

Railroad Grade Beach Nourishment Study

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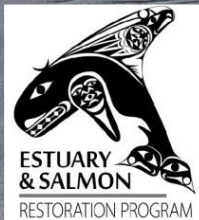


Photo: Phil Bloch

Shoreline Armoring Team

for prior studies

Jason Toft, UW School of Aquatic and Fishery Sciences

Sarah Heerhartz, School of Aquatic and Fishery Sciences, UW

Jeff Cordell, SAFS, UW

Andrea Ogston, Oceanography, UW

Aundrea McBride, Skagit River System Cooperative

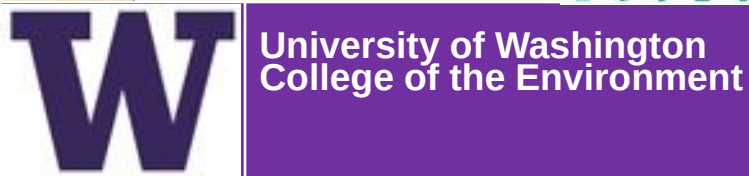
Eric Beamer, Skagit River System Cooperative

Helen Berry, Washington Dept of Natural Resources

Wendel Raymond, Friday Harbor Labs

Hugh Shipman, Washington Dept of Ecology

Funders



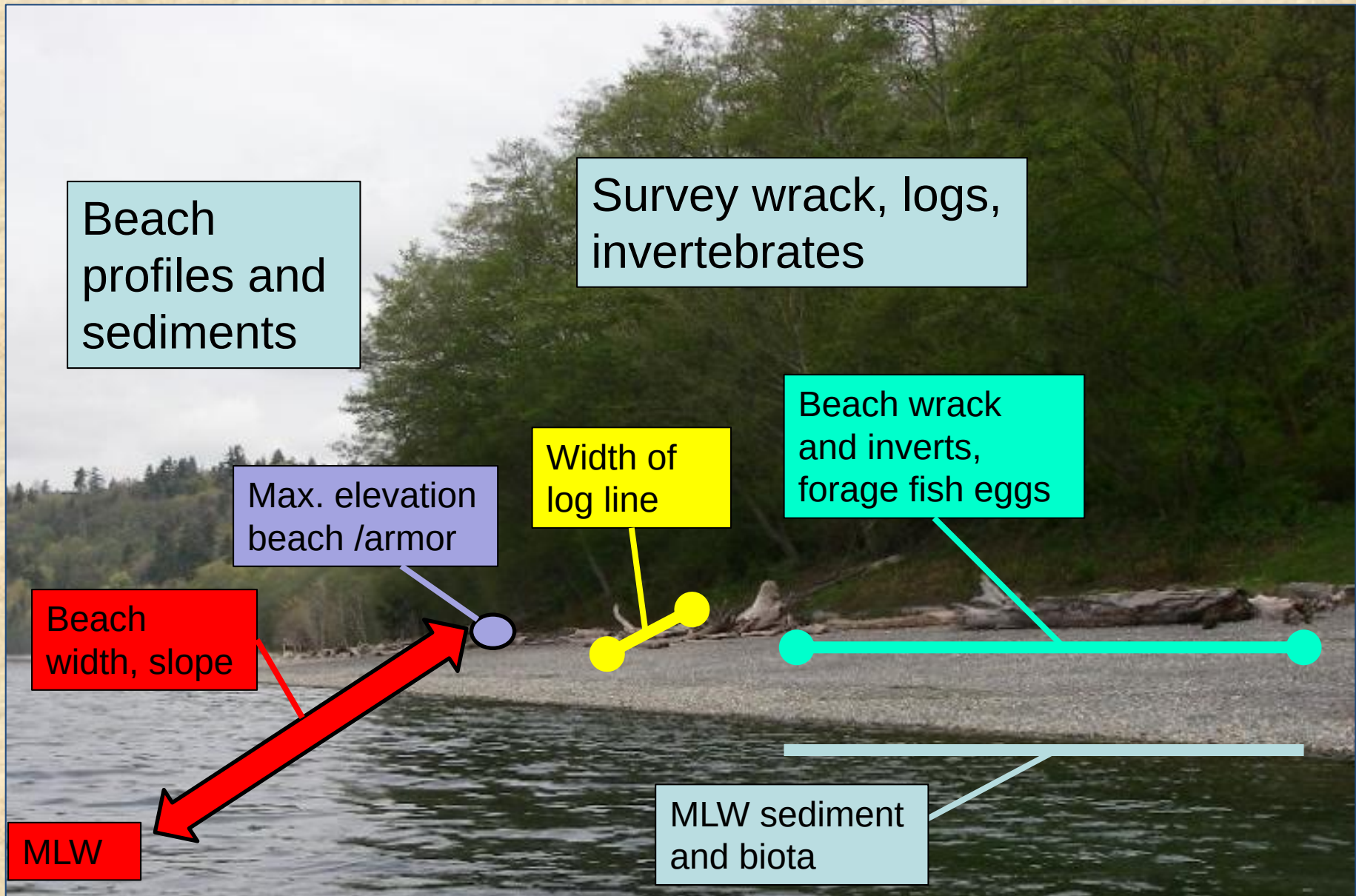
Most photos are
Hugh Shipman's!

