Nearshore Restoration and Beach Monitoring in Puget Sound

Jason Toft
Senior Research Scientist
UW School of Aquatic and Fishery Sciences

Illustration by Chad Lewis

Fish Below Your Feet and Other Solutions for a Living Harbor

In Seattle, Singapore, and other waterfront cities around the world, engineers are creating life-enhancing designs to encourage marine biodiversity.

ERODING COASTS NEED PROTECTION — AND NEW SOLUTIONS ARE AT HAND

Seawalls and other common strategies to control erosion don't always protect the land. Another possibility? Living shorelines.

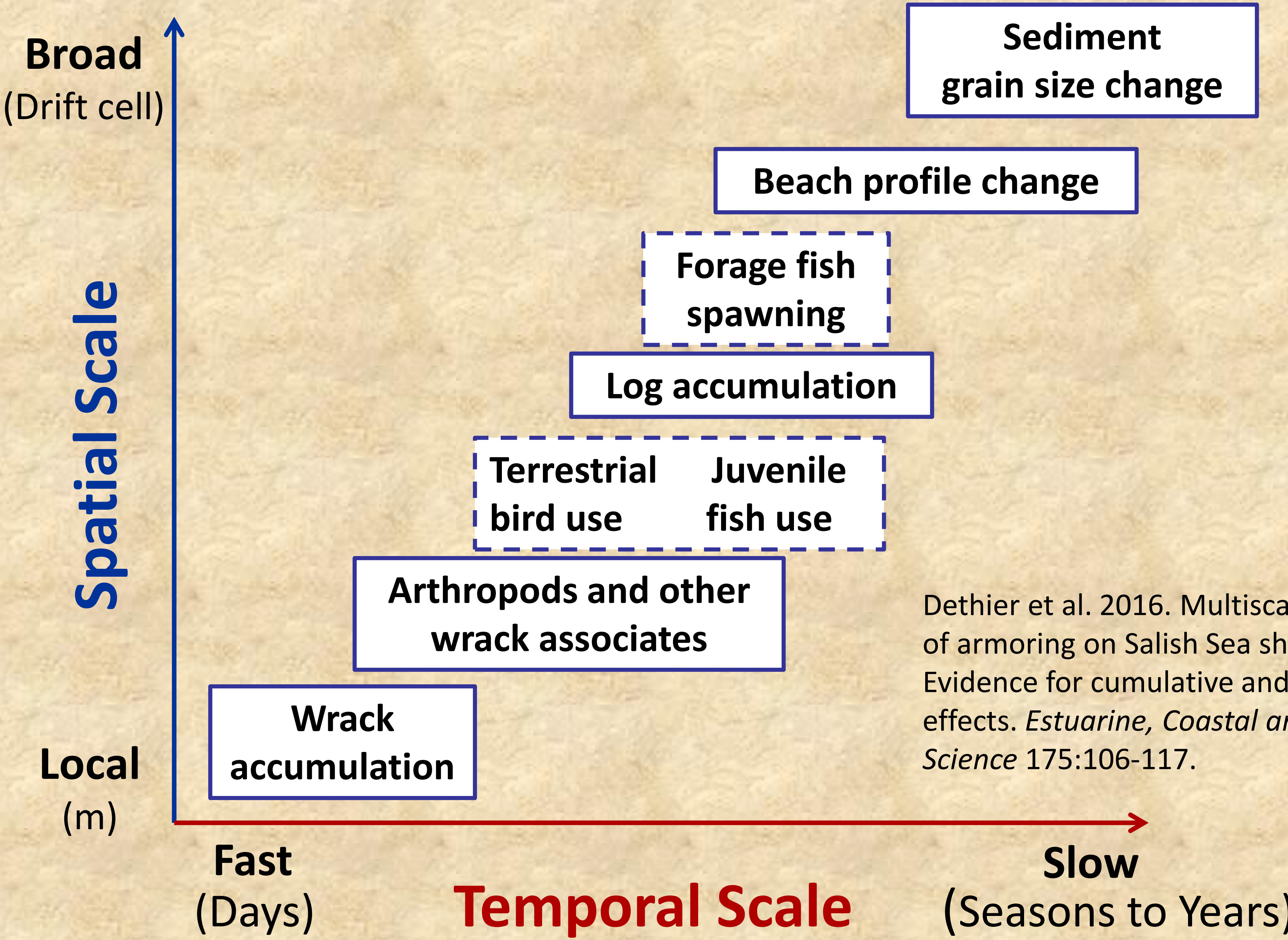
Photo courtesy of Kathleen Pozarycki

WRITER
Maria Dolan

March 5, 2018 — On a blustery January day at Seahurst Park, a tree-fringed shoreline in the town of Burien just south of Seattle, Jason Toft searches for a promising beach log among the many specimens at hand. Beachgoers sit or climb on top of these washed-up pieces of wood, but Toft, a research scientist at the University of Washington School of Aquatic and Fishery Sciences, is more interested in their undersides.

He squats in the sand, rolls back a fire-log-size chunk of driftwood with gloved

Armoring Impacts

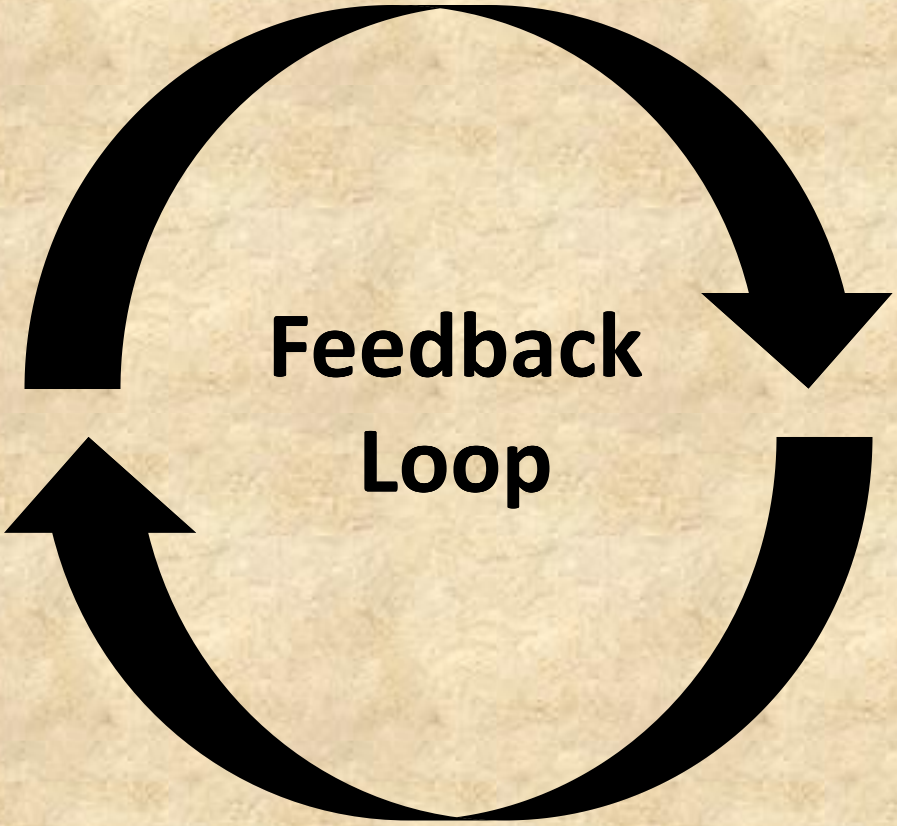


Dethier et al. 2016. Multiscale impacts of armoring on Salish Sea shorelines: Evidence for cumulative and threshold effects. *Estuarine, Coastal and Shelf Science* 175:106-117.

SEAHURST PARK (2005 restoration)

