Olympic Sculpture Park: Biological Monitoring of the Shoreline

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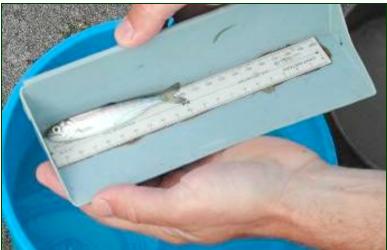
What we do: SCIENCE

- Juvenile salmon use of estuaries and nearshore.
- Function of restoring and natural habitats.
- Ecological effects of shoreline modifications.



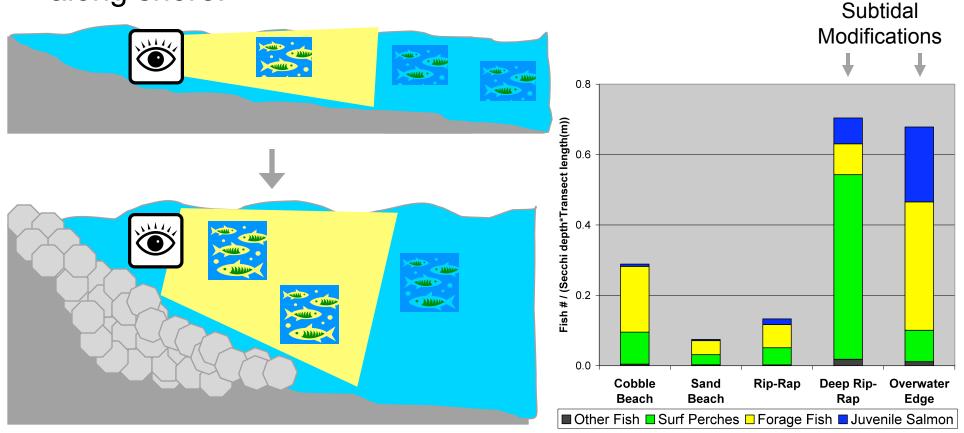






Habitat Measurements:

Shoreline modifications truncate the shallow water zone, gradual slope is lost. Pelagic fish that are typically spread-out along a large intertidal area must inhabit deep water directly along shore.

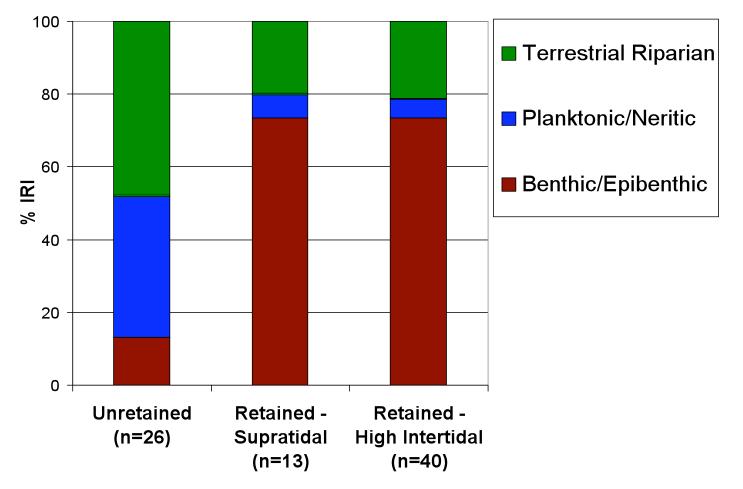


Toft et al. 2007. Fish distribution, abundance, and behavior along city shoreline types in Puget Sound. *North American Journal of Fisheries Management* 27:465-480.

Diet Analysis:

Gastric lavage of juvenile Chinook shows less terrestrial/riparian input (insects) at sites with retaining structures at intertidal or supratidal.