Impacts of shoreline armoring:

- Relatively well-known for open-coast sandy beaches
- Poorly demonstrated for gravelly inland seas like the Salish Sea



Overall Methods



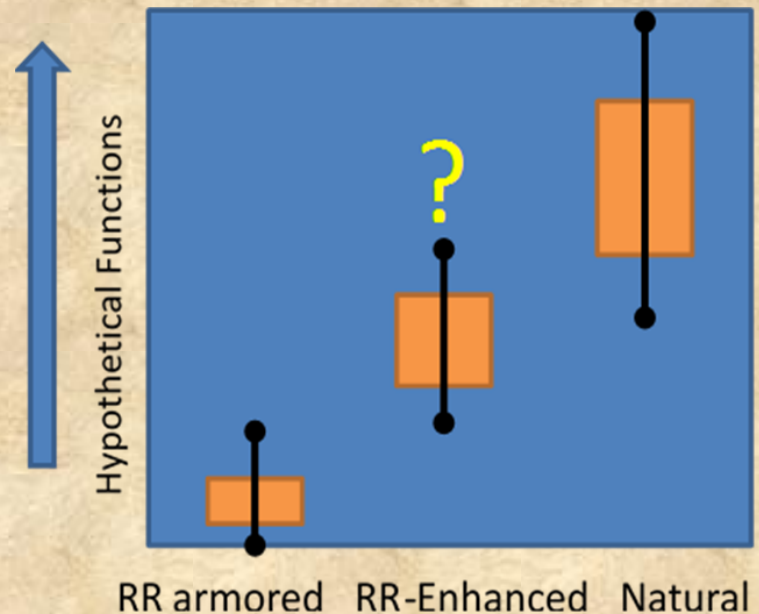
Overall, at those 65 sites we found armored sites had:

- Narrower, less shady beaches
- Slight trend towards steeper beaches with fewer fine sediments, especially in heavily-armored drift cells
- Less organic debris and fewer logs
- Fewer wrackline invertebrates overall
- Fewer talitrid amphipods
- Fewer insects in fallout traps
- Little change at Mean Low Water



But many questions remained from this work:

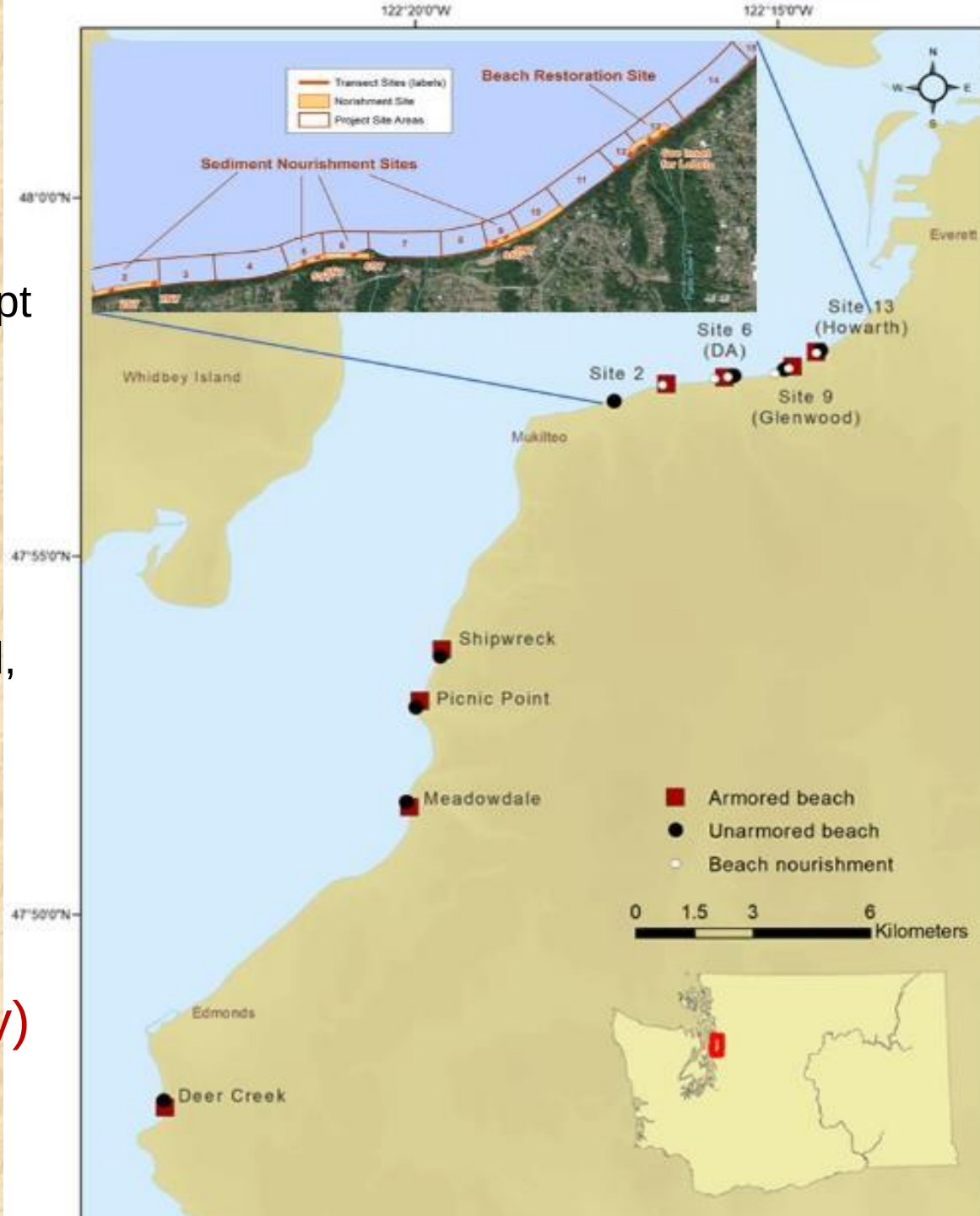
- Cause and effect?
- IF cause and effect, how rapidly do these changes occur following armoring?
- Can changes be reversed with restoration?
- When, where, how is restoration most effective?