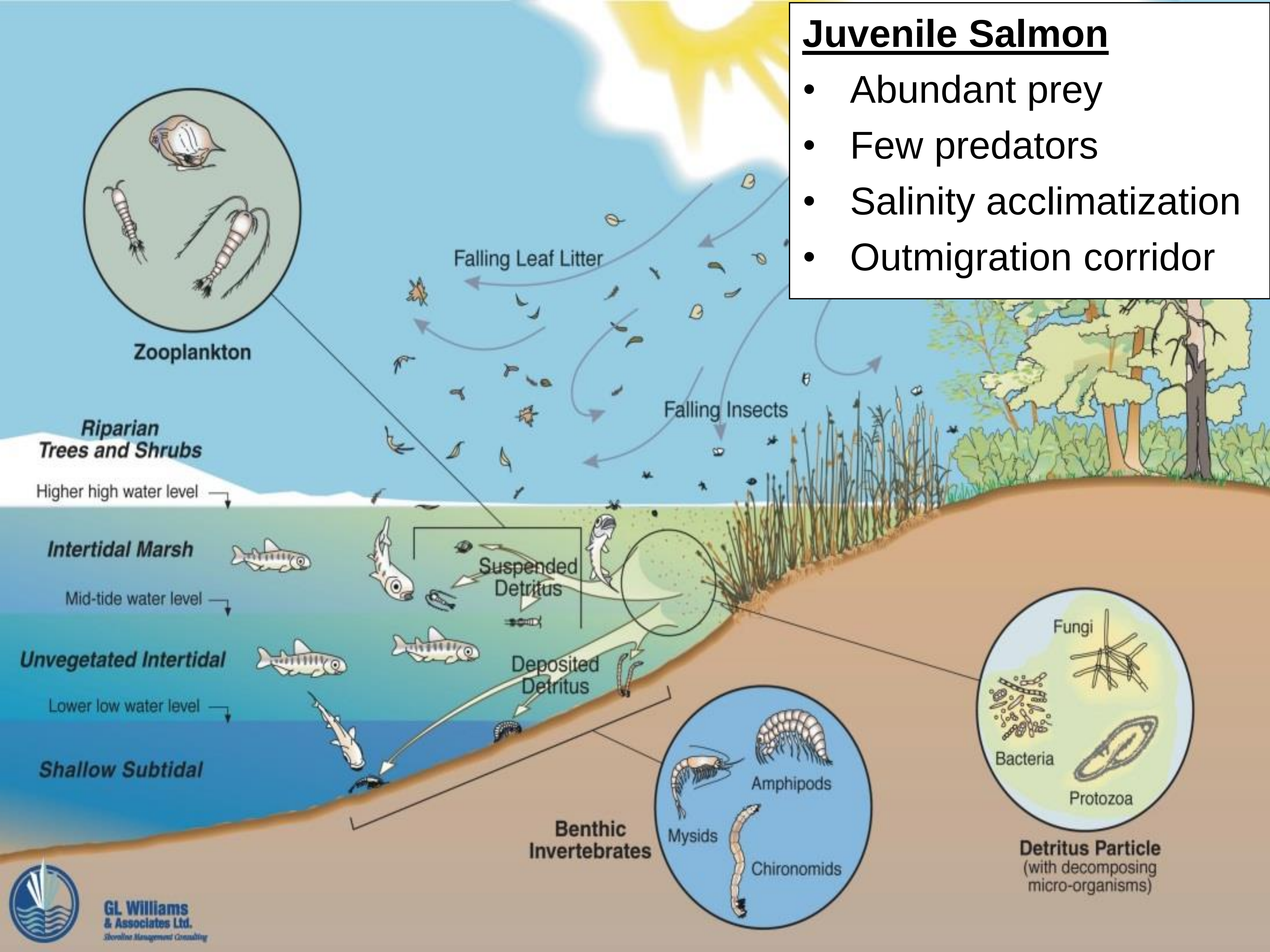
The Role of Science in Restoration

- Prior to restoration – *Inform goals*
- During project design – *Incorporation of data*
- Monitoring restoration – *What works, what doesn't*



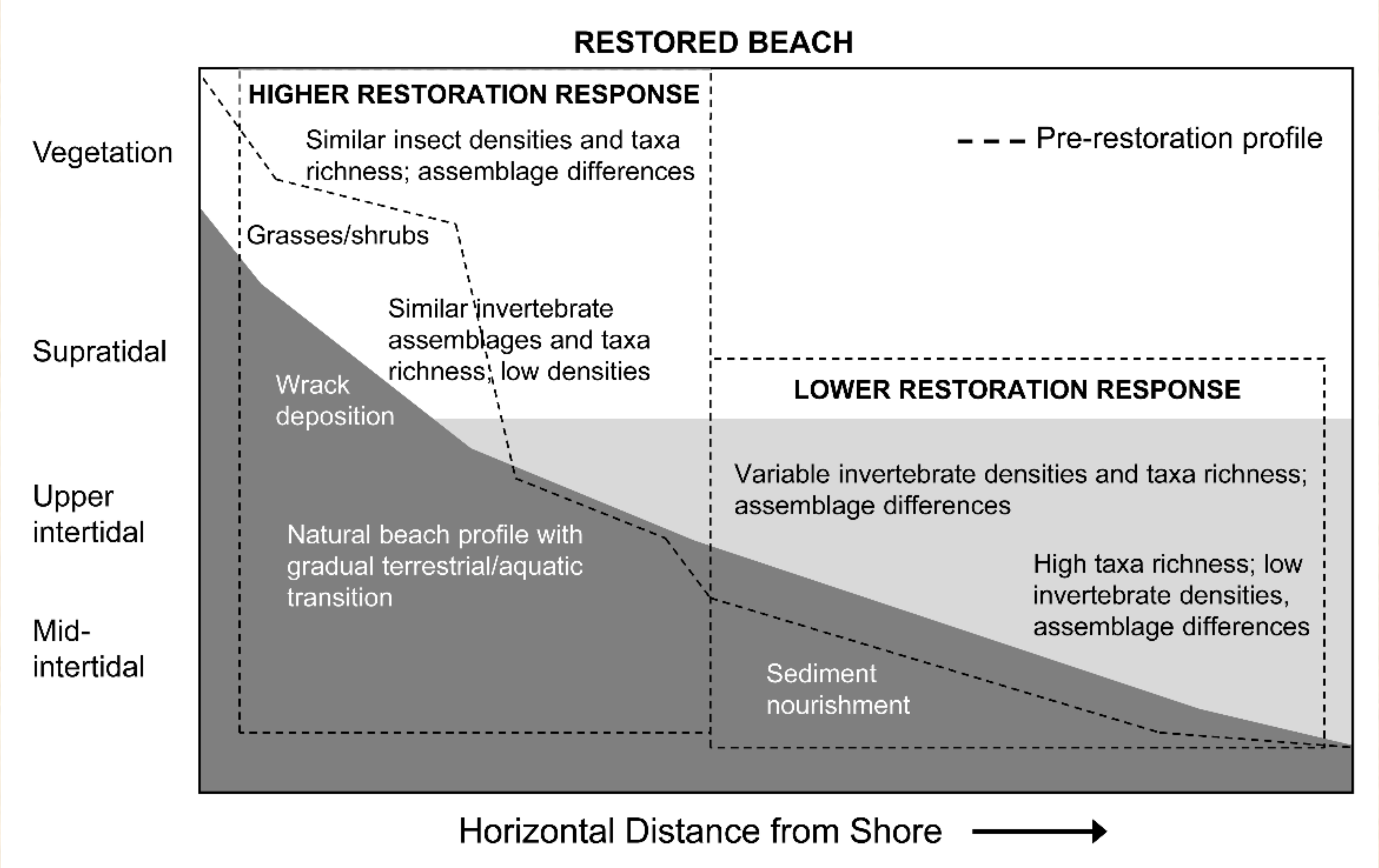
Juvenile Salmon

- Abundant prey
- Few predators
- Salinity acclimatization
- Outmigration corridor



Seahurst Park

Higher response dependent on elevation of armoring placement and restoration actions



Toft et al. 2014. Shoreline armoring impacts and beach restoration effectiveness vary with elevation. *Northwest Science* 88:367-375.

