Part III. Historic Steelhead Abundance

Conclusion

In the attempt to piece together a history of Hoh River steelhead, it has been necessary to examine the steelhead histories of neighboring river basins of the Olympic Peninsula – the Queets, Quileute, and Quinault – as well as Puget Sound and the Stillaguamish River, in order to collect enough data to develop a regional pattern that can help to fill in the many historic blanks. The history of the harvest of sea otters was also examined. Sea otters provide the example of an animal whose original North Pacific Rim range was nearly identical to that of steelhead, whose abundance was great, and whose near extinction was strictly that of overharvest with little compromise of habitat at the time. And lastly, the example of Alaska's Situk River is examined where a steelhead population was targeted for purposeful eradication, went into great depletion, and then through management changes has made considerable progress toward steelhead recovery.

The combined comparisons of these steelhead histories found there was a general pattern of great steelhead depletion that has occurred with steady progression over the past 80 to 120 years since the advent of industrial level fish harvests whose motivation was strictly immediate profit as the culmination to a human cultural/economic shift that occurred on the West Coast of North America. In some cases wild steelhead populations were targeted for harvest by the varied economic interest groups, in others they were incidentally harvested, and in at least one case wild steelhead were a perceived threat to those economic interests and were targeted instead for eradication. In the end the reason has not mattered – direct harvest, incidental harvest, or eradication – the consequences have been largely the same: great depletions.

The geologic histories of the river basins of the Olympic Peninsula west coast are complex, and none more so than that of the Hoh River Valley where six separate alpine glacial events advanced and retreated between 17,000 and 70,000-110,000 years ago during the Wisconsin glacial era (Thackray 1996; and 2001). Differing areas of refugia for salmon and steelhead existed during the Wisconsin period, including areas north of the glacial ice sheet advances and retreats such as the Queen Charlotte Islands (Beacham et al. 2006) and the Kamchatka Peninsula (McPhail & Lindsey 1970; and McCusker et al. 2000). During the Wisconsin glacial events, sea level was much lower than present (Booth et al. 2003). The Olympic Peninsula coastline at the mouth of the Hoh River was 35-40 km (22-25 mi) offshore 21,000-22,000 years ago, and no glacial advance down the Hoh Valley ever reached closer than 12 km of today's coast (Thackray 1996) leaving a river beyond the glacier terminus that was sometimes as long as it is today.

Although much of the ancient Hoh River valley is now drowned beneath the Pacific, it is known from pollen (Heusser 1972; and 1974) and beetle records (Cong and Ashworth 1996) archived in glacial layers that life continuously persisted in the Hoh Valley with conditions that resemble those found in tundra landscapes in Alaska and the Kamchatka Peninsula today. In the case of the Hoh River, there was also a large lake created by a former glacial retreat that persisted for 30,000 years between 73,000 and 43,000 years ago (Thackray 1996) which could have created a particularly productive salmon and steelhead ecosystem not unlike the more recent history of Lake Quinault or the Situk River system in Alaska.

Whether the Hoh River provided a refugium for salmon and steelhead continuously, or even partially, through the Wisconsin glacial era does not appear to have been considered in any great detail. However, in the absence of investigations to effectively examine the evidence one way or the other, it must remain a consideration. From the information available, it is apparent that science is still on the peripheral edge of understanding the evolutionary sequence of North Pacific Rim salmon and steelhead distribution before, during, and after the Wisconsin era.

Integral to steelhead history has been human history. From the time of earliest aboriginal hunter/gatherer passage from Asia to North America (generally thought to be 12,000-15,000 years ago but potentially much earlier) to first contact with explorers from expanding agricultural civilizations from Asia and Europe (likely the Chinese in 1422-1423, the Russians beginning in 1741, and world capitalist interests when James Cook's 1778 voyage made a fortune trading sea-otter furs) human culture was driven by a "gift economy" as described by Lichatowich (1999). Aboriginal economics was based on a barter system of communal sharing of resources and giving back to each other, and to the ecosystem from which resources came. Whatever was accepted as a gift from Nature or from fellow tribal members carried with it the heavy obligation of giving back as much as had been accepted. In the case of Nature's gifts, the obligation was most often symbolic through complex ceremony deeply ingrained into the culture; but between tribal members and neighboring villages, what was accepted was materially given back. The West Coast potlatch was but one example of cultures driven by recycling, rather than accumulating, wealth.

Although there is little remaining record of how initial Chinese contact may have altered the aboriginal communities they made contact with (Menzies 2004), shortly after first contact with Russian explorations beginning in 1741 the coastal tribes were immediately exploited (Ford 1966; and Dmytryshyn et al. 1988) by a culture driven by a very different economy whose motive was to take as much as could be taken, and to give back as little as possible in order to accumulate wealth. In order to expedite the most rapid taking of resources that would transfer into accumulated wealth, industrialization resulted. This can be termed either the "take" or the "industrial" economy that global controlling agricultural civilizations have become, and out of survival necessity this includes the tribal remnants of the aboriginal people now assimilated into it.

1741 is the known point in time when the aboriginal tribes along the North American West Coast were initiated into a 150 year assimilation into the industrial economy. Beaten, brutalized, subjugated, extorted, robbed, assaulted, or more genteelly cajoled or bribed, the initiation of aboriginal peoples into the industrial economy was one of join it or die (Diamond 1997). On the Olympic Peninsula, the latter became pervasive through sweeping epidemics, dramatic loss of population size, and resulting breakdown of the ability to defend their homelands or to maintain their cultures (Taylor 1963; Lane 1973; and White 1980).

By the late 1800s with the advent of commercial fishing by the Quileute people, it was found that traditional practices had ceased, including abandonment of the fishing society and the first salmon ceremony (Pettit 1950). By 1900, the original North American gift economy had been fully replaced by the industrial economy no matter what the skin color or ethnic origin of the peoples then sharing the west coast of the Olympic Peninsula and the Hoh River Valley. It was not a matter of choice; it was a matter of the biological reality of adapt or die. There was no remaining place on the North American West Coast to escape to. The Olympic Peninsula was one of the last geographic areas to yield to colonization by agricultural civilization.

The record of this 150 year shift in economies on the North American West Coast was initially driven by the potential for wealth provided by sea otter furs, an animal with the same range around the North Pacific Rim as steelhead. One of their most abundant areas on the West Coast was around Point Grenville near the mouth of the Quinault River (Scheffer 1940; and Richardson and Allen 2000). Of significance, Quinault River sockeye salmon were so preferred and so well known for their food quality by Euro-Americans dating to at least 1811 that other species of salmon are still mistakenly called "Quinnat" salmon in Europe and New Zealand (Brown 1982). This signifies the importance Quinault sockeye salmon evidently had during early European colonial explorations. They were likely acquired as part of the trade negotiations with the Quinault Indians for sea otter furs and to resupply the depleted provisions for the crews of the sailing ships.

By 1911 sea otters were extinct in Washington (Richardson and Allen 2000). They were thought to be extinct in North America by 1925 until a mother and pup were sighted in Alaska in 1931 (Ford 1966). They were reintroduced in Washington in 1969 and 1970 (Richardson and Allen 2000). While numbers have slowly risen, their range remains limited primarily to the Olympic Coast National Marine Sanctuary. They remain listed as Endangered in Washington. The sea otter record remains as a lesson to learn from for steelhead management in Washington.

The Wild Salmon Center has focused salmon and steelhead restoration efforts on the Olympic Peninsula into the collection of data that can identify key habitat areas used by salmon and steelhead at varied life history stages and then to coordinate purchases of privately owned land in those areas. To date this has resulted in the purchases of 4,685 acres through the coordinated efforts of the Western Rivers Conservancy, Wild Salmon Center, Washington Department of Natural Resources, and Section 6 funding supervised by the U.S. Fish and Wildlife Service. The Hoh Trust will own and manage the land in perpetuity with a goal to ensure the Hoh River remains a stronghold for salmon and steelhead biodiversity by 1) ensuring that sufficient, functionally connected habitat exists to sustain robust native salmon and steelhead populations, 2) enough salmon make it back to the river basin to maintain healthy, functional ecosystems, and 3) local communities benefit from strong salmon runs and healthy ecosystems.

As indicated by the presently limited distribution of sea otters in Washington State (in a managed marine sanctuary), securing and protecting habitat areas as functioning ecosystems are critical. In the case of such widely ranging animals as anadromous fish, migrations to and from a protected habitat area must be sufficient to allow it to function as a salmon and steelhead driven ecosystem. Habitat purchases made to recreate functioning salmon and steelhead ecosystems are rendered ineffective without sufficient numbers of the key species that drive them.

Table 29 provides the comparative steelhead histories found for Puget Sound, Stillaguamish River, Queets River, Quileute River, and Quinault River in Washington and the Situk River in Alaska, regarding the population size changes that have occurred between known points in time.

Table 29. Comparisons of drainage areas and historic-to-current steelhead population estimates for the Hoh, Stillaguamish, Queets, Quileute, Quinault, and Situk Rivers; and for the cumulative steelhead populations of Puget Sound streams (summer runs in red type)

River or region	Drainage area	Historic date	Historic steelhead number	Most current steelhead estimate
Hoh	299 sq mi	1953	summer 507-837	~100 (surveys 1994-2005)
		1948-1961	winter 7,938-13,230 (avg)	4,501 (recent 5-yr avg)
Puget Sound	not applicable	1895	327,592-818,980	13,083 (recent 10-yr avg)
Stillaguamish	684 sq mi	1895	60,000-90,000	593 (recent 5-yr avg)
Queets	450 sq mi	1953	summer 1,204-2,007	~100 (recent 10-year estimate)
		1923	winter 48,980-81,633	6,188 (10-yr avg)
Quileute	629 sq mi	1972	summer 1,236-2060	~100-150 (surveys 2002-2005)
		1948-1961	winter 17,614 (avg)	14,568 (1962-2005 avg)
Quinault	434 sq mi	1953	summer 1,268-2,113	<50 (surveys 2005)
		1952	winter 19,000	4,892 (recent 5-year avg)
Situk	77 sq mi	1952	25,000-30,000	12,368 (2004 & 2005 avg)

The percent of the present steelhead population size to a known historic population size for each summer run population is:

- the Hoh River summer run is presently 11.9%-19.7% of that in 1953;
- the Queets River summer run is presently 5.0%-8.3% of that in 1953;
- the Quileute River summer run is presently 4.9%-12.1% of that in 1972;
- the Quinault River summer run is presently 3.9% of that in 1953.

Summer run steelhead populations on the west side of the Olympic Peninsula are clear case examples that alteration, or elimination, of habitat is not always the primary driver toward steelhead extinction. Instead, it can be, and often is, fishery management itself through hatcheries and harvest. This should be anticipated to be the case. A common mantra that has been repeatedly cited as the cause for salmon and steelhead depletions for at least 25 years now is the "four Hs": habitat, hydro, harvest, and hatcheries. On the west side of the Olympic Peninsula there are no hydroelectric dams so fishery problems are limited to the "three Hs": habitat, harvest, and hatcheries. Within the Olympic National Park on the west side of the Olympic Peninsula fishery problems are further limited to the "two Hs": harvest and hatcheries.

