

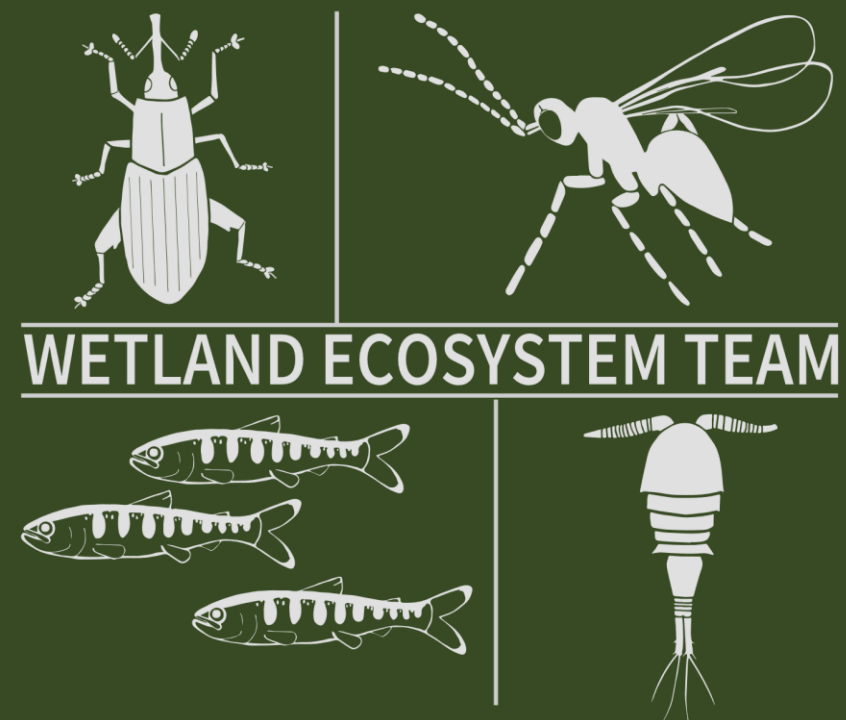
# Shoreline Restoration Effectiveness in the Salish Sea



Jason Toft – Principal Research Scientist

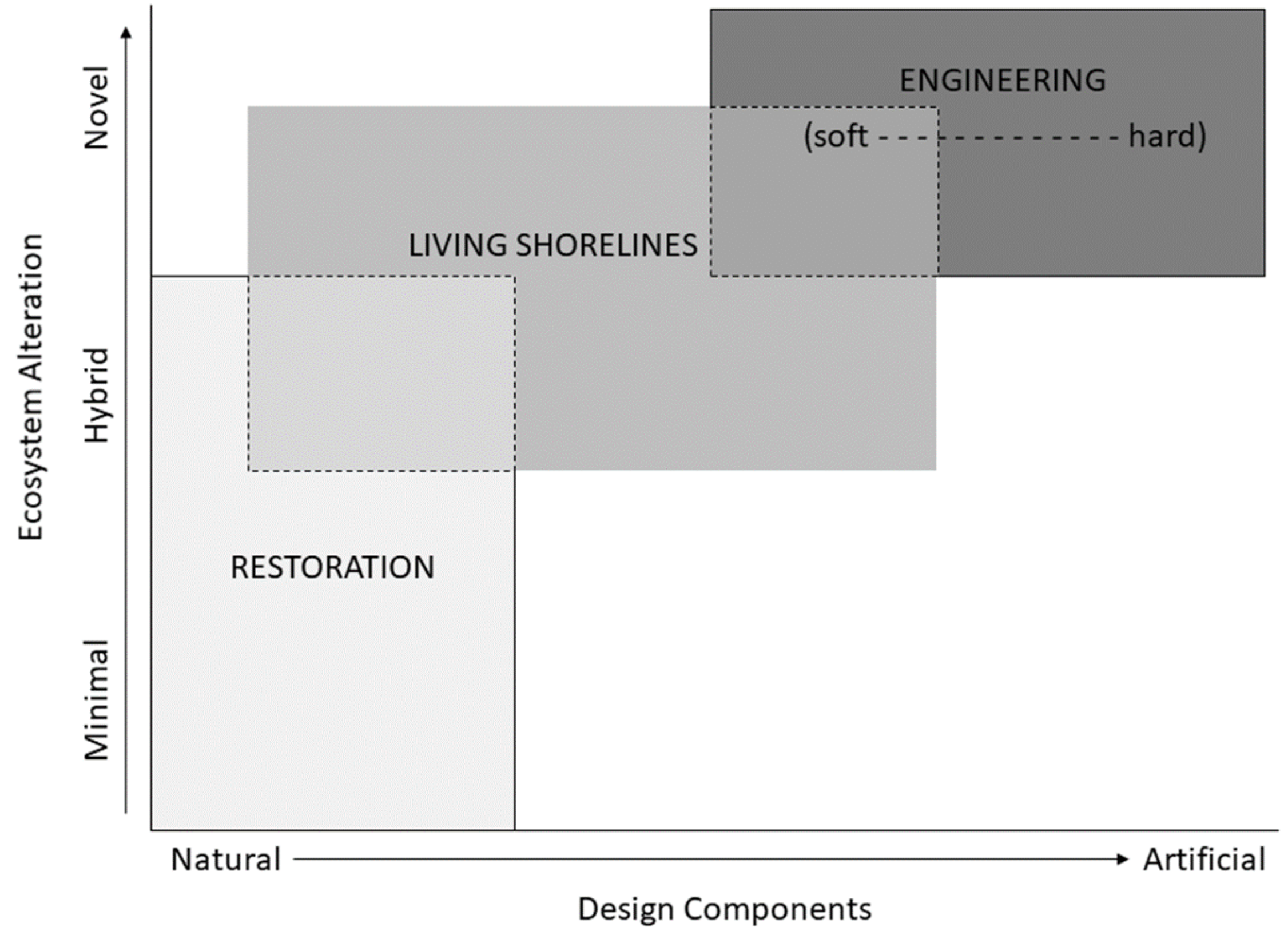
Wetland Ecosystem Team

UW School of Aquatic and Fishery Sciences



# Living Shorelines

Bilkovic, D.M., M.M. Mitchell, M.K. La Peyre, and J.D. Toft (Eds). 2017. Living Shorelines: The Science and Management of Nature-Based Coastal Protection. CRC Press.