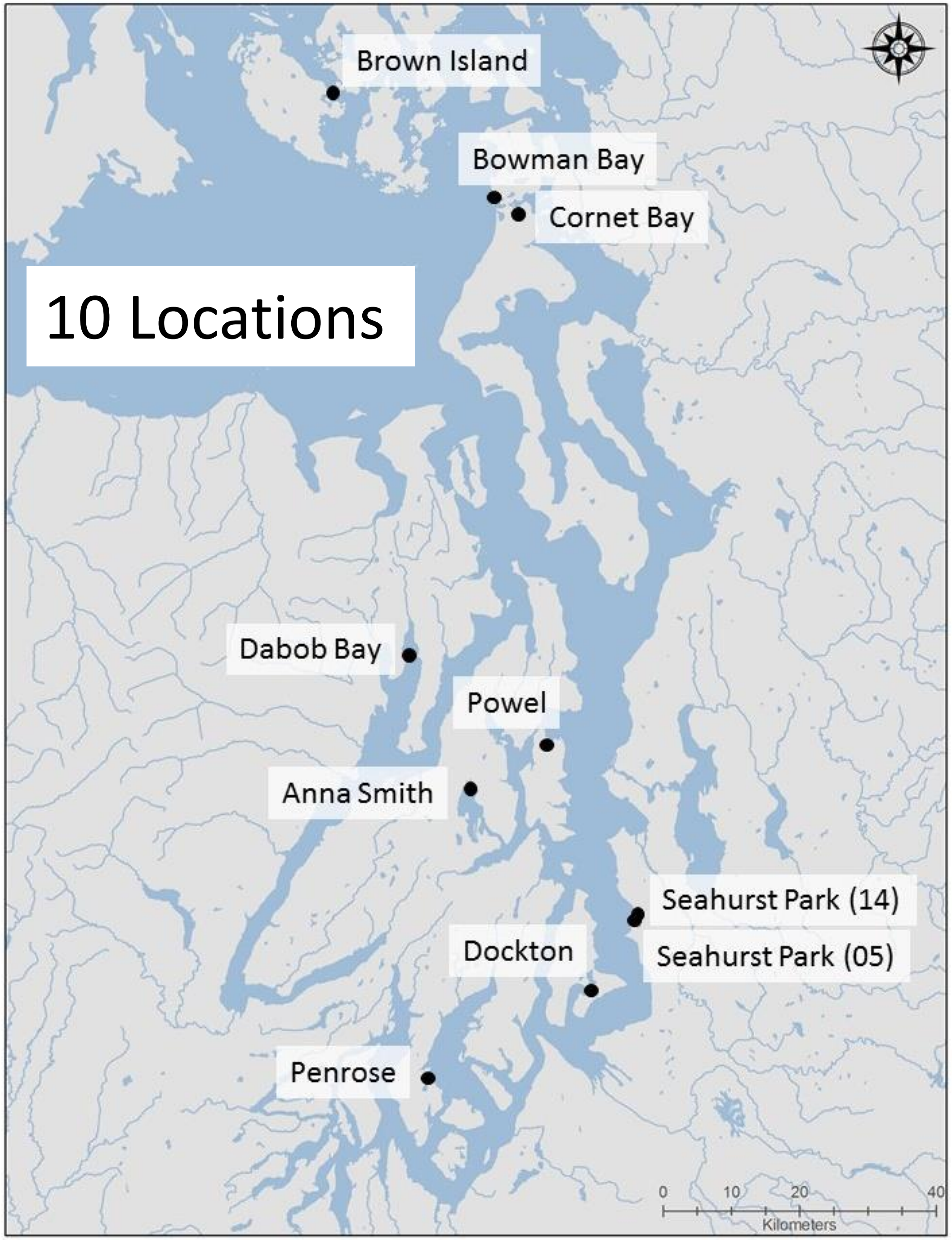
2016 Field Season

3 Strata

Restored

Armored

Reference



Summary of Statistical Tests: Darker Blue Colors are Greater

Metric	Armored	Restored	Reference
Wrack Total %			
Wrack Terrestrial %			
Wrack Algae %			
Wrack % Composition (new)			
Wrack % Composition (old)			
Wrack Depth			
Log Number			
Log-line Width			
Log % Plant Growth			
Wrack Worms			
Wrack Amphipods			
Wrack Diversity			
Wrack Invertebrate Assemblage			
Insect Total			
Insect Diversity			
Insect Assemblage			
Relative Encroachment to MHHW			
Overhanging Vegetation %			

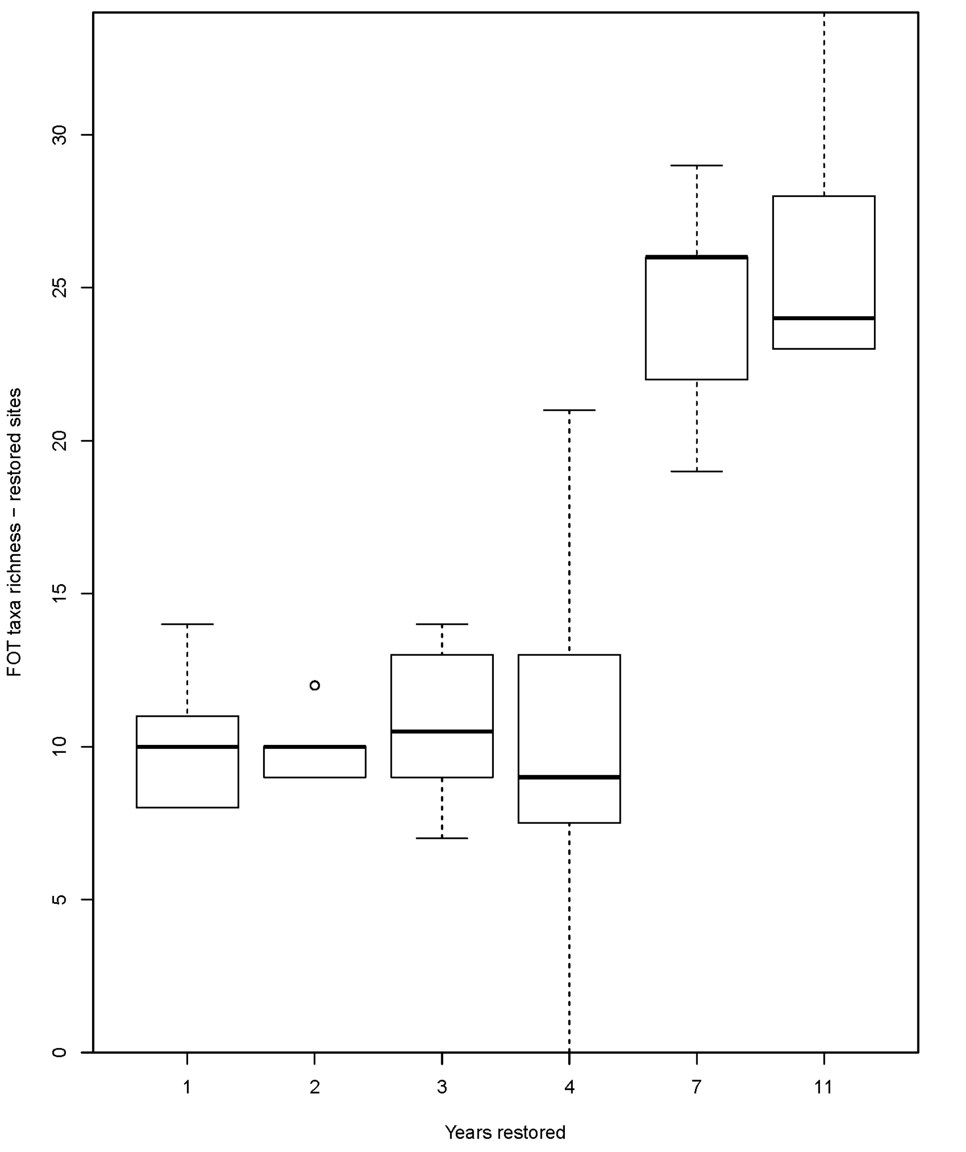
Not Significant: Wrack Eelgrass %, Wrack width, Wrack Taxa Richness, Insect Taxa Richness, Sediment Sand %, Beach Width (m), Beach Slope, Wrack Relative Encroachment to MHHW, Fallen Tree #

Restoration Trajectories

Two metrics increased with age of restoration:
1. Insect taxa richness
2. Logs with plant growth

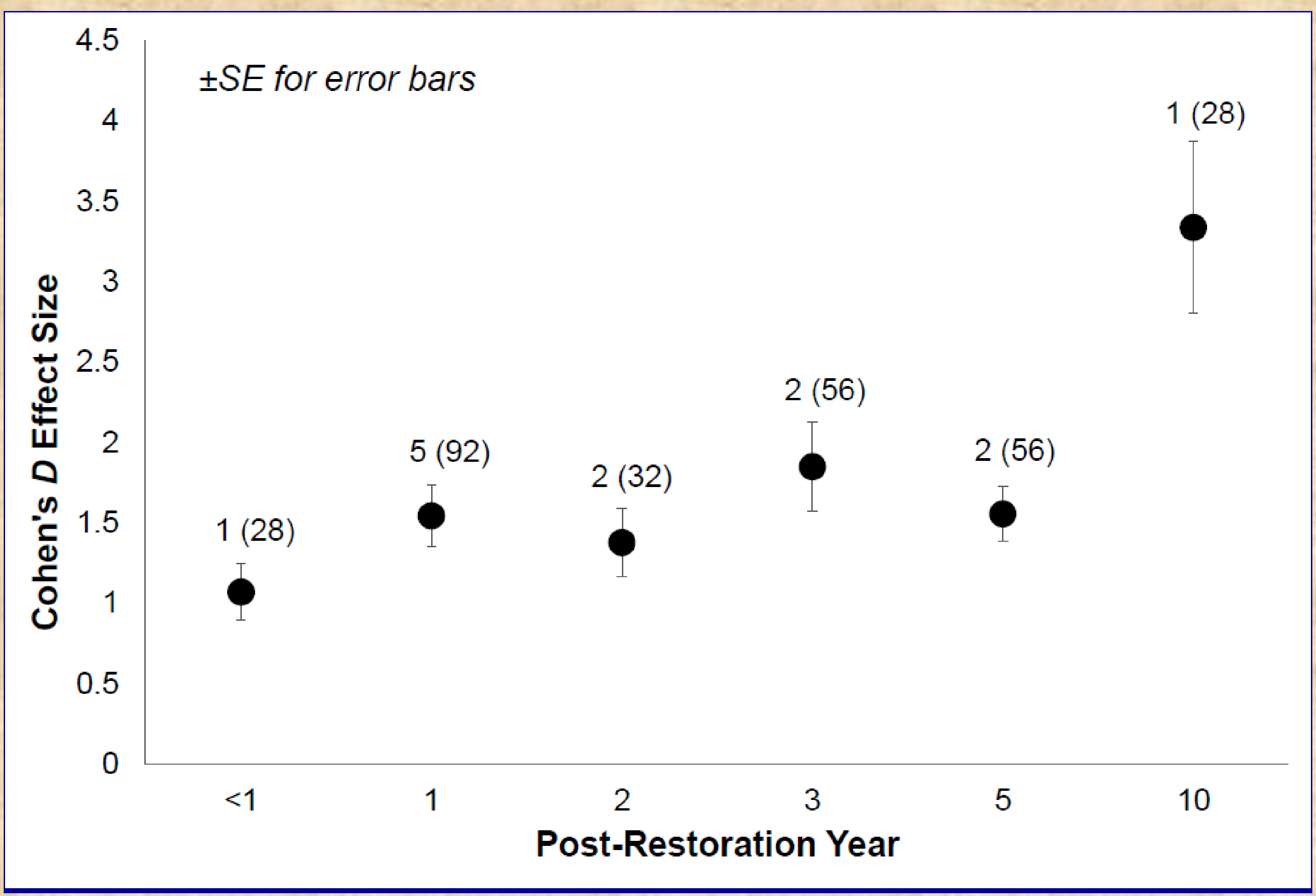
Both of these terrestrial associated metrics increased when beaches were restored greater than four years

