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Shoreline Habitats and Restoration along Urbanized Sections of Central Puget Sound: Fish and Invertebrate Response

Jason Toft, Jeffery Cordell, Sarah Heerhartz, Beth Armbrust, Charles Simenstad

Wetland Ecosystem Team
UW School of Aquatic and Fishery Sciences
Seattle, WA

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Outline

- Background: Fish response to shoreline habitats (2003) – beaches, riprap, edge of pier

- Monitoring of armoring removals:
  (**1**) Olympic Sculpture Park (2005 – current)
  (**2**) Seahurst Park (2004 – current)

- Conclusions and Future Research

Juvenile Chinook, schooling and feeding

Puget Sound Shoreline Habitats

PSP Action Agenda

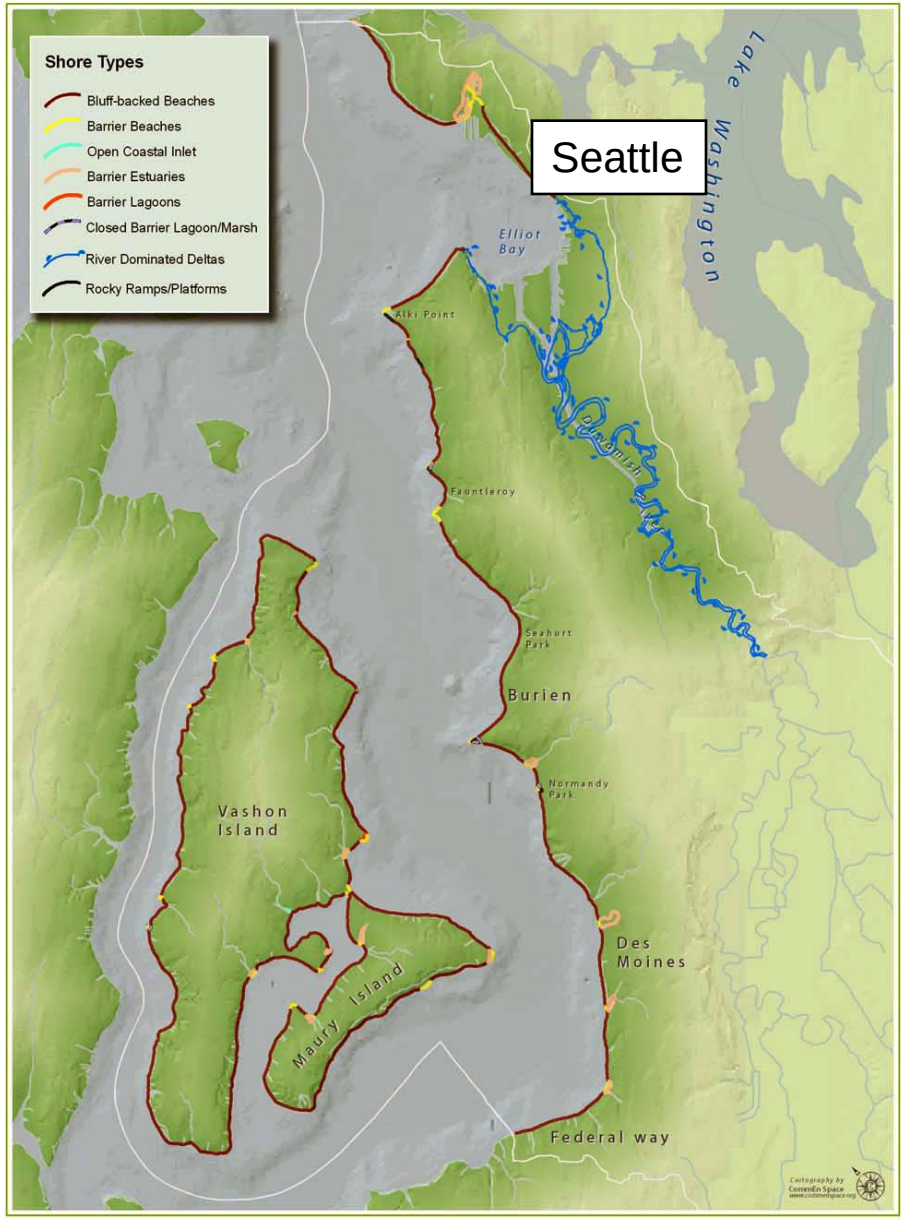
- Threat: Habitat Alteration
- Priority: Restoration

Science and Management

Important link relating knowledge of juvenile salmon in the nearshore to policy decisions on habitat use and restoration goals.