The percent of the present steelhead population size to a known historic population size for each winter run population examined is:

- the Hoh River winter run is presently 34%-56% of the 1948-1961 average;
- the Puget Sound winter run is presently 1.6%-4.0% of than in 1895;
- the Stillaguamish River winter run is presently 0.7%-0.9% of that in 1895;
- the Queets River winter run is presently 7.6%-12.6% of that in 1923;
- the Quileute River winter run is presently 82.7% of the 1948-1961 average;
- the Quinault River winter run is presently 25.7% of that in 1952;
- the Situk River fall/spring run is presently 49.5%-41.2% of that in 1952, and the historic low from 1960 to 1980 was 3.3%-6.0% of that in 1952.

Beyond the fact that all of the steelhead populations used for comparison have experienced declines from their historic population sizes, two factors stand out:

- the level of depletion is highest when the historic baseline is oldest;
- summer steelhead have especially high levels of depletion.

As might be anticipated, the closer the available historic baseline is to that time before industrial level exploitation of resources first occurred, the greater has been the measurable level of steelhead depletion since. This is the very reason for the pertinence of developing baselines sufficiently far back in history that they provide a useful background for conservation of steelhead to occur, from which to make management decisions for sustainable populations, and from which to develop steelhead recovery plans when necessary.

For Puget Sound and the Stillaguamish River, 1895 appears to be far enough back to provide an effective historic baseline for winter steelhead. The equivalent date for Olympic Peninsula rivers may be 1923 as shown for the Queets River, the earliest year steelhead harvest information was found there. The Queets winter steelhead pattern fits with those of Puget Sound and Stillaguamish River winter steelhead, but those of the other rivers do not.

For instance, the winter steelhead run sizes computed from the catch for the Stillaguamish River in 1895 (60,000-90,000) [catch data in Collins 1898], and for the Queets River in 1923 (49,000-82,000) [catch data in Cobb 1930], roughly replicate the proportional differences in their drainage areas (Stillaguamish 684 sq. miles; Queets 450 sq. miles). This enforces the probability that these may be effective historic baselines for both river systems. If the differing proportions of summer steelhead returning to the two rivers were similarly factored into the amount of steelhead habitat that is actually accessible to both races combined, it may provide an even closer fit. In this regard, the Queets steelhead history is particularly valuable as a comparative means for developing more appropriate baseline estimates for the other rivers of the Olympic Peninsula's west coast.

In the cases of the Hoh, Quileute, and Quinault winter run steelhead, and for all of the summer steelhead populations examined, no historical points were available from which to create a baseline earlier than the late 1940s, and more commonly the 1950s and 1960s. Because of this limitation, it is probable that these steelhead populations are even more depleted than is indicated.

It is apparent that the Olympic Peninsula summer steelhead populations examined are at the edge of extirpation. The Quinault population may be the most dire, with estimated returns of less than 50 fish for the entire watershed whose spawning destinations are further reduced in their split between the North and East forks – potentially less than 25 fish destined for each. The Clearwater population of the Queets system, and the Sol Duc and Bogachiel populations of the Quileute system may be similarly low, with only 2-3 dozen fish returning to each. In fact, the Quinault, Clearwater, Sol Duc, and Bogachiel populations may already be functionally extinct.

The South Fork Hoh River snorkel surveys have found slightly more promising numbers that might be 50 returning wild summer steelhead, although hatchery fish among them are common and there is nothing known about the upper mainstem Hoh population. The only summer steelhead population that may be reasonably sustainable at present levels is that of the Sitkum River of the Quileute system where waterfalls have tended to exclude hatchery steelhead entry. The return destined there may be 75-100 wild summer steelhead in the better years.

Houston and Contor (1984) indicated that straying hatchery steelhead were the greater part of summer steelhead catches in the Hoh, Queets and Quinault from 1979 into the 1980s. This has not changed in the years since. The combined hatchery and wild catches of summer run steelhead have spiked far above what the wild catches alone historically were. With hatchery steelhead present in such large numbers there is the perpetual dilemma of a mixed stock fishery: if hatchery steelhead are sufficiently harvested to minimize their escapement to the spawning grounds, already depleted wild populations mixed with them will be harvested to extinction. If the hatchery fish are not harvested they will swamp the spawning grounds and also potentially eradicate wild steelhead as distinct genetic populations. In the case of the Olympic Peninsula, both of these mixed stock fishery consequences have been in effect for more than 25 years.

Although the Olympic Peninsula winter steelhead populations examined were not found to be as immediately threatened as the summer steelhead populations, or the winter steelhead populations of Puget Sound or the Stillaguamish River, they are managed under the same assumptions that are leading them to those same ends. This is particularly concerning due to the comparative lack of population growth and human development activities that have occurred on the west side of the Olympic Peninsula, and where most of the watersheds are Olympic National Park, Olympic National Forest, Washington Department of Natural Resources, and Indian reservation lands where it would be anticipated that managers are legally bound to effectively sustain resources for future generations. In the case of steelhead (and salmon) this is not being accomplished.

A major reason for the steelhead failures on the Olympic Peninsula has been the insufficient use of creating effective baselines from which to make management evaluations. The one river with the oldest available steelhead harvest history is the Queets River dating to a 1923 cannery record (Cobb 1930). Because the historic baseline for the Queets River is the oldest for the Olympic Peninsula steelhead populations examined, and because the steelhead histories for all of them have been similar in the years since, its present wild winter steelhead run size average that is 7.6%-12.6% of that in 1923 may similarly represent the level of winter steelhead depletion that has occurred since 1923 on neighboring rivers. For instance, the Hoh River wild winter steelhead population, whose recent 5-year average run size is 4,500 fish, would have been about 35,000-59,000 fish in the early 1920s using the Queets River levels of depletion.

Unless it is recognized that significant steelhead depletion has occurred, there is no reason from which to implement management mechanisms whose goal is recovery rather than sustained depletion. Because of an inappropriate baseline, a management that accommodates continuing steelhead depletion is in effect on the Olympic Peninsula.

Although Olympic Peninsula winter steelhead populations have not yet collapsed to the levels of some other populations in Washington, the life history strategies that were historically characteristic to these populations have been just as radically reshaped by fisheries management. These alterations may critically minimize the ability of these populations to adapt to altered watersheds and to an altering climate, and may deny the potential for recovery.

For each river examined, a major shift in wild winter steelhead run timing was found to have occurred since the 1940s and 1950s with a pattern consistently the same:

- prior to the early 1960s wild winter steelhead returns peaked between December and February;
- wild winter steelhead run timing from the 1980s onward has increasingly shifted to March and April, with elimination of the early run component.

Early run timing is particularly important in order to provide a diversity of spawning time options which may vary from year to year as determined by differing weather and water conditions. Cederholm (1984) provided evidence of the wide breadth of wild steelhead spawning time in the Clearwater River (sub-basin to the Queets) that occurred prior to hatchery returns and how it fit with differing flow and water temperature patterns that may vary between tributaries (and to the mainstem), as well as between differing years. He found that peak spawning time could vary as much as 39 days between the warmest year (1978) and coldest year (1975) in the eight years of surveys. Yet river entry time for Queets basin steelhead remained the same all years. He also found that steelhead spawning time in tributaries was more evenly dispersed than in the mainstem, and that early spawning was more prevalent in tributaries.

Logging has been pervasive on the Olympic Peninsula outside the National Park boundaries. The conversion of large areas of the Olympic Peninsula river basins from old growth to deciduous trees and immature second growth conifers has resulted in altered tributary hydrologies that are pervasively limited by summer low flows, or flows that go dry (Smith et al. 2001). Tributary flow conditions may become further aggravated by global warming, whose symptoms have been found to occur on steelhead spawning grounds in Russia (Savvaitova et al. 1997; and Pavlov et al. 2001). Although alterations in stream hydrology are known to have occurred, it has seldom been considered how this might relate to steelhead run timing, spawning timing, and emergence timing.

The altered hydrologies that have occurred through clearcut logging on the Olympic Peninsula resemble hydrologic conditions that can naturally occur in more arid climates. In southern Oregon's Rogue River basin steelhead largely depend on tributaries that commonly go dry by June (Everest 1973). The habitat has selected for steelhead that spawn early, emerge early, and outmigrate early. As a result the Rogue River is a very productive steelhead system because the wild steelhead population retains a sufficient breadth of life history strategies (including early spawning and emergence) to take advantage of the habitat limitations available.

This is no longer the case on the Olympic Peninsula, nor other areas in Washington. Harvest pressures of 80%-95% have long focused on early returning steelhead in the effort to maximize harvest of hatchery steelhead (SASSI 1994; and McHenry et al. 1996). This has resulted in harvest of early returning wild steelhead at similarly high levels whose dominant historic return timing was also December through February as found in the historic tribal and sport catch records (WDG 1956; 1957; 1996; and Taylor 1979). A subsequent run timing shift in wild winter run steelhead has occurred. Wild winter steelhead that return early have been nearly eliminated. Most wild steelhead now enter in March and April as found on the Hoh River by Hiss et al. (1986). This is confirmed by more recent sport catch data from throughout Washington (WDFW 2006).

Obviously, a run timing that begins in March or April precludes the ability of steelhead to spawn in January or February. The Quileute tribal "calendar" dating to ancient times identified the month of January as the beginning of steelhead spawning (Frachtenberg 1916). In an ethnographic study it was indicated that the "spawning habits of certain fish have been the most important single factor in determining the course of Quileute history …" (Pettit 1950). It is apparent from the historic run timing of steelhead prior to hatchery introductions that wild steelhead primarily returned from December through February in both the tribal fisheries (Taylor 1979) and sport fisheries (WDG 1956; 1957; and WDFW 1996). There had to have been significant reasons for this early historic run timing. Early spawning is one obvious consideration. Most early steelhead spawning was found to occur in tributary streams as found by Cederholm (1984), and it has been estimated that 75 percent of winter steelhead that once spawned in Washington's Skagit River Basin used tributary streams (Phillips et al. 1980; Phillips et al. 1981; and Woodin et al. 1984).

The available historic evidence indicates:

- most wild winter steelhead in Washington historically returned early (December-February);
- most wild steelhead historically spawned in tributaries;
- early wild steelhead spawning was once of greater importance than presently considered or managed for;
- conditions now favor early steelhead spawning even more than was historically the case;
- but early entry wild winter steelhead have been nearly eliminated.

Given these considerations, it is little wonder that wild winter steelhead populations may now be depleted from historic numbers, if for no other reason than the reshaping of their life history options through modern fishery management. What is worse, the habitat they return to has been altered to create conditions that favor early spawning to an even greater extent than was historically the case due to elimination of old growth forests, subsequently altered tributary hydrologies, and global warming.

