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 streams 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 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, 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.

- 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).

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)

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 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.

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 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 floodplain 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 as well as a reduced sediment transport due to the construction of the Elwha dams. As the dams blocked sediments from moving downstream, the river sediments coarsened and the delta at the river mouth was reduced. Additionally, the nearshore habitat east of the river mouth has steepened, the sands and gravels 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 productive, 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 fisheries 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 Took 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, 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 (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 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 remove 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 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, 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 identified a number of issues and uncertainties that cross many Puget Sound watersheds. Where a regional approach is needed in addition to a local approach to address these items, they 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 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, and
- the need to address water resources/flows.

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.