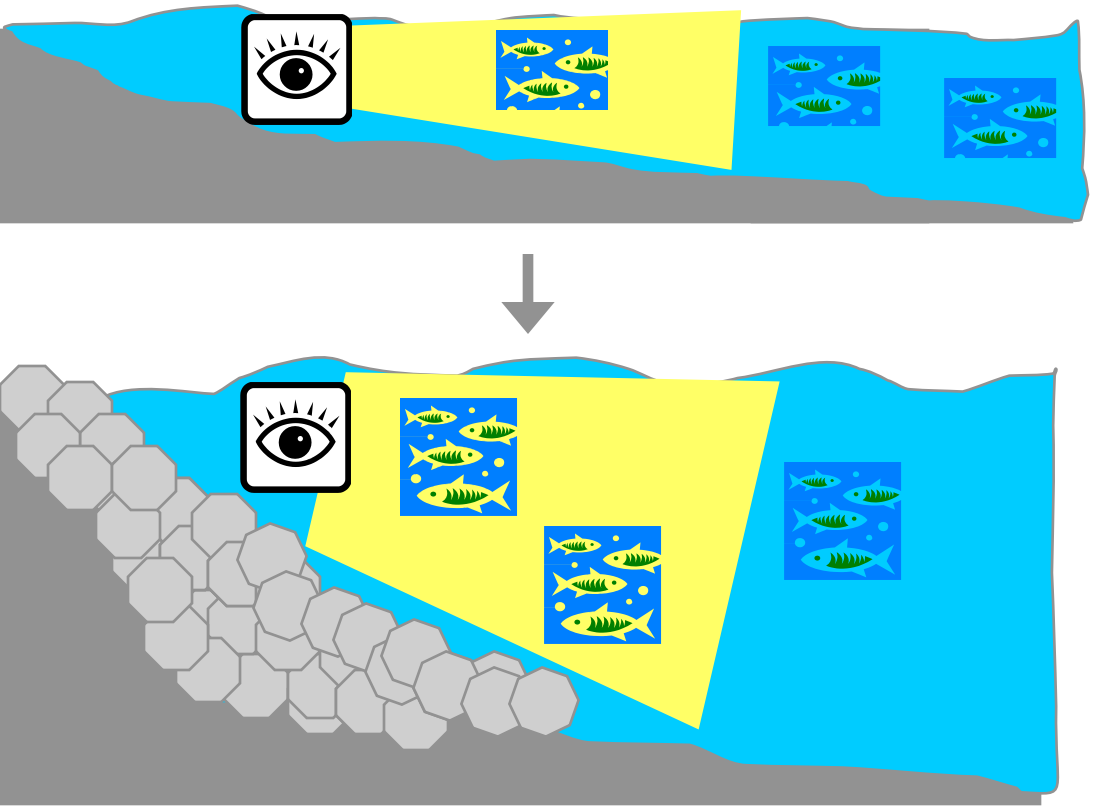
2003 data

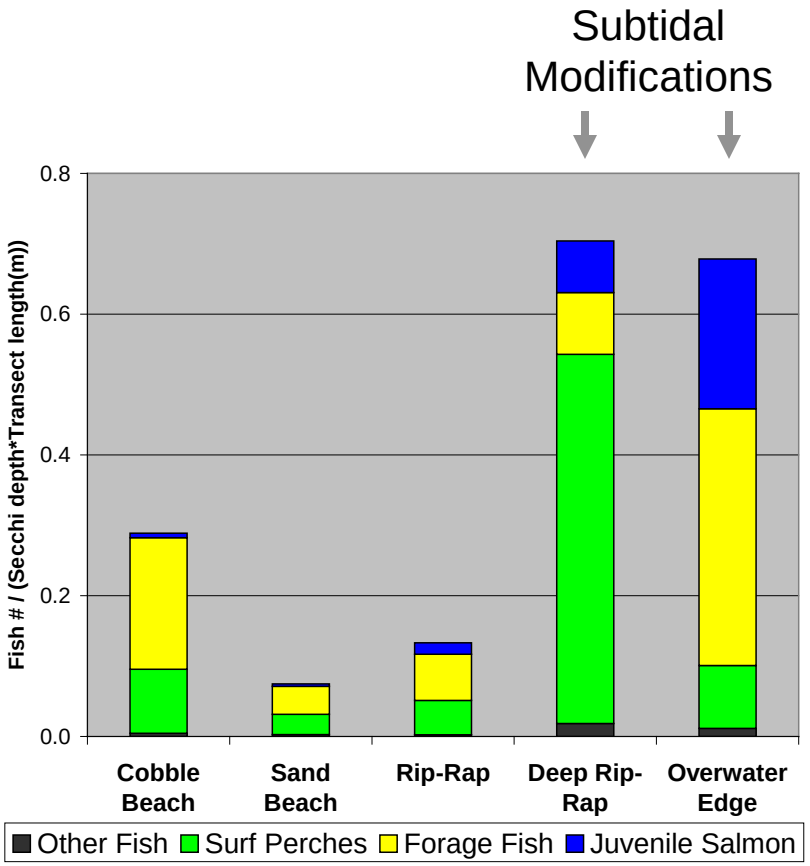
Compare fish use directly along shore.



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.

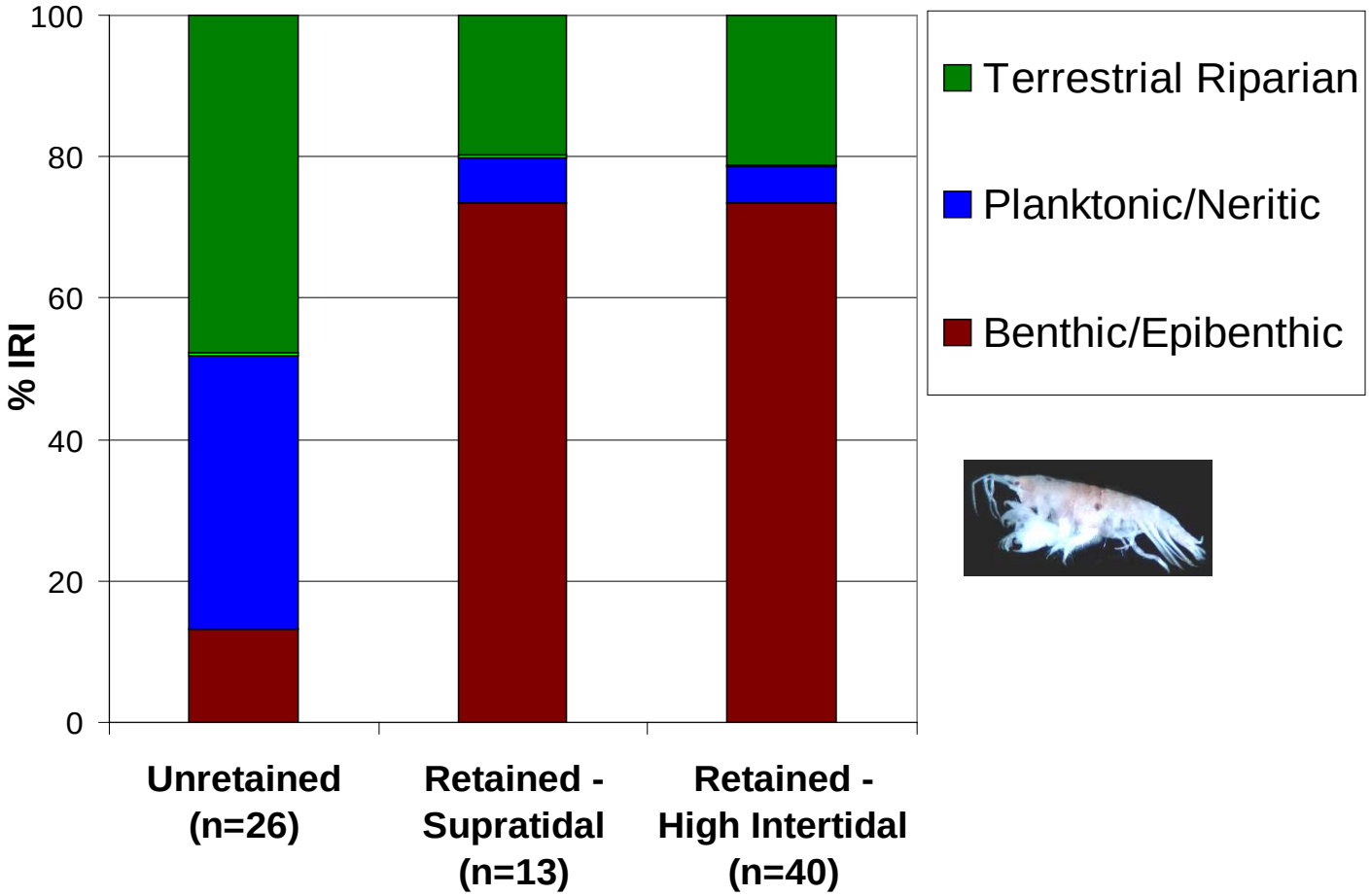




Toft et al. 2007. Fish distribution, abundance, and behavior along city shoreline types in Puget Sound. *North American Journal of Fisheries Management* 27:465-480.