Of particular comparative value regarding planning for wild steelhead recovery is the example of Alaska's Situk River near Yakutat. In 1952, despite a river basin size of only 77 sq. mi., 25,000-30,000 steelhead kelts emigrated out of the Situk after spawning as counted at a U.S. Fish and Wildlife Service weir. Yet, just one year later the steelhead population plummeted and was reported nearly non-existent in 1953 and 1954. This was due to the combined effects of attempted steelhead eradication efforts that occurred from 1930 into the 1940s; the initiation of sport fishing harvest in the 1940s; decreased returns of salmon related to an ocean cycle shift and related decrease in nutrients; and several years of record drought conditions that occurred. Steelhead numbers, estimated at 1,000-1,500, remained low for 30 years. Reduced to 3.3%-6.0% of the 1952 steelhead count, the magnitude of Situk steelhead depletion was not unlike that of Olympic Peninsula summer steelhead populations today, or the winter run steelhead of Puget Sound.

When management began to monitor the Situk steelhead population in the 1970s and 1980s, sport fishing was the primary harvest component, although total harvest rates were only in the range of 15%-35%. Despite these seemingly low harvest levels, they were evidently sufficient to keep the population from recovering.

With rising sport fishing pressure through the 1980s, Alaska managers responded with catch and release regulations in 1991 subsequently modified to a ban on bait and an annual limit of two steelhead over 36 inches in length in 1994. However, in effect, it remained a catch and release fishery with minimal harvest (in Washington, as low as wild steelhead populations are, a "trophy" fishery is an unrealistic consideration until some indication of sustained recovery occurs).

The Situk steelhead population has responded positively, increasing in increments by doubling each decade since the 1970s from 1,000-1,500; to 3,000; to 6,000; to over 12,000 steelhead in 2004 and 2005. The Alaska steelhead managers could have chosen hatcheries as the primary restoration tool, but did not. Without the added complications of a hatchery program and resulting mixed stock fishery combined with hatchery/wild interactions, the wild population has recovered to within 50% of its historic population size.

Although logging has occurred in the Situk basin and related roads have been built in the lower watershed, habitat remains mostly intact. The entire watershed is in Tongass National Forest and the headwaters are in designated wilderness.

The Situk River represents the potential of what could occur on the Hoh River, and other Olympic Peninsula rivers, if most of the watershed habitat were managed for recovery of an ecosystem driven by historic levels of salmon and steelhead.

The basic components resulting in a continuing Situk River steelhead recovery have been:

- altering steelhead harvest levels to well below those generally determined by MSY (commercial harvest limited to incidental catch during salmon fisheries; sport catch and release in 1991; no bait & annual sport limit of two over 36" in 1994);
- increased numbers of salmon and nutrients beginning about 1989 (probable result of a PDO cyclic shift in ocean productivity);
- habitat that continues to be intact;
- no hatcheries; no hatchery releases; no hatchery straying (of known consequence).

Another useful example regarding salmon recovery efforts is provided by a comparison of the differences that occurred in management of British Columbia's Fraser River as compared to that which occurred over the same span of time on the Columbia River through U.S. management entities.

In the case of the Fraser River, $21.3 million was spent between 1937 and 1985. The approach taken by the International Pacific Salmon Fisheries Commission on the Fraser River in 1937 focused on stock-by-stock harvest management, habitat, and natural production (Lichatowich 1999). It resulted in a successful, sustained recovery program that brought Fraser River sockeye salmon that had been reduced to an average return of

3.3 million fish from 1917 to 1949 up to 5.6 million fish from 1949 to 1982, to 7.8 million fish from 1983 to 1986, and to 10.2 million fish in recent years. In 1990, 22 million sockeye salmon returned to the Fraser River system.

By contrast, over the same period of time the Lower Columbia River Fisheries Development Program increasingly came to focus on building more and larger hatchery facilities and transfers of hatchery stocks from the upper to the lower Columbia to accommodate the perceived realities of dam construction (Lichatowich 1999). About $3 billion was spent on Columbia River salmon recovery with an additional $50 million slated for yet more hatcheries and a further $1 billion to improve the passage of juveniles over the dams the hatcheries had helped to justify. Although hatchery advocates indicate that 80% or more of Columbia salmon production is now from hatcheries, the total run size has dropped to 5% of its historic abundance. At the same time, hatcheries were further contributing to the decline of wild salmon, creating a deadly spiral to extinction that managers failed to detect. As a result of Columbia River hatchery production emphasis, wild coho in the lower Columbia River have disappeared, populations of salmon and steelhead in other parts of the basin have become severely depressed, hatchery costs continue to mount, and there have been no tangible results.

The Columbia River may singularly be the greatest, and certainly the most expensive, failure in the history of fish and wildlife restoration that has ever occurred.

In *Rivers Without Salmon: A History of the Pacific Salmon Crisis*, Jim Lichatowich (1999) indicated:

"Even when faced with the threat of Moran Dam in the 1950s [on the Fraser River], *the Canadians still relied on science and did not allow the hatcheries' promise of a quick fix to lure them into trading away the Fraser's mainstem. The commission's restoration program was based on the latest science, which stressed the importance of the salmon's stock structure and the importance of habitat*.

"On the Columbia, this scientific understanding was ignored…Instead, the Columbia River restoration program invested in a 'conspiracy of optimism,' clinging to the unfounded hope that hatcheries could restore the salmon."

Of the four Olympic Peninsula river basins examined regarding their steelhead histories, the Hoh River appears to have human use and ecosystem attributes from which restoration efforts might most thoroughly and rapidly occur. It has the largest remaining proportion of its basin in Olympic National Park (60%-65%) providing intact habitat; the commitment to hatchery salmon and steelhead has been less intensive; and degraded habitat outside the ONP may be more rapidly recoverable with significantly large land acquisitions already in place that are managed to provide for salmon and steelhead recovery.

The Hoh River may never have been as productive for salmon and steelhead as the neighboring Quinault, Queets and Quileute as determined from early 20th century cannery records. Because the Hoh River is the smallest of the four basins regarding drainage size, smaller salmon and steelhead run sizes would be anticipated. Also, the Hoh is considered the most dynamic coastal river with a perpetually altering river channel may be a particular constraint on mainstem spawning and rearing productivity. This may trace back to the six glaciations that occurred and the influence the remaining glaciers still have on the Hoh in it origins from Mount Olympus. As a result, tributaries may always have been particularly important.

Given the known shifts that have occurred to steelhead entry timing, the extent of tributary habitat degradation, and the successful Fraser River and Situk River examples to draw from, any realistic potential for Hoh River steelhead recovery must include:

- the provision of sufficient salmon escapement from which to recreate a salmon driven ecosystem of which steelhead are particular benefactors from increased salmon nutrients;
- harvest alterations that will allow the rebuilding of historically dominant wild winter steelhead run timing from December through February without which steelhead may never rise above present levels due to the inability to make use of tributary habitat available to them;
- elimination of hatchery salmon and steelhead releases into the basin to reduce the consequences of mixed stock fisheries and to eliminate the potential for hatchery/wild interactions to occur;
- elimination, or minimization, of hatchery salmon and steelhead released into neighboring river basins in order to significantly reduce hatchery straying into the Hoh basin;
- habitat protection/recovery plans for tributaries on federally and state managed lands;
- strategic acquisitions of private lands as they become available;
- reinvestment of hatchery funding into more beneficial recovery options;
- management driven by sustaining fish diversity and functioning ecosystems, not sustained yield or harvest;
- more effective means of monitoring salmon and steelhead populations;
- assessments of the salmon and steelhead production potential for the entire basin if all available habitat were recovered combined with escapement goals set high enough to accommodate steady increases toward those levels.

Lastly, because salmon and steelhead depletions have been so directly tied to the human cultural shift on the West Coast of North America from a "gift economy" to an "industrial economy," there is the consideration of investment in the Hoh Tribe. The reservation land is presently limited and precarious. The instability of their land can't help but tell on the tribe itself. The Hoh Tribe is integral to Hoh River fishery planning, and that future planning may be expected to provide more profound results if the tribal members are more stabilized with a feeling that they have a future to pass on.

References

Alaska Department of Fish and Game (ADF&G). 2003 and 2006. Alaska Department of Fish and Game website for Situk Weir counts as accessed in 2003 and 2004: http://sf.adfg.state.ak.us/Region1/escapement/situk_weir.cfm

Alaska Department of Fish and Game (ADF&G). 2003a. Situk Weir steelhead counts from 1988 through 2003, and year end totals along with sport catch totals (Excel spreadsheet). Alaska Department of Fish and Game, Yakutat.

Alaska Department of Fish and Game (ADF&G). 2006a. Alaska Department of Fish and Game website for Situk River steelhead sport fishing information as accessed in 2006: http://www.sf.adfg. state.ak.us.Region1/areas/yak_sh.cfm

Arndt, K. L. 2004. The Russian-American Company and the Northwest fur trade: North American scholarship, 1990-2000. *Meeting of Frontiers* Conference.

Augerot, Xanthippe. 2005. *Atlas of Pacific Salmon: The First Map-Based Status of Salmon in the North Pacific*. University of California Press, Berkeley.

Bahls, P. 2004. A Tale of Two Rivers: The Sol Duc, Rain Forest Jewel; The Free Flowing John Day. *The Osprey,* Issue No. 49, September 2004. Federation of Fly Fishers. Bozeman, MT.

Bain, C., S.T. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Anchorage.

Bali, M.B. 1958. Scale analysis of steelhead trout from various coastal watersheds of Oregon. Masters Thesis, Oregon State College.

Barlup, B.T., H. Lura, H. Saegrov, and R.C. Sundt. 1994. Inter- and intra-specific variability in female salmonid spawning behaviour. Can. J. Zool. 72:636-642. **[I]**

Beacham, T.D., B. McIntosh, C. MacConnachie, K.M. Miller, R.E. Withler, and N. Varnavskaya. 2006. Pacific rim population structure of sockeye salmon as determined from microsatellite analysis. *Transactions of the American Fisheries Society* 135:174-187.

Beamish, R.J., Neville, C.-E.M., and Cass, A.J. 1997*a*. Production of Fraser River sockeye salmon (*Oncorhynchus nerka*) in relation to decadal-scale changes in the climate and the ocean. Can. J. Fish. Aquat. Sci. 54: 543-554.

Beamish, R.J., Mahnken, C., and Neville, C.M. 1997*b*. Hatchery and wild production of Pacific salmon in relation to large-scale, natural shifts in the productivity of the marine environment. ICES J. Mar. Scie. 54: 1200-1215.

Beamish, R.J., G.A. McFarlane, and R.E. Thomson. 1999. Recent declines in the recreational catch of coho salmon (*Oncorhynchus kisutch*) in the Strait of Georgia are related to climate. *Can. J. Fish. Aquat. Sci.* 56:506-515.

Beardslee, K. 1996. Unpublished snorkel survey data collected on the Tolt River from 1989-1996. Washington Trout, Duvall, WA.

Beddington, J.R. and R.M. May. 1977. Harvesting natural populations in a randomly fluctuating environment. *Science* 197:463-465.

Berry, W.B. 1939. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Bilby, R.E., B.R. Fransen, and P.A. Bisson. 1996. Incorporation of nitrogen and carbon from spawning coho salmon into the trophic system of small streams: evidence from stable isotopes. *Can. J. Fish Aquat. Sci.* 53:164-173.