* First discovery of surf smelt eggs at Bowman 5 years after restoration, at Cornet 2 years after restoration (NW Straits)



Restoration Trajectories

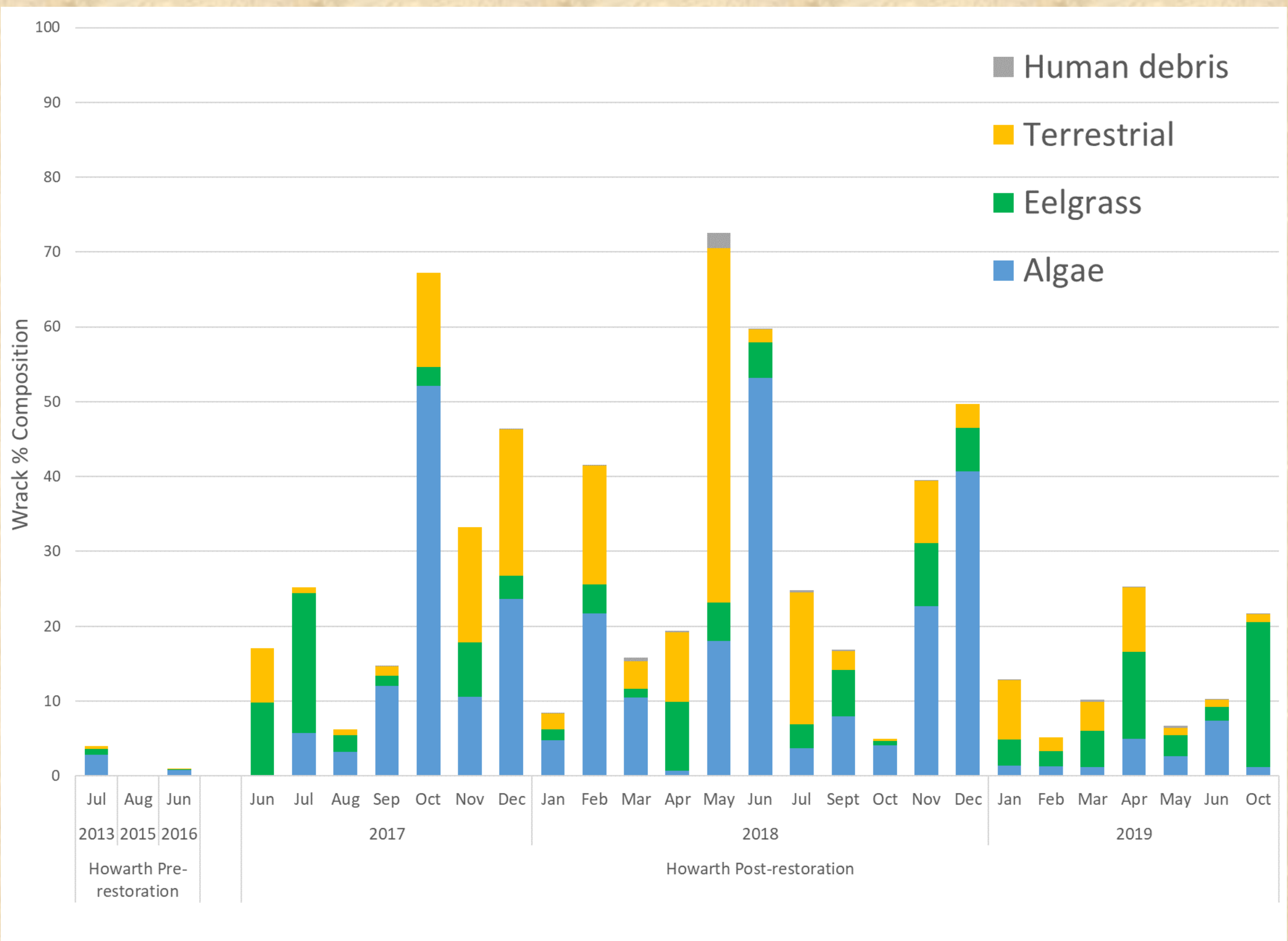
Similar response with meta-analysis of pre-post restoration data of 5 biotic measures at 6 sites in Puget Sound



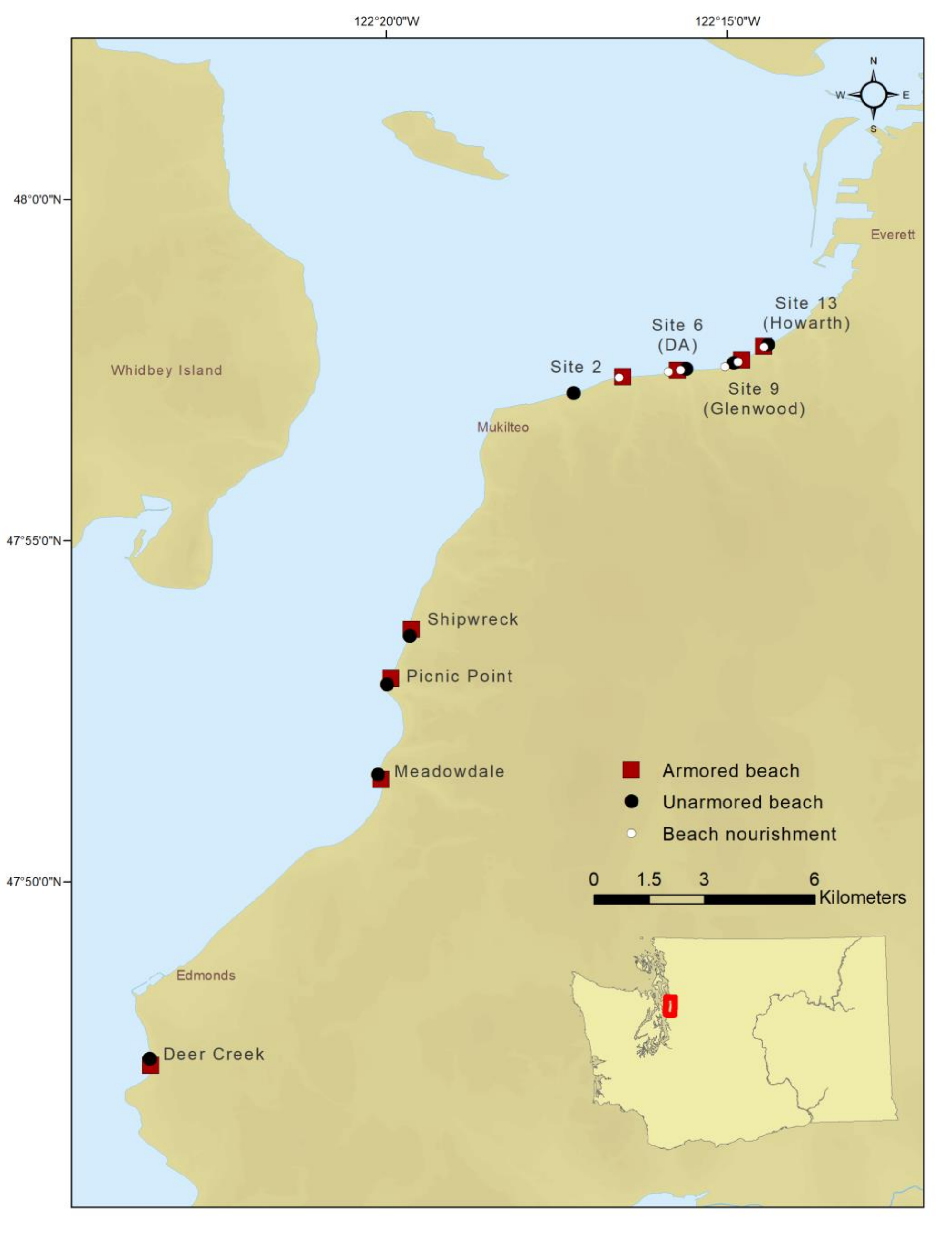
Lee, T.S., J.D. Toft, J.R. Cordell, M.N. Dethier, J.W. Adams, and R.P. Kelly. 2018. Quantifying the effectiveness of shoreline armoring removal on coastal biota of Puget Sound. PeerJ. 6:e4275.