# Armor Impacts

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



# Restoration Effectiveness?



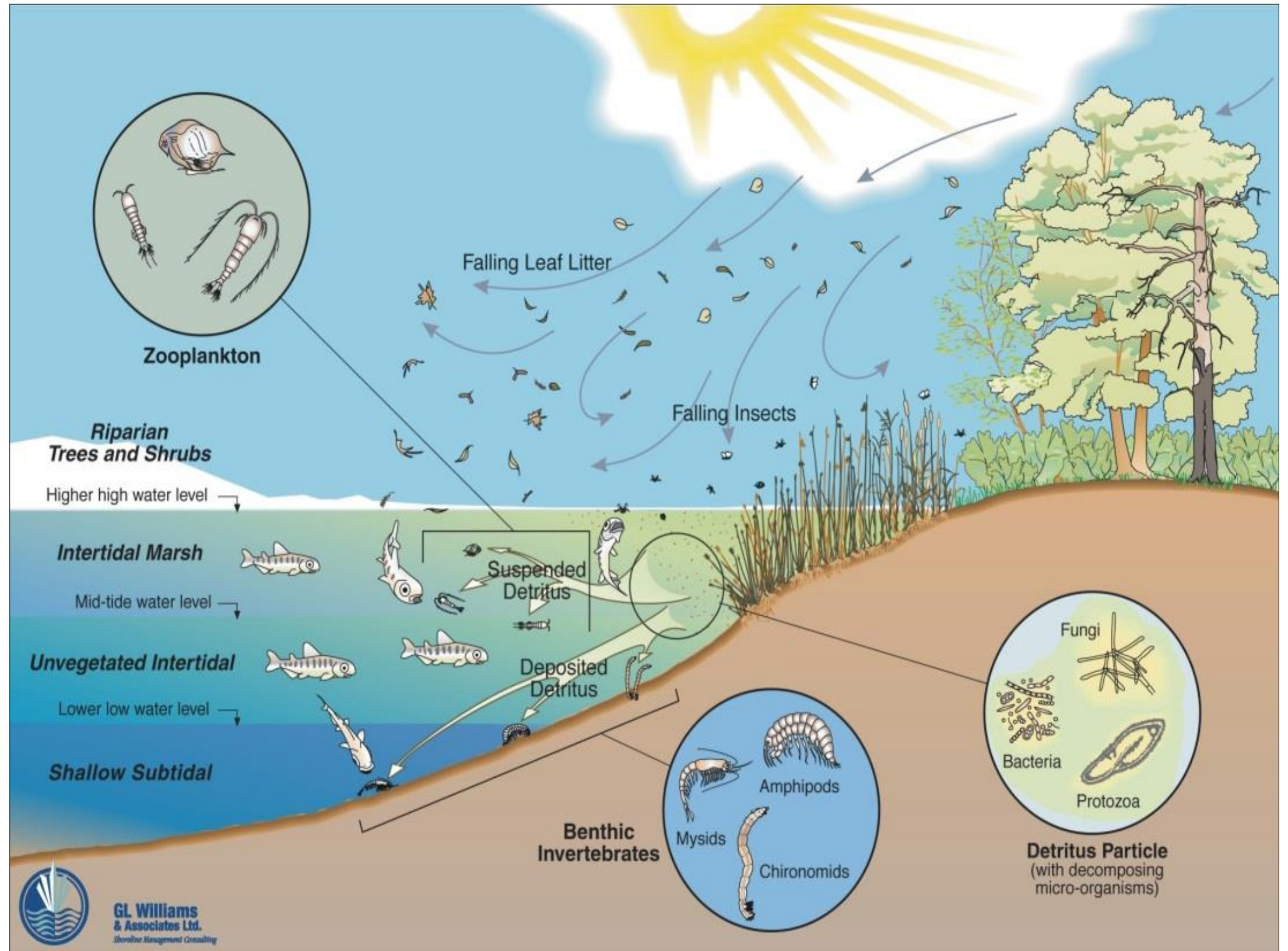
# Impacts of Armor, and Restoration Effectiveness



Armor removal and restoration at Seahurst Park, a site of longer-term monitoring

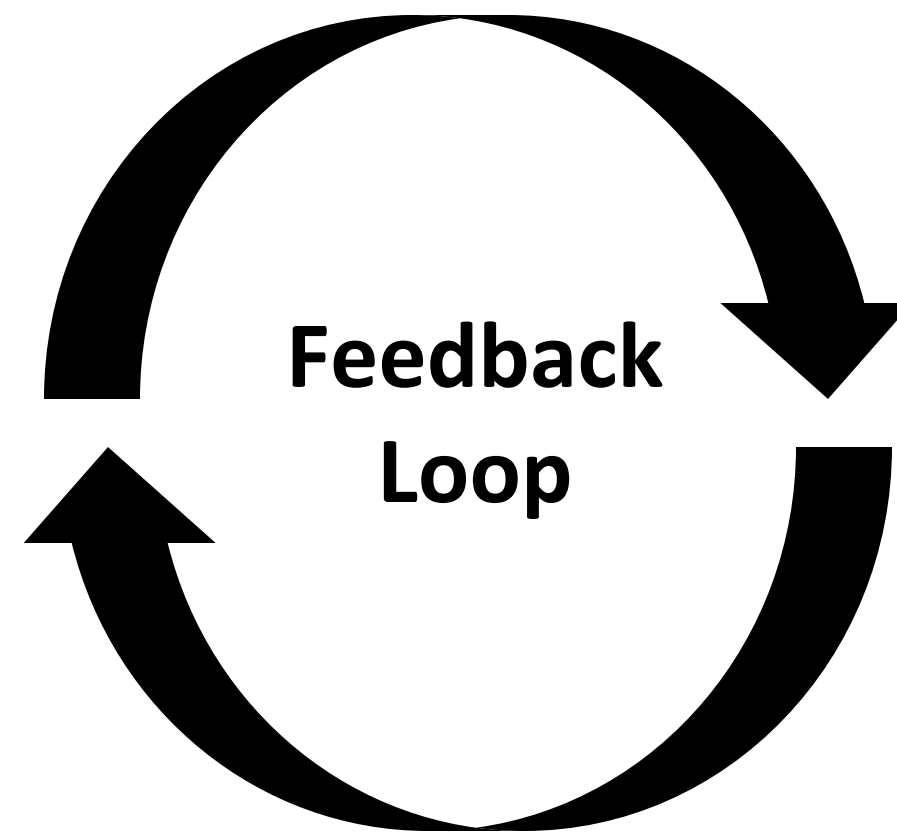
## Juvenile Salmon

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



## The Role of Science in Restoration

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



# Online Database

## www.shoremonitoring.org

- Community scientist engagement
- Protocol accessibility
- Data upload and download in a centralized format
- Data visualizations



PUGET SOUND ECOSYSTEM  
MONITORING PROGRAM

Home User Guide Decision Tree Protocols Database and visualizations Map Documents References Contact Restoration Sites Sign Up Log In

Welcome to the Shoreline Monitoring Database.

A resource to upload data from standardized protocols for monitoring shorelines in Puget Sound, WA.

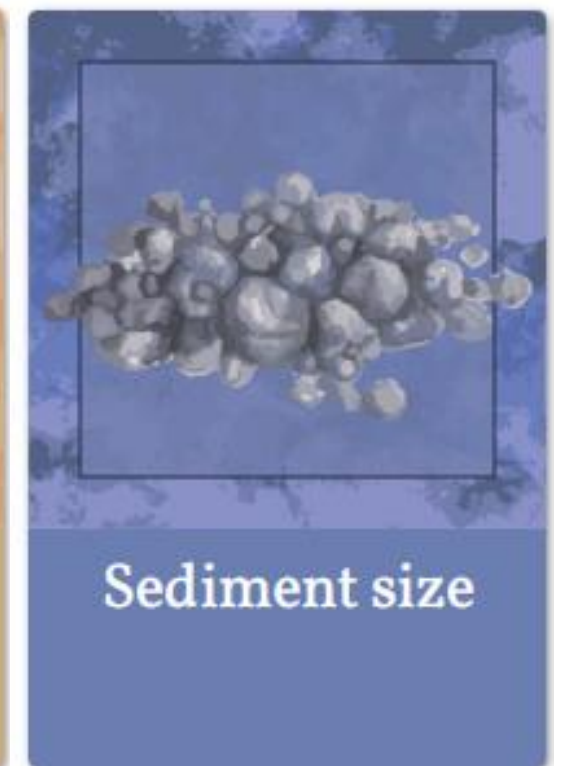
Sea Grant  
Washington

UNIVERSITY of WASHINGTON  
COLLEGE OF THE ENVIRONMENT



# Protocols

- Twenty protocols available
- Eleven have data features including visualizations