Bilby, R.E., B.R. Fransen, P.A. Bisson, and J.K. Walter. 1998. Response of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*) to the addition of salmon carcasses to two streams in southwestern Washington, U.S.A. *Can. J. Fish. Aquat. Sci.* 55:1909-1918.

Bilby, R.E., B.R. Fransen, J.K. Walter, C.J. Cederholm, and W.J. Scarlett. 2001. Preliminary evaluation of the use of nitrogen stable isotope ratios to establish escapement levels for Pacific salmon. *Fisheries* 25(1):6-14.

Booth, D.B., K.G. Troost, J.J. Clague, and R.B. Waitt. The cordilleran ice sheet. *Development in Quaternary Science* 1: 17-43.

Bradner, Enos. 1950. *Northwest Angling*. Binford and Mort, Pub., Portland, OR.

Brannon, E.L., K.P. Currens, K. Goodman, J.A. Lichatowich, W.E. McConnaha, B.E. Riddell, and R.N. Williams. 1999. Review of Artificial Production of Anadromous and Resident Fish in the Columbia River Basin, Part I: A Scientific Basis for Columbia River Production Program, Northwest Power Planning Council, 139 pp.

Brenkman, Sam. 2006. Unpublished snorkel survey data. Olympic National Park, Port Angeles, WA.

Brenkman, S.J., and S.C. Corbett. 2005. Extent of anadromy in bull trout and implications for conservation of a threatened species. *North American Journal of Fisheries Management* 25:1073-1081.

Brockman, F. 1937. Early Voyages of Discovery in the North Pacific. *Mount Rainier National Park Nature Notes*. Vol. XV, No. 2, pp 48-57. Mt. Rainier National Park, National Park Service.

Brown, Bruce. 1982. *Mountain in the Clouds*. Simon and Schuster. New York.

Burger, C.V., Spearman, W.J., and Cronin, M.A. 1997. Genetic differentiation of sockeye salmon subpopulations from a geologically young Alaskan lake system. *Transactions of the American Fisheries Society* 126: 926-938.

Burgner, R.L, J.T. Light, L. Margolis, T. Okazaki, A. Tautz and S. Ito. 1992. Distribution and Origins of Steelhead Trout (*Oncorhynchus mykiss*) in Offshore Waters of the North Pacific Ocean. Bulletin Number 51. International North Pacific Fisheries Commission. Vancouver, Canada. 92 p.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon, and California. NOAA Tech. Memo. NMFS-NWFSC-27. Seattle. 261 pp.

Cederholm, C.J., L.M. Reid and E.O. Salo. 1981. Cumulative effects of logging road sediment on salmonid populations in the Clearwater River, Jefferson County, Washington. *In* Proceedings from the Conference: Salmon Spawning Gravel – A Renewable Resource in the Pacific Northwest? Presented by Washington Water Research Center, Washington State University and the University of Washington, Seattle, Washington. pp 98-110.

Cederholm, C.J. 1984. Clearwater River wild steelhead spawning timing. In J.M. Walton and D.B. Houston (eds.). *Proceedings of the Olympic Wild Fish Conference* (March 23-25, 1983). Fisheries Technology Program, Peninsula College, Port Angeles, WA. 257-268.

Chadd, E. 1997. Altered streambanks in Olympic National Park: balancing a dual mandate. Prepared for the Olympic National Park, Port Angeles, WA.

Chapman, D.W. 1957. Studies on age, growth and migration of steelhead trout in the Alsea River, Oregon. Masters Thesis, Oregon State College.

Chilcote, M.W., Leider, S.A., and Loch, J.J. 1986. Differential reproductive success of hatchery and wild summer-run steelhead under natural conditions. *Trans. of the American Fisheries* Society 115: 726-735.

Clark, Ella E. 1953. *Indian Legends of the Pacific Northwest*. Berkeley: University of California Press.

Clark, J.H., S.A. McPherson, and G.F. Woods. 2002. Biological escapement goal for sockeye salmon in the Situk River, Yakutat, Alaska. Alaska Department of Fish and Game, Special Publication, No.02-03, Anchorage.

Clark, M.D., and S.J. Paustian. 1989. Hydrology of the Russell Lake – Old Situk River watershed. Pages 103-111 *in* E.B. Alexander Editor. Proceedings of watershed '89, a conference on the stewardship of soil, air, and water resources. U.S. Department of Agriculture, Forest Service, Juneau, AK.

Cobb, J.N. 1911. The salmon fisheries of the Pacific coast. Bureau of Fisheries Document 751. Report of the Commissioner of Fisheries for the fiscal year 1910 and special papers, U.S. Bureau of Fisheries.

Cobb, J.N. 1930. Pacific Salmon Fisheries. Appendix XIII to the Report of the U.S. Commissioner of Fisheries for 1930. Bureau of Fisheries Document No.1092, U.S. Bureau of Fisheries.

Cohen, Fay G. (With contributions by Joan La France and Vivian L. Bowden). *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. 1986.

Collins, J.W. 1892. Report on the fisheries of the Pacific Coast of the United States. Report of the commissioner for 1888. Part XVI. United States Commission of Fish and Fisheries. Government Printing Office, Washington D.C.

Colson, Elizabeth. 1953. *The Makah Indians: A Study of an Indian Tribe in Modern American Society*. Minneapolis: University of Minnesota Press.

Combellick, R.A., and W.E. Long. 1983. Geologic hazards in Southeast Alaska: An overview. Department of Natural Resources, Division of Geological and Geophysical Surveys, Report of Investigations 83-17.

Combs, Trey. 1988. *The Steelhead Trout*. Second Printing. Frank Amato Publications, Portland, OR.

Cong, S. and A.C. Ashworth. 1996. Palaeoenvironmental interpretation of middle and late Wisconsin fossil coleopteran assemblages from western Olympic Peninsula, Washington. *Journal of Quaternary Science*.

Cook, James and James King. 1784. *A Voyage to the Pacific Ocean …in his Majesty's Ships the "Resolution" and "Discovery," in the years 1776, 1777, 1778, 1779, and 1780.* 3 vols. London.

Cooper, R. and T.H. Johnson. 1992. *Trends in Steelhead Abundance in Washington and Along the Pacific Coast of North America*. Report #: 92-20. Fisheries Management Division. Washington Department of Wildlife. Olympia, WA. 90 p.

Crawford, B.A. 1979. The origin and history of the trout brood stocks of the Washington Department of Game. Fishery Research Report. Washington Department of Game. Olympia, WA. 76 pp.

Crawford, B.A. 1986. Recovery of game fish populations impacted by the May 18, 1980 eruption of Mount St. Helens. Part II. Recovery of surviving fish populations within the lakes in the Mount St. Helens Monument and adjacent areas. Washington Department Wildlife. Fishery Management Report No. 85-9B. 134 pp.

Dahlberg, M.L., S. Fowler, N. Maloney, and R. Heintz. 1989. Incidence of coded-wire-tagged salmonids in catches of commercial and research vessels operating in the North Pacific Ocean and Bering Sea in 1988-89. (Document submitted to International North Pacific Fisheries Commission.) 33 p. Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., Natl. Oceanic Atmos. Admin., Auke Bay Laboratory, Auke Bay.

de Laguna, E., E.A. Riddell, D.E. McGeein, K.S. Lane, J.A. Freed, and C. Osborne. 1964. Archeology of the Yakutat Bay area, Alaska. Smithsonian Inst. Bur. Am. Ethnol. Bull. 192, 245 p.

DeShazo, J.J. 1985. Thirty years (plus) of hatchery steelhead in Washington. Harvest management problems with co-mingled wild stocks. Washington Department of Game, Fisheries Management Division Report 85-16. Olympia, WA. 62 pp.

Diamond, Jared. 1997. *Guns, Germs, and Steel: The Fates of Human Societies*. W.W. Norton and Company, Inc., New York.

Didier, A.J., Jr., and R.P. Marshall. 1991. Incidental harvest and voluntary release of steelhead and chinook salmon in the Situk River commercial set gillnet fishery during 1990. Fishery Data Series No. 91-19. Alaska Department of Fish and Game, Division of Sport Fish, Anchorage.

Dietrich, William. 1995. *Northwest Passage: The Great Columbia River*. University of Washington Press, Seattle.

(DOE) Washington Department of Ecology. 1998. Candidate 1998 Section 303(d) List-WRIA 20. Unpublished Report. June 16, 1998. Lacey, WA.

Drewberry, Charley. 2004. *Saving Science: A Critique of Science and Its Role in Salmon Recovery*. Guttenberg College Press, Eugene, OR.

Dmytryshyn, Basil, and E.A.P. Crownhart-Vaughan and Thomas Vaughan (Edited and translated by). 1988. *Russian Penetration of the North Pacific, 1700-1799 (To Siberia and Russian America, Volume 2)*. Oregon Historical Society Press, Portland.

Easterbrook, Don J., and David A. Rahm. 1970. *Landforms of Washington: The Geologic Environment*. Union Printing Co., Bellingham, WA.

Eels, Myron. 1878. Traditions of the "Deluge" Among the Tribes of the North-West. *American Antiquarian and Oriental Journal* 1:70-72.

Eels, Myron. 1985. *The Indians of Puget Sound: The Notebooks of Myron Eells*. George B. Castile, ed. Seattle: University of Washington Press.

Elmendorf, William W. 1961. Skokomish and Other Coast Salish Tales. *Washington State University. Research Studies* (3):119-150. Pullman.

Erickson, R.P., and S.A. McPherson. 1997. Smolt production and harvest of coho salmon in the Situk River, 1992-1993. Alaska Department of Fish and Game, Fishery Data Series No. 97-26, Anchorage, AK.

Essig, E.O. 1933. The Russian settlement at Fort Ross. *California Historical Society Quarterly* 12.

Everest, F.H. 1973. Ecology and management of summer steelhead in the Rogue River. Oregon State Game Commission, Fishery Research Report Number 7. Portland, OR. pp. 48.

Flagg, T.A., F.W. Waknitz, D.J. Maynard, G.B. Milner, and C.V.W. Mahken. 1995. The effect of hatcheries on native coho salmon populations in the lower Columbia River. Pages 366-375 *in* H.L. Schramm, Jr., and R.G. Piper. Uses and effects of cultured fishes in aquatic ecosystems. American Fisheries Society Symposium 15, Bethesda, MD.

Ford, Corey. 1966. *Where the Sea Breaks Its Back*. Little, Brown & Company, Boston.

Frachtenberg, L.J. 1916. Quileute Ethnology: LaPush, Washington. (Field notebooks, manuscript No. E0 (W3a5). [Freeman No. 3177] in American Philosophical Society Library, Philadelphia.)

Frachtenberg, L.J. 1921. The Ceremonial Societies of the Quileute Indians. *American Anthropologist* 23(3):320-352.

Franklin, J. and C. Dyrness. 1984. *Natural Vegetation of Washington and Oregon*. Oregon State University Press, Corvallis.

Frear, Gordon (Editor). 1956. *Pacific Northwest Fishing and Hunting Guide* (Twelfth Edition). Wood & Reber, Inc., Seattle, WA.

Gibson, James R. 1969. *Feeding the Russian fur trade: provisionment of the Okhotsk seaboard and the Kamchatka Peninsula 1639-1856*. Madison, Wisconsin.