Diet Analysis:

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



Restored Sites: Shoreline armoring removal

- Pre- and post-monitoring gives valuable information on status of site development.
- Data can be useful for development of future design features.
- Not always possible to "restore" to original habitat, but can enhance or improve.
- Natural reference habitats are rare, compare through time and to adjacent habitats.

Map source: King County

Olympic Sculpture Park
2005: Pre-Construction

Pocket Beach
Art and Trees
Habitat Bench

Case Study 1: Olympic Sculpture Park

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

Before – 2005

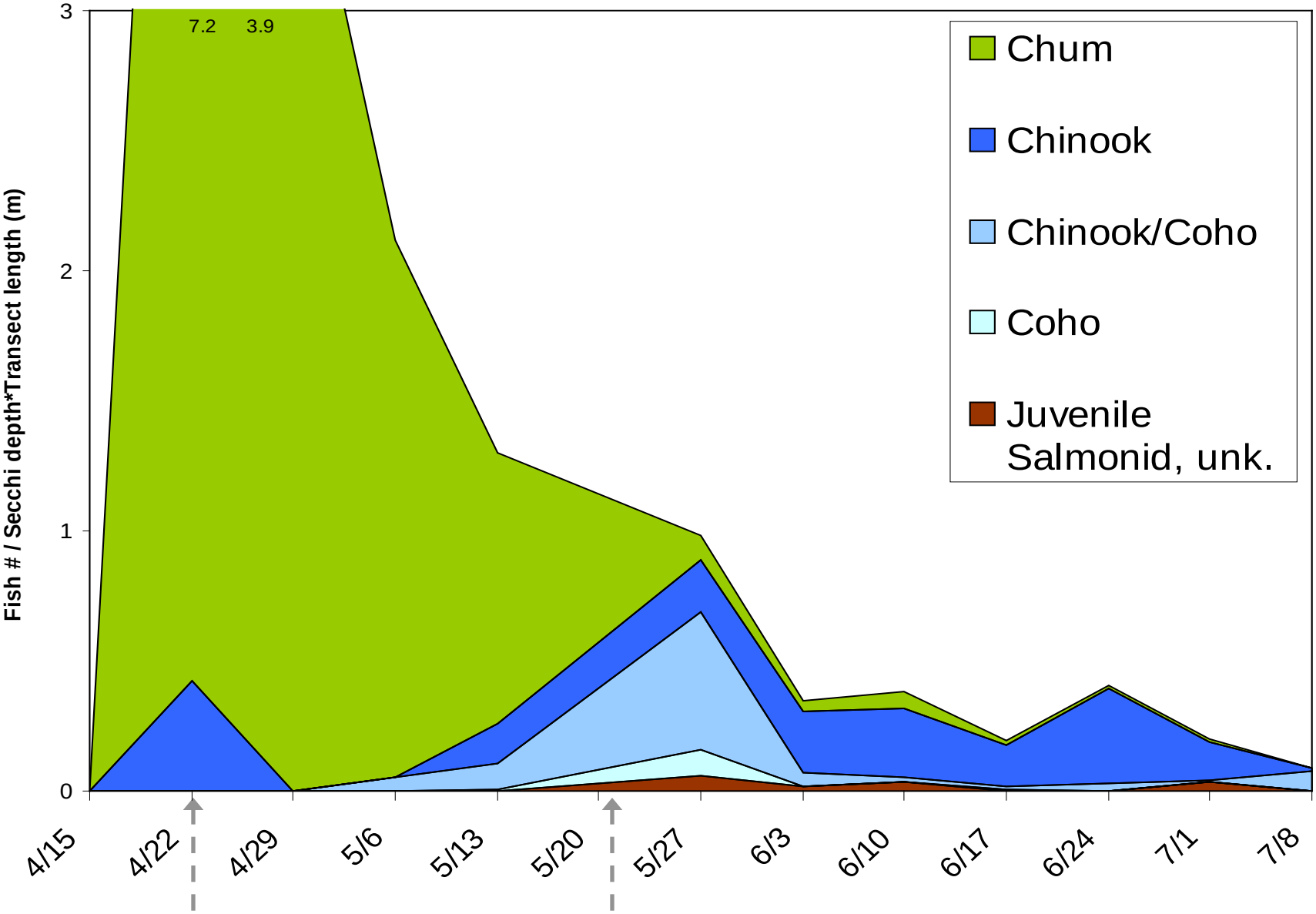
After – 2007

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 profile.

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.