# Restoration Effectiveness

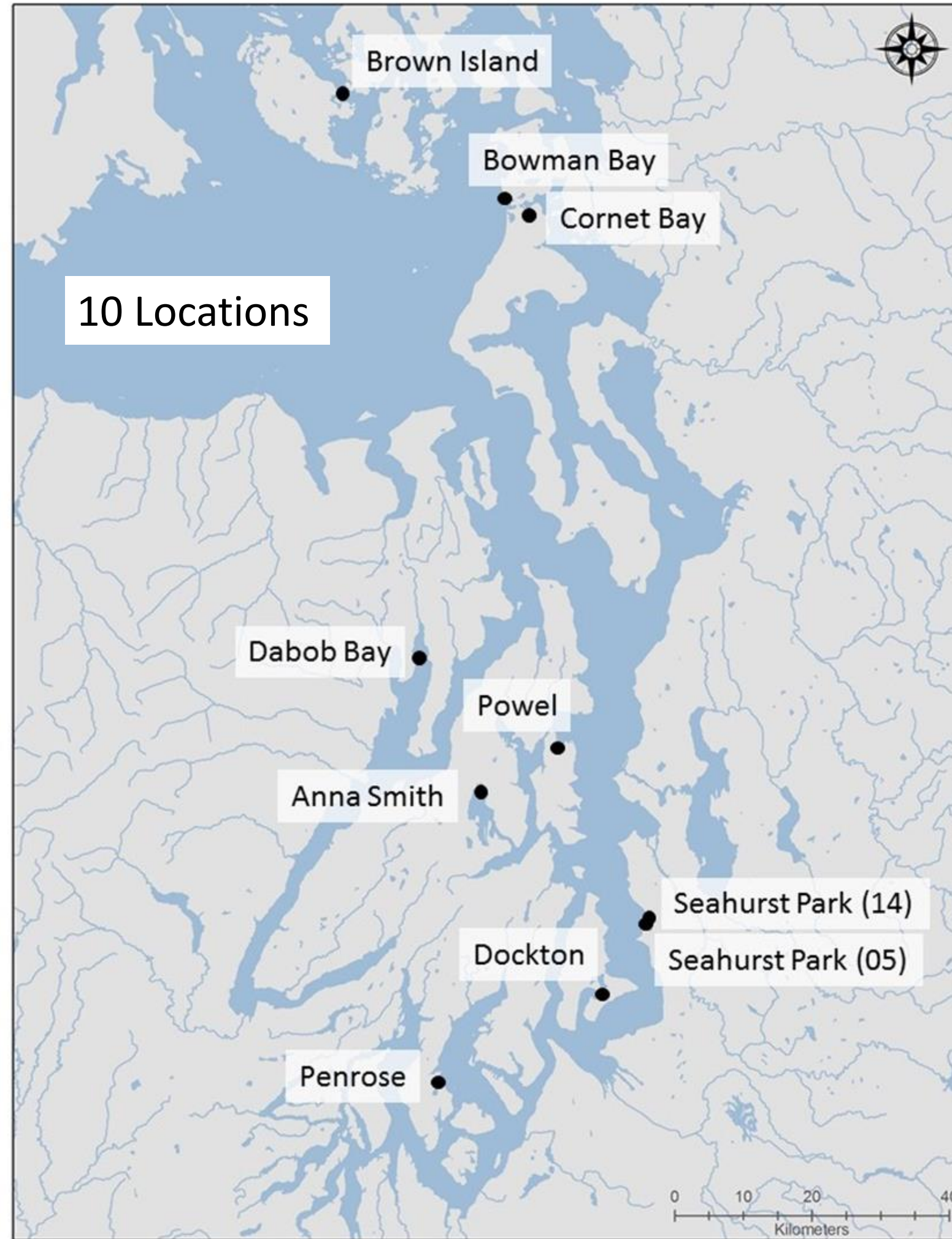
Restored



Armored



Reference



# Summary of Statistical Tests: Darker Blue Colors are Greater

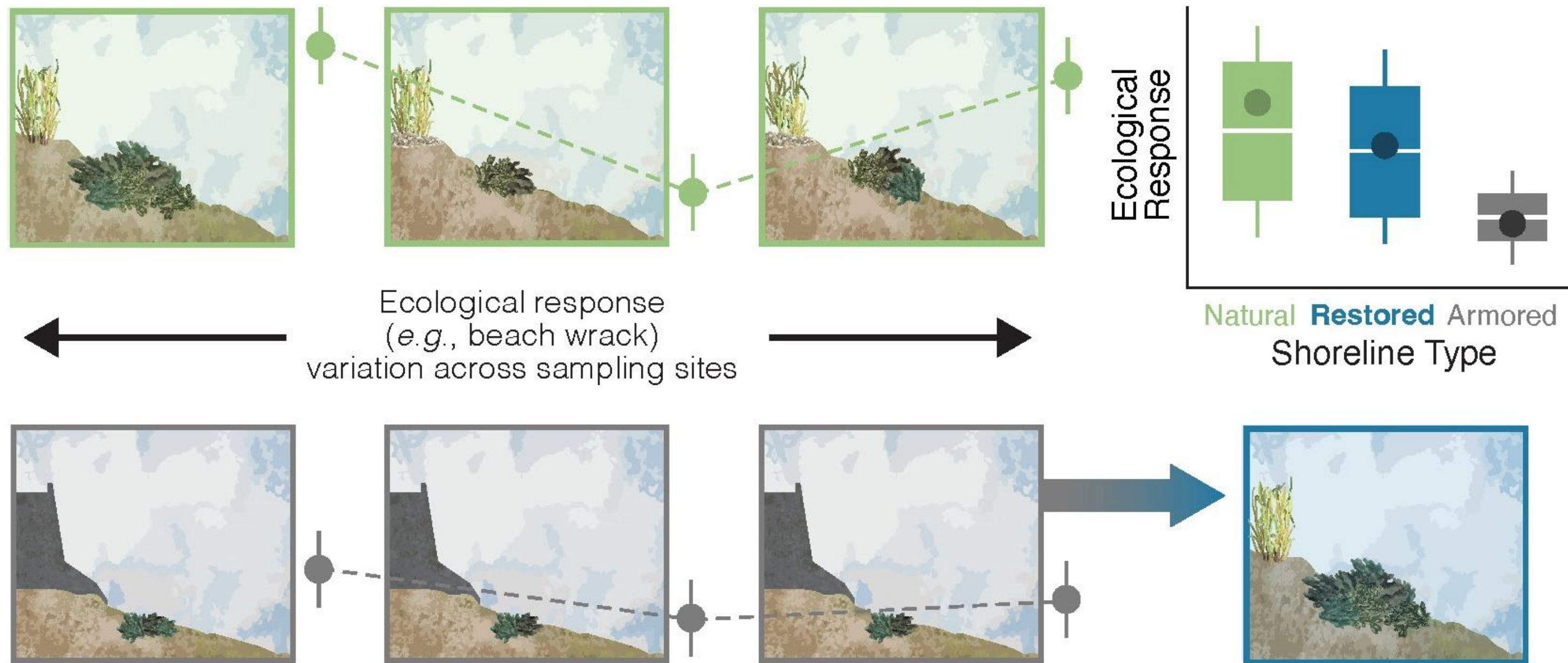


Metric	Armored	Restored	Reference
Beach Wrack	Light Blue	Dark Blue	Dark Blue
Logs and Riparian Vegetation	Light Blue	Light Blue	Dark Blue
Wrack Invertebrates	Light Blue	Medium Blue	Dark Blue
Insects	Light Blue	Medium Blue	Dark Blue



# Shoreline Armor Removal Can Restore Variability

New data collected through citizen science efforts across Puget Sound, WA show that **armor reduces the variation in ecological responses** compared to natural, unarmored shorelines.