Historical Perspective

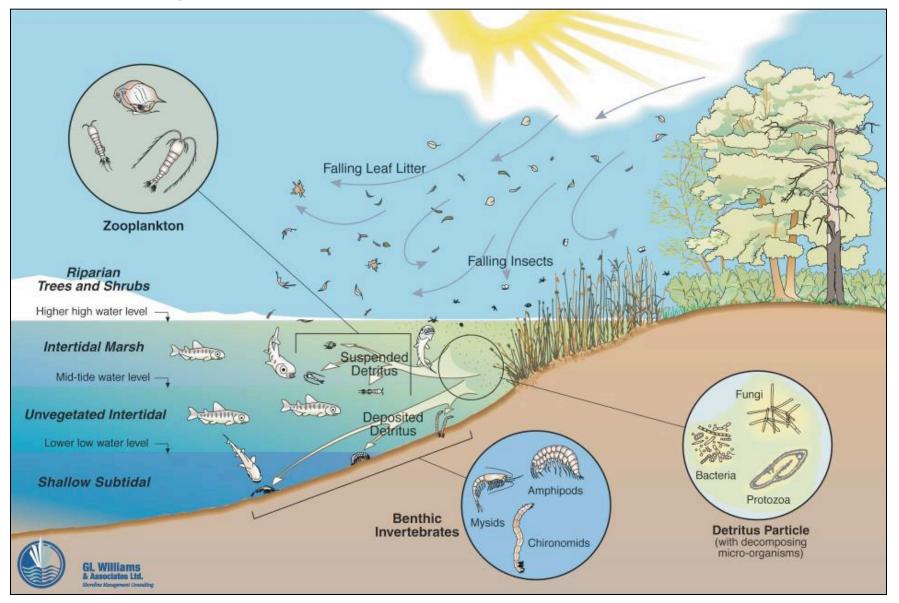
- Increased urban development leading to the degradation of natural habitats.
- 84-97% of the current Seattle shoreline is modified by retaining structures.
- Chinook Salmon threatened under the Endangered Species Act.
- Nearshore important to juvenile salmon as a rearing and migration corridor.





Natural Shoreline

In altered landscapes, goal is to restore or "enhance" back towards original conditions.



Seattle trying to woo salmon back downtown with park's seawall makeover

By Warren Cornwall Seattle Times staff reporter

"...spark public interest in ecological revitalization of the downtown waterfront, and to serve as a test case for future work on the rest of the seawall."

Habitat bench

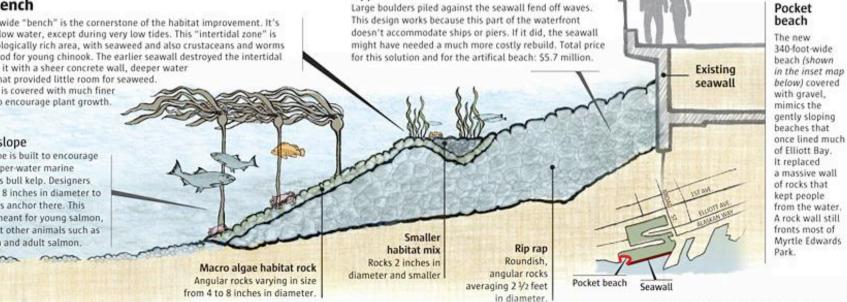
A 15-to-20-foot-wide "bench" is the cornerstone of the habitat improvement. It's covered in shallow water, except during very low tides. This "intertidal zone" is typically an ecologically rich area, with seaweed and also crustaceans and worms that serve as food for young chinook. The earlier seawall destroyed the intertidal zone, replacing it with a sheer concrete wall, deeper water and big rocks that provided little room for seaweed.

The new bench is covered with much finer gravel meant to encourage plant growth.

The lower slope

The lower slope is built to encourage growth of deeper-water marine plants, such as bull kelp. Designers used rock 4 to 8 inches in diameter to help the plants anchor there. This habitat isn't meant for young salmon, but can attract other animals such as crabs, rockfish and adult salmon.

