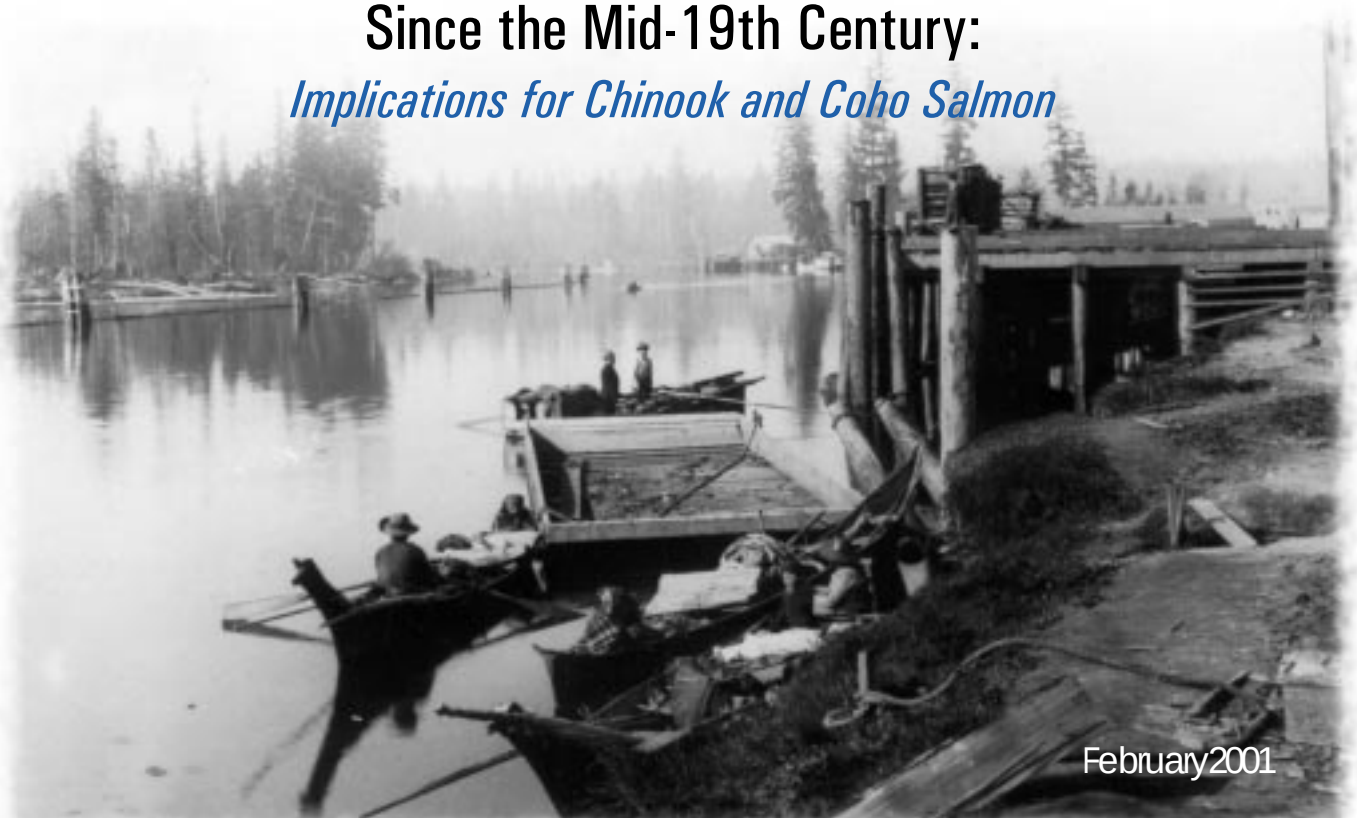
A Historical Analysis of Habitat Alterations in the Snohomish River Valley, Washington, Since the Mid-19th Century:

Implications for Chinook and Coho Salmon



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TULALIP TRIBES

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Working together for people, streams & fish.

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Cover photo: Snohomish River and Ebey Island viewed from "Spithill's Wharf" at the east end of California Ave., Everett, WA in 1892. *King and Baskerville, April 13, 1892. Courtesy of Everett Public Library.*

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EXECUTIVE SUMMARY

This report addresses salmonid habitat quantity and smolt production capacity in the Snohomish River estuary, floodplain and main stem from an historical perspective. The Snohomish River basin, located northeast of Seattle, Washington, is the second largest Puget Sound drainage. The Snohomish River, formed by the convergence of the Skykomish and Snoqualmie rivers, flows for 34 kilometers through a broad alluvial floodplain and estuary before entering Possession Sound between the Tulalip Indian Reservation and the city of Everett.

Beginning in the mid-19th century, settlers cleared, drained, ditched and diked the Snohomish River valley. Snag boats removed wood obstructions to facilitate steamboat navigation. The cumulative impact of these actions has been dramatic losses and widespread degradation of salmonid habitat. Habitat loss and degradation, in turn, has reduced salmonid production capacity in the Snohomish River basin. Restoration and reconnection of lost habitat will play a major role in the recovery of threatened stocks. Understanding the type and extent of habitat loss is a fundamental component of restoring salmon runs. An historical context clarifies the causes of decline, provides a reference for desired future conditions and allows land managers to set clear goals for restoring lost and degraded habitats.

Primary objectives of this report are: 1) to describe and quantify salmonid habitat alterations in the Snohomish River valley over the last 150 years; 2) to assess the impact of modified habitat conditions on the production potential of chinook (*Oncorhynchus tshawytscha*) and coho salmon (*Oncorhynchus kisutch*); 3) and to inform and guide the development of a restoration strategy through historical analysis.