# Length of Armor Removed & Additional Actions

Pre-Restoration

Post-Restoration

Big Beach, Vashon Island



Cornet Bay, Deception Pass

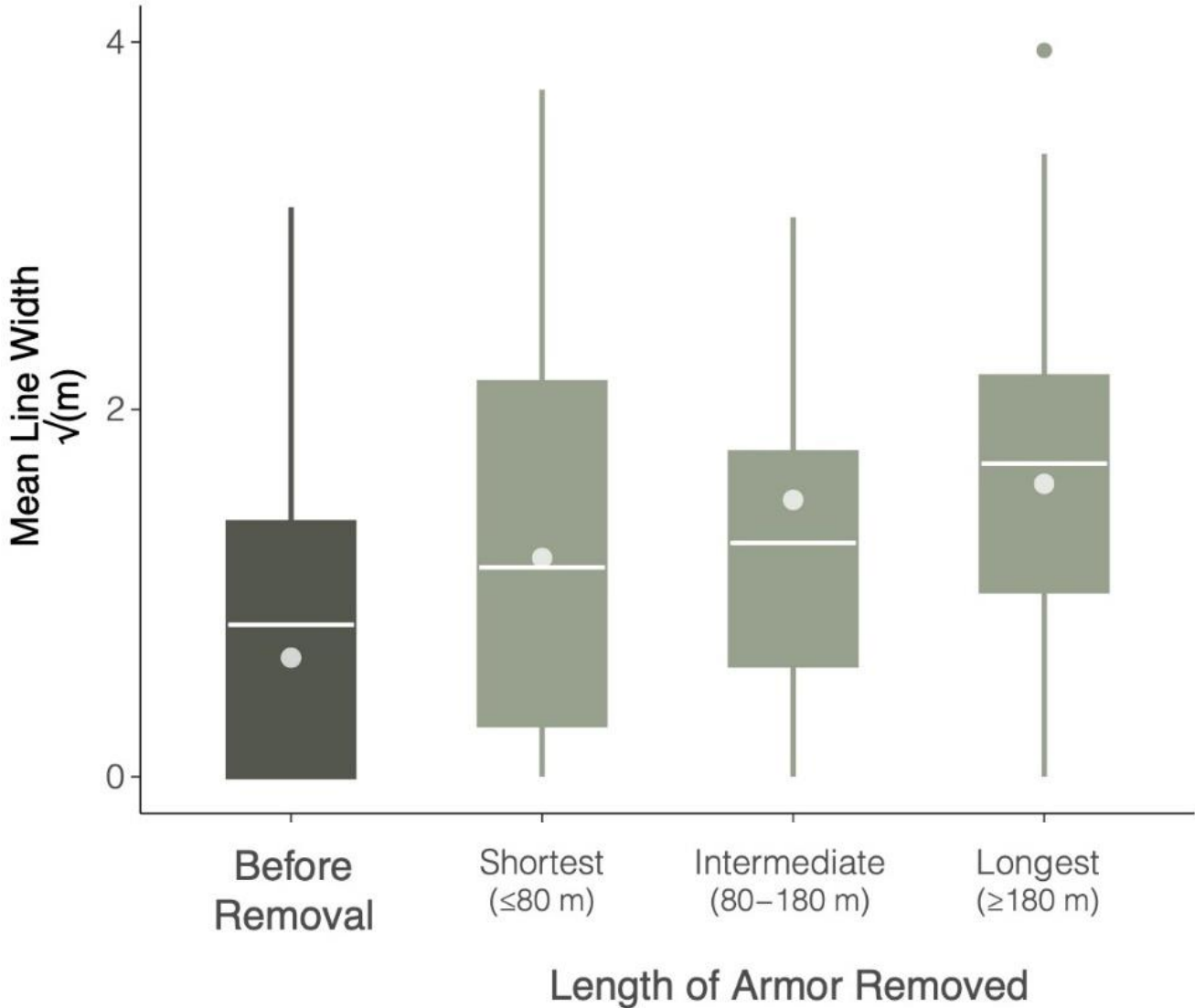


Des Roches et al. 2024. Shoreline restoration including armor removal and log placement affect ecosystem recovery through time. *Restoration Ecology*.

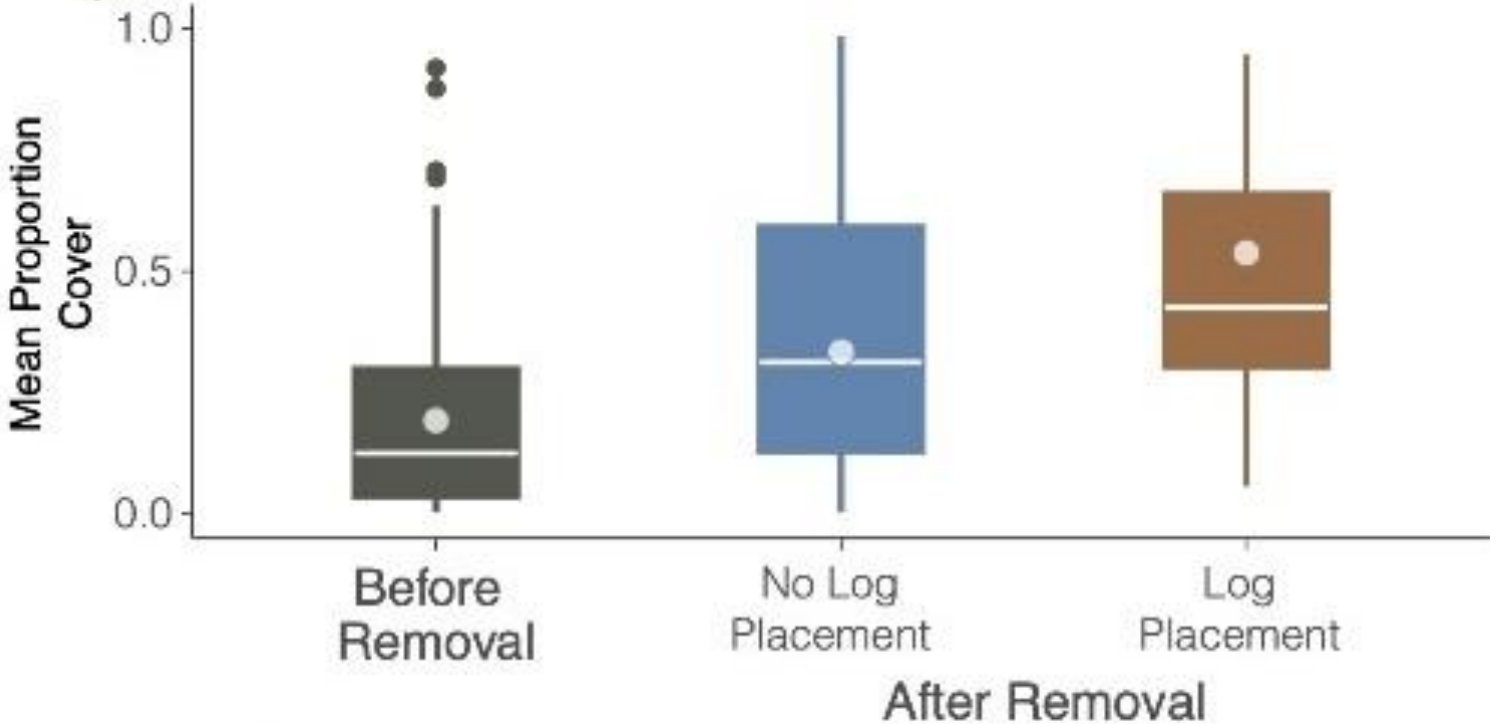
# Armor Length Removed, and Log Placement



