The value of estuary habitat restoration for Skagit Chinook salmon recovery

Washington Department of FISH and WILDLIFE

Estuaries form where freshwater and saltwater mix, and provide a wealth of environmental services that make them valuable habitats to conserve and restore. They serve as nursery habitats for a variety of marine life, filter nutrients from run-off, support a host of wildlife species, and can shield coastal areas from storm surge, flooding, and erosion. Estuaries take a variety of forms, including tidal forests, salt marshes, beaches and bays.

Juvenile Chinook grow larger and stronger in estuaries, increasing their chance of survival.

Estuaries are vitally important for Chinook salmon

Every year adult Chinook salmon return to spawn in the Skagit River and its tributaries, producing young that will begin making their way toward Puget Sound within days or up to a year after hatching from an egg and emerging from the gravel. Along the way the ocean bound emigrants use rearing habitats in river floodplains and estuaries to varying degrees. Estuary-rearing Chinook typically spend a few weeks to months in the estuary between February and August, with a peak use of the estuary from March through May.

Estuaries provide important habitat for juvenile Chinook salmon in several major ways. Estuary habitats range from tidal freshwater forests and shrubby areas to saltier marshes and unvegetated mud- or sand-flats. Collectively these extremely productive habitats provide rich food sources that support juvenile chinook growth and development, a salinity mixing zone where rearing Chinook transition from fresh to salt water, and refuge from predation by larger fish. These rich feeding and rearing grounds allow fish to be bigger and better adapted to life in Puget Sound and beyond.

More estuary area = More space and food for more mouths = More outmigrants to the ocean = Better chance of more adults available to feed orcas and humans, and create the next generation of salmon

Puget Sound Chinook recovery

Puget Sound Chinook were listed as threatened under the Endangered Species Act in 1999, which prompted state and federal agencies to develop a recovery plan. In the early 2000s, local entities representing fourteen watersheds in Puget Sound developed the Puget Sound Chinook Recovery plan. The plan was adopted by the federal government in 2007. WDFW and the Skagit River System Cooperative wrote the Skagit Chinook Recovery Plan, which was adopted as a chapter of the Puget Sound Chinook Recovery Plan.

1999
Puget Sound Chinook listed as threatened under Endangered Species Act

Early 2000s
Puget Sound Chinook Recovery Plan developed

2007
Plan adopted by federal government

For more information, contact: Jenny Baker | jenny.baker@dfw.wa.gov | 360-855-8325

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Puget Sound estuaries have declined

Less than 15% of historic estuaries remain along the Washington, Oregon, and California coastlines. In Puget Sound, 70-80% of estuary habitat has been lost as it was diked and drained to make land suitable for agriculture and development. In the Skagit delta—which spans from Camano Island north to Padilla bay—there is a net loss of 73% of historic tidal wetlands and channels and an 88% loss of the estuarine habitats specifically used by juvenile Chinook.