Primary results are:

- **Habitat Changes in the Lower Estuary** – Prior to human induced changes, the Snohomish River basin included approximately 3,950 hectares of tidal marsh (not including mudflats) between Priest Point and the divergence of Ebey Slough from the main stem. The marsh was composed of 5 percent within the estuarine emergent

marsh (EEM) zone, 29 percent within the emergent/forested transition (EFT) zone, and 66 percent within the forested riverine/tidal (FRT) zone. Only one sixth of the historic marsh area remains. Sixty-one blind tidal channel networks greater than six meters wide at the mouth have been lost, and only one-forth of the blind tidal slough area remains intact and connected to the channel network. Distributary slough and main-stem channel area and position have changed little, but near continuous diking, riparian clearing and wood removal have significantly modified habitat condition in the channel margins.

- **Habitat Changes in the Floodplain** – Prior to timber harvest and clearing in the late 19th century, one-fifth of the floodplain riparian forest was coniferous, and it contained trees up to 4 meters in diameter. Currently, 70 percent of the Snohomish River has no riparian forest greater than or equal to one site-potential tree height (56 m) in width. The remaining floodplain riparian forest, which is almost entirely comprised of cottonwood (*Populus trichocarpa*), contains only 2 percent coniferous trees. Very few trees exceed 1 meter in diameter. As a result of these changes to the riparian forest coupled with extensive diking, the river receives limited recruitment of wood that is large enough to function as cover or influence the channel morphology. Land-use impacts also reduced off-channel habitat. Settlers drained and/or isolated approximately 3,370 hectares of palustrine marsh in the floodplain upstream of Ebey Slough. Flow control devices isolates or restrict access to tens of kilometers of channels from the river. Diking and bank armoring has also contributed to a 2-kilometer decrease in the total length of side-channels and a 55 percent reduction in the area of side-channel sloughs. Beaver pond area occupies only three-fifths of its historic extent (not including habitat loss in vast floodplain marshes).
- **Habitat Changes in the Snohomish River** – Main-stem channel position and area have changed little from 1884 through 1998, presumably because of diking and bank armoring. Pools within the main stem (upstream of RK 24.5) are currently large and spaced on average every three channel-widths. Wood debris in the Snohomish consists of individual pieces of old, relict cedar on the bed of the river, and secondarily, smaller-diameter, younger pieces on the banks. It averages 0.42 meters in

diameter and 8 meters in length. Only 22 percent of logs have rootwads. The Snohomish River contains an average of 18 debris pieces per channel width. In contrast, a largely undisturbed reach of the Nisqually River contains 140 debris pieces per channel width (Collins *et al*., 2001, submitted). In the Snohomish River, wood as a percentage of channel edge habitat in the slack-water channel margin along hydromodified banks is less than 50 percent of wood abundance in the slackwater channel margin of natural banks.

- **Changes in Chinook and Coho Salmon Production Potential –**

  Lower Estuary –Prior to development, the estuary (between the head of Ebey Slough and Priest Point) could support approximately 2.6 million chinook smolts. Current smolt production capacity is between 1.0 and 1.6 million smolts, a decrease of 40 to 61 percent. The greatest loss in production potential by habitat zone (56%) has occurred in the emergent/forested transition (EFT) zone followed by the estuarine emergent marsh (EEM) zone and the forested riverine/tidal zone, respectively. By habitat type, the greatest loss has occurred in blind tidal channel networks, where chinook salmon smolt production potential has decreased by 68 percent. Coho salmon production potential in the forested riverine tidal (FRT) zone (freshwater component of estuary) has decreased by approximately one-half.

  Floodplain –Disconnection and destruction of off-channel habitat has eliminated approximately 95 percent of chinook salmon rearing capacity and coho salmon smolt production capacity in the floodplain. Pre-smolt chinook rearing capacity in the floodplain decreased from a mean estimate of approximately 1.2 million in the mid-19th century to 36,000 in 1998. Summer coho smolt production potential decreased from a mean estimate of 3.4 million smolts in the mid-19th century to 155,000 smolts currently. Winter coho smolt production potential dropped from approximately 7.4 million to 376,000. While significant losses occurred through the isolation of side-channel sloughs, the vast majority of habitat loss occurred through the draining and diking of Marshland and French Creek marshes.

  Main stem - Historic production estimates for chinook salmon, summer coho salmon parr, and winter pre-smolt coho salmon in the main stem are 76, 161 and 52 percent

greater than current estimates, respectively. If old-growth remnant logs decay and are not replenished through new recruitment, then future production potential for chinook, summer coho parr, and winter pre-smolt coho in the main stem could decrease by 39, 54, and 35 percent, respectively, in addition to losses experienced to the present.

Summary and Implications – The largest relative change in chinook smolt production capacity (-96%) occurred in the floodplain, primarily within Marshland and French Creek marshes. The largest production capacity change (1.0-1.6 million smolts) occurred in the estuary. Our analysis suggests that the Snohomish estuary is commonly a bottleneck to chinook production. Assuming comparable freshwater survival in the Snohomish to the Skagit (280-400 smolts/spawner), Snohomish escapement estimates and a carrying capacity for the estuary of 1.3 million smolts, between 1968 and 1999, chinook experienced density-dependent constraints on production in the estuary between 45 and 87 percent of the time. To the extent that competition with hatchery fish, habitat fragmentation and temperature reduce capacity, production may be constrained further. For coho salmon, the greatest relative and actual change in production capacity occurred through the disconnection and draining of larger palustrine marshes within the floodplain.

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