a) Beach Logs

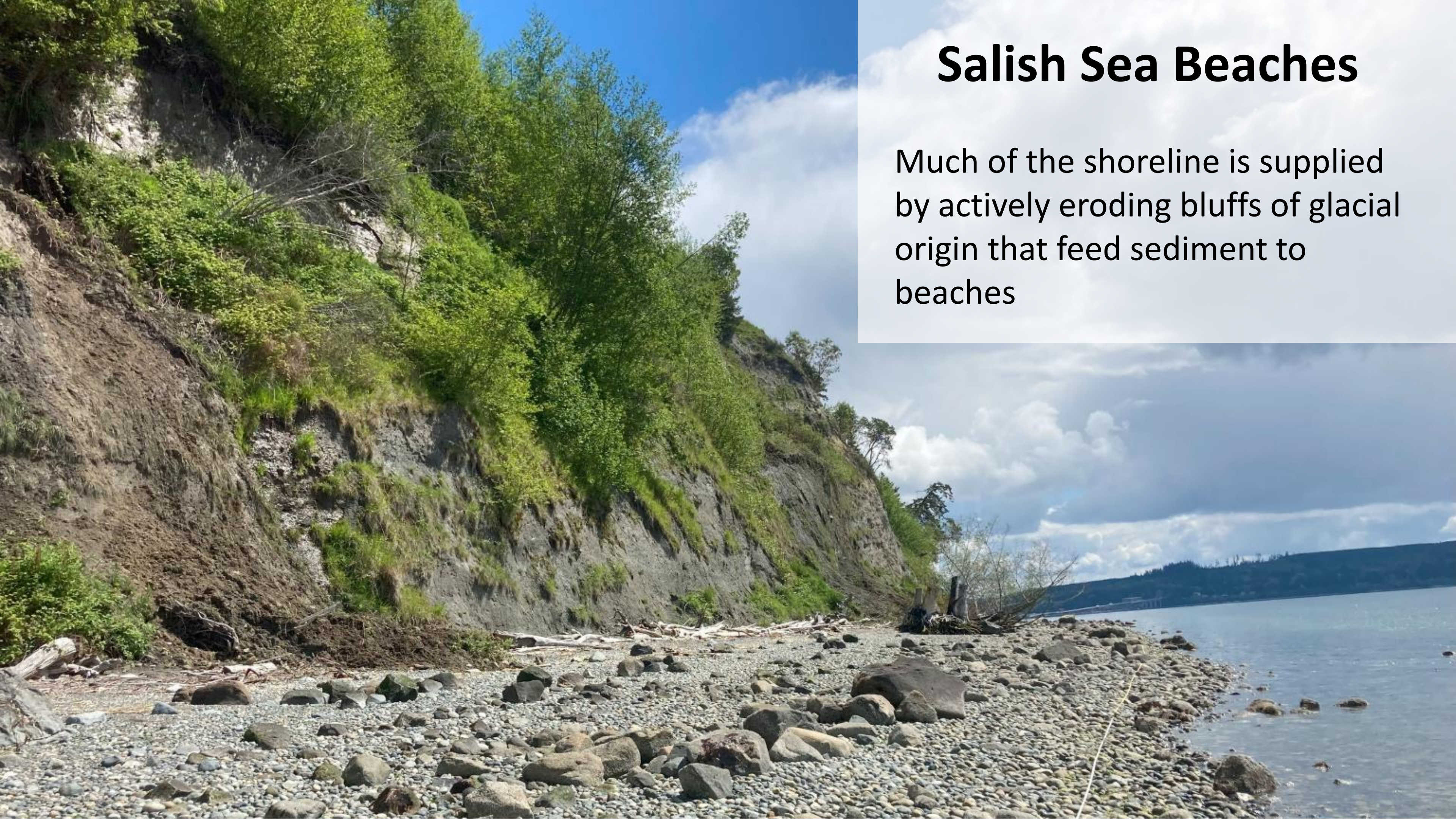


c) Beach Wrack

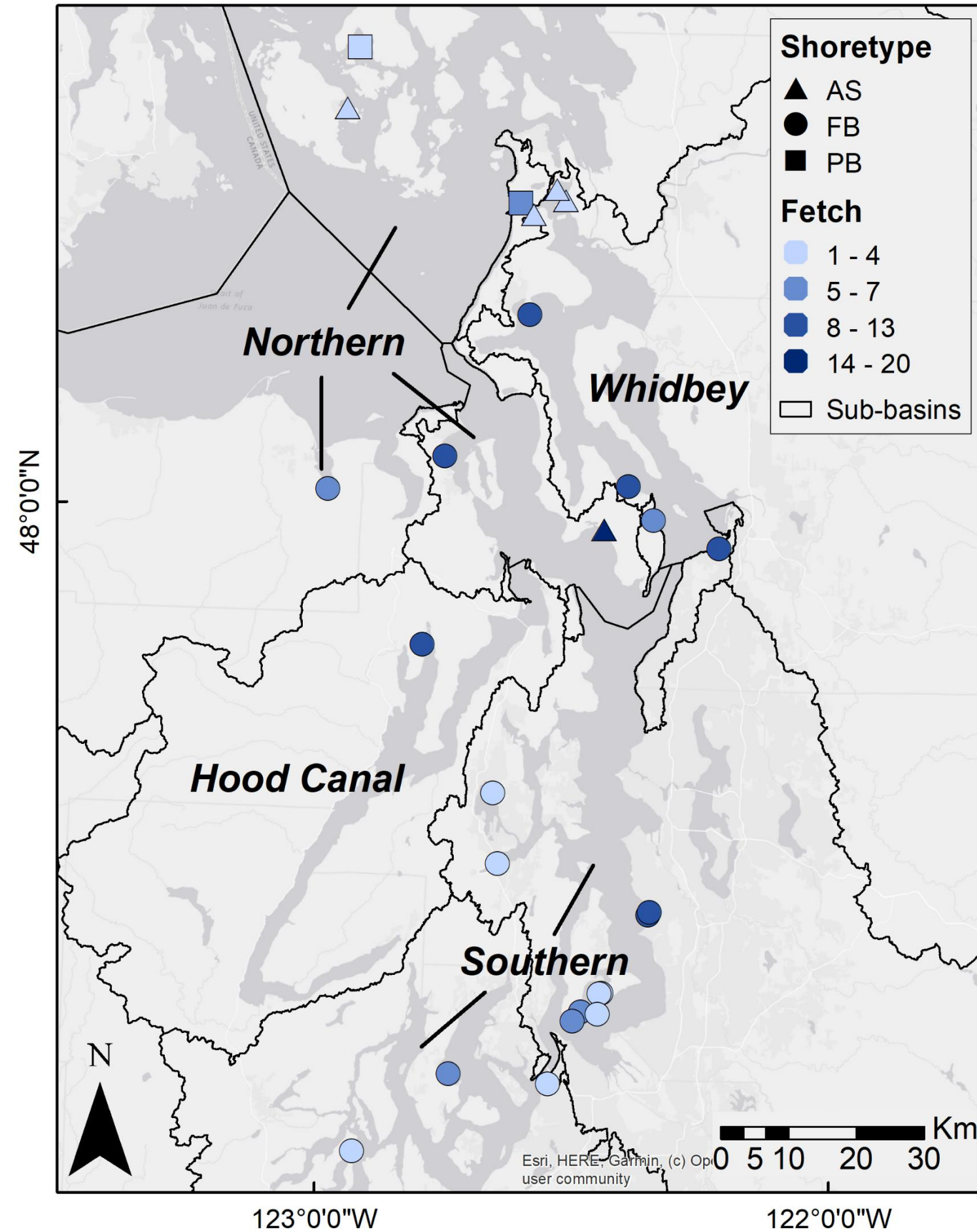


# Salish Sea Beaches

Much of the shoreline is supplied by actively eroding bluffs of glacial origin that feed sediment to beaches