Gibson, James R. 1976. *Imperial Russia in frontier America.* Oxford University Press, New York.

Gillis, A.J. 1974. History of the Neah Bay Agency. Pp: 91-115 in Coast Salish and Western Washington Indians, III. *American Indian Ethnohistory: Indians of the Northwest*. New York: Garland.

Glynn, B., and S. Elliott. 1993. Situk River steelhead trout counts, 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-29, Anchorage.

Gorbics, C.S., G.R. VanBlaricom, B.E. Ballachey, N.J. Thomas, and M.M. Staedler. 2000. Sea otter conservation: Report from the Sixth joint U.S.-Russian Sea Otter Workshop. Marine Mammals Management Technical Report MMM 00-1. U.S. Fish and Wildlife Service, Anchorage, Alaska. 62 pp.

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 a nutrient deficit in the freshwater systems of the Pacific Northwest. *Fisheries* 25(1):15-21.

Gunther, Erna. 1972. *Indian Life of the Northwest Coast of North America as Seen by the Early Explorers and Fur Traders During the Last Decades of the Eighteenth Century*. Chicago: University of Chicago Press.

Gudjonsson, T.V. 1946. Age and body length at the time of seaward migration of immature steelhead trout in Minter Creek. Master Thesis. University of Washington.

Harding, R., and D. Jones. 1991. Peterson Creek and Lake system steelhead evaluation. 1990. Fishery Data Series 91-31. Juneau, AK: Alaska Department of Fish and Game.

Harding, R., and D. Jones. 1992. Peterson Creek and Lake system steelhead evaluation, 1991. Fishery Data Series 92-46. Juneau, AK: Alaska Department of Fish and Game.

Harding, R., and D. Jones. 1993. Karta River steelhead: 1992 escapement and creel survey studies. Fishery Data Series No. 93-30. Juneau, AK: Alaska Department of Fish and Game.

Harding, R., and D. Jones. 1994. Sitkoh River steelhead: 1993 escapement and harvest. Draft report for Fishery Data Series 93-30. Juneau, AK: Alaska Department of Fish and Game.

Hare, S.R., N.J. Mantua, and R.C. Francis. 1999. Inverse Production Regimes: Alaska and West Coast Pacific Salmon. *Fisheries* 24, 1: 6-14.]

Harr, R.D. 1982. Fog drip in the Bull Run Watershed, Oregon. *Water Resources Bulletin* 18(5):785-789.

Harr, R.D. 1983. Potential for augmenting water yield through forest practices in western Washington and western Oregon. *Water Resources Bulletin*, Vol. 19:383-393.

Heusser, C.J. 1972. Palynology and phytogeographical significance of a late Pleistocene refugium near Kalaloch, Washington. *Ecology* 45:23-40.

Heusser, C.J. 1974. Quaternary vegetation, climate, and glaciation of the Hoh River Valley, Washington. Geological Society of America Bulletin 85:1547-1560.

Heusser, C.J. 1978. Palynology of Quaternary deposits of the lower Bogachiel River area, Olympic Peninsula, Washington. *Canadian Journal of Earth Sciences* 15:1568-1578.

Hewitt, C.G. 1919. The Coming Back of the Bison. *Natural History* (December). New York.

Hewitt, G.W. 1958. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Hicks, Brent A. 2004. *Marmes Rockshelter: A Final Report on 11,000 Years of Cultural Use*. Washington State University Press.

Hicks, B.J., R.L. Beschta, and R.D. Harr. 1991. Long-term changes in streamflow following logging in western Oregon and associated fisheries implications. *Water Resources Bulletin* Vol 27:217-226.

Hilson, Stephen E. 1981. *Exploring Puget Sound and British Columbia*. Auburn, Washington: Publishing Enterprises.

Hiss, J.M., J.H. Meyer, R.S. Boomer, and D. Cole. 1986. Hatchery winter steelhead contribution to the Hoh River fisheries and potential impacts on the native stock. Final Report. U.S. Fish and Wildlife Service. Olympia.

Houston, D.B. and R.J. Contor. 1984. Anadromous fish in Olympic National Park: status and management considerations. In J.M. Walton and D.B. Houston (eds.). *Proceedings of the Olympic Wild Fish Conference* (March 23-25, 1983). Fisheries Technology Program, Peninsula College, Port Angeles, WA. 97-111.

Hughes, Pauline B. 1990. *The Pomeranian*. Delinger Publishers Ltd., Edgewater, FL.

Hume, Mark. 1992. *The Run of the River*. New Star Books Ltd. Vancouver, B.C. 215 pages.

Humphry, M., and J. Thedinga. 1991. ABL Scientists Study Glacier's Threat to Yakutat Fisheries. *NWAFSC Quarterly* (April, May, June 1991), Alaska Fisheries Science Center, Juneau.

Hunter, J.G. 1959. Survival and production of pink and chum salmon in a coastal stream. J. Fish. Res. Board Can. 16:835-886.

ICC (Indian Claims Commission). 1974(a). Commission Findings: The S'Klallam Tribe of Indians, Petitioner, vs. The United States of America, Defendant. Decided: December 2, 1957. Findings of Fact. Pp. 344-369 in Coast Salish and Western Washington Indians V. *American Indian Ethnohistory: Indians of the Northwest*. New York: Garland.

ICC (Indian Claims Commission). 1974(b). Commission Findings: The Quileute Tribe of Indians, on its own behalf; Quileute Tribe of Indians on behalf of the Hoh Tribe or Band of Indians; Hoh tribe or Band of Indians on relation of and represented by Scott Fisher, Petitioners, vs. The United States of America, Defendant. Decided: December 1, 1958. Findings of Fact. Pp. 202-235 in Coast Salish and Western Washington Indians V. *American Indian Ethnohistory: Indians of the Northwest*. New York: Garland.

Irving, Washington. 1949. *Astoria or Anecdotes of an Enterprise Beyond the Rocky Mountains*. Putnam. New York.

Johnson, Bob. 2003. Unpublished Situk River historic notes (e-mailed July 2003). Alaska Department of Fish and Wildlife, Yakutat.

Johnson, R.E. 1990. Steelhead studies: Situk River, 1989. Fishery Data Series No. 90-47. Alaska Department of Fish and Game, Anchorage.

Johnson, R. E. 1991. Situk River steelhead studies, 1990. Fishery Data Series No. 90-47. Alaska Department of Fish and Game, Anchorage.

Johnson, R.E. 1996. Situk River steelhead trout studies, 1994. Fishery Data Series No. 96-1. Alaska Department of Fish and Game. Anchorage.

Johnson, R.E. 2005. Situk River Chinook and sockeye salmon sport harvest estimates, 2000, 2001, 2001, and 2003. Alaska Department of Fish and Wildlife, Fishery Data Series No. 05-06, Anchorage.

Johnson, R.E., and J.D. Jones. 2000. Southeast Alaska steelhead studies, 1999. Situk River weir and surveys of regional index streams. Fishery Data Series No. 00-16. Alaska Department of Fish and Game, Anchorage.

Johnson, T. 1992. Untitled presentation in: *Proceedings of Washington Steelhead Symposium* (September 26 & 27, 1992). Washington Department of Wildlife. Olympia, WA. 175 p.

Johnston, N.T., J.S. MacDonald, K.J. Hall, and P.J. Tschaplinski. 1997. A preliminary study of the role of sockeye salmon (*Oncorhynchus nerka*) carcasses as carbon and nitrogen sources for benthic insects and fishes in the "Early Stuart" stock spawning streams, 1050 km from the ocean. British Columbia Ministry of Environment, Lands and Parks. Fisheries Project Report RD55, Victoria.

Jones, D.E. 1983. Steelhead investigations in Southeast Alaska. Anadromous Fish Studies, Annual Performance Report, 1982-1983, Project AFS-42, 24(10-B):18-33. Alaska Department of Fish and Game. Anchorage.

Jones, D. 1994. Wild steelhead in southeast Alaska. Seattle, WA: *The Osprey*, Federation of Fly Fishers.

Jonnasson, B.D., R.C. Carmichael and T.A. Whitesel. 1995. Lower Snake River compensation plan—residual steelhead characteristics and potential interactions with spring chinook salmon in northeast Oregon. Oregon Department of Fish and Wildlife, Fish Research Project, 1995 Annual Progress Report, Portland, OR.

Kinsey, W.W. 1934. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Kinsey, W.W. 1935. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Kingdon, Jonathan. 1993. *Self-Made Man: Human Evolution from Eden to Extinction?* John Wiley and Sons, Inc., New York.

Kline, T.C., Jr., J.J. Goering, O.A. Mathisen, P.H. Poe, and P.L. Parker. 1990. Recycling of elements transported upstream by runs of Pacific Salmon: 1. δ15N and δ^{13}C evidence in Sashin Creek, southeastern Alaska. *Canadian Journal of Fisheries and Aquatic Sciences* 47:136-144.

Knapp, L. 1951. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Knapp, L. 1952. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Knapp, L. 1953. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Knapp, L. 1954. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Koenings, J. P., and R. D. Burkett. 1987. An aquatic Rubic's Cube: restoration of the Karluk Lake sockeye salmon (*Oncorhynchus nerka*). Pages 419-434. In H. D. Smith, L. Margolis, and C. C. Wood (ed.) Sockeye salmon (*Oncorhynchus nerka*) population biology and future management. Can. Spec. Publ. Fish and Aquat. Sci. 96:486 p.

Kostow, K.E., A.R. Marshall, and S.R. Phelps. 2003. Naturally spawning hatchery steelhead contribute to smolt production but experience low reproductive success. *Trans. of the American Fisheries Society* 132: 780-790.

Krasheninnikov, S.P. 1755. Opisanie zemli Kamchatki. [*A Description of the Land of Kamchatka*], Part I. St. Petersburg.

Kreider, Claude M. 1948. *Steelhead*. G.P. Putnam's Sons. New York.

La Marche, J., and D.P. Lettenmaier. 1998. Forest road effects on flood flows in the Deschutes River Basin, Washington. University of Washington Department of Civil Engineering. Waster Resources Series-Technical Report No. 158, Seattle, WA.

Lamke, R.D., B.B. Biglow, J.L. Van Maanen, R.T. Kemnitz, and K.M. Novcasky. 1991. Water resources data Alaska water year 1990. U.S. Geological Survey Water-Data Report AK-90-1, 252 p. U.S. Geological Survey, Water Resources Division, 4230 University Drive – Suite 201, Anchorage, AK 9508-4664.

Lane, Barbara. 1973. Anthropological Report on the Identity, Treaty Status and Fisheries of the Skokomish Tribe of Indians. In Political and Economic Aspects of Indian-White

Culture Contact in Western Washington in the Mid-19th Century. (Unpublished Report prepared for U.S. v. Washington.)

Larosa, D. 1999. Quinault watershed analysis, section 2.9 riparian. *In* Quinault River Watershed Analysis. The Quinault Indian Nation, the U.S.D.A. Forest Service, and the Olympic National Forest.

Larson, R.W. 1953. Annual report to Washington State Game Department. Unpublished. From L.A. Royal, 1972.

