ongoing
Shared Strategy and its successor*	Encourage and coordinate regional and watershed education and incentive programs that focus on habitat areas that are intact and providing significant benefits to salmon.	ongoing
WA Dept. of Ecology	Complete TMDL's for prioritized WRIA's	2005-2010
WA Dept. of Ecology	Work with watershed groups to identify flow-related problems that limit salmon recovery and identify "recovery flows" to support salmon recovery; consider relationship between freshwater flows and the nearshore-marine waters; develop and implement instream flow protection and enhancement programs to prioritize, fund and solve instream flow deficiencies related to salmon recovery.	2005-2015
NOAA	NOAA will participate in the Pacific Salmon Treaty negotiations at the next available opportunity and, without presupposing results, will encourage the use of all available methods in fishery planning that reduce impacts to listed salmon and provide important harvest opportunities	2007-2010
Long-term (2014 and beyond)		
Watershed Groups/Entities; Regional nearshore experts; and Shared Strategy successor*	Refine and/or develop protection and restoration program beyond ten years and implement actions necessary to reach recovery goals	2014 and ongoing

* The Shared Strategy facilitated plan development with watershed groups, state, tribal, and federal agencies. It is currently funded through December 31, 2005. By the end of the year, the region will determine the organization/s that will lead implementation functions for the region.

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