# Coastal Landforms and Fetch



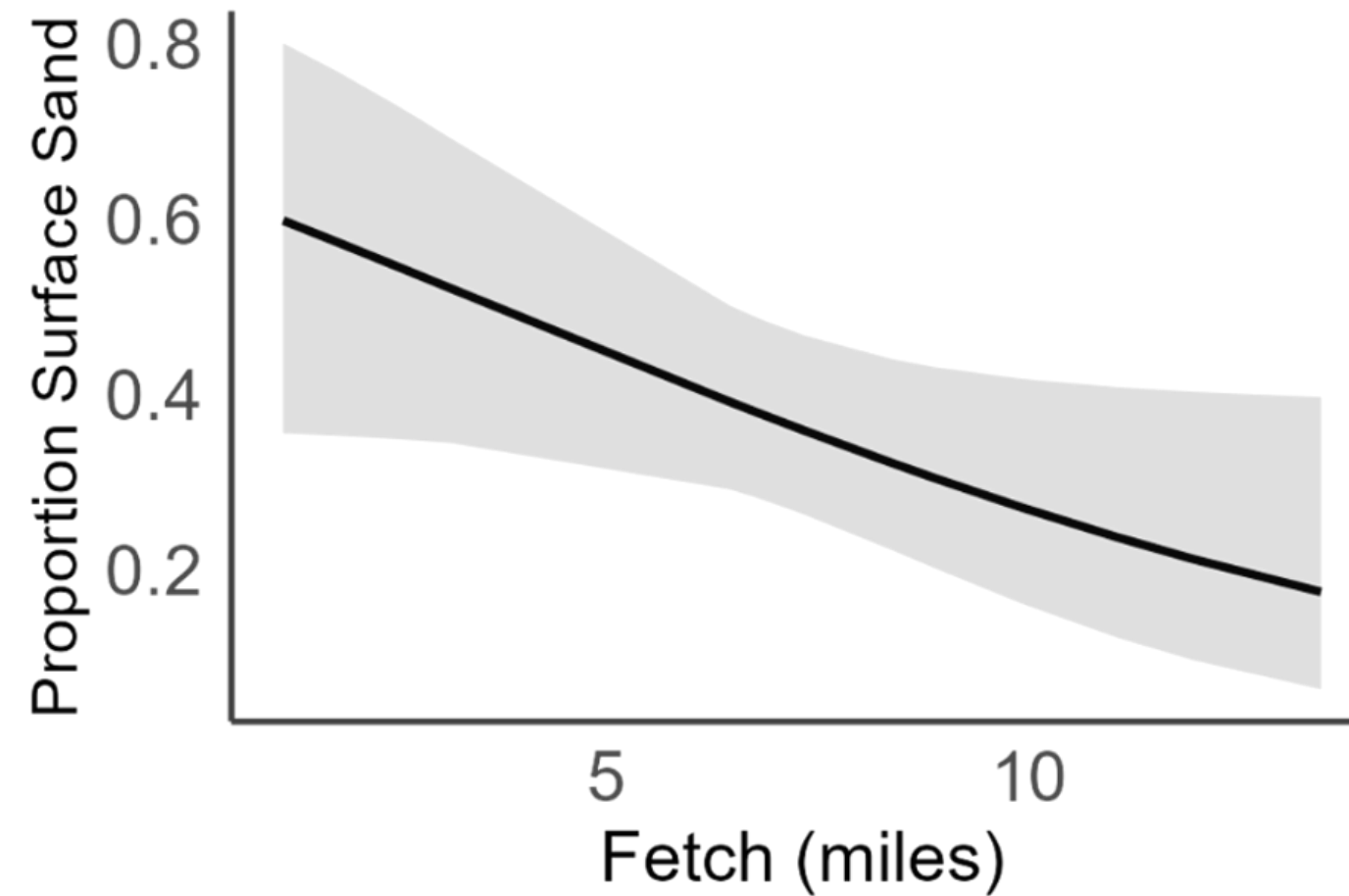
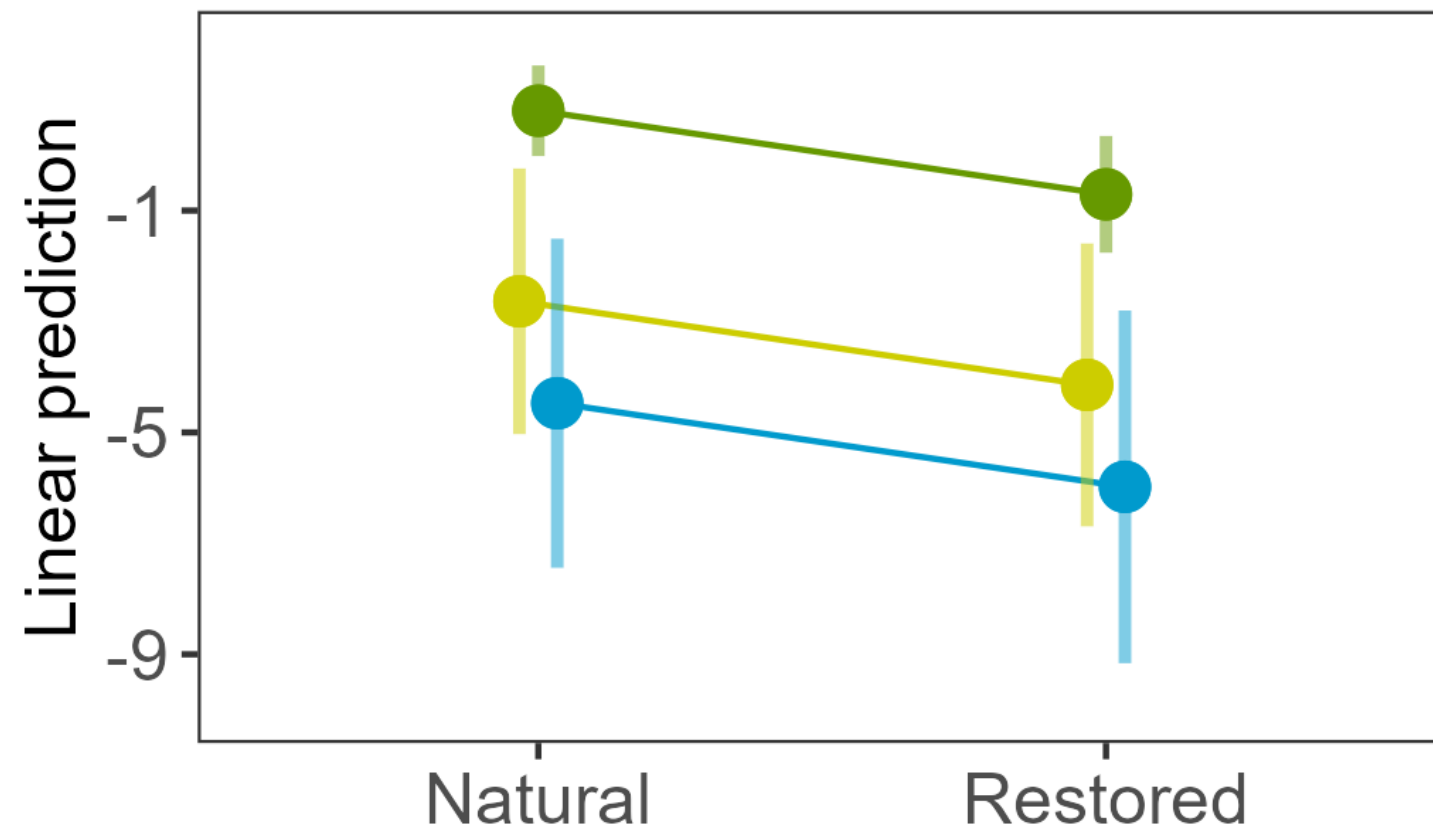


# Shoretype at Natural and Restored Sites



- Shoretype
- Accretion Shoreform
  - Feeder Bluff
  - Pocket Beach

**Count of Fallen Trees**



# Bluff restoration

Restoring sediment supply processes at beaches with armored bluffs could double their ecological function.



