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Shoreline armoring removal: assessment of restoration effectiveness in the Salish Sea

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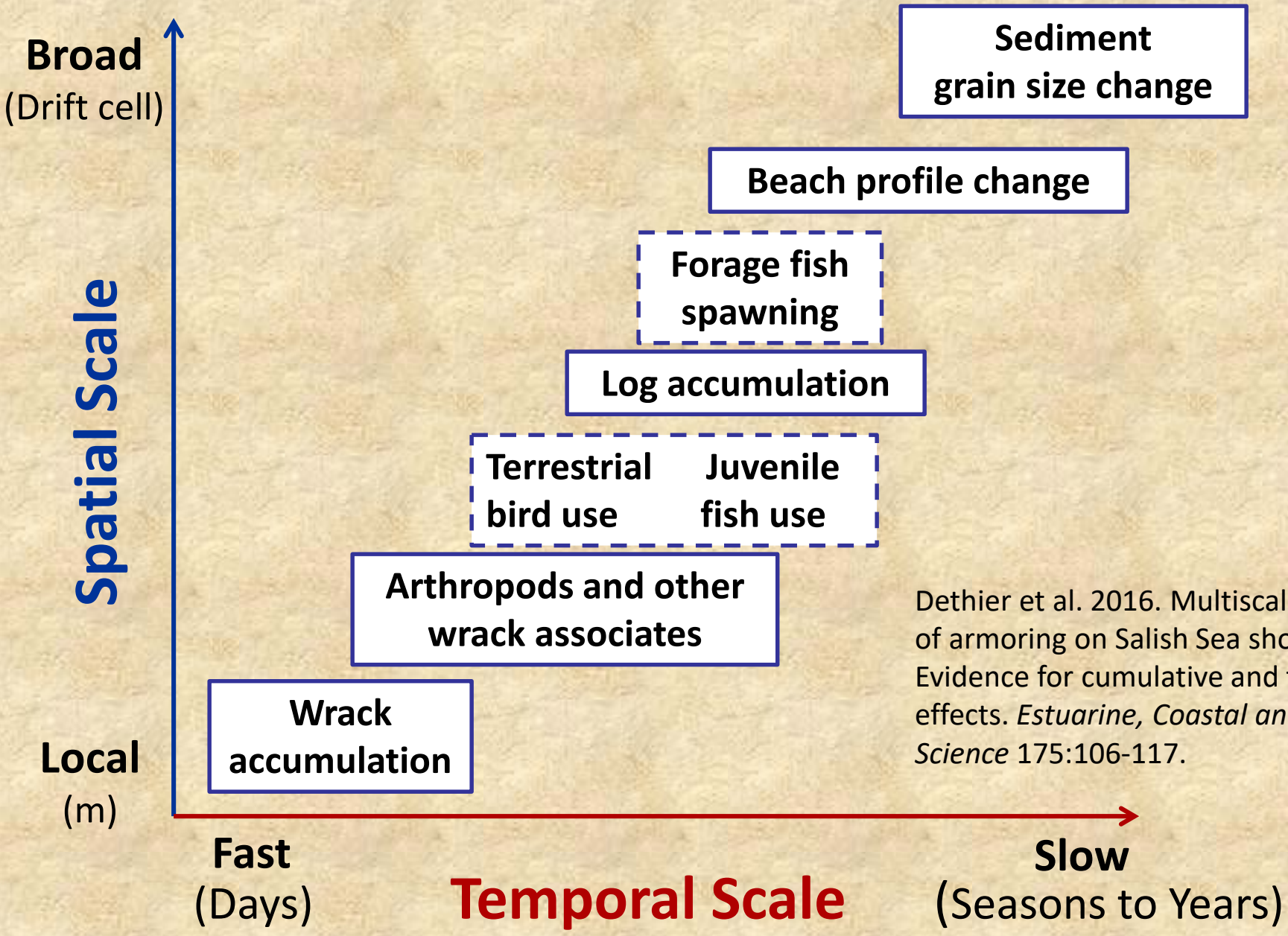
Sea Grant Washington

SHORELINE ARMORING

Erosion control practices using hard structures (e.g., concrete or wood walls, or rock riprap) that stabilize the shore and the bank or bluff behind it

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.