Howarth Park – other sites with monitoring data

Howarth Park – Monthly sampling of the wrack line, post-restoration from June 2017 - October 2019 by Beachwatcher volunteers

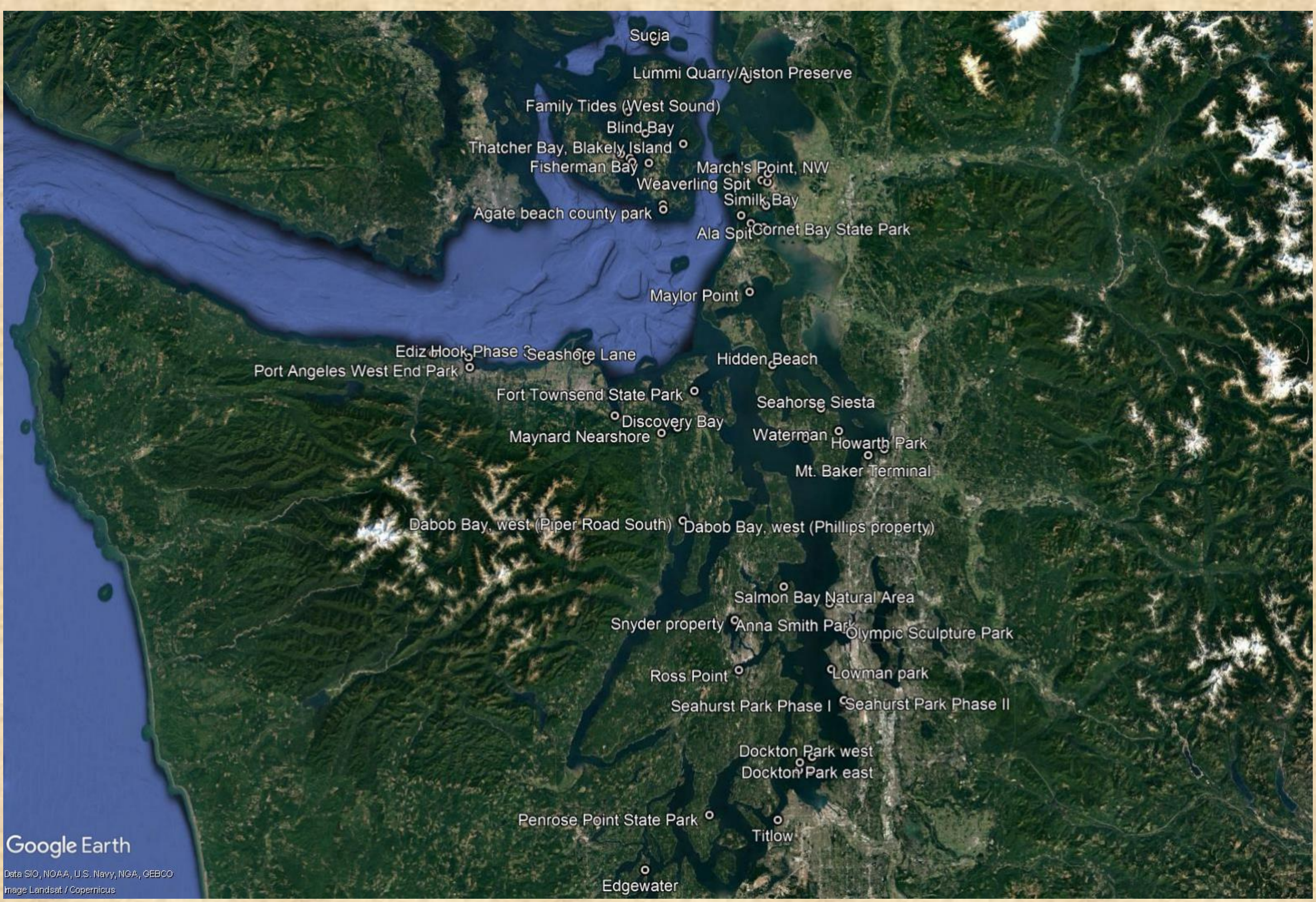


Howarth Park – other study sites in the vicinity



Tracking projects - monitoring

The PSEMP Nearshore work group recently compiled a list of sites that have had restoration and monitoring occur since 2005



Tracking projects - monitoring

Links to files: Summary, Excel file, Map

PSEMP Nearshore Work Group

PUGET SOUND ECOSYSTEM MONITORING PROGRAM

The Nearshore work group is an independent collaboration of monitoring practitioners, researchers, and data users from across the region that was formed in autumn 2013 as part of the Puget Sound Ecosystem Monitoring Program (PSEMP). The three main Puget Sound Partnership Vital Sign indicators that apply to the Nearshore work group are: (1) Shoreline Armoring, (2) Eelgrass, and (3) Estuaries.

Also see the 2020 Nearshore work plan, the 2019 annual report, and the updated 2020 compilation of monitoring details associated with shoreline armor restoration.

Chair(s): Tish Conway-Cranos (ESRP) Tish.Conway-Cranos@dfw.wa.gov
Coordinator: Jason Toft (UW SAFS) tofty@u.washington.edu

Shoreline Monitoring Toolbox

wsg.washington.edu/toolbox

An online resource that provides simple, affordable, and standardized approaches to monitor nearshore sites in Puget Sound

Beach Wrack

Characterizing beach wrack provides valuable information on the habitat of the upper beach and marine-terrestrial connectivity. This may change depending on shoreline armoring, source material alterations, and winter storms. Beach wrack provides food and shelter for many invertebrates, and foraging habitat for shorebirds.

Materials

- 50 m transect tape
- 32 x 32 cm pvc quadrat, subdivided with string into 25 6 x 6 cm small squares

Sampling Summary

- 50 m transect parallel to shore
- 0.1 m^2 quadrat (32 x 32 cm)
- N=10 random quadrats per transect
- Transects at most recent wrack line and higher elevation older wrack line
- Measure % cover of algae, eelgrass, terrestrial plants, and trash

Scale of Effort

$ Cost – low, simple materials and data are all field-based

$ People – low, 2-3 people can establish transects and record quadrat data

$ Fieldwork time – low, 1 day, once a year in September when wrack lines are exposed

$ Processing time – low, entering field data into computer format

$ Technical expertise – low, identification of major wrack types

Additional Resources

Reports that have used this method:
Dethier et al. 2016
Heerhartz et al. 2014
Sobocinski et al. 2010

Other methods that require a larger scale of effort and more technical expertise: methods in Heerhartz et al. 2014 that measure biomass of wrack

Suggested citation: Shoreline Monitoring Toolbox. Washington Sea Grant.
Website: wsg.washington.edu/toolbox

Methods

At ten random points along a 50 m transect parallel to shore, place a 0.1 m^2 quadrat on the beach surface and conduct a visual estimate of the percent composition of algae, eelgrass, terrestrial plant material, and trash. Divide the quadrat with string into 25 6 x 6 cm small squares to facilitate these estimates – each square equals 4%. If possible, specify the algae type (e.g., red, green, brown, or species). Establish two transects: (1) at the most recent high tide line that has fresh wrack deposition, and (2) just above MHHW in older wrack. The most recent high tide line will target mobile wrack, whereas the higher elevation sample will target the more stable wrack layer. If there is a bluff or shoreline armoring, sample the elevation at the base. Sample in September as it is typically a period of high wrack accumulation, and on an ebbing tide when the upper beach +6' MLLW and above is exposed.

Data to record in the field

Date, time, site name, transect elevation, sample number, beach wrack data. It is advisable to take a digital photo of the transect and of some example quadrats for documentation.