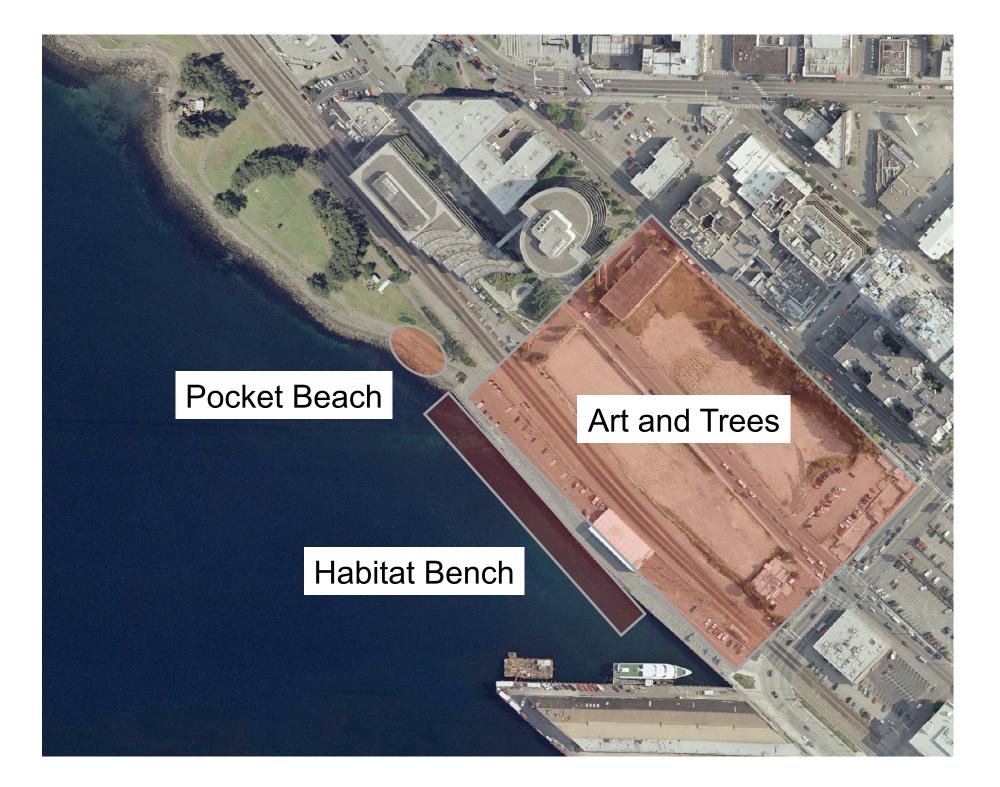


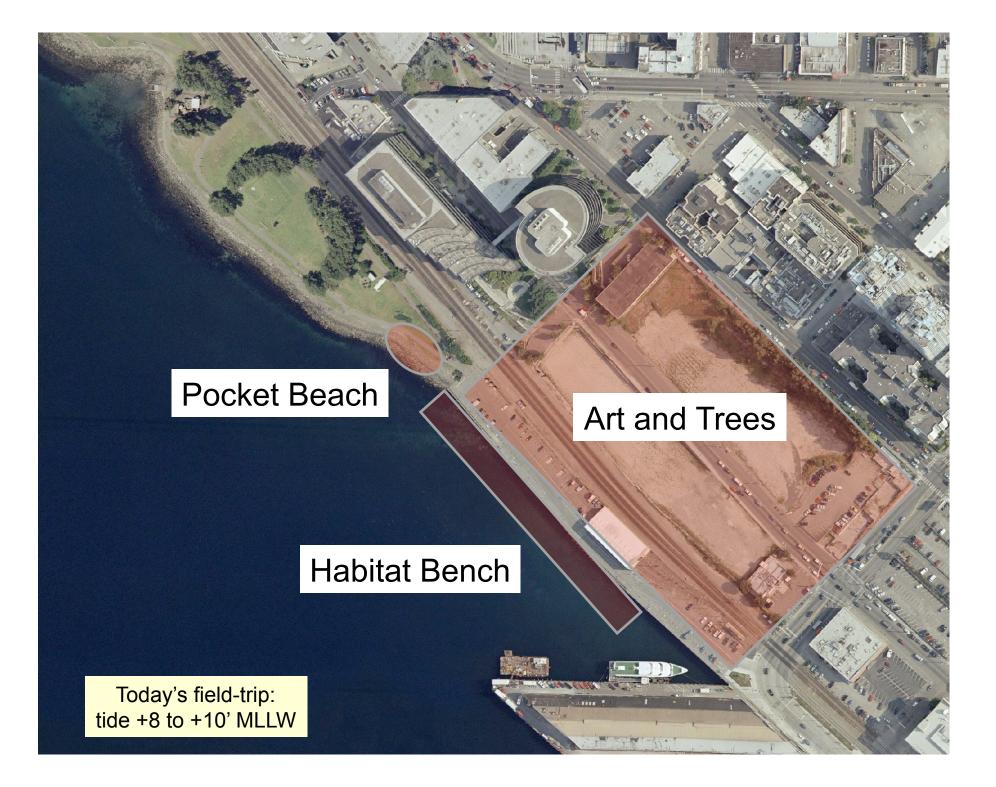


MICHELE LEE MEMULIEN / THE SEATTLE TIMES.