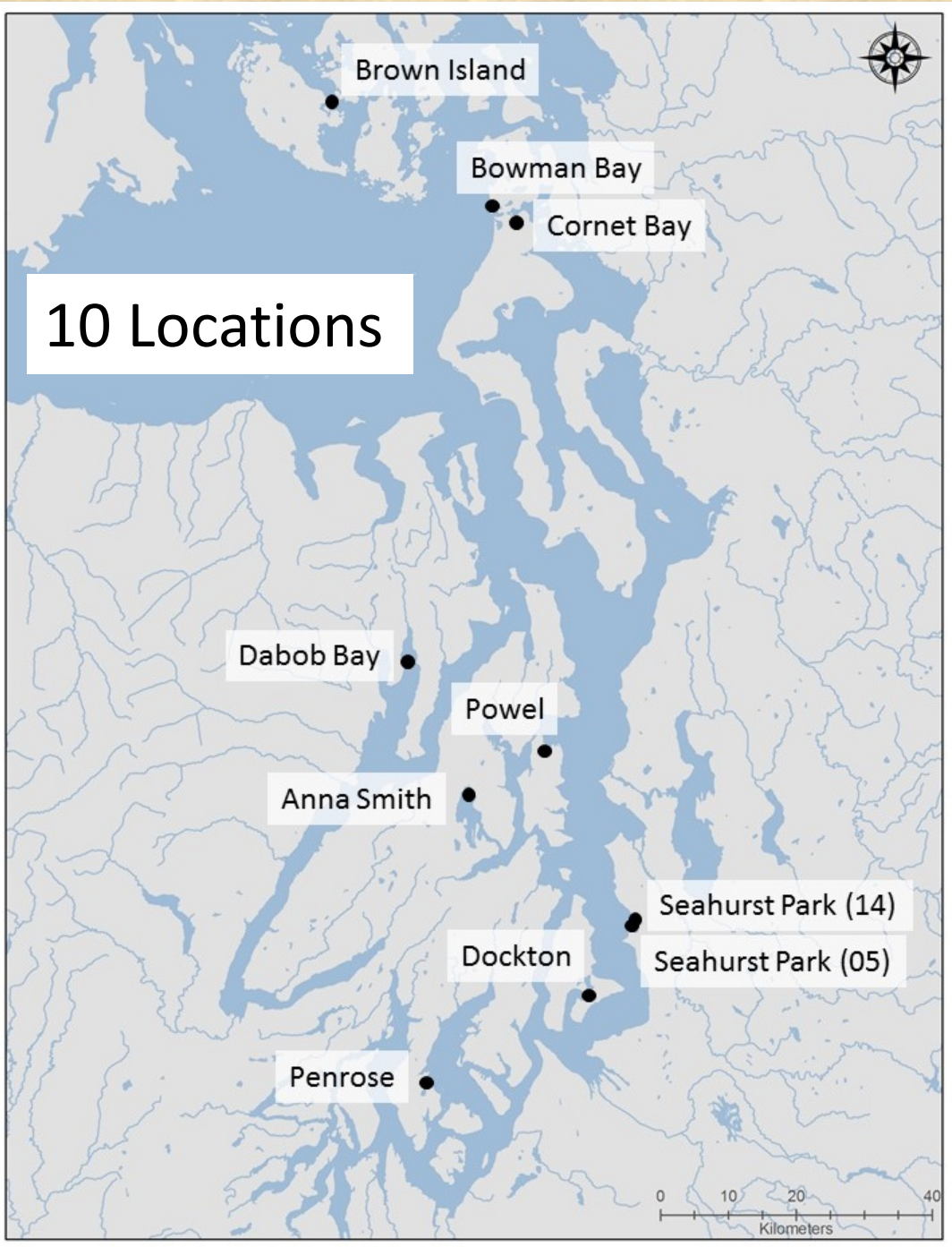
2016 Field Season

3 Strata

Restored

Armored

Reference



Restored Sites

Site	Year of Restoration	Years restored in 2016	Length of armor removed (m)
Anna Smith	2012	4	198
Bowman Bay	2015	1	165
Brown Island	2015	1	61
Cornet Bay	2012	4	250
Dabob Bay	2009	7	30
Dockton	2013	3	107
Penrose	2013	3	213
Powel	2012	4	30
Seahurst 2005	2005	11	335
Seahurst 2014	2014	2	549
	Average:	**4**	**194**

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

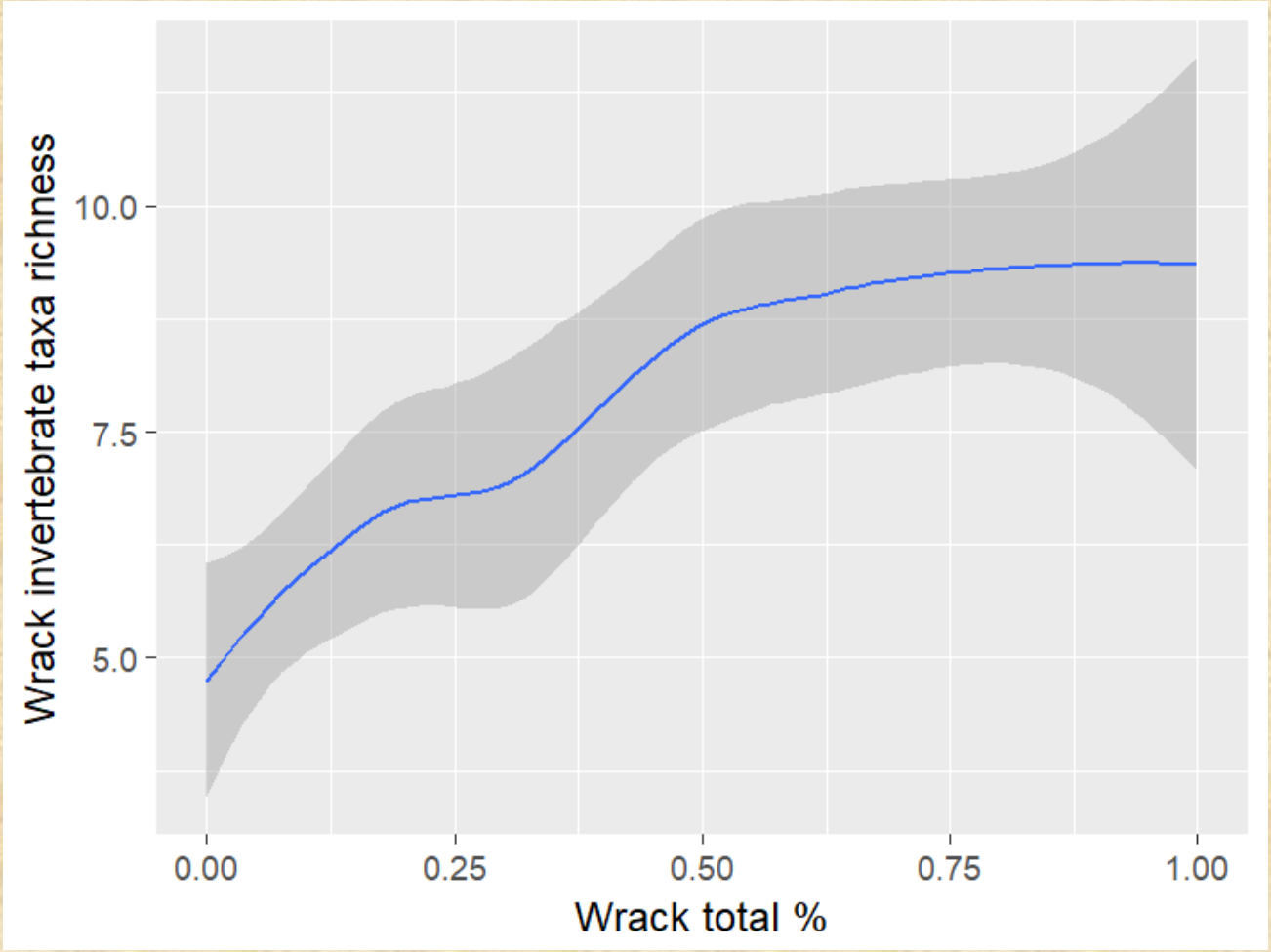
Enter the field data into computer spreadsheets. The percentages for each wrack type can be analyzed separately, or combined for a percentage of total wrack cover. The different wrack types give information on the source material available (e.g., riparian vegetation for terrestrial sources), and the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

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		■	
Wrack Width		■	■
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 Taxa Richness, Insect Taxa Richness, Sediment Sand %, Beach Width (m), Beach Slope, Wrack Relative Encroachment to MHHW, Fallen Tree #

Other parameters besides strata

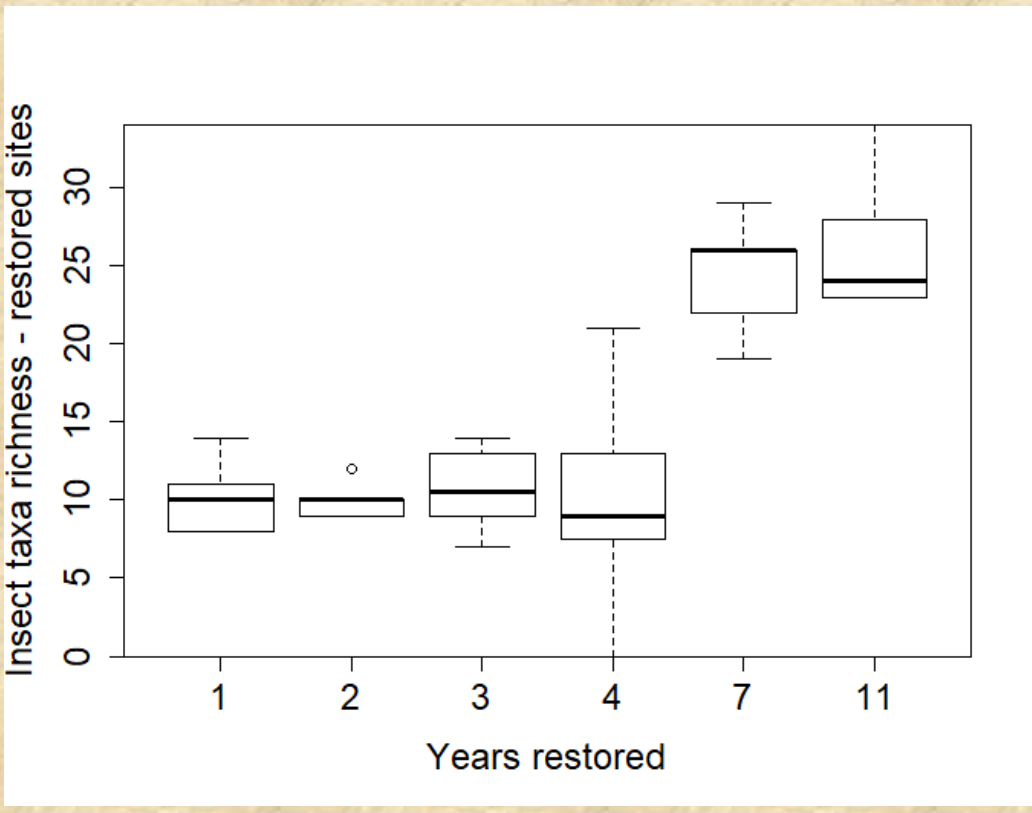


Restoration Trajectories

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

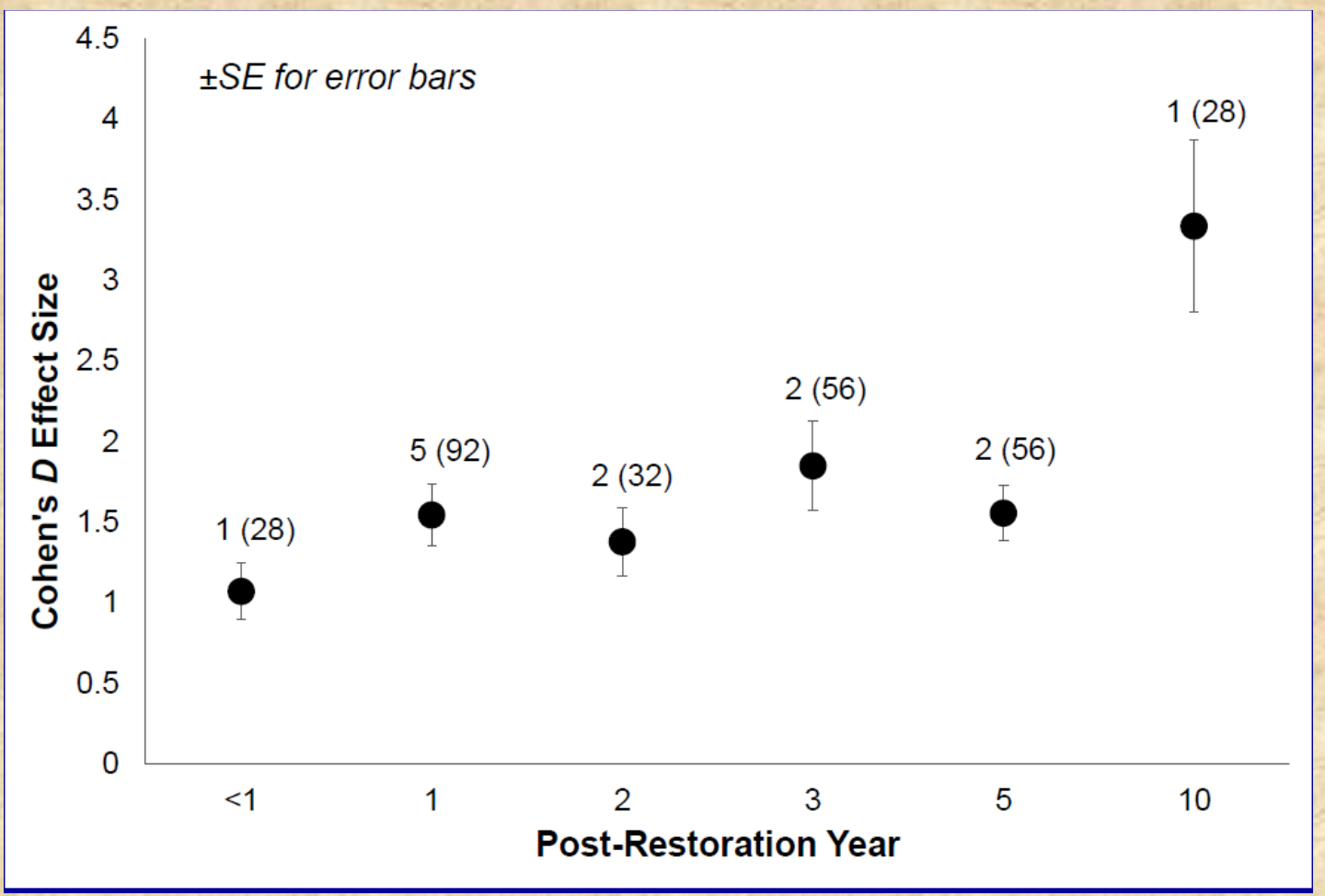
Both of these terrestrial associated metrics increased when beaches were restored greater than four years

* First discovery of surf smelt eggs at Bowman 5 years after restoration, at Cornet 2 years after restoration.



Restoration Trajectories

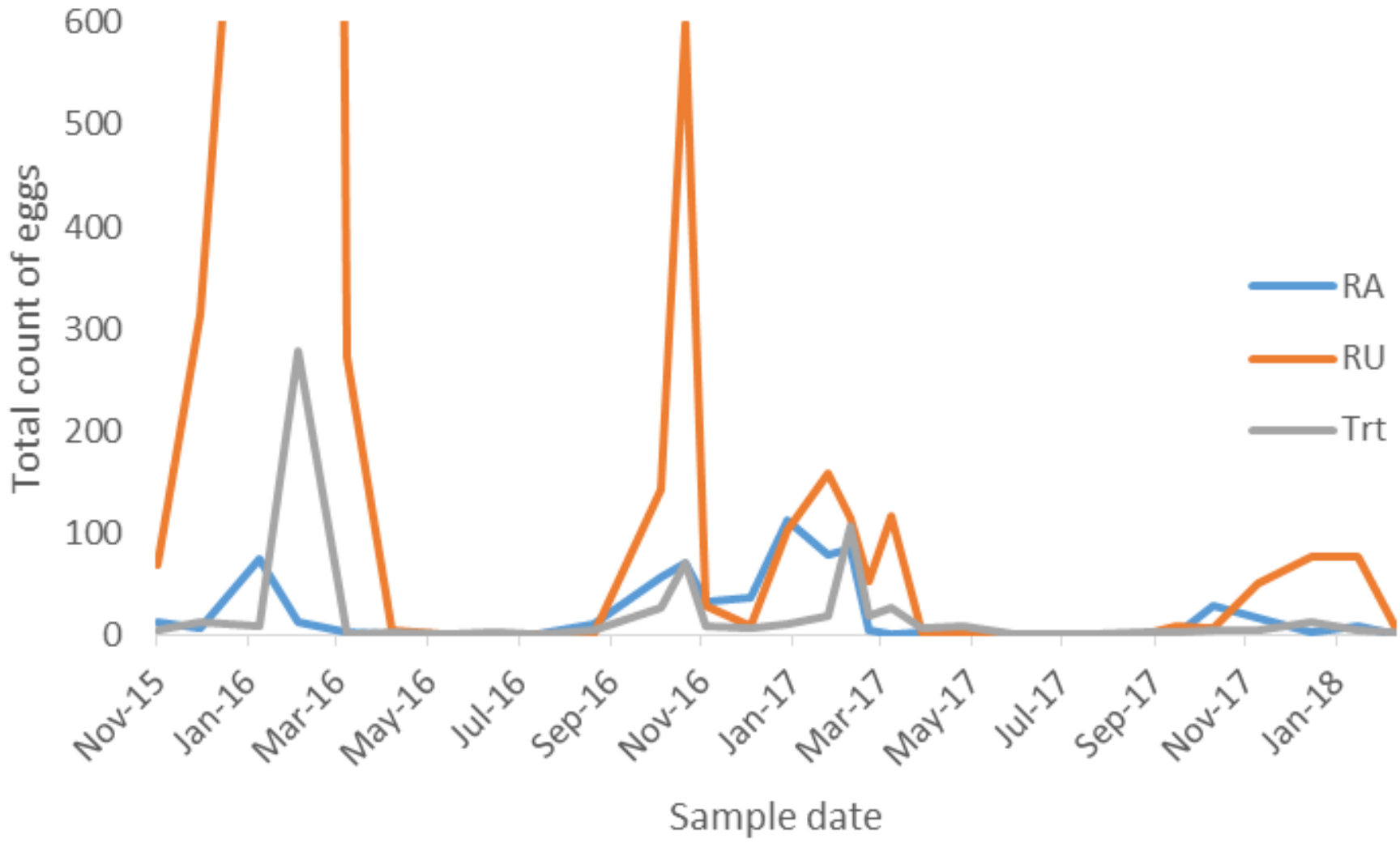
Similar response with meta-analysis of pre-post restoration data of 5 biotic measures at 6 sites in Puget Sound



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.

Edgewater – other sites with pre-post data

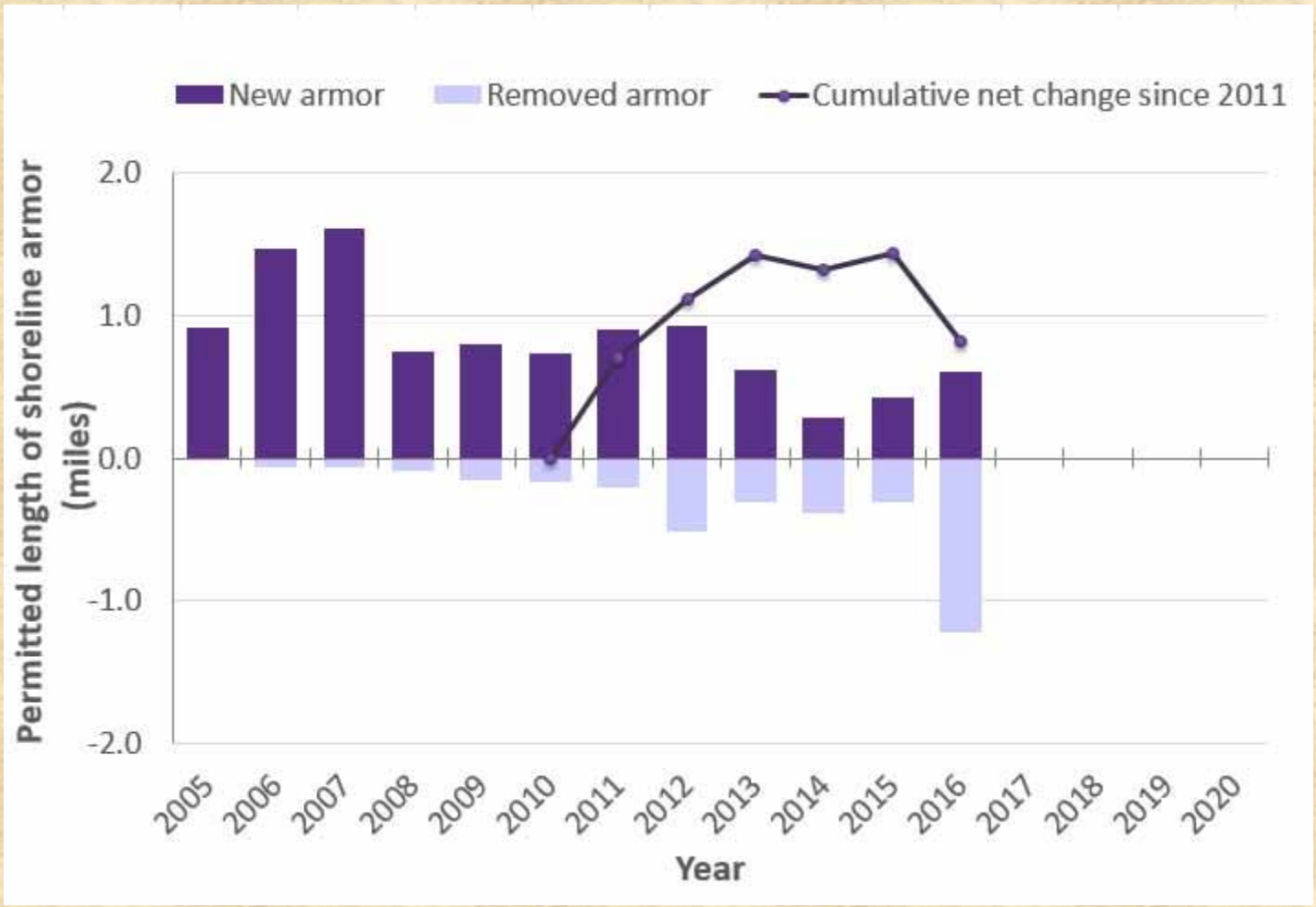
Edgewater – Total count of surf smelt eggs pre-post restoration in Oct 2016



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

- Restored sites are intermediate to armored and reference conditions (short term).
- Signs of improved restoration trajectory for terrestrial-associated metrics through time, and forage fish spawning.
- Need for long-term monitoring, including other restoration details such as soft-shore techniques.

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Washington