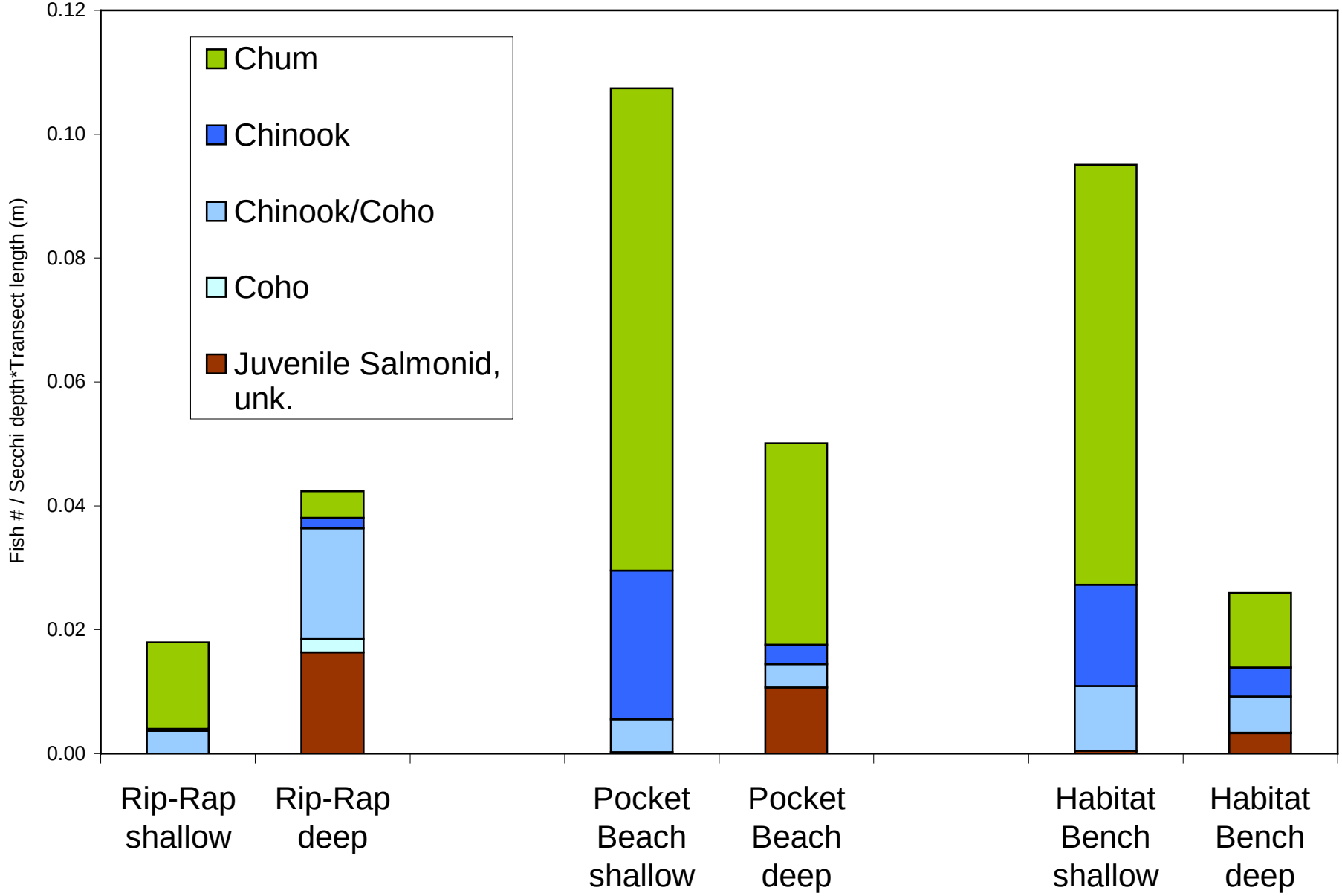
Juvenile Salmon Densities: Time



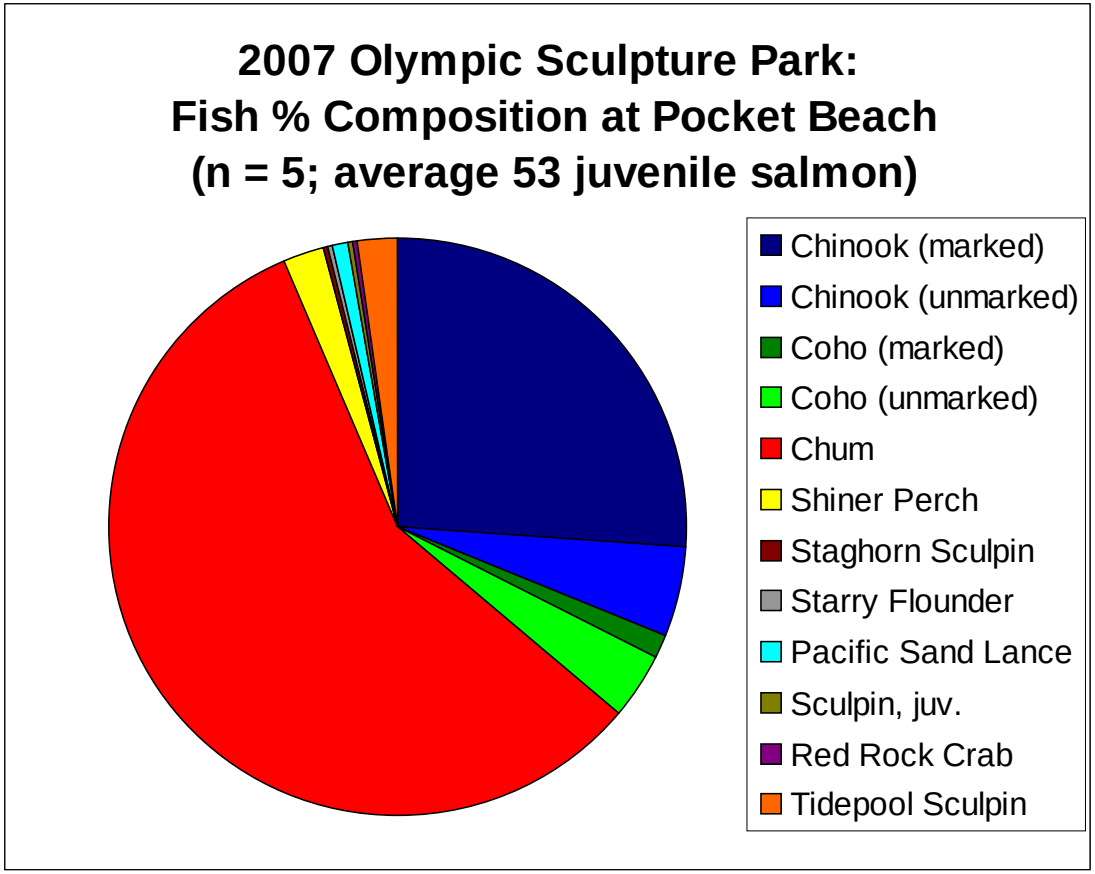
Wild Chinook Fry

Soos Creek Hatchery Chinook Release

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



2007 net data:

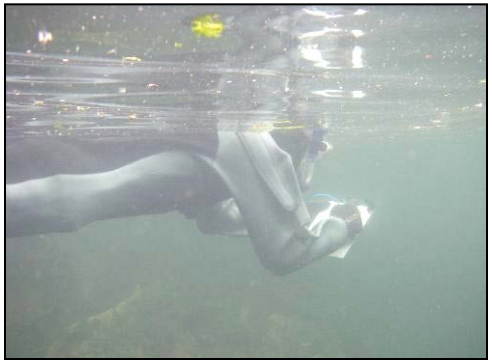


2008 (see Sarah Heerhartz's poster):

- 1,228 juvenile pink salmon netted on April 25th.
- High abundance of post-larval forage fish ~3 cm length.
- Juvenile salmon densities similar to most other sites in Elliott Bay, except for higher densities at Seacrest – still room for development?

Sampling: More diversity, greater densities, available habitat?

Fish



Aquatic Invertebrates living on bottom substrates and algae

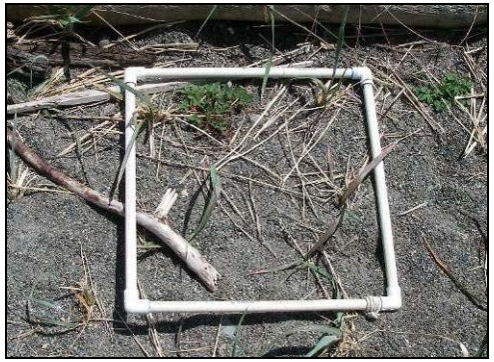
Invertebrates living within beach gravel

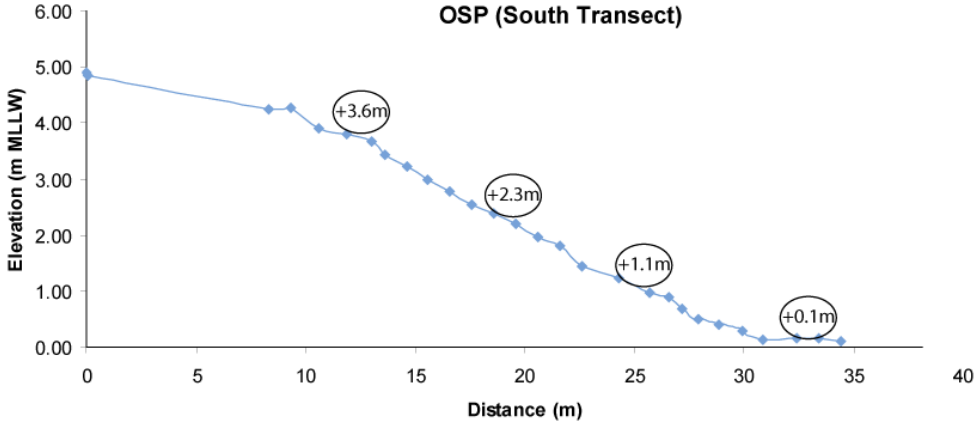
Sampling: Beach and vegetation development.