Larson, R.W., and J.M. Ward. 1954. Management of steelhead trout in the State of Washington. Trans. Am. Fish. Soc. 84:261-274.

Leider, S.A., Hulett, P.L, Lock, J.J., and Chilcote, M.W. 1990. Electrophoretic comparison of the reproductive success of naturally spawning transplanted and wild steelhead trout through the returning adult stage. *Aquaculture* 88: 239-252.

Lestelle, L. and J. Blum. 1989. Assessment of damages to the fisheries resources of the Quinault reservation due to logging practices administered by the Bureau of Indian Affairs. Draft report submitted to the Quinault Business Committee. Taholah, Washington.

Lichatowich, James A. 1999. *Salmon Without Rivers: A History of the Pacific Salmon Crisis*. Island Press. Washington, DC.

Lindsay, R.B., K.R. Kenaston and K.R. Schroeder. 1991. Steelhead production factors – annual progress report. Project Number F-120-R. Oregon Department of Fish and Wildlife. Portland, OR.

Lindsay, R.B., K.R. Kenaston and K.R. Schroeder. 1992. Steelhead production factors – annual progress report. Project Number F-120-R-8. Oregon Department of Fish and Wildlife. Portland, OR.

Lindsay, R.B., K.R. Kenaston and K.R. Schroeder. 1993. Steelhead production factors – annual progress report. Project Number F-120-R-8. Oregon Department of Fish and Wildlife. Portland, OR.

Little, A.C. 1989. Ninth Annual Report of the State Fish Commissioner to the Governor of the State of Washington. State of Washington, 70 pp.

Little, A.C. 1901. Tenth and Eleventh Annual Report of the State Fish Commissioner to the Governor of the State of Washington. State of Washington, 113 pp.

Lohr, S.C., and M.D. Bryant. 1999. Biological characteristics and population status of steelhead (*Oncorhynchus mykiss*) in Southeast Alaska. United States Dept. of

Agriculture, Forest Service, Pacific Northwest Research Station. General Technical Report PNW-GTR-407. Juneau.

Lorenz, J.M. 1994. Distribution and habitat of adult salmon in the Situk River, Alaska: Potential impacts of flooding from Russell Fiord. U.S. Department of Commerce. NOAA Technical Memo NMFS-AFSC-30. 27 p.

Lucas, B. 1985. Recovery of game fish populations impacted by the May 18, 1980 eruption of Mount St. Helens. Part I. Recovery of winter-run steelhead in the Toutle River watershed. Fishery Management Report 85-9A. Washington Department of Game. Olympia, WA. 45 pp.

Lucas, B., and R. Nawa. 1986. Wind River steelhead redd survey and management analysis (1985). Washington Department of Game, Fisheries Management Division 86-4. Olympia, WA.

Lucas, B. 1986. Recovery of winter-run steelhead in the Toutle River watershed. 1985 Progress Report. Fishery Management Report 86-6. Washington Department of Game. Olympia, WA. 12 pp.

Lucas, B., and K. Pointer. 1987. Wild steelhead spawning escapement estimates for Southwest Washington Streams – 1987. Washington Department of Game, Fisheries Management Division 87-6. Olympia, WA.

Lucas, B. and J.Weinheimer. 2003. Recovery of fish populations in lakes affected by the May 18, 1980 eruption of Mount. St. Helens. Report No.: FPT 03-07. Washington Department of Fish and Wildlife. Olympia, WA. 113 pp.

MacDowell, Syl. 1948. *Western Trout*. Alfred A. Knopf, Inc. New York.

Maher, F.P., and P.A. Larkin. 1954. Life history of the steelhead trout of the Chilliwack River, British Columbia. Trans. Am. Fish. Soc. 84:27-38.

Mantua, N., J. Johnson, and T. Ripley. 2004. Comments on the Draft EIS for the Proposed Skagit River Steelhead Rearing and Acclimation Facility. Submitted to: Teresa Eturaspe, SEPA/NEPA Coordinator, Habitat Regulatory Services, WDFW, 600 Capitol Way North, Olympia, WA 98501-1091 on July 18, 2004. The Wild Steelhead Coalition, Kirkland, WA. 14 p.

Mantua, N.J, S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis. 1997. A Pacific-interdecadal climate oscillation with impacts on salmon production. Full. Amer. Meteor. Soc. 78:1,069-1,079.

Maybury, C.R. 1928. Thirty-Sixth and Thirty-Seventh Annual Reports of State Department of Fisheries and Game Division of Fisheries for the period from April 1, 1929, to March 31, 1931. Fiscal Years of 1929 and 1930. State Department of Fisheries and Game. Olympia, WA.

Maybury, C.R. 1932. Fortieth and Forty-First Annual Reports of State Department of Fisheries and Game Division of Fisheries for the period from April 1, 1925, to March 31, 1927. Fiscal Years of 1925 and 1926. State Department of Fisheries and Game. Olympia, WA.

Mayo, L.R. 1988. Advance of Hubbard Glacier and closure of Russell Fiord, Alaska-Environmental effects and hazards in the Yakutat area. *In* J.P. Galloway and L.D. Hamilton (editors), Geological studies in Alaska by the U.S. Geological Survey during 1987, p.4-16. U.S. Geological Survey Circular 1016. U.S. Geological Survey, Federal Cent., Box 25425, Denver, CO 80225.

McCusker, M.R., E. Parkinson, and E.B. Taylor. 2000. Mitochondrial DNA variation in rainbow trout (*Oncorhynchus mykiss*) across its native range: testing biogeographical hypotheses and their relevance to conservation. *Molecular Biology* 9, 2089-2108.

McHenry, M.L., J. Lichatowich, and R. Kowalski-Hagaman. 1996. Status of Pacific Salmon & their Habitats on the Olympic Peninsula, Washington. Department of Fisheries. Lower Elwha Klallam Tribe, Port Angeles, WA. 240 p.

McHenry, M.L. 2001. Fisheries habitat module. Middle Hoh River Watershed Analysis. Washington State Department of Natural Resources, Forks, WA.

McHugh, M., Jones, D.E., and R.T. Baade. 1971. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1970-1971, Project F-9-3, 12(G-1):1-27.

McHugh, M., Jones, D.E., and R.T. Baade. 1972. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1971-1972, Project F-9-4, 13(G-1):1-16.

McLeod, Ken (Editor). 1944. *Fishing Guide to the Northwest.* Western Printing Co., Seattle, WA. 248 p.

McMillan, B. 1988. Forgotten Fisheries: Resident Trout of the Northwest. *Salmon Trout Steelheader*, Portland, OR. 21(5):90-91, 84-87.

McMillan, B. 1999. Abundance: finding a definition for wild salmon recovery. *Washington Trout Report*, Vol.9, No.1:10-11,18-19, and 22.

McMillan, B. 2001. Males as vectors to hatchery/wild spawning interactions and the reshaping of wild steelhead/rainbow populations through fishery management. Washington Trout, Duvall, WA. 56 p.

McMillan, B. 2004. Comparisons of Steelhead Abundance in Alaska's Situk River with Washington's Skagit River. A special report published by the Wild Steelhead Coalition, Seattle, WA. 22 p.

McMillan, B. 2005. Males as vectors to hatchery/wild spawning interactions and the reshaping of wild steelhead/rainbow populations through fishery management. PowerPoint presentation to Puget Sound steelhead Biological Review Team (June 20, 2005). NOAA Fisheries, Northwest Fisheries Science Center. Seattle, WA.

McMillan, J., and J. Starr. 2006. Unpublished snorkel survey data. Wild Salmon Center. Portland, OR.

McMillan, J.R., S.L. Katz and G.R. Pess. [in press]. Observational evidence of spatial and temporal structure in a sympatric anadromous (winter steelhead) and resident *Oncorhynchus mykiss* mating system on the Olympic Peninsula, Washington State. *Transactions of the American Fisheries Society*.

McPhail, J.D. and C.C. Lindsey. 1970. Freshwater fishes of northwestern Canada and Alaska. *Fisheries Research Board of Canada. Bulletin* 173.

McPhail, J.D. and C.C. Lindsey. 1986. Zoogeography of the freshwater fishes of Cascadia (the Columbia system and rivers north to the Stikine). In: *The Zoogeography of North American Freshwater Fishes* (eds Hocutt, C.H. and E.O. Wiley), pp. 615-637. Wiley, New York.

McPhail, J.D. and R. Carveth. 1993. *A foundation for conservation: the nature and origin of the freshwater fish fauna of British Columbia*. BC Environment, Victoria.

McPhail, J.D. and E.B. Taylor. 1999. Morphological and genetic variation in northwestern longnose suckers, *Catostomus catostomus*. The Salish sucker problem. *Copeia*, 1999, 884-893.

Menzies, Gavin. 2004. *1421: The Year China Discovered America*. First Perennial Edition. HarperCollins Publishers, New York (originally published in 2002 in Great Britain by Transworld Publishers).

Miller, L.M.; T. Close; and A.R. Kapuscinski. 2004. Lower fitness of hatchery and hybrid rainbow trout compared to naturalized populations in Lake Superior tributaries. *Molecular Ecology* 13, 3379-3388.

Mobbs, M. 1999a. Quinault watershed analysis, section 2.6, fish. *In* Quinault River Watershed Analysis. The Quinault Indian Nation, the U.S.D.A. Forest Service, and the Olympic National Forest.

Mobbs, M. 1999b. Quinault watershed analysis, section 2.7, water quality. *In* Quinault River Watershed Analysis. The Quinault Indian Nation, the U.S.D.A Forest Service, and the Olympic National Forest.

Morgenroth, Chris. 1991. *Footprints in the Olympics an Autobiography* (edited by Katherine Morgenroth Flaherty). Ye Galleon Press, Fairfield, Washington.

Mortensen, C.C. 1945. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Mortensen, C.C. 1946. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Mortensen, C.C. 1947. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Mortensen, C.C. 1948. Annual Report, Yakutat District. United States Department of the Interior. Fish and Wildlife Service, Washington D.C. *In*: Appendix A1. Bain, C., S.J. Elliot, R.E. Johnson, and G. Woods. 2003. Situk River steelhead: a review of historical data through 1996. Fishery Manuscript No. 03-01, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Myers, J. 2005. Historical abundance estimates. (Unpublished report of Puget Sound steelhead numbers and distribution.) NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA. 4 p.

Naiman, R.J., C.A. Johnston, and J.C. Kelly. 1988. Alteration of North American streams by beaver. *Bioscience* 38: 753-762.

NOAA. 1978. Climate of Washington Climatography of the United States. No. 60. National Oceanic and Atmospheric Administration.

NOAA. 2005. NOAA's National Marine Fisheries, Northwest Regional Office website: http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Steelhead/PS-Stlhd-Petition.cfm (as accessed February 2006).

Norse, E.A. 1990. *Ancient Forests of the Pacific Northwest*. Washington, D.C. Island Press.

(NRC) National Research Council. 1996. Upstream: salmon and society in the Pacific Northwest. Committee on Protection and Management of Pacific Northwest Anadromous Salmonids, National Academy of Science, Washington, D.C.