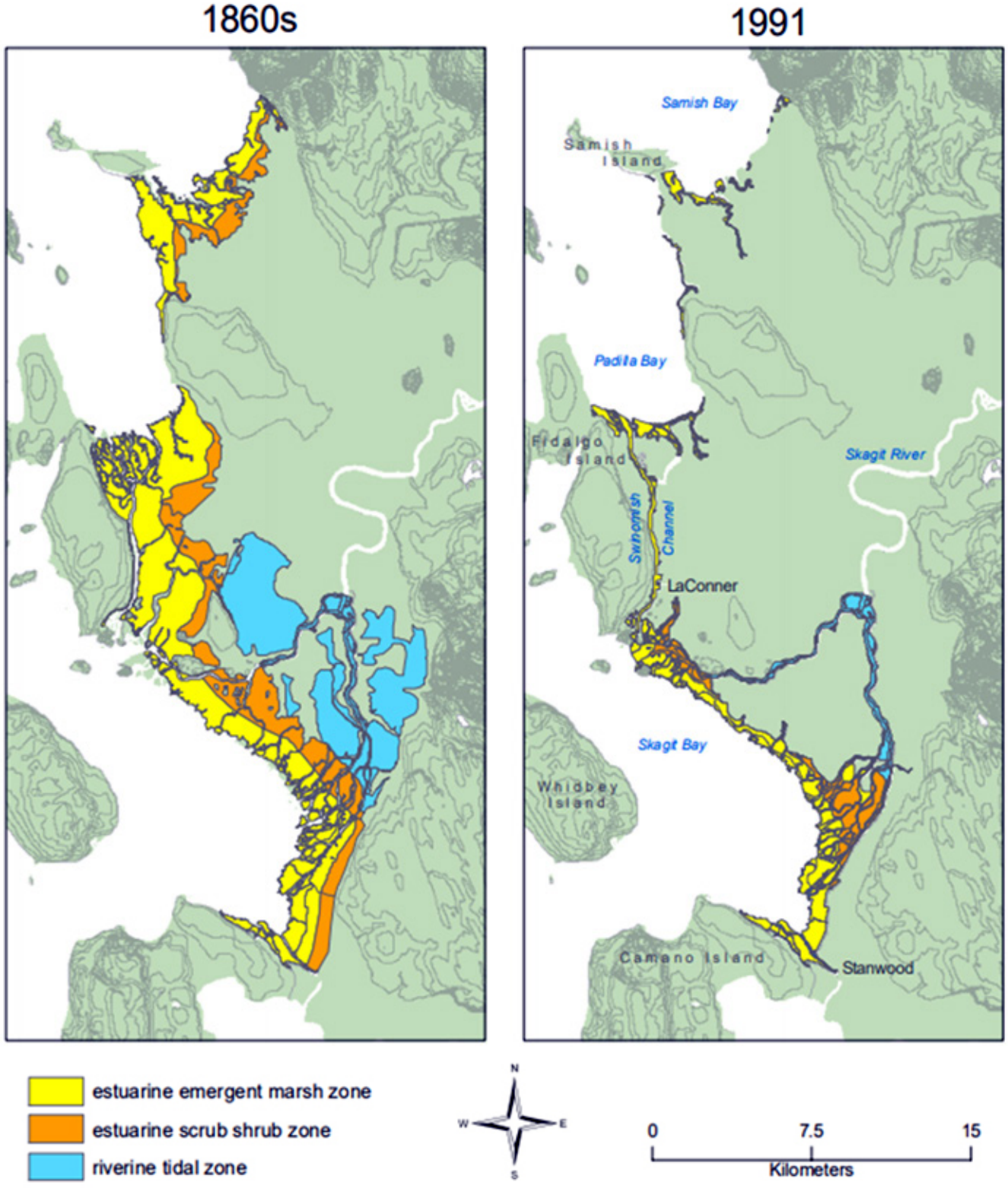
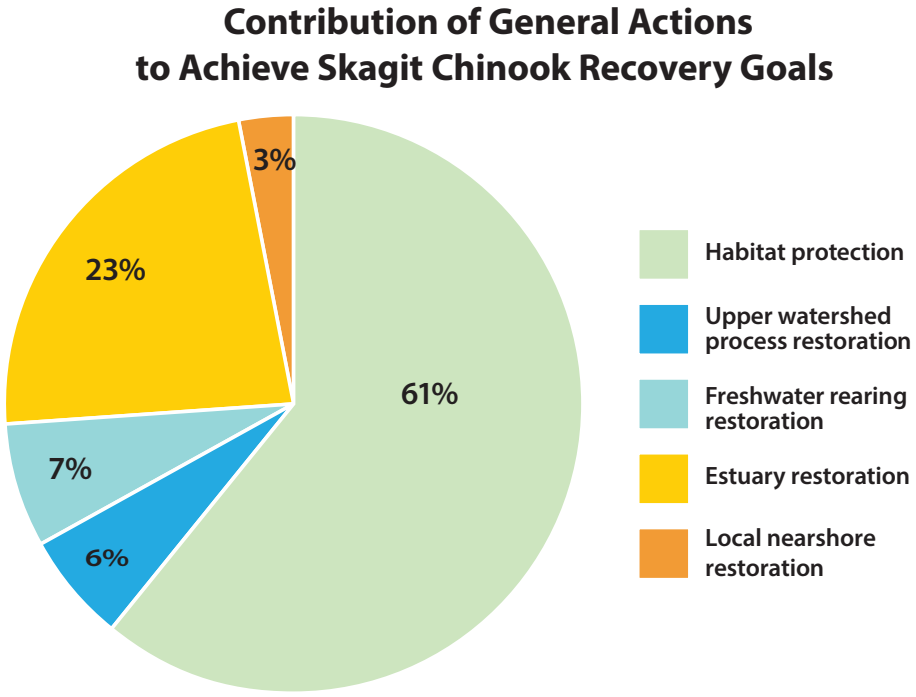