Source: Seattle Times research by Warren Cornwall, Seattle Art Museum

Olympic Sculpture Park 2005: Pre-Construction

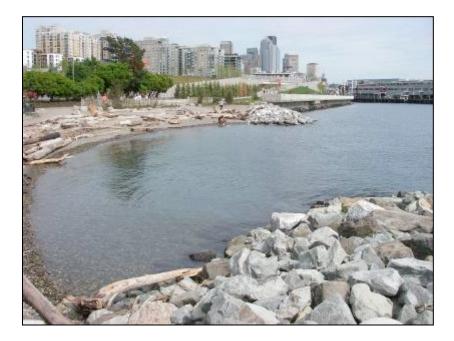




Olympic Sculpture Park

Removal of shoreline modifications and enhancement of intertidal zone, with linkages to riparian habitat.





Before – 2005

After - 2007

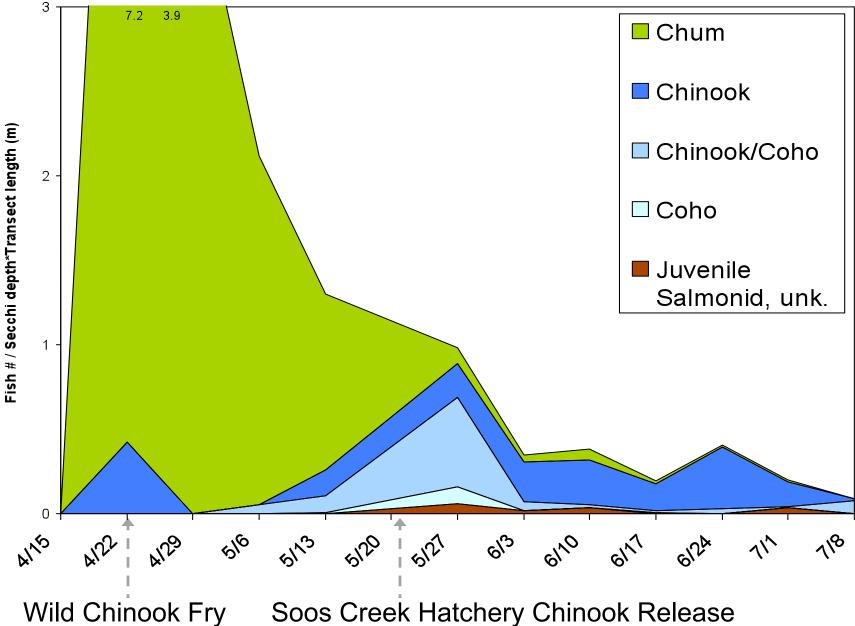
Pre and Post-Construction Monitoring:

- 1. Fish sampling with snorkel surveys.
- 2. Aquatic invertebrates.
- 3. Terrestrial insects.
- 4. Added in 2007: Vegetation, Fish netting, Beach.

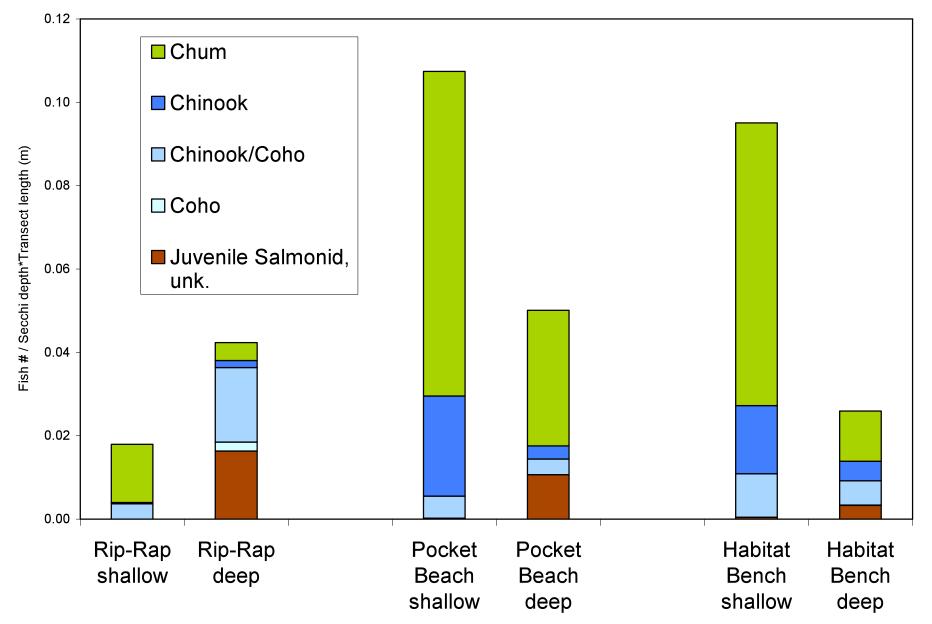
Toft, J., J. Cordell, S. Heerhartz, E. Armbrust, A. Ogston, and E. Flemer. 2008. Olympic Sculpture Park: Results from Year 1 Post-construction Monitoring of Shoreline Habitats. Technical Report SAFS-UW-0801.



Juvenile Salmon Densities: Time

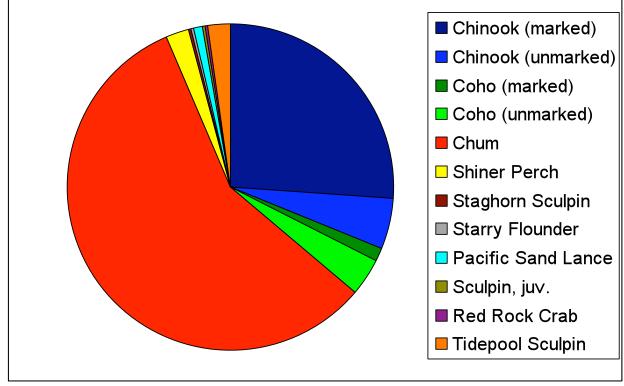


Juvenile Salmon 2007: More abundant in shallow water depths at Pocket Beach and Habitat Bench.



2007 net data:

2007 Olympic Sculpture Park: Fish % Composition at Pocket Beach (n = 5; average 53 juvenile salmon)







Note: In 2008 during juvenile pink salmon outmigration, 1,228 juvenile pinks netted on 4/25/08

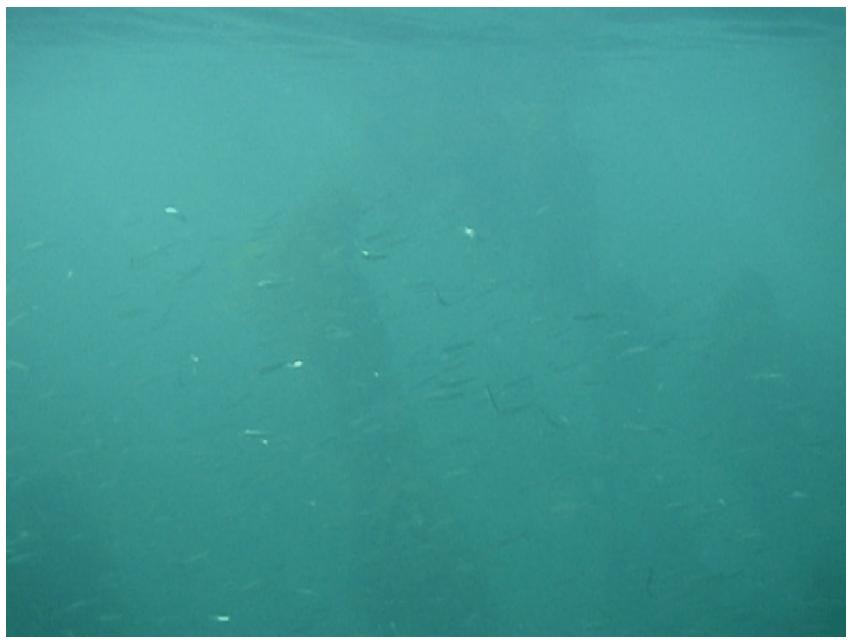
Juvenile Chinook, schooling and feeding



Juvenile Chum, schooling and feeding



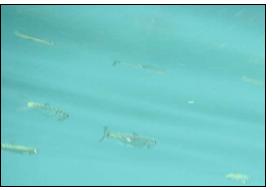
Herring, schooling and feeding



Sampling: More diversity, greater densities, available habitat?

Fish





Aquatic Invertebrates living on bottom substrates and algae









Invertebrates living within beach gravel





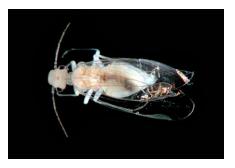


Sampling: Beach and vegetation development.

Terrestrial Insects







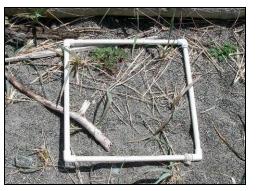
Aquatic Algae











The Future

- *Monitoring is important*! Potential benefits to juvenile salmonids not known until postmonitoring occurs; help guide future efforts.
- Is it making a difference? High costs for limited space along urban corridor; public areas put it in the spotlight; education opportunities – thousands of visitors at Olympic Sculpture Park.
- **Benefits of multiple sites?** Combined effects of individual sites create larger signature.

Making Seattle's waterfront more fish-friendly

1. HABITAT BENCH

fish habitat.

Rocks and gravel are placed to create habitat for young

Existing seawall

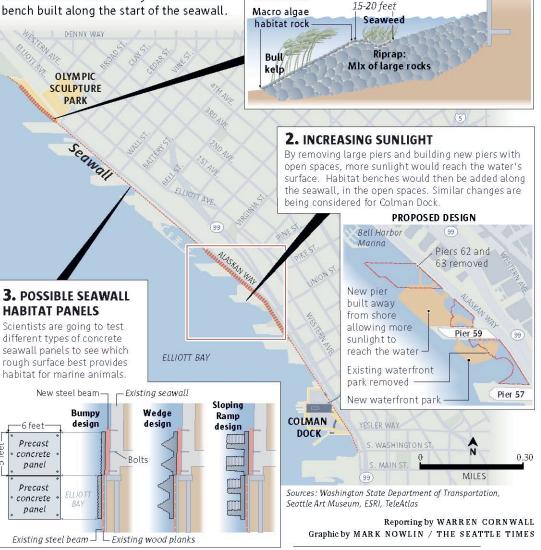
salmon and other marine life and plants, such as

crustaceans, worms and seaweed. An artificial

beach at the northern end also provides

The Seattle Art Museum's Olympic Sculpture Park is the first

of several projects that could give the city's waterfront an ecological makeover. The city and state are studying options for other parts of the waterfront. At the sculpture park, the first project is an artificial beach followed by a rock habitat bench built along the start of the seawall.



Seawall: Habitat Panels, Troughs

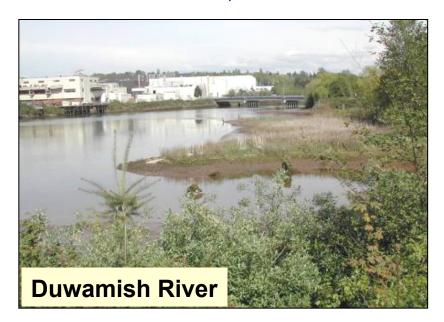








Connectivity Watershed-scale, balance of restoration sites across continuum.











<u>E-mail</u>: tofty@u.washington.edu <u>Technical Reports:</u> www.fish.washington.edu <u>Wetland Ecosystem Team</u>: Si Simenstad, Jeff Cordell, Lia Stamatiou, Beth Armbrust, Sarah Heerhartz, Maureen Goff, Kotaro Ono.