ONP (Olympic National Park). 2005. The Olympic National Park website as accessed in December 2005.

Ott, J. 2003. "Ruining" the Rivers in the Snake Country: The Hudson Bay Company's Fur Desert Policy. *Oregon Historical Quarterly* 104(2): 166-195

Ostberg, C.O. and G.H. Thorgaard. 1994. Karyotypes of *Oncorhynchus mykiss* from three Puget Sound rivers. Washington State University, Unpubl. rep. to Washington Department of Fish and Wildlife, 10 p. (Available from Environmental and Technical Services Division, Natl. Mar. Fish. Serv., 525 N.E. Oregon Street, Suite 500, Portland, OR 97232).

Pauly, D. 1995. Anecdotes and the shifting baseline syndrome of fisheries. *Trends in Ecology and Evolution* 10(10): 430.

Pautzke, C.F., and R.C. Meigs. 1940. Studies on the life history of the Puget Sound steelhead. Washington State Department of Game, Biological Bulletin 3, 24 p.

Pautzke, C.F., and R.C. Meigs. 1941. Studies on the life history of the Puget Sound steelhead trout (*Salmo gairdneri*). Trans. Am. Fish. Soc. 70:209-220.

Pavlov, D.S., K.A. Savvaitova, K.V. Kuzishchin, M.A. Gruzdeva, S.D. Pavlov, B.M. Mednikov, and S.V. Maksimov. 2001. *The Pacific Noble Salmons and Trouts of Asia* (Eds: D.S. Pavlov and K.A. Savvaitova). Moscow Scientific World, Moscow.

Pearsons, T.N., S.R. Phelps, S.W. Martin, E.L. Bartrand, and G.A. McMichael. 2003. Gene flow between resident and anadromous rainbow trout in the Yakima River basin: ecological and genetic evidence. *In* Howell, P., and D., Buchanon (editors), Proceedings of the Inland Rainbow Trout Workshop, P. 1-9. Oregon Chapter Amer. Fish. Soc., Princeton, OR.

Pettit, G.A. 1950. The Quileute of La Push: 1775-1945. *University of California Anthropological Records* 14(1). Berkeley.

Phelps, S.R., B.M. Baker, P.L. Hulett, and S.A. Leider. 1994. Genetic analysis of Washington steelhead: initial electrophoretic analysis of wild and hatchery steelhead and rainbow trout. Report No. 94-9. Washington Department of Fish and Wildlife, Olympia, WA.

Phillips, E.L. and W.R. Donaldson. 1972. Washington Climate Cooperative Extension Service, Washington State University.

Phillips, C., W. Freymond, D. Campton, and R. Cooper. 1980. Washington State Department of Game Skagit River Salmonid Studies, 1977-1979. Washington State Game Department and U.S. Fish and wildlife Service, 32. p. plus six appendices.

Phillips, C., R. Cooper, and T. Quinn. 1981. Washington State Department of Game Skagit River Salmonid Studies, 1977-1981. Washington State Department of Game and U.S. Fish and Wildlife Service, 40 p. plus five appendices.

Phinney, L., P. Bucknell, and R.W. Williams. 1975. *A Catalog of Washington Streams and Salmon Utilization, Vol. 2, Coastal Region*. Washington Department of Fisheries. Olympia.

Porter, S.C. and Swanson, T.W. 1998. Radiocarbon age constraints on rates of advance and retreat of the Puget love of the Cordilleran ice sheet during the last glaciation. *Quaternary Research* 50:205-213.

Powell, J. 1999. Cultural Resources Module. Part. I: Hoh tribal cultural resources. Hoh River Watershed Analysis. Washington Department of Resources, Forks. 20 p.

Quammen, David. 1997. *The Song of the Dodo: Island Biogeography in an Age of Extinction*. Touchstone, New York.

Quinault Indian Nation and U.S. Forest Service. 1999. Quinault River watershed analysis. Quinault Indian Nation, Taholah, Washington.

Rathbun, R. 1900. A review of the fisheries in the contiguous waters of the State of Washington and British Columbia. Report of the Commissioner for the year ending June 30, 1899. R.S. Commission of Fish and Fisheries, 253-350.

Reagan, A.B. 1917. Archaeological Notes on Western Washington and Adjacent British Columbia. *Proceedings of the California Academy of Sciences, 4th ser.*, 7(1). San Francisco.

Reisenbichler, R.R., and J.D. McIntyre. 1977. Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, *Salmon gairdneri*. *Journal of Fish. Res. Board of Canada* 34: 123-128.

Renker, A.M., and M. (Parker) Pascua. 1989. Makah Traditional Cultural Property Study. (Unpublished Report Submitted to Office of Archaeology and Historic Preservation. Washington.)

Richardson, S. and H. Allen. 2000. Washington State recovery plan for the sea otter. Washington Department of Fish and Wildlife. Olympia, Washington. pp75.

Royal, L.A. 1972. An examination of the anadromous trout program of the Washington State Game Department. Washington Department of Game. Olympia. 176 pp.

Roghair, C.N. and C.A. Dolloff. 2005. Brook trout movement during and after recolonization of a naturally defaunated stream reach. *North American Journal of Fisheries Management* 25:777-784.

Rudgley, Richard. *The Lost Civilizations of the Stone Age*. The Free Press, New York. 1999.

Savvaitova, K.A., V.A. Maksimov, M.V. Mina, G.G. Novikov, L.V. Kokhmenko, and V.E. Matsuk. 1973. The noble trouts of Kamchatka (systematics, ecology, and the possibilities of using them as the object of trout-culture and acclimatization.) The Voronezh University, Publishers. [Translated by L.V. Sagen and G.A. Kautsky. Edited by G.A. Kautsky and J.T. Light. Fisheries Research Institute, University of Washington, Seattle. 119 p.

Savvaitova, K.A., K.V. Kuzishchin, S.V. Maximov, and S.D. Pavlov. 1996. Report of the second joint Russian-American expedition for the study of steelhead, Kamchatka, 1995 [Translated by S. Karpovich]. Department of Ichthyology, Moscow State University, Moscow, Russia. 28 p.

Savvaitova, K.A., K.V. Kuzishchin, S.V. Maximov, and S.D. Pavlov. 1997. The population structure of mikizha *Salmo mykiss* of the Utkholok River (western Kamchatka). *Problems in Ichthyology*: Vol. 37, No. 2, pages 179-188.

(SASSI). 1994. 1992 Washington State Salmon and Steelhead Stock Inventory. Appendix One. Puget Sound Stocks – Hood Canal and Strait of Juan de Fuca. Appendix Two: Coastal Stocks. Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes, Olympia, WA.

(SaSI). 2003. 2002 Washington State Salmonid Stock Inventory. Washington Department of Fish and Wildlife, Olympia, WA.

Scammon, C.M. 1970. The sea otter. American Naturalist 4:65-74.

Scarlett, W.J. and C.J. Cederholm. 1996. The response of a cutthroat trout population to a logging road caused debris torrent in Octopus-B Creek. *In* Type 4 & 5 waters Workshop Proceedings. N.M.F.S. Sandpoint Facility Seattle. October 16, 1996. pp 84-92.

Schaffer, W.M. 2004. Life histories, evolution, and salmonids. *In*: *Evolution Illuminated: Salmon and Their Relatives* (Eds: Andrew P. Hendry and Stephen C. Stearns) p 20-51. Oxford University Press, New York.

Scheffer, V.B. 1940. The sea otter on the Washington coast. Pacific Northwest Quarterly 10:370-388.

Schlichte, K. 1991. Aerial photo interpretation of the slope failure history of the Huelsdonk Ridge/Hoh River area. *In* Huelsdonk Ridge: Hoh River Slope Stability Task Force. Forest Management Alternatives of Land Management by the DNR inside the Huelsdonk Ridge; Hoh River Area. NWIFC Technical Report, Lacey, WA.

Seamons, T.R., P. Bentzen, and T.P. Quinn. 2004. The mating system of steelhead (*Oncorhynchus mykiss*) inferred by molecular analysis of parents and progeny. Env. Biol. Fishes 69: 333-344.

Sedell, J.R., J.E. Yuska, and R.W. Speaker. 1984. Habitats and salmonid distribution in pristine, sediment rich river valley systems: South Fork Hoh, and Queets River, Olympic National Park. In Meehan, W.R., T.R. Merrell, and T.A. Hanley (eds.), *Fish and Wildlife Relationships in Old Growth Forests.* Proceedings of a symposium, Juneau, Alaska, April 12-15, 1982, American Institute of Fisheries Research Biologists.

Shackleton, N.J. 1987. Oxygen isotopes, ice volume and sea level: Quaternary Science Reviews 6:183-199.

Shaffer, M.L. 1978. *Determining Minimum Viable Population Sizes: A Case Study of the Grizzly Bear (Ursus arctos L.)* Ph.D. dissertation, Duke University. *IN*: Quammen, David. 1997. *Song of the Dodo: Island Biogeography in an Age of Extinction*. Touchstone. New York.

Shaffer, M.L. 1981. Minimum Population Sizes for Species Conservation. *BioScience*, Vol.31, No.2. *IN*: Quammen, David. 1997. *Song of the Dodo: Island Biogeography in an Age of Extinction*. Touchstone. New York.

Shaffer, M.L. 1987. Minimum Viable Populations: Coping with Uncertainty. In Soulé. *IN*: Quammen, David. 1997. *Song of the Dodo: Island Biogeography in an Age of Extinction*. Touchstone. New York.

Shaffer, M.L. 1990. Population Viability Analysis. *Conservation Biology*, Vol.4, No.1. *IN*: Quammen, David. 1997. *Song of the Dodo: Island Biogeography in an Age of Extinction*. Touchstone. New York.

Shapovalov, L. and A.C. Taft. 1954. Life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*) with special reference to

Waddell Creek, California, and recommendations regarding their management. Fish Bull. 98. Sacramento, CA: California Department of Fish and Game. 375 p.

Small, M.P., T.D. Beacham, R.E. Withler, and R.J. Nelson. 1998. Discriminating coho salmon (*Oncorhynchus kisutch*) populations within the Fraser River, British Columbia, using microsatellite DNA markers. *Molecular Biology* 7, 141-155.

Smith, C.J. 2000. Salmon and Steelhead Habitat Limiting Factors in the North Washington Coastal Steams of WRIA 20. Washington State Conservation Commission, Lacey, WA.

Smith, C.J. and J. Caldwell. 2001. Salmon and Steelhead Habitat Limiting Factors in the Washington Coastal Streams of WRIA 21. Washington State Conservation Commission. Lacey.

Smith, C.T., R.J. Nelson, C.C. Wood, and B.F. Koop. 2001. Glacial biogeography of North American coho salmon (*Oncorhynchus kisutch*). *Molecular Biology* 10, 2775-2785.

Soverel, P.W., K.A. Savvaitova, K.V. Kuzishchin, and R. Reeve. 1997. Kamchatka steelhead project, scientific report 1996 [Translated by S. Karpovich]. Department of Ichthyology, Moscow State University and the Wild Salmon Center, Edmonds, WA. 35 p.