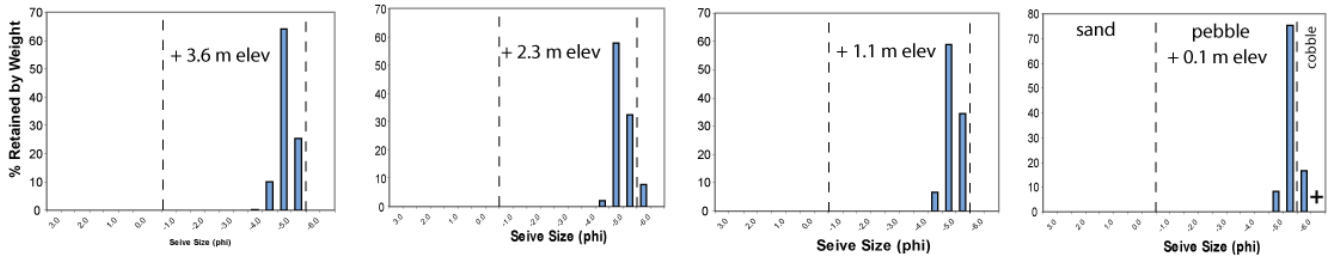
Terrestrial Insects

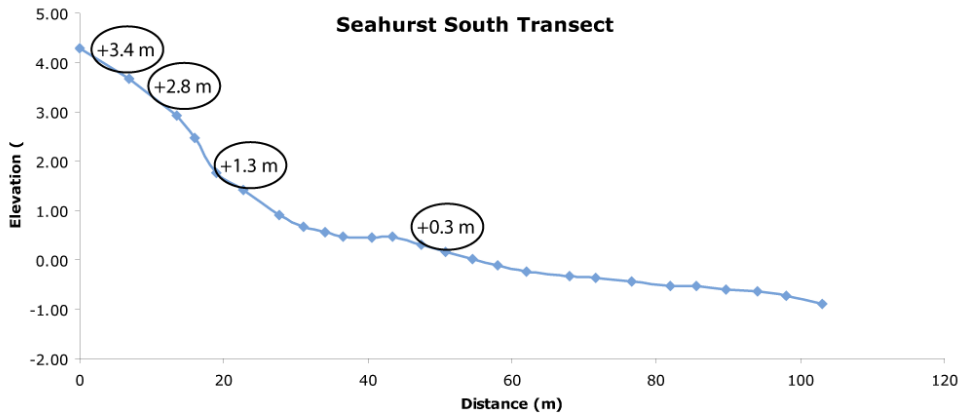
Aquatic Algae

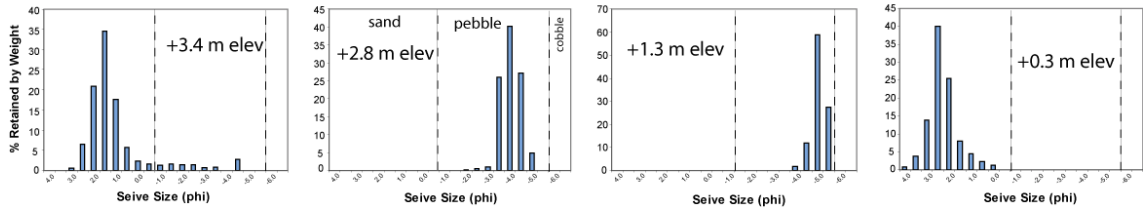
Vegetation, Beach structure




OSP (South Transect)
Elevation (m MLLW)
Distance (m)
+3.6m
+2.3m
+1.1m
+0.1m


% Retained by Weight
+ 3.6 m elev
+ 2.3 m elev
+ 1.1 m elev
sand
pebble
+ 0.1 m elev
cobble
Seive Size (phi)


Seahurst South Transect
Elevation (
Distance (m)
+3.4 m
+2.8 m
+1.3 m
+0.3 m


% Retained by Weight
+3.4 m elev
sand
pebble
+2.8 m elev
cobble
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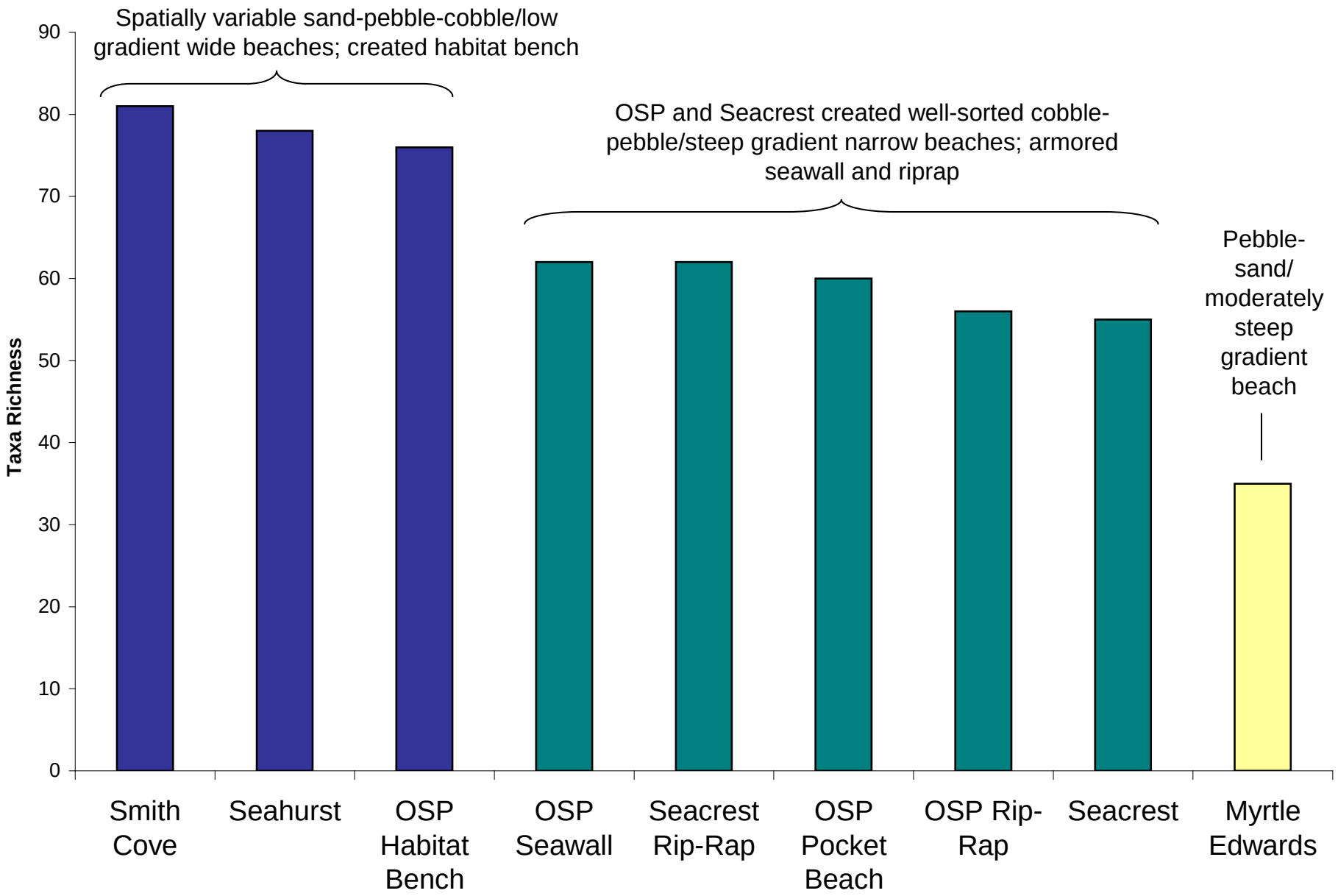
+0.3 m elev
Seive Size (phi)