Figure from http://skagitcoop.org/wp-content/uploads/Appendix-D-Estuary1.pdf

Restoring estuary is a critical need for Chinook recovery

Because the greatest losses of rearing habitat have happened in the estuary, and because of its relatively high rearing productivity, the Skagit Chinook Recovery Plan identifies **estuary habitat as the greatest habitat restoration need for Chinook recovery in the Skagit watershed.** The plan establishes a goal of restoring enough estuary habitat to hold an additional 1.35 million juvenile Chinook beyond its current capacity. Supported by existing science at the time, the recovery plan estimated that **2,700 acres of additional estuary would be needed to hold 1.35 million juvenile Chinook.**

From continuing research we now know not all estuary habitat is equal; some estuary habitat holds higher numbers of fish while some holds far fewer. The characteristics of a particular site such as proximity to migration pathways and relative tidal influence are two things that influence the number of fish that site can hold (its "carrying capacity"), and its contribution towards the overall goal of 1.35 million juvenile Chinook. In addition, existing estuary habitats may shrink or grow due to both human and natural causes. This means the actual number of acres that need to be restored may end up being more or less than 2,700.



Contribution of habitat protection and restoration to achieving juvenile Chinook salmon targets identified in the 2005 Skagit Chinook Recovery Plan, assuming no loss of existing habitats.

What's been done?

WDFW and others have completed a number of estuary restoration projects in the Skagit over the last 20 years. The goal of estuary restoration is to restore processes that will create and maintain important habitats over time, while ensuring no negative impacts on neighboring properties. This includes restoring tides and river flows so that water and the sediment it carries create and maintain channels, and sediment and nutrients are delivered to rich floodplains and meadows where bugs and vegetation grow. Restoration involves removing or setting back dikes and levees, excavating channels, and establishing native vegetation. Infrastructure such as dikes, levees, tidegates and pumps are often incorporated into projects in order to maintain drainage and flood protection on neighboring lands.

The best restoration sites contain lots of channel area and are close to pathways used by juveniles as they make their way from spawning areas to Puget Sound. Once restored, vegetation management can be important. For instance, invasive cattail may reduce habitat for Chinook and other species that use the estuary.

Restoration project effectiveness

Because the Skagit Chinook Recovery Plan estuary goals are based on predictions, and estuaries and our understanding of restoration is evolving over time, monitoring the outcomes of restoration projects is a high priority for WDFW and other restoration partners.

Estuary-wide monitoring has shown that restoration is making fish less crowded, and thus increasing the habitat carrying capacity and allowing juveniles to spend more time in the estuary. Site-scale monitoring has shown that **when new areas are restored they are occupied as soon as juveniles come down the river.** Some project sites are providing habitat for more juvenile Chinook than predicted. For instance, the Wiley Slough restoration project was predicted to provide habitat for just over 38,000 juvenile Chinook. Monitoring data indicates this site can currently hold up to as many as 367,000 juveniles. (Read on for why this might change over time.) Other projects are able to hold as many juvenile Chinook as predicted (e.g. Fir Island Farm).