Stearns, S.C., and A.P. Hendry. 2004. Introduction: the salmonid contribution to key issues in evolution. *In*: *Evolution Illuminated: Salmon and Their Relatives* (Eds: Andrew P. Hendry and Stephen C. Stearns) p. 3-19. Oxford University Press, New York.

Stockner, J.G. 2000. Quinault Lake report: state of the lake and sockeye salmon stocks. Report prepared for Quinault Fisheries Division, Quinault Indian Nation. Eco-Logic, Ltd. West Vancouver, British Columbia, Canada.

Stringer, Christopher, and Robin McKie. 1996. *African Exodus: The Origins of Modern Humanity*. Henry Holt and Company, Inc., New York.

Swan, James G. 1870. The Indians of Cape Flattery, at the Entrance to the Strait of Fuca, Washington Territory. *Smithsonian Contributions to Knowledge* 16(8):1-106. Washington. (Reprinted: Shorey Publications, Seattle, 1972.)

Taft's Sportsman's Guide and Handbook, Fishing Edition, Western Washington State (no author listed). 1925. Piper & Taft, Inc. Seattle, WA. 184 pp.

Taylor, B. 1979. Treaty Indian Commercial Steelhead Fisheries for Calendar Year 1976, 1977 and 1978. (Unpublished report to John Bishop, National Marine Fisheries). Washington Department of Game. Olympia.

Taylor, E.B., S. Pollard, and D. Louie. 1999. Mitochondrial DNA variation in bull trout (*Salvelinus confluentus*) from northwestern North America: implications for zoogeography and conservation. *Molecular Ecology* 8, 1155-1170.

Taylor, Herbert C., Jr. 1963. Aboriginal Populations of the Lower Northwest Coast. *Pacific Northwest Quarterly* 54(4):158-165.

Thackray, G.D. 1996. Glaciation and Neotectonic Deformation on the Western Olympic Peninsula, Washington. PhD dissertation. University of Washington, Seattle. 139 p.

Thackray, G.D. 2001. Extensive early and middle Wisconsin glaciation on the Western Olympic Peninsula, Washington, and the variability of Pacific moisture delivery to the Northwestern United States. Quaternary Research 55: 257-270.

Thedinga, J.F., S.W. Johnson, K.V. Koski, J.M. Lorenz, and M.L. Murphy. 1993. Potential Effects of Flooding from Russell Fiord on Salmonids and Habitat in the Situk River, Alaska. Alaska Fisheries Science Center Processed Report 93-01, U.S. Department of Commerce, Juneau.

Thedinga, J.F., S.W. Johnson, and K.V. Koski. 1998. Age and marine survival of ocean-type chinook salmon *Oncorhynchus tshawytscha* from the Situk River. Alaska Department of Fish and Game, Alaska Fishery Research Bulletin, 5(2):143-148.

Thorgaard, G.H. 1977. Chromosome studies of steelhead. In T.J. Hassler and R.R. VanKirk (eds.), *Proceedings of the Genetic Implications of Steelhead Management Symposium*. May 20-21, 1977, Arcata, CA, p. 20-25. Special Report 77-1. Calif. Coop. Fish. Res. Unit.

Thorgaard, G.H. 1983. Chromosomal differences among rainbow trout populations. Copeia 1983 (3):650-662.

Tietson, Sari Brewster. 1987. *The New Pomeranian*. Howell Books, New York.

Tipping, J.M., R.V. Cooper, J.B. Byrne, and T.H. Johnson. 1995. Length and condition factor of migrating and nonmigrating hatchery-reared winter steelhead smolts. *North American Journal of Fisheries Management* 15: 120-123.

Troop, S. and D. Wicker. 1996. Necanicum River basin "3M" steelhead surveys January-April, 1996. Oregon Department of Fish and Wildlife, Portland, OR. 14 p.

Tudge, Collin. 1996. *The Time Before History: 5 Million Years of Human Impact*. Scribner, New York.

United States Bureau of Fisheries (USBF). 1900. Report of the U.S. Commissioner of Fish and Fisheries. Washington DC.

United States Bureau of Fisheries (USBF). 1923. Report of the U.S. Commissioner of Fish and Fisheries for the Fiscal Year 1922. Dep. Commerce, Washington DC.

U.S. Fish and Wildlife Service. 1999. Hatcheries Thrive on Partnership with Tribes. *Fish and Wildlife News* (July/August 1999). U.S. Department of the Interior, U.S. Fish and Wildlife Service.

U.S. Forest Service (USFS). 1985. Situk River wild and scenic river final environmental impact statement and study report. Admin. Doc. 120. U.S. Forest Service, 709 W. 9th St., Juneau, AK 99801.

U.S. Forest Service (USFS). 1995. Matheny Creek Watershed Analysis. Quinault Ranger District, Olympic National Forest, Lake Quinault, Washington.

Utley, Robert M. 1997. *A Life Wild and Perilous: Mountain Men and the Paths to the Pacific*. Henry Holt and Company, Inc. New York.

Viola, A.E., and M.L. Schuck. 1995. A method to reduce the abundance of residual hatchery steelhead in rivers. *North American Journal of Fisheries Management* 15:488-493.

Wahlgren, Iva (Hosack). 1998. *Memories of a Quillayute and Sol Duc Country Pioneer*. West End Pioneers Club. Forks, Washington.

Ward, B.R. 2006. The case for wild steelhead recovery without artificial fish culture intervention (March 2006). British Columbia Ministry of Environment, University of British Columbia, Vancouver.

Warren, Henry C. 1982. *Olympic: The Story Behind the Scenery*. KC Publications. Las Vegas, Nevada.

Washington Department of Fisheries and Game (WDFG). 1928. Thirty-sixth and thirty-seventh annual reports of State Department of Fisheries and Game. Division of Fisheries, Olympia, WA.

Washington Department of Fisheries and Game (WDFG). 1932. Fortieth and forty-first annual reports of State Department of Fisheries and Game. Division of Fisheries, Olympia, WA.

Washington Department of Fish and Wildlife (WDFW). 1996. An analysis of the natural return timing of wild winter steelhead in the Quillayute River system. Report to the Washington Department of Fish and Wildlife Commission. 20 pp. Appendix A: McLachlan, B. 1994. Historical evidence indicating the natural return timing of Quillayute winter steelhead with reference to the present return timing. A preliminary report to the Washington Wildlife Commission. Appendix B: Steelhead sport regulations. Appendix C: Wild winter steelhead sport harvest. Appendix D: Hahn, P. 1996. Final consulting report. State of Washington Department of Fish and Wildlife Resource Assessment Division.

Washington Trout. 2004. Comments to: Lower Skagit River Steelhead Acclimation and Rearing Facility Draft Environmental Impact Statement. Submitted to: Teresa A. Eturaspe, SEPA/NEPA Coordinator, Agency Designated Official, Habitat Program, Regulatory Services Section, Washington Department of Wildlife, 600 Capitol Way North, Olympia, WA 98501-1091, on July 22, 2004. Washington Trout. Duvall, WA. 100 p.

WDFW (Washington Department of Fish and Wildlife). 1994-2002. Annual Washington steelhead sport and tribal harvest summaries. Washington Department of Fish and Wildlife. Olympia, WA.

WDFW. 2000. *Sport Fish Investigations in Washington State*. Progress Report Westside Volume. (eds. Leland, B. and J. Hisata). Fish Program Report FPA 00-08. Washington Department of Fish and Wildlife. Olympia, WA.

WDFW. 2000a. Selected information for WRIA 21 from fish passage barrier assessment and database, April 2000.

WDFW. 2006. Steelhead historical database (as provided by Bill Gill in January, 2006). WDFW Fish Management Headquarters. Washington Department of Fish and Wildlife. Olympia, WA.

WDG (Washington Department of Game). 1948-1978. Section I.D. Steelhead sport harvests and numbers of steelhead smolts stocked in Boldt Case Area rivers (section from otherwise unidentified WDG report likely dating to 1979 or 1980). Washington Department of Game, Olympia. pp: 88-103.

WDG (Washington Department of Game). 1956. What happened on last year's steelhead season (1954-1955). WDG Bulletin, Vol. 8, No. 1. Olympia, WA. 2 p.

WDG (Washington Department of Game). 1957. These are last season's steelhead figures (1955-1956). WDG Bulletin, Vol. 9, No. 1. Olympia, WA. 2 p.

WDG (Washington Department of Game). 1962-1986. Annual summaries of Washington steelhead sport catch. Washington Department of Game. Olympia, WA.

WDG (Washington Department of Game). 1975. Summary of 1974 summer-run and 1974-75 winter-run steelhead sport catch in Washington. State Game Department. Olympia. 4 pp.

WDW (Washington Department of Wildlife). 1987-1993. Annual Washington steelhead sport harvest summaries. Washington Department of Fish and Wildlife. Olympia, WA.

Weiner, Jonathan. 1996. *The Beak of the Finch: A Story of Evolution in Our Time*. Alfred A. Knopf, Inc. New York.

Werlen, C. 2003. Hatchery smolts that fail to migrate: Reasons, magnitude and impacts on wild steelhead trout in the Keogh River, a coastal stream in British Columbia (Canada). Master thesis of Christian Werlen, Department Environmental Sciences, ETH Zurich. Supervisor: Bruce Ward. Ministry of Water, Land and Air Protection. Fisheries Research and Development. Vancouver, BC.

White, Richard. 1980. *Land Use, Environment and Social Change*. University of Washington Press, Seattle.

Wilcox, W.A. 1898. Notes on the fisheries of the Pacific Coast in 1889. Part XXII. Report of the Commissioner for the year ending June 30, 1896. U.S. Commission of Fish and Fisheries. Washington, DC: 575-613.

Wilcox, W.A. 1904. The Commercial Fisheries of the Pacific Coast States in 1904. Bureau of Fisheries Document No. 612. Washington DC.

Wild Salmon Center. 2005. Unpublished Draft: Hoh Conservation Plan. Wild Salmon Center. Portland, OR.

Withler, I.L. 1966. Variability in life history characteristics of steelhead (*Salmo gairdneri*) along the Pacific coast of North America. *Journal of the Fisheries Research Board of Canada*. 23: 365-393.

Wood, Robert L. 1967. *Across the Olympic Mountains: The Press Expedition, 1889-90*. Seattle: The Mountaineers and the University of Washington Press.

Woodin, R.M, S.C. Crumley, Q.J. Stober, and G. Engman. 1984. Skagit River Interim Agreement Studies, Volume II: Salmon and Steelhead Studies. Final Report, March 1980 to February 1983 to Seattle City Light, 61 p. FRI-UW-8406.

Wray, J.C. 1997. *Olympic National Park Ethnographic Overview and Assessment*. Olympic National Park. Port Angeles, WA. 252 p.

Wright, T. 1993. Presentation on tribal hatchery programs by the Northwest Indian Fisheries Commission: *IN* Proceedings of Washington Steelhead Symposium, September 26 & 27, 1992. Washington Department of Wildlife. Olympia, WA. Pages 86-90.

Wydoski, Richard S., and Richard R. Whitney. 1979. *Inland Fishes of Washington*. University of Washington Press.