Taxa Richness of Epibenthic Invertebrates related to physical characteristics



Case Study 2: Seahurst Park

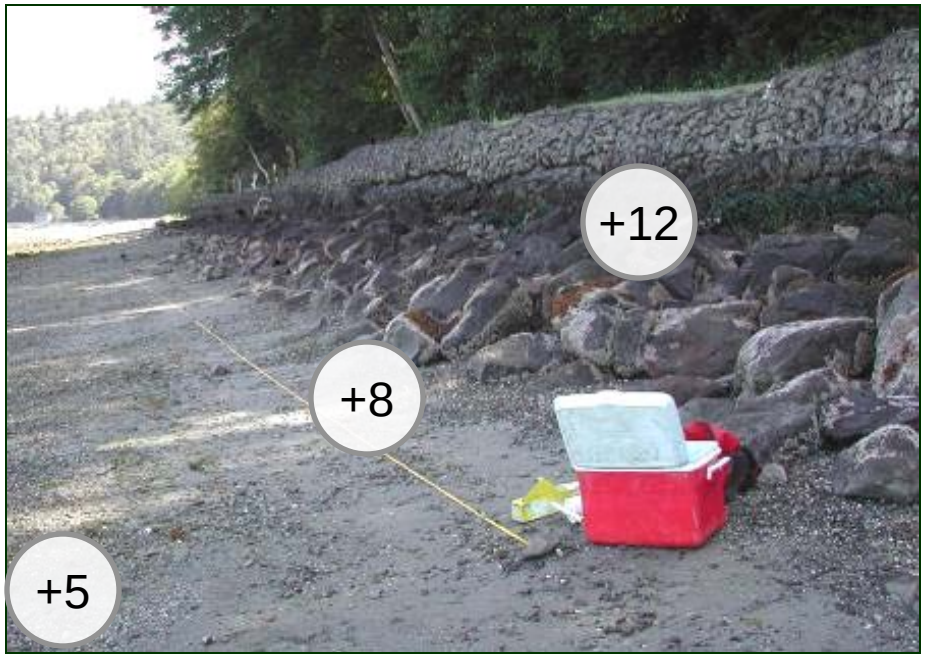
Sobocinski's Thesis: Conclusions

- Benthic invertebrates are removed by shoreline modifications (Paired Benthos)
- Sites with intact vegetation show more taxa-rich insect communities (Paired Insects, Synoptic)
- Talitrids may be a good predictor, may respond to sediment and organic detritus changes (Paired Benthos and Insects)
- Shoreline modifications that encroach on the intertidal (below MHHW) *may* have a greater impact on the invertebrate assemblage than those installed higher than MHHW

Sampling

Three different tidal elevations:

+12' MLLW: Wrack line.
+8: Base of modifications.
+5: Low elevation of beach regrade.



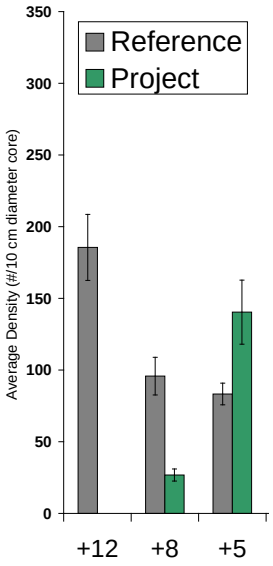
Before – 2004

Three different years:
2004: Pre-restoration
2006: Year 1 Post-removal
2008: Year 3 Post-removal (still analyzing, report due soon)

Toft, J.D. 2007. Benthic macroinvertebrate monitoring at Seahurst Park 2006, post-construction of seawall removal. Technical Report SAFS-UW-0702, prepared for City of Burien. 40 pp.

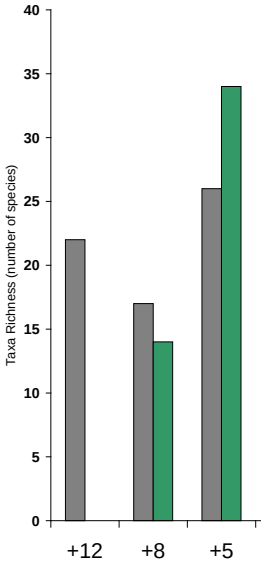
Benthic Macroinvertebrates at Tidal Elevations and Years

Densities:



2004 **2006** **2008**

Taxa Richness:



Benthic Macroinvertebrates at Tidal Elevations and Years

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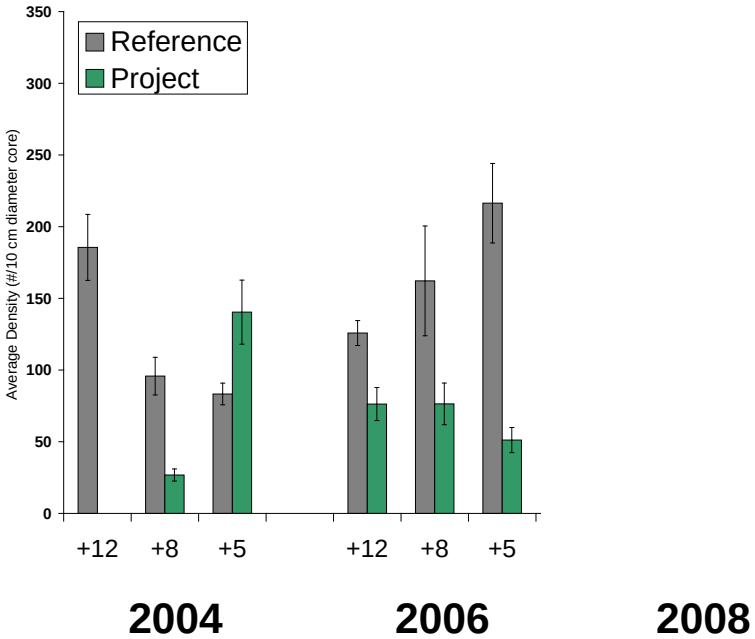
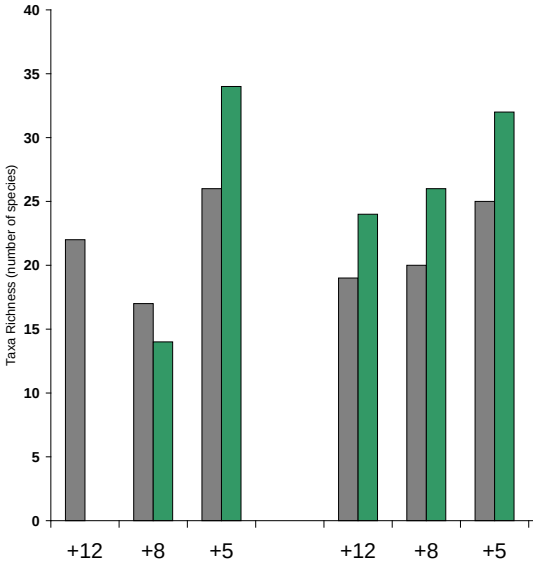
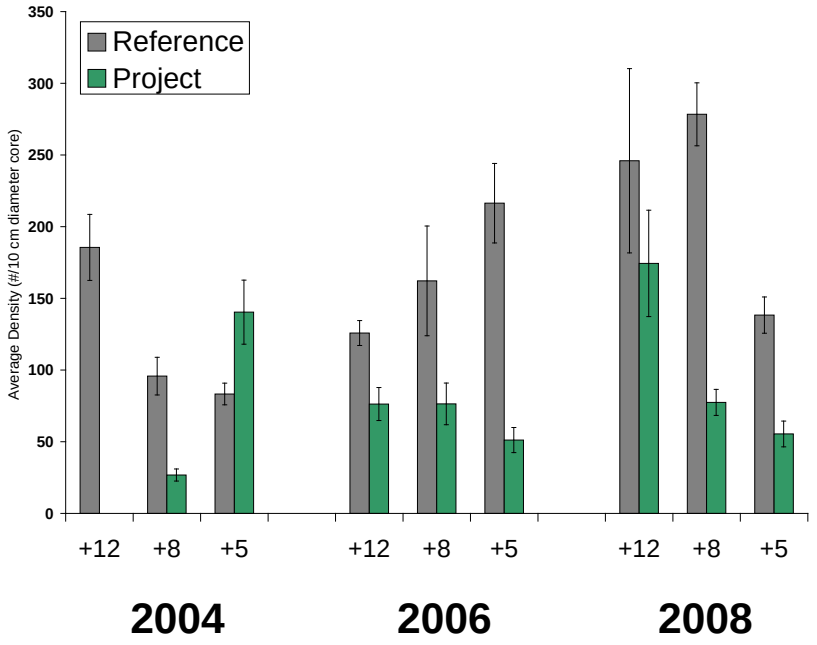


Taxa Richness:

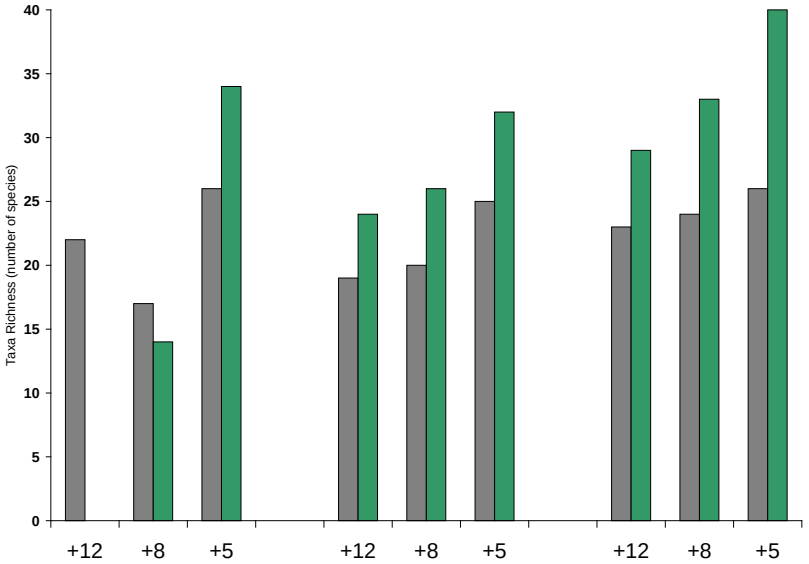


Benthic Macroinvertebrates at Tidal Elevations and Years

<u>Densities</u>: Greater at Reference site, but improvement post-restoration at Project site where modifications were removed (+12 and +8).

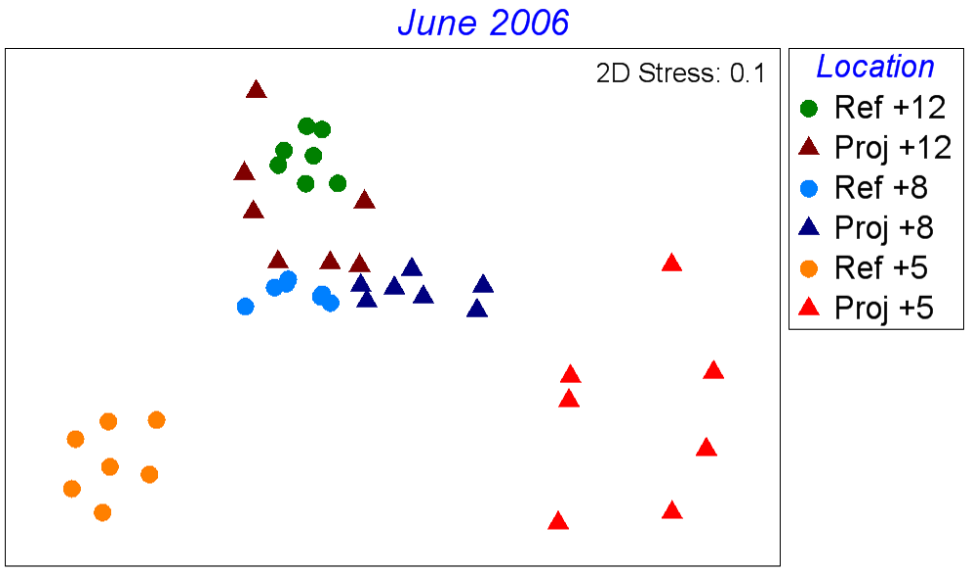


<u>Taxa Richness</u>: Greater at Project site, again improvement post-restoration at elevations where modifications were removed.

