

## Restoration Monitoring in South Lake Washington

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A key component of habitat restoration projects is biological monitoring to establish the effectiveness of the project to target species. Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) are currently listed as threatened under the Endangered Species Act and many restoration projects have been designed to improve their habitat conditions in lotic and lentic environments. Recently, the Washington Department of Natural Resources (WDNR) and the City of Seattle completed restoration projects in the south end of Lake Washington to benefit Chinook salmon. Monitoring of these projects is needed to determine if conditions have been improved for juvenile Chinook salmon.

In the Lake Washington system, the major spawning tributary is the Cedar River and large numbers of fry emigrate from January to April to rear in the south end of Lake Washington. These fish prefer shallow, non-armored shorelines with sand and gravel substrates that have both open beaches and areas with riparian vegetation that provide woody debris and overhanging vegetation (Tabor et al. 2011). However, the Lake Washington shoreline has been extensively developed and resource managers have looked for opportunities to improve shoreline habitat conditions. Also, small non-natal streams can be heavily used by juvenile Chinook salmon (Tabor et al. 2011); however, land use changes in some areas have significantly reduced the number of these small non-natal creeks. The abundance of juvenile Chinook salmon is substantially higher at sites close to the mouth of the Cedar River (Tabor et al. 2006). Therefore, restoration projects close to the Cedar River are likely to have a stronger effect on the Chinook salmon population than projects located further away.

In the summer of 2014, WDNR removed most of the Shuffleton Power Plant flume structure and replaced it with a gentle-sloping sand/gravel beach (see above photos) and engineered log jams (ELJs). The flume was built to help cool water from the adjacent power plant. The power plant has been torn down and thus the flume structure was no longer used.

The structure was also only about a half of a kilometer from the mouth of the Cedar River. This restoration site is relatively large in comparison to other potential restoration sites; the part of the flume structure removed was about 150-m long and is part of a 360-m long shoreline section owned by WDNR. The flume structure consisted of two parallel, vertical steel walls that resulted in poor habitat conditions (i.e., little shallow water, no sand and gravel substrates, and little structural complexity) for juvenile Chinook salmon.

Also in the summer of 2014, the City of Seattle daylighted the lower 125 m of Mapes Creek to provide shallow-water habitat for juvenile Chinook salmon. Prior to the restoration work, the lower part of Mapes Creek was in a culvert and eight feet below the lake surface and did not provide any habitat for Chinook salmon. Post-project monitoring of this site began in 2015. Additionally, the City of Seattle is proposing restoration work on Taylor Creek and pre-project monitoring began in 2015.

Monitoring of the restoration sites was accomplished primarily through night snorkeling. Snorkeling allowed us to effectively survey a variety of habitat types and no handling of fish was required. Night surveys were undertaken to minimize the effect the snorkeler had on the behavior of juvenile Chinook salmon. At night, juvenile Chinook salmon typically are inactive, rest near the bottom, can be easily approached by snorkelers and can be accurately counted.

**WDNR Shuffleton Power Plant flume site.**-- Because good numbers of juvenile Chinook salmon (i.e., > 40 fish on each survey night) were observed along the old flume transect in 2015 and their density was similar or higher than control sites, removal of the flume structure and replacing it with a sandy beach appeared to create valuable habitat for juvenile Chinook salmon. This site should be particularly valuable for juvenile Chinook salmon because it is close to the mouth of the Cedar River, the source from which large numbers of Chinook salmon fry emigrate in the winter and early spring. The old flume wall structure is a good example of a suboptimal habitat: little shallow water, no sand and gravel substrates, steep slope, and little structural complexity (Tabor et al. 2011). The restored nearshore habitat now has a large area of shallow water < 1 m deep, primarily sand and gravel substrate, a gentle slope, and some nearby engineered log jams for refuge. Monitoring of the WDNR restoration will continue in 2016 and 2017.

**City of Seattle restoration sites.** -- Juvenile Chinook salmon were observed in Mapes Creek from February to May 2015 with a peak abundance of 62 fish on March 10. Abundance in the small tributary was often higher than that along a nearby lake reference site. The newly-constructed stream channel appears to provide valuable habitat conditions for juvenile Chinook salmon. The stream channel has a low gradient and provides shallow water habitat. Monitoring of this site will continue in 2016 and 2017. Currently, the lower reach of Taylor Creek has a moderate gradient with mostly riffle habitat and juvenile Chinook salmon abundance was low in 2015. Also, a boulder weir 100 m upstream from the lake appears to create a barrier to juvenile Chinook salmon and other small fishes moving upstream. Pre-project monitoring of Taylor Creek will continue in 2016 and 2017.