There are also projects where monitoring data indicate there is less space for juvenile Chinook than predicted – this may be the case with the Milltown Island restoration project. Carrying capacity and adaptive management actions that could improve salmon habitat at Milltown are currently being assessed.

The number of fish a particular site can hold ("carrying capacity") is based on current site conditions. As sites change over time, their carrying capacity may change. Sediment may fill in some areas and reduce space for fish, as predicted at Wiley Slough. Sea level rise may change the amount of habitat available for fish as well.

We expect the increase in estuary rearing capacity from restoration to ultimately improve adult returns. However, because of the wide variety of factors that affect juvenile-to-adult survival, it is difficult to isolate the effect of estuary rearing from other factors such as ocean conditions. However, research is underway to examine this for the Skagit and other systems in Puget Sound.

Photo by Marlin Greene/One Earth Images

Table: Skagit estuary restoration projects 2005-current

Juvenile chinook carrying capacity (the number of fish a certain area of habitat can hold) for restoration projects that have been completed since the Skagit Chinook Recovery Plan was written in 2005. Numbers shown are based on an assumption that the number of juveniles coming down the river from spawning grounds is very large (e.g. there is a large outmigration size and the estuary is full to capacity). Actual numbers of fish using these sites vary year by year based on the outmigration size. Additionally, the pre-project estimate presented for each site is a mid-point of a range of predicted values.

Project Name	Description	Year Completed	Pre-project estimate of smolt carrying capacity	Post-project smolt carrying capacity	
				As-built	Long-term
Milltown Island	dike removal and channel creation	2007	57,179	30,000*	30,000*
SF Dike Setback	dike setback and channel creation	2007	14,588	7,487	7,487
Swinomish Channel Fill Removal**	fill removal and channel creation	2008	unknown	unknown	unknown
Smokehouse/ Fornsby Phase 1	tidegate improvements and channel reconnection	2008	11,157	11,157	11,157
Wiley Slough	dike setback and channel reconnection	2009	38,492	367,613	74,105
Fisher Slough	tidegate improvements, dike setback and channel creation	2011	16,431	21,823	21,823
Fir Island Farm	dike setback and channel reconnection	2016	65,000	64,428	50,000
	TOTAL RESTORED		202,847	472,508	164,572
	recovery goal		1,350,000	1,350,000	1,350,000
	% recovery goal		15.03%	35.00%	12.19%

*Milltown as-built estimates and the number of smolts that can be attributed to restoration are under review and may change

**complete information on this project was not available as of January 2020

The science is improving

As we learn more, the science and predictions improve. Juvenile Chinook carrying capacity predictions were recently updated for many sites based on changes to how much channel is expected to form. The new predictions take into account how much tidal exchange there is on a site (more at the bayfront, less up the river) and whether the site is adjacent to marsh where existing channels will get bigger with increased tidal exchange.

That said there is still uncertainty about the predictions. We can't say with exactly how many acres of channels will develop or the exact number of juveniles a site will support. As a result, a range of how many juvenile Chinook a site will hold is provided. For this reason **monitoring completed projects continues to be a critical need.**

Monitoring estuary restoration sites will continue to improve the science.

Juvenile Chinook need more estuaries.

What does all of this mean?

Restored sites are being used by hundreds of thousands of juvenile Chinook each year. However not all sites are functioning the same – some actually have more space for juvenile Chinook than predicted and some have less. There is still more work to do to optimize the function of sites that are not holding as many juveniles as predicted, and there is a need to restore more estuary habitat to reach recovery plan goals. Continued monitoring of past restoration sites is important so that we understand what changes happen on these sites over time and how that affects the number of juvenile Chinook they can hold. Monitoring future restoration sites is also critically important to verify how many juveniles they support, and how this changes over time.

This summary has been developed in support of the Island Unit Alternatives Analysis

For more information contact:
Jenny Baker | jenny.baker@dfw.wa.gov | 360-855-8325