An underwater photograph showing a diver in the foreground on the right, looking towards the left. In the middle ground, a sea lion is swimming. The background shows a rocky seabed with green algae. The water is clear and blue-green.

**PRIORITIZING BEACH  
RESTORATION AND PROTECTION**

TOFT, KOBELT, ACCOLA, DETHIER, OGSTON, AND VOLLERO  
2023

ESRP LEARNING PROJECT

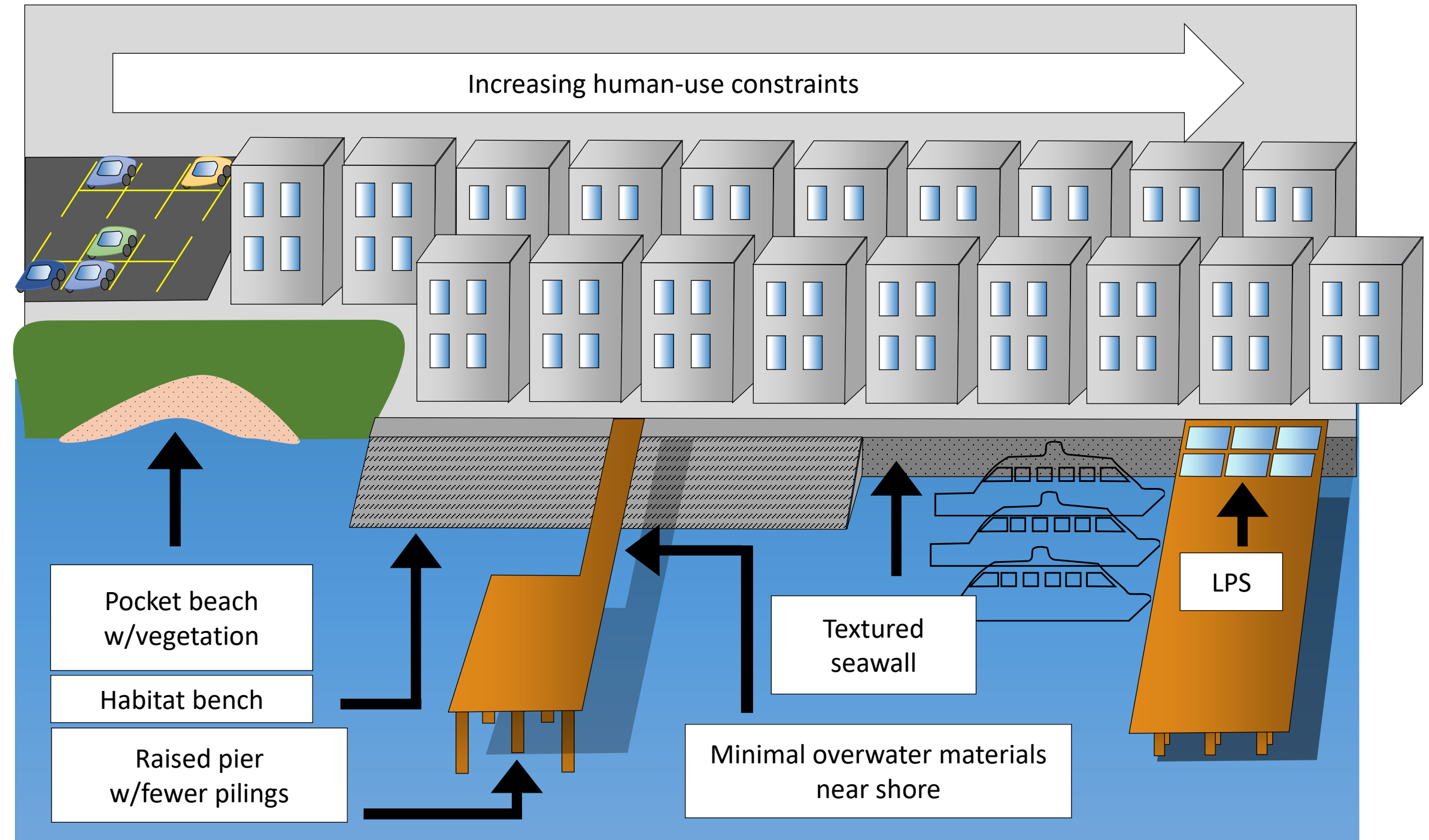
# Key Messages (so far)

- Armor removal often effective at restoring close to natural levels.
- The length of armor removed can lead to increased response in some cases.
- Placement of logs is an effective Living Shoreline treatment.
- Shoretype and fetch can govern restoration response.



# New Directions: Eco-engineering

Munsch et al. 2017. Effects of shoreline armoring and overwater structures on coastal and estuarine fish: opportunities for habitat improvement. *Journal of Applied Ecology*.