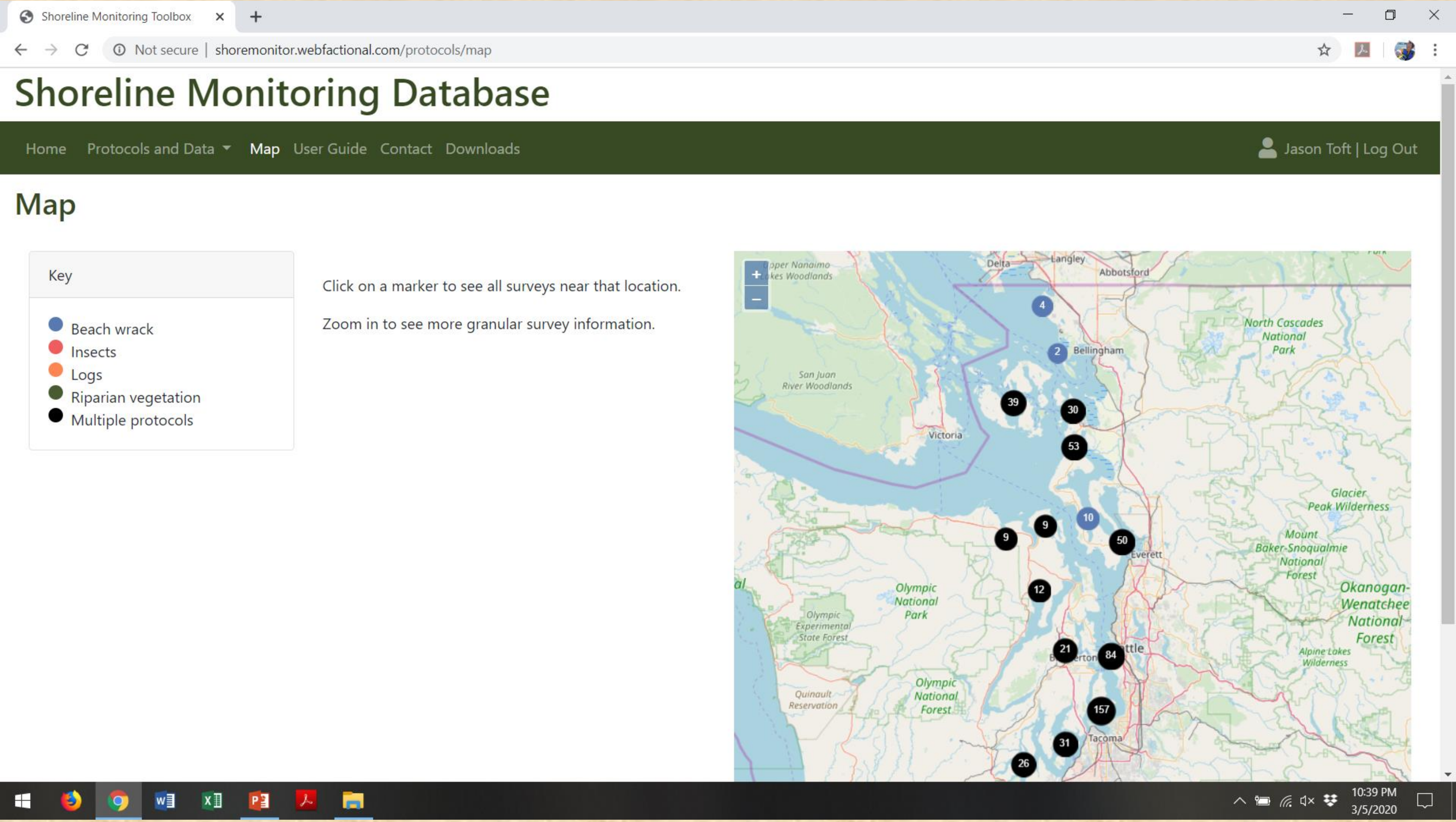
Processing

Enter the field data into computer spreadsheets. The percentages for each wrack type can be analyzed separately, or combined for a percentage of total wrack cover. The different wrack types give information on the source material available (e.g., riparian vegetation for terrestrial sources), and the amounts that deposit on the beach.

Shoreline Monitoring Database

A resource to upload data from standardized protocols

Shoremonitoring.org



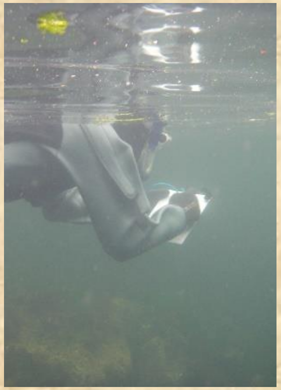
Next Steps

- **Data Analysis**: Analyze and interpret data that have been collected using Toolbox protocols and database.
- **Data Visualization**: Develop a web interface to make outputs and queries interactive.
- **Further develop database protocols**: Incorporate an additional 3-5 protocols.
- **Enhance online database functionality**: Maintain and update database features, such as mapping of data sampling locations.
- **Increase data expanse**: Harvest older datasets to incorporate.

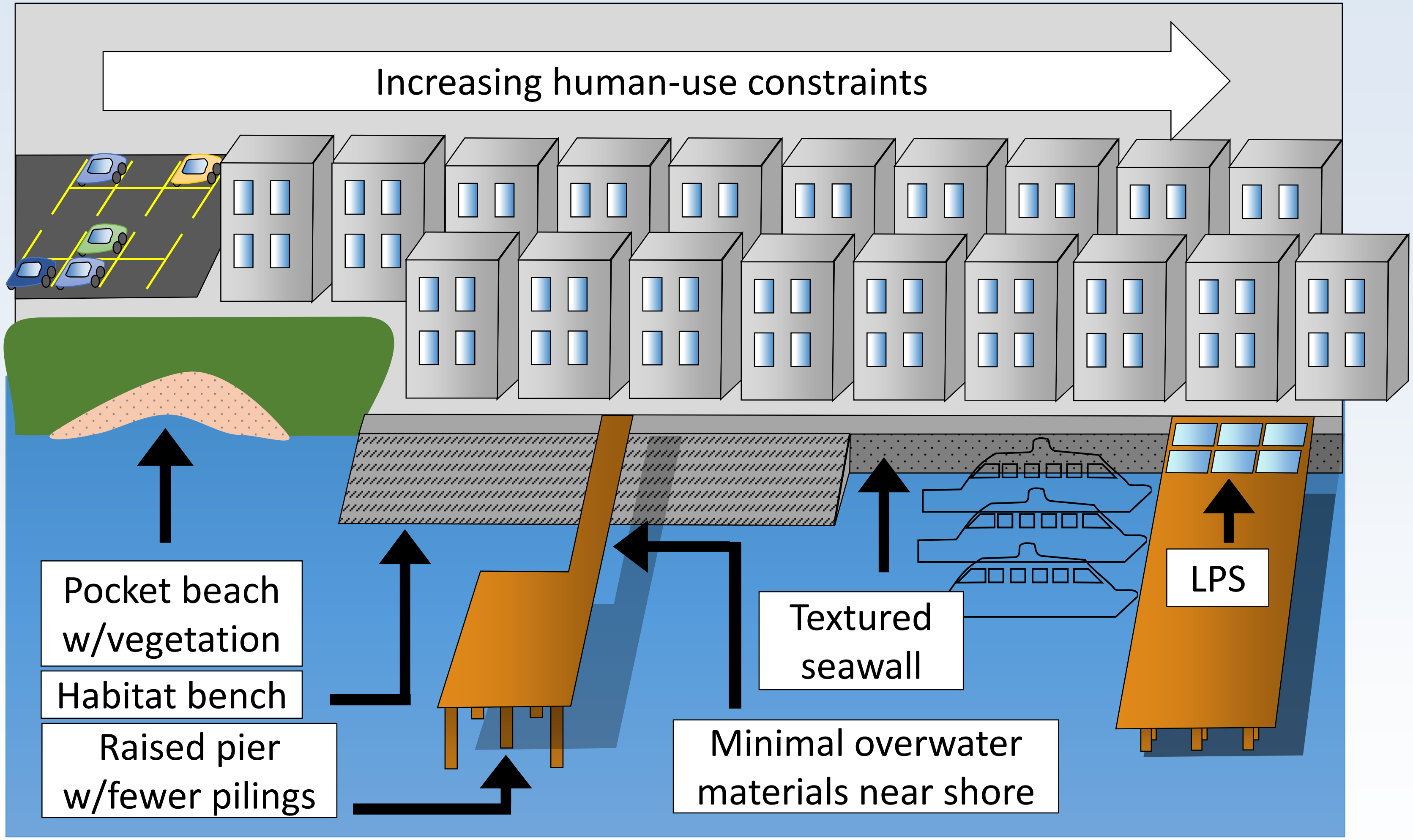
Next protocols, options

- **Surface epifauna and algae**: Many years of data and volunteer groups (low tide quadrat surveys).
- **Physical**: Beach profiles, sediment size.
- **Epibenthic invertebrates**: juvenile salmon prey, eelgrass and aquaculture datasets.
- **Fish**: Snorkel, beach seines, fish diets.
- **Others…**




New Directions: Eco-engineering

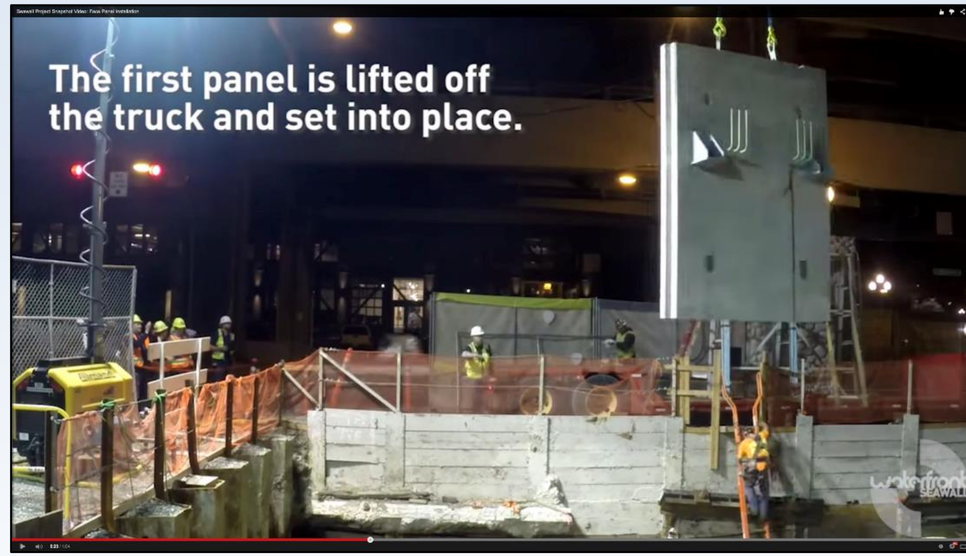


Munsch, S.H., J.R. Cordell, and J.D. Toft. 2017. Effects of shoreline armouring and overwater structures on coastal and estuarine fish: opportunities for habitat improvement. *Journal of Applied Ecology*.

Research & management opportunity: Reconstruction of a highly modified shoreline

1934

2014



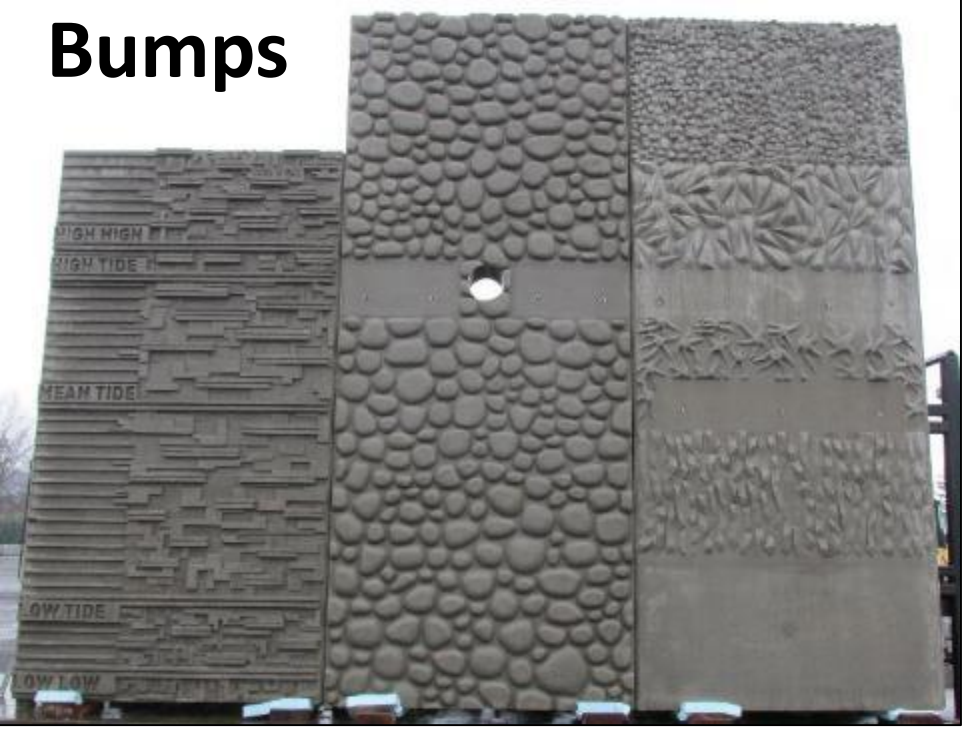
- 2001 Nisqually Earthquake damaged the Elliott Bay seawall
- Waterfront needed reconstruction
  - Do armoring and overwater structures impair fish habitat?
  - Can we improve habitat along a highly modified waterfront?

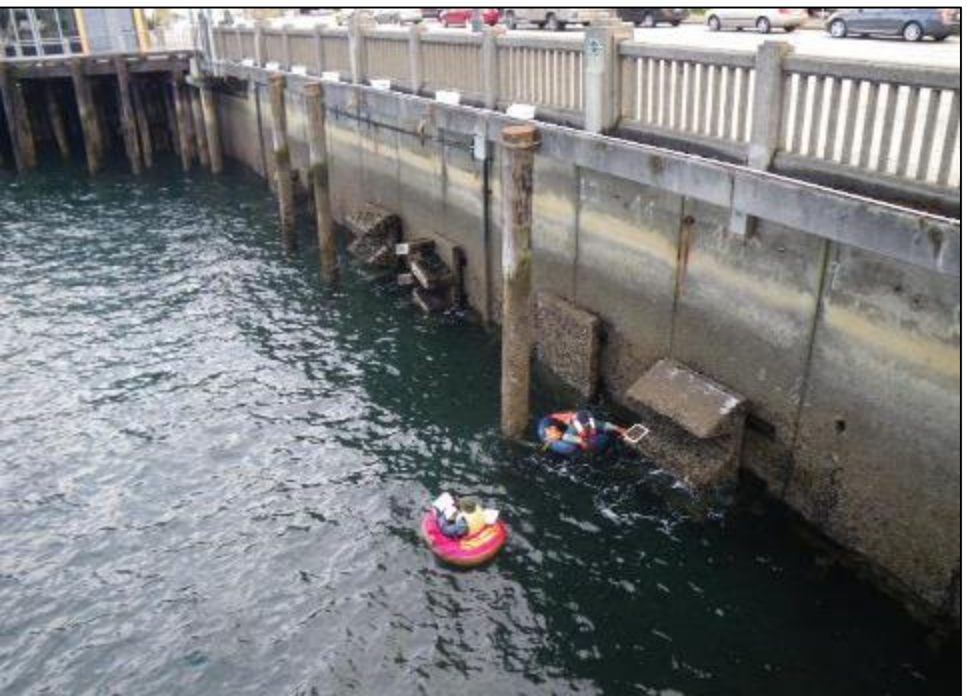
OLYMPIC SCULPTURE PARK

Toft et al. 2013. Ecological response and physical stability of habitat enhancements along an urban armored shoreline. *Ecological Engineering*.

Benches

Bumps





Monitoring of the New Seattle Seawall

Initiated March 2018, post-construction of Phase 1 seawall rebuild:

- Fish – snorkel, SCUBA, DIDSON hydroacoustic camera
- Mobile invertebrates – epibenthic pump
- Sessile invertebrates and algae - quadrats
- Light – Photosynthetically Active Radiation

May 18, 2017

Seattle seawall's novel fish features are a potential model for the world

Michelle Ma

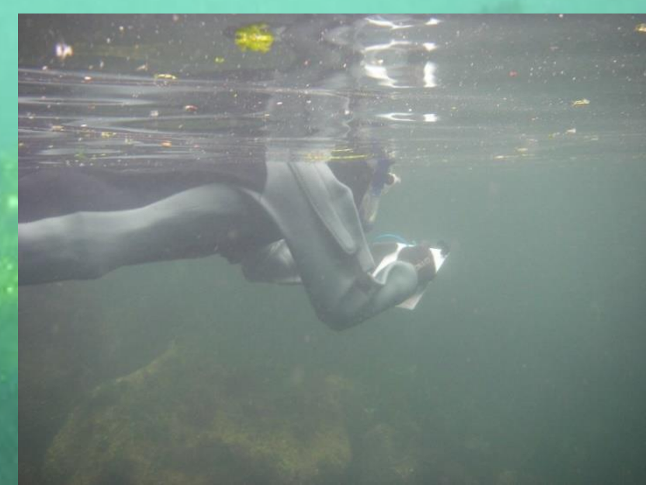
UW News

A segment of the new Seattle seawall. The sidewalk's light-penetrating glass panels let light through to the water below to encourage young salmon to migrate along the engineered shoreline. ***SDOT/Flickr***

Juvenile Salmon

Chinook emphasis

- Numbers
- Feeding
- Invertebrate prey



Instagram – salmon.underfoot

Juvenile chum salmon

Juvenile Chinook salmon

Larval fish – often surf smelt

Bonus

(Tiny Bonus)

Preliminary results – encouraging!

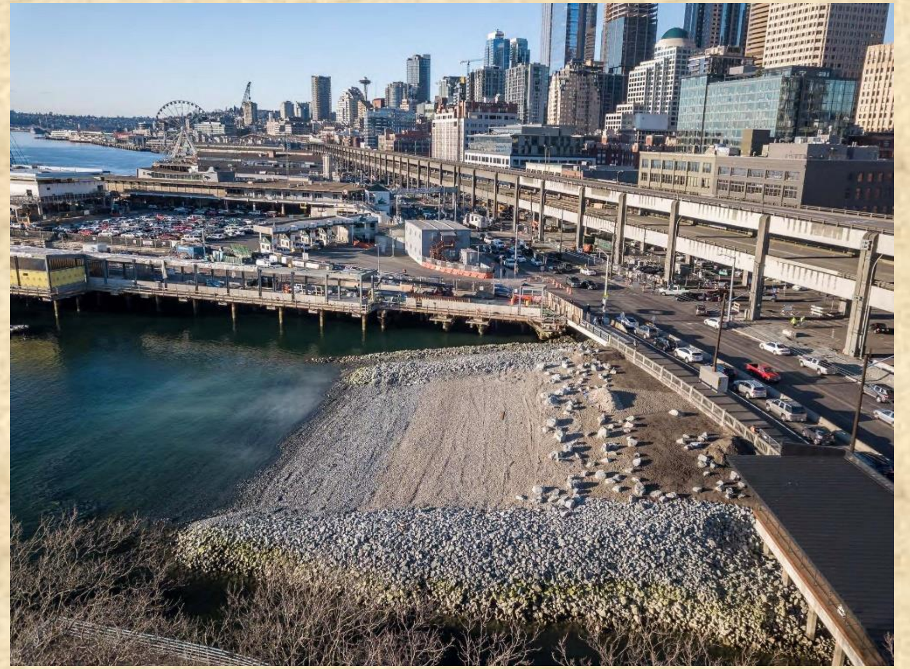
- Improvements in juvenile salmon presence and feeding than before habitat enhancements.
- Fish predators on juvenile salmon extremely rare.
- Lots of bull kelp on areas with extended habitat bench – fringe benefits.