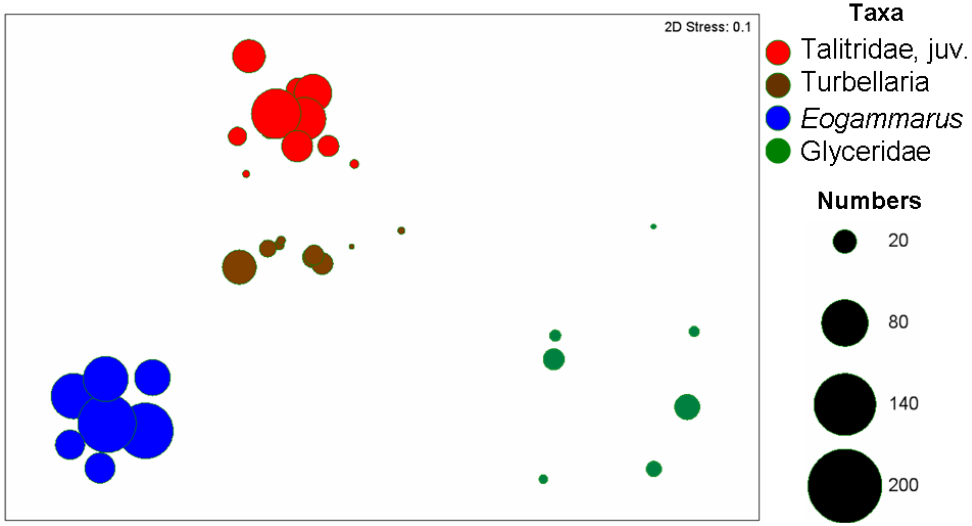


Benthic Macroinvertebrates at Different Tidal Elevations

Multivariate Analysis: Ordination shows invertebrate assemblages distinct from each other, especially at +5 elevation (ANOSIM $p < 0.003$; $R > 0.6$).



Taxa Differences: Response of early restoration stage, or physical characteristics? (sediment size, freshwater input)



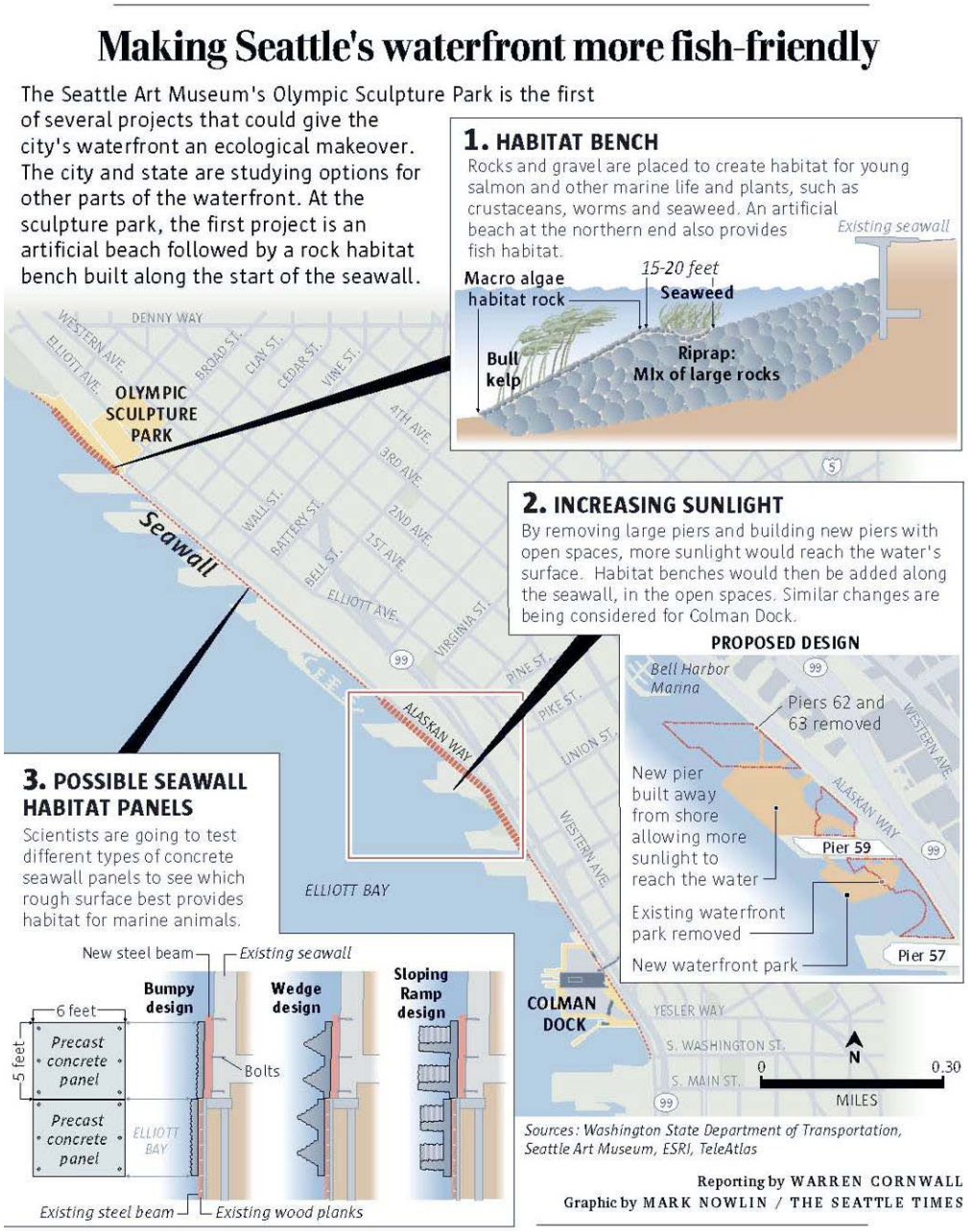
Conclusions

- Not always possible to “restore” to original habitat, but can enhance or improve.

- Data can be utilized to help guide shoreline armoring removal and restoration of beach processes.

- Data strengths: Optimized when there’s a focused experimental design, precise data.

- 10 years from now, what information are you going to wish you had collected?



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