# OLYMPIC SCULPTURE PARK



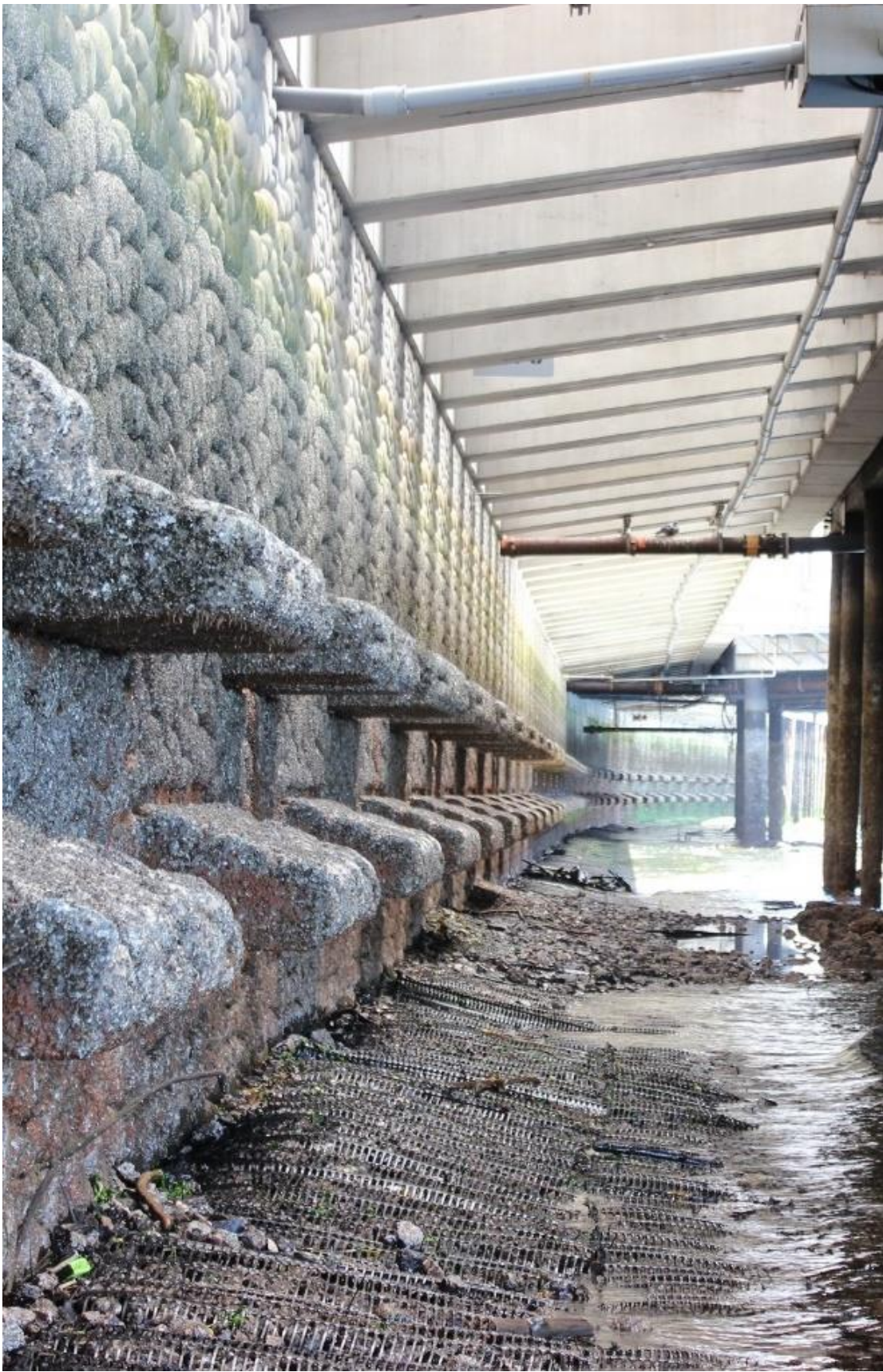
Toft et al. 2013. Ecological response and physical stability of habitat enhancements along an urban armored shoreline. *Ecological Engineering*.



## Benches



# Bumps





## Monitoring of the New Seattle Seawall

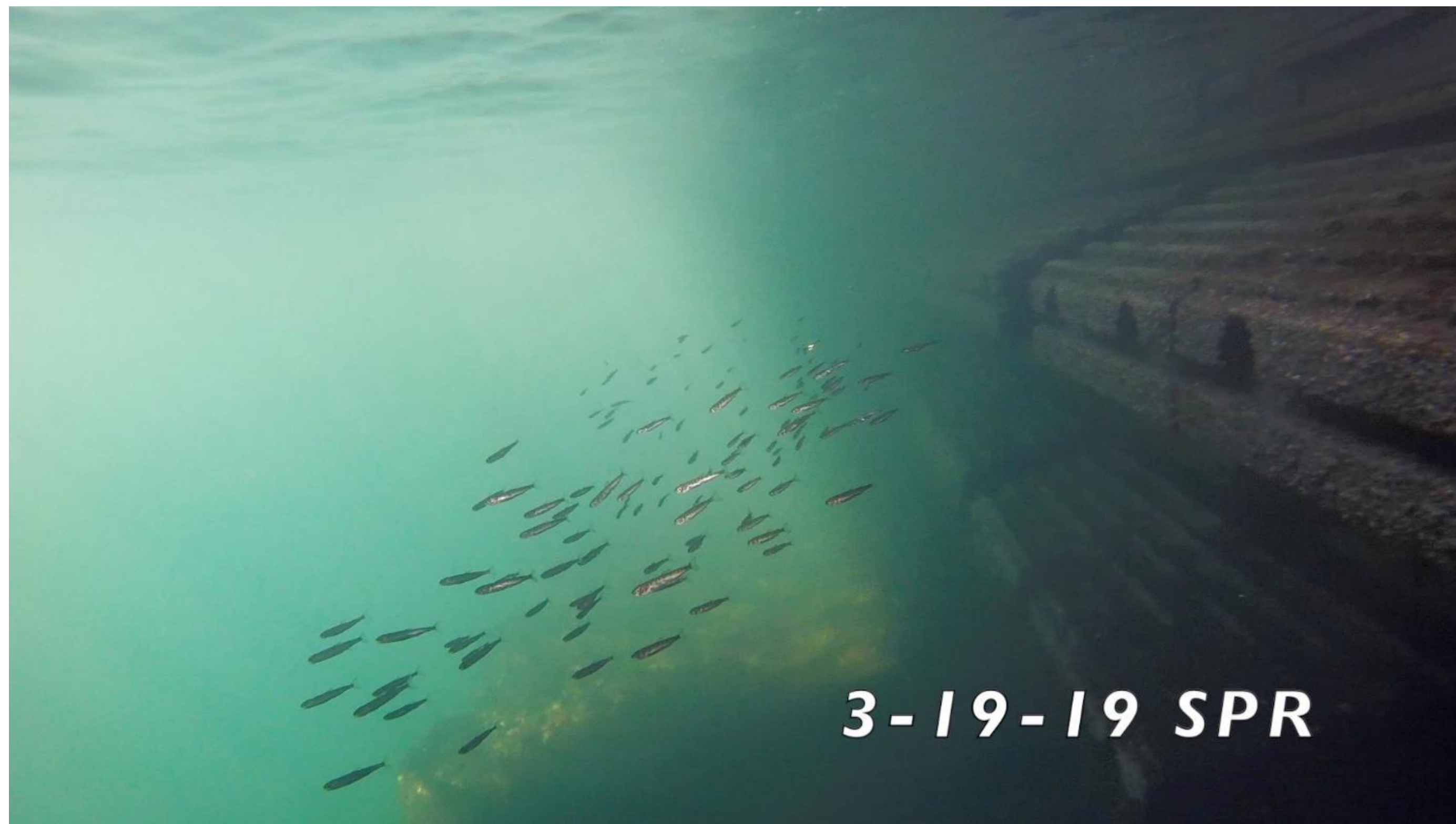
“Overall, we found that juvenile salmon were distributed more evenly across a spatial mosaic of habitats following eco-engineering... enhanced ambient light penetration in nearshore under-pier habitats, and juvenile salmon use of these habitats increased concurrently.”

Sawyer et al. 2020. Seawall as salmon habitat: Eco-engineering improves the distribution and foraging of juvenile Pacific salmon. *Ecological Engineering*



Sept  
2022

Juvenile chum  
salmon



Juvenile Chinook  
salmon

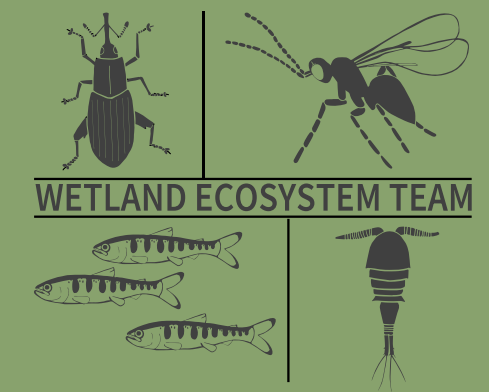


“UW Seattle  
Seawall 2021  
fish surveys”  
underwater  
videos on  
YouTube



# Thanks!

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<https://depts.washington.edu/wetlab/>  
Instagram – @uw\_wetlandecosystemteam

## Acknowledgements:

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