Strata	Feeding %
Open Seawall	28%
Under Pier	24%
OSP Pocket Beach	29%
OSP Habitat Bench	32%

Range of engineering

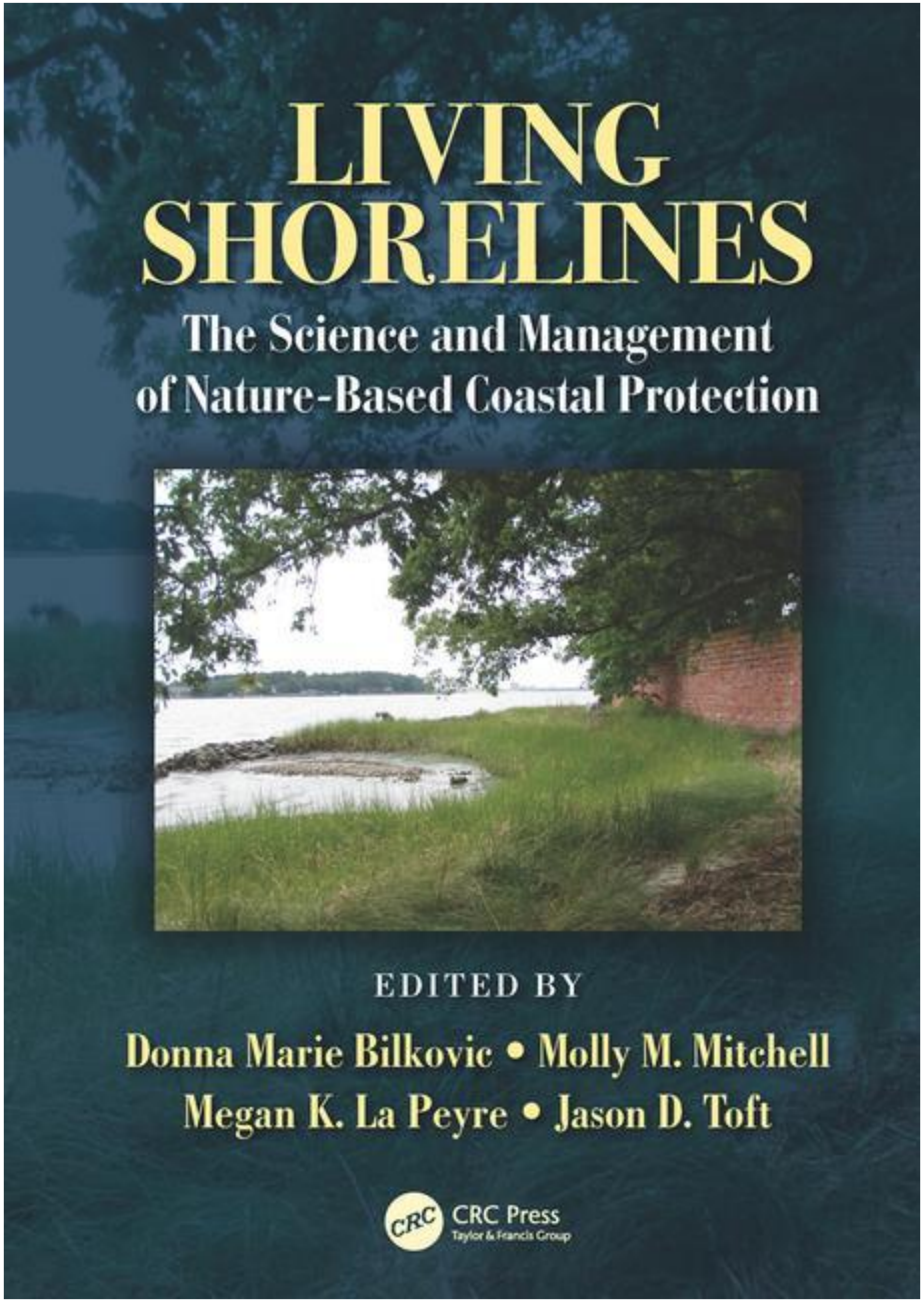
Lots – in front of seawall

COLMAN BEACH – SEATTLE SEAWALL



Little – remove and let it slide

EDGEWATER – PRIVATE



CHAPTER 21

Benches, Beaches, and Bumps

How Habitat Monitoring and Experimental Science Can Inform Urban Seawall Design

Jeffery R. Cordell, Jason D. Toft, Stuart H. Munsch, and Maureen Goff

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CHAPTER 7

Green Shores

Using Voluntary Ratings and Certification Programs to Guide Sustainable Shoreline Development

Brian Emmett, D.G. Blair, and Nicole Faghin

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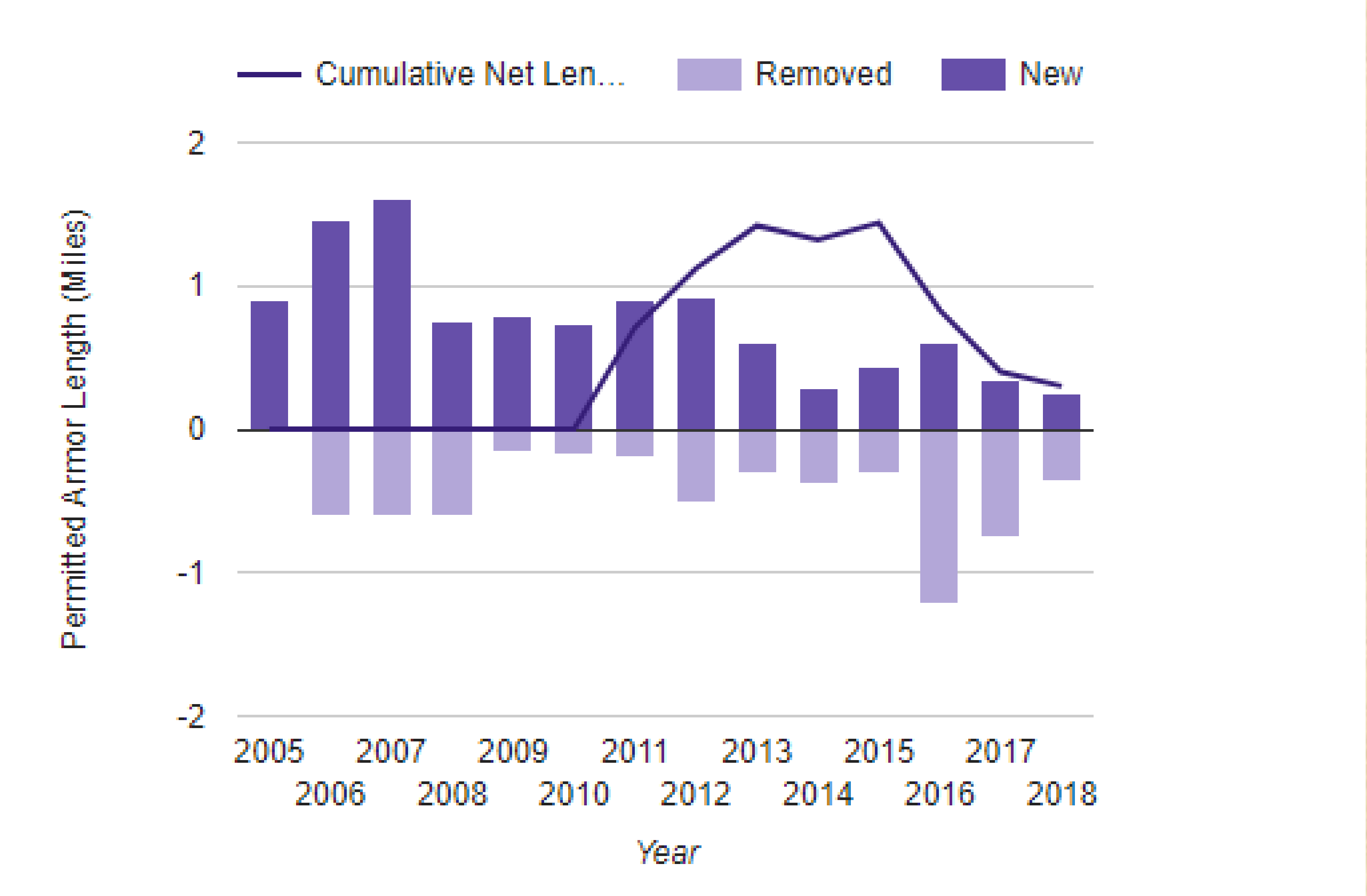
Will it work? Broaden spatial and temporal scale

When do we know if we're making a difference?
Are there "thresholds" within Puget Sound, or specific to certain beach types and locations, etc?



The 1-slide summary

- Gradual natural slope better than artificial steep slope.
- Minimize artificial shading.
- Increase aquatic-terrestrial connections.
- Monitor new ideas to measure how they work.

Acknowledgements

Many co-authors mentioned throughout

Main UW collaborators in recent years:
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Stuart Munsch
Sarah Heerhartz
Kate Litle

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My e-mail:
tofty@uw.edu