4 pairs of site in the
Nourishment area:
Study impacts of adding
sediment without other
management measures (except
at Howarth Park)

4 pairs of sites to the
south, no nourishment:
Controls: monitor temporal
changes over the same period,
with no local restoration

Same parameters
monitored at all sites
except for forage fish
sampling (north sites only)



Site 13

Un-Armored



Site 13 – w/ Howarth Park (Armored)



Site 9 – ~310 feet/ 4500 cy

Pre-



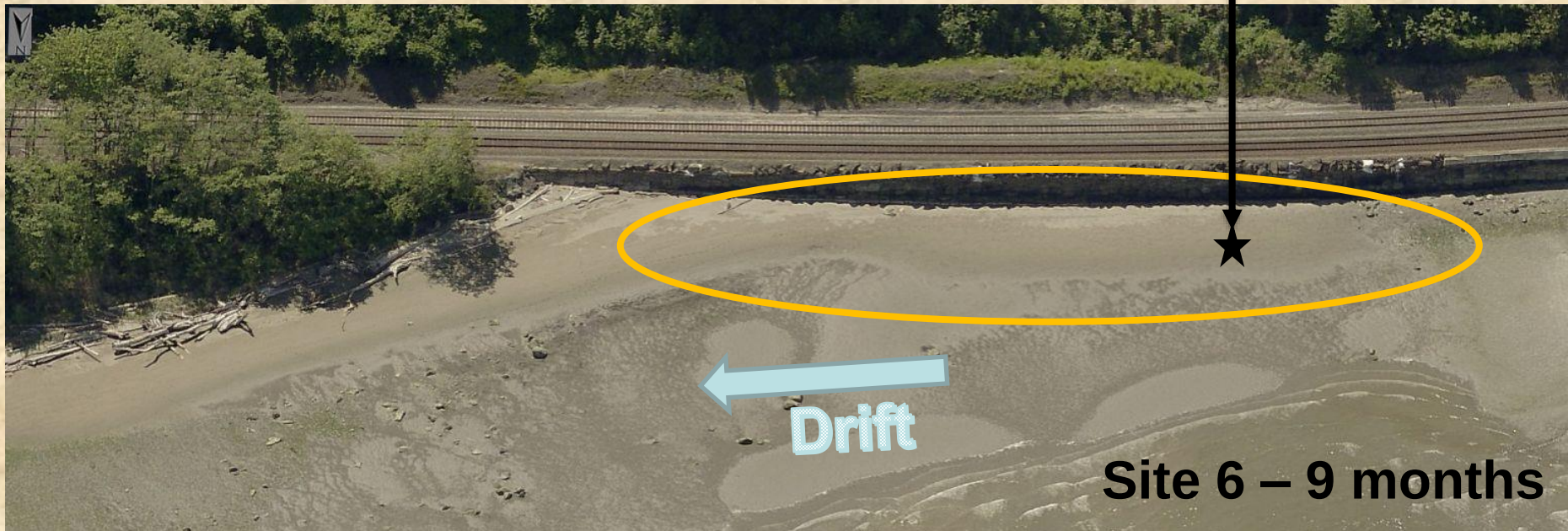
As-Built



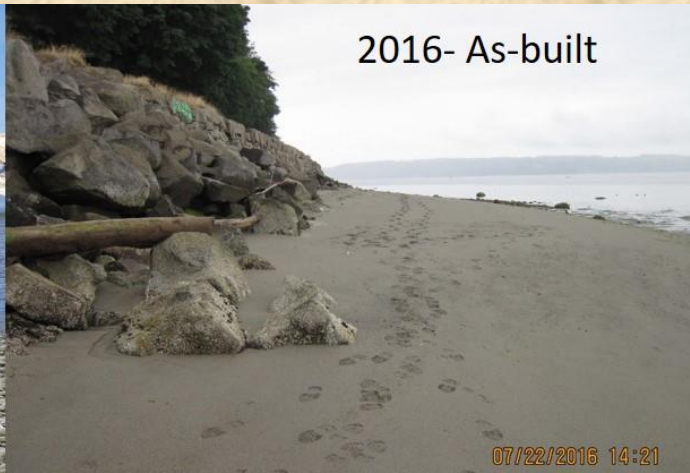
Post- 35 months



Site 6 – ~270 feet/ 2900 cy



Site 2 – ~305 feet/ 2300 cy



A photograph of a beach with large logs and researchers. The scene shows a sandy beach with several large, weathered logs scattered across it. In the background, a group of people are standing near the water's edge. The foreground is dominated by the logs and the sand. The text 'Methods' is overlaid on the left side of the image.

Methods

- Profile
- Substrate
- Topography

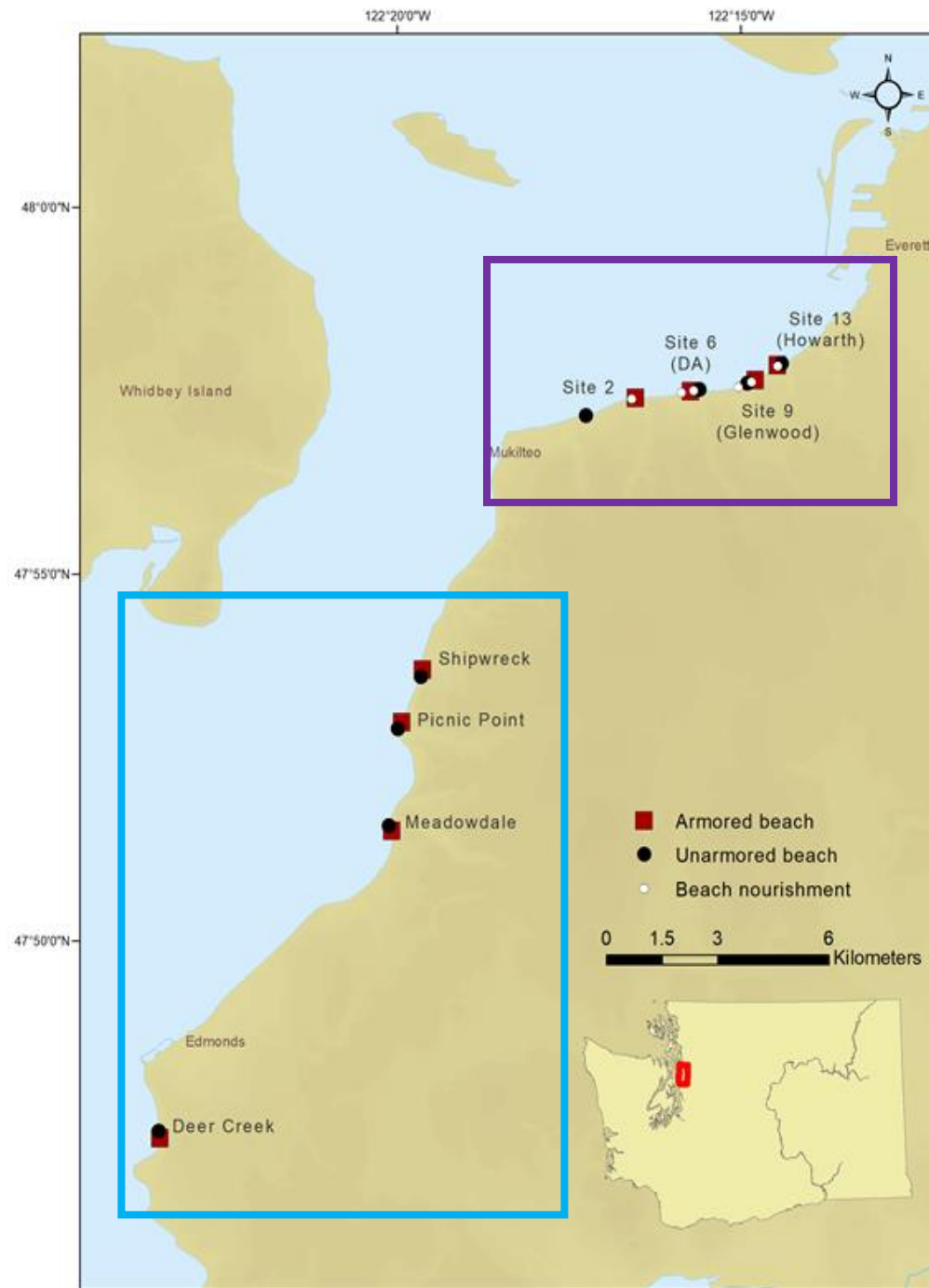
PHYSICAL PARAMETERS

Changes associated with nourishment

- Wider
- Less steep
- With more sand

Differences associated with armoring

Regional patterns



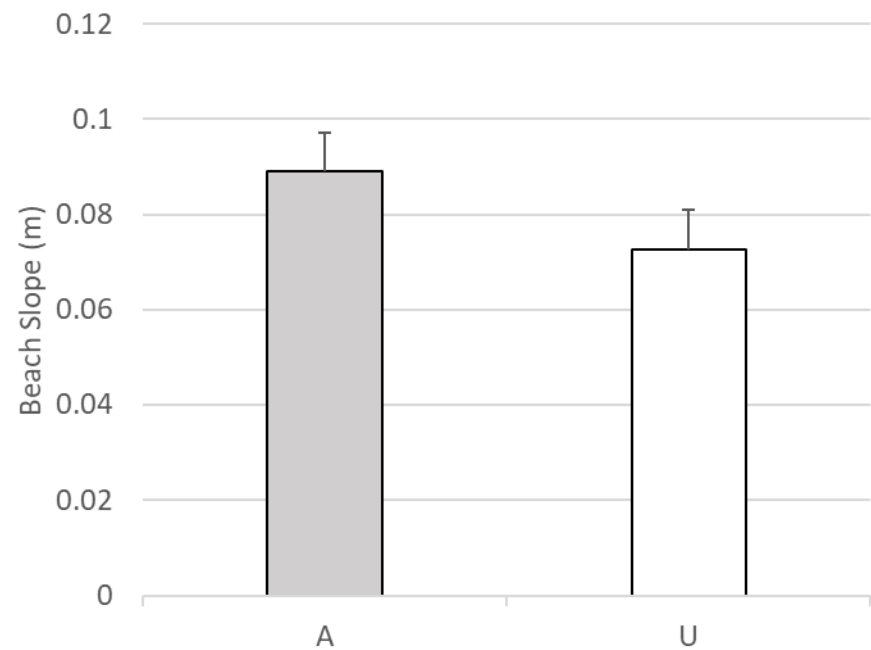
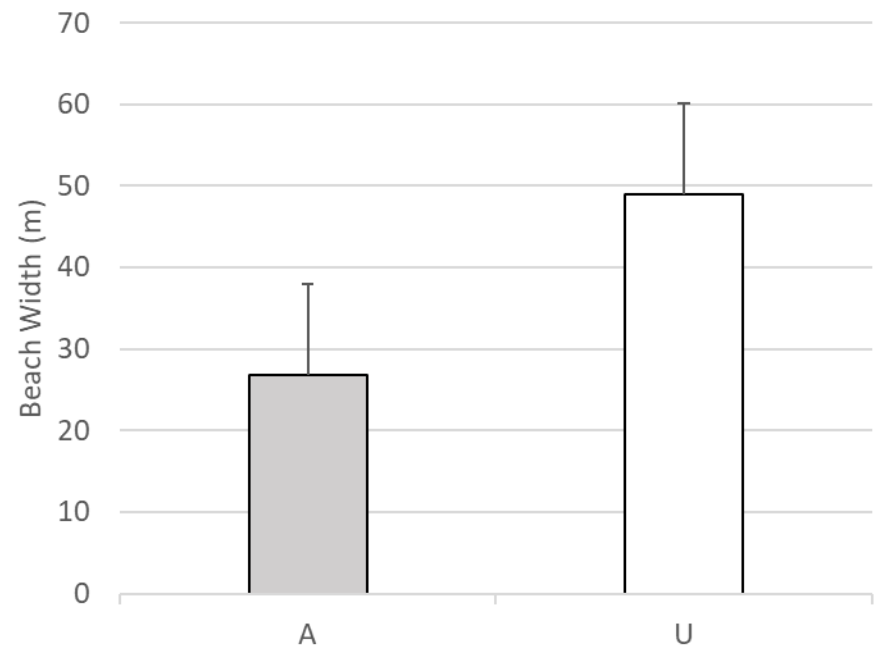
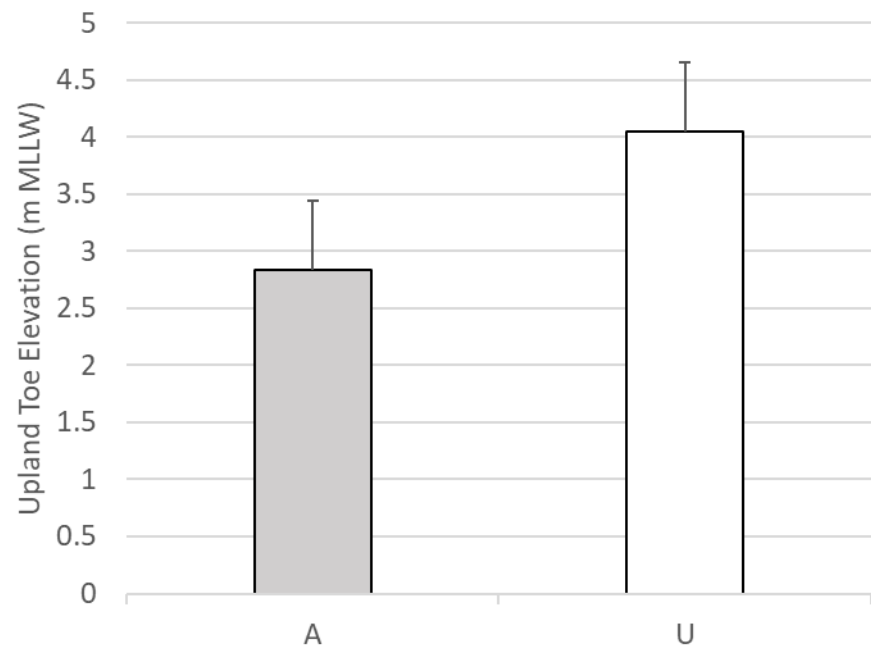
Nourishment Region

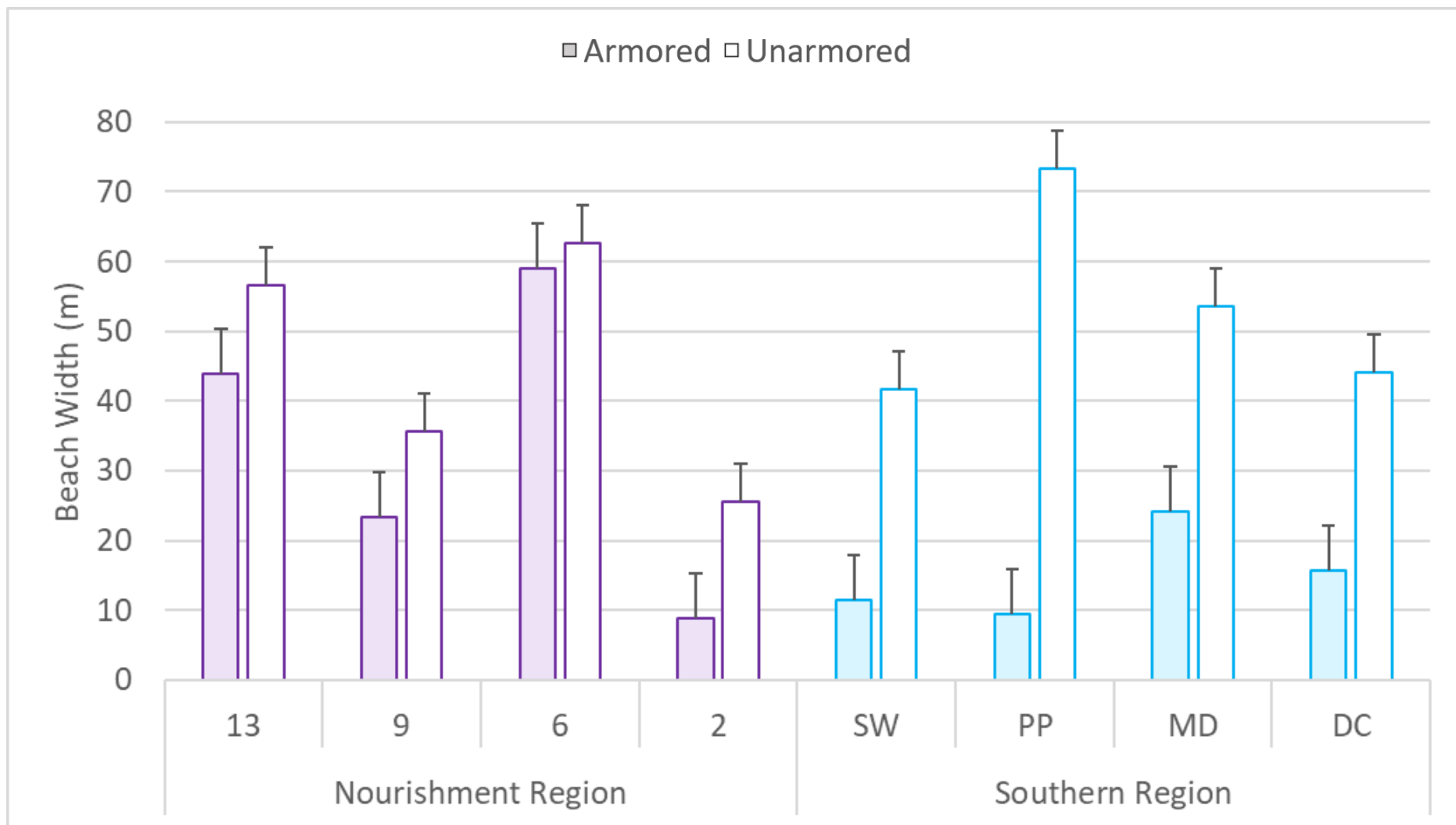
LOWER TOE ELEVATION

NARROWER WIDTH

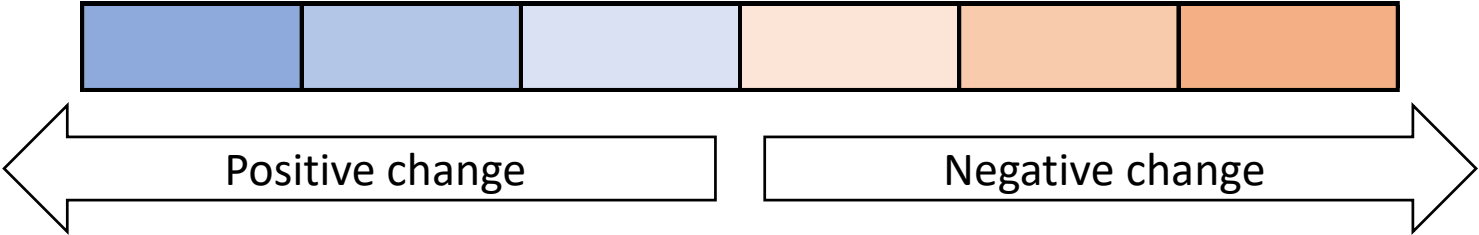
STEEPER SLOPE

Southern Region





	Northern Region		Southern Region	
	Armored	Unarmored	Armored	Unarmored
Toe elevation (m MLLW)				
Beach width (m)				
Beach slope (m)				
Percent sand				
Percent surf smelt				
Percent sand lance				

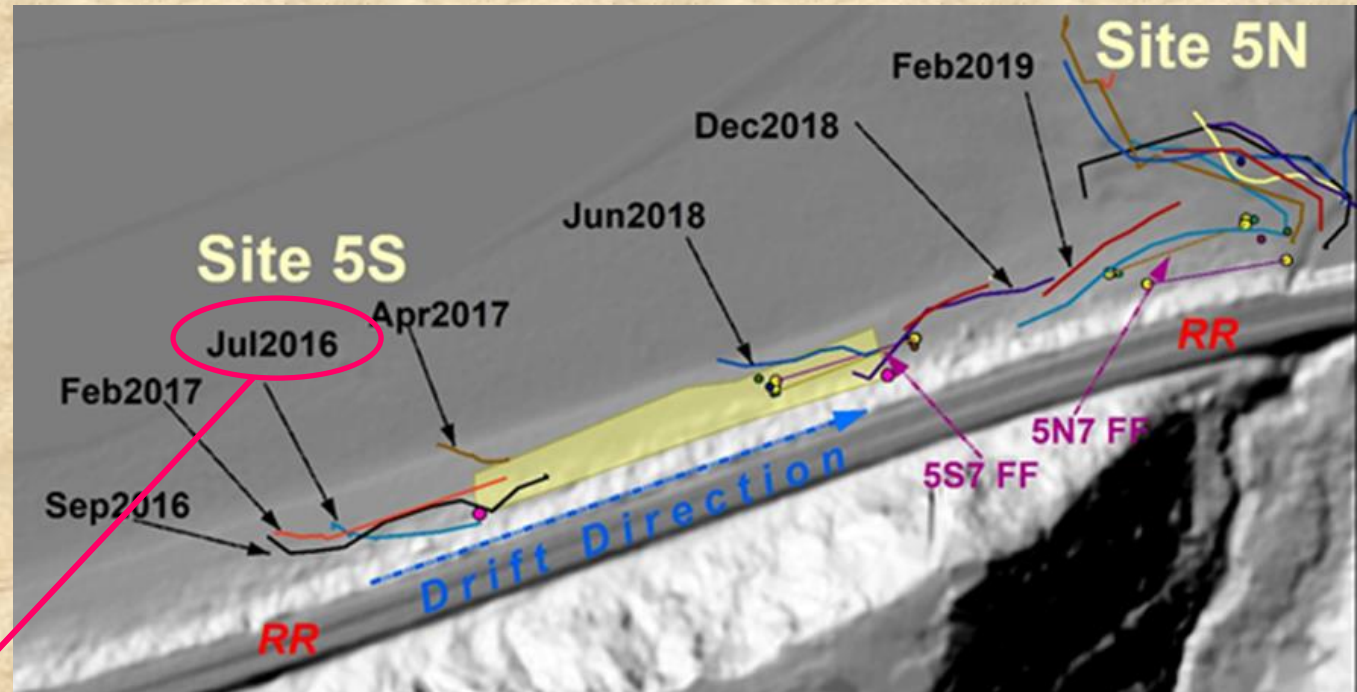


Forage fish substrate size suitability from nourishment

- Bulk samples from 13 forage fish sites, 4 yrs PRE/ 4 yrs POST (2012-2020), monthly Sept-Feb.
- Photo points of same; GPS-based drift maps
- Sand lance/Surf smelt substrate size suitability (Penttila 2007)
- Treated (Nourished) vs. Downdrift (100-200m)
 - Sites 13, 9, 6, 5, 2
- Pre- vs. Post-Nourishment (monthly) timeframe

Drift Mapping – Site 5 (300ft/ 3000 CY)

- Dec 2018 all sand had exited placement area
- Drift rate was $\cong 102$ cy/month.



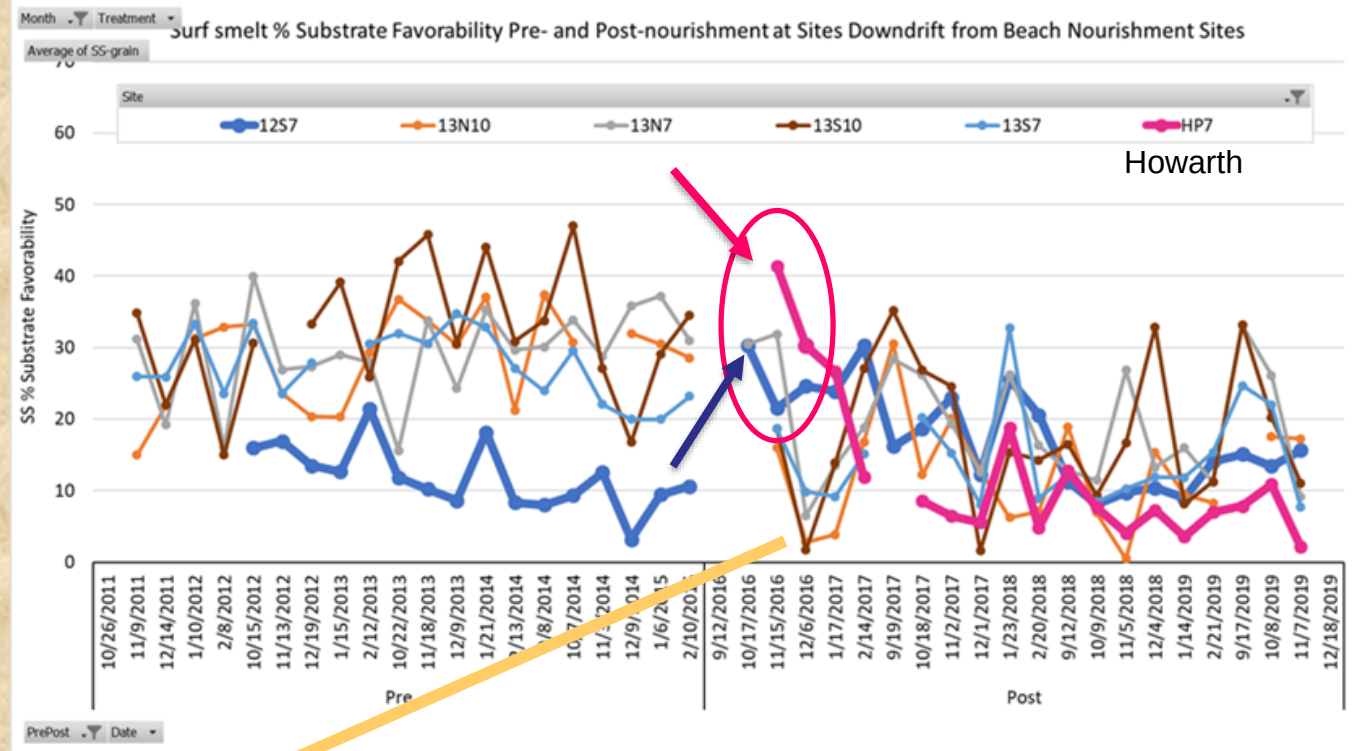
DOWN-DRIFT SITES WITH ACCRETING SHOREFORM



DOWN-DRIFT SITES IN TRANSPORT ZONE



Surf smelt
monthly
suitability –
Site 13,
Howarth/
12S



Nov 2014

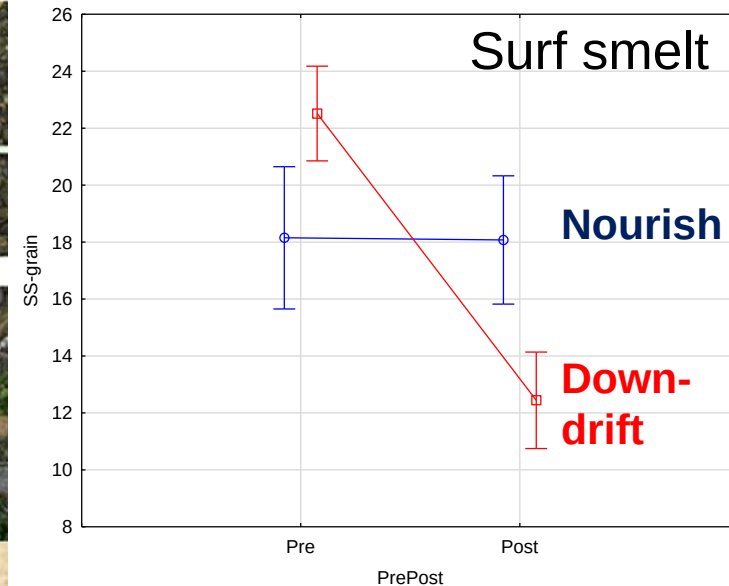
Nov 2016 – 4 months post-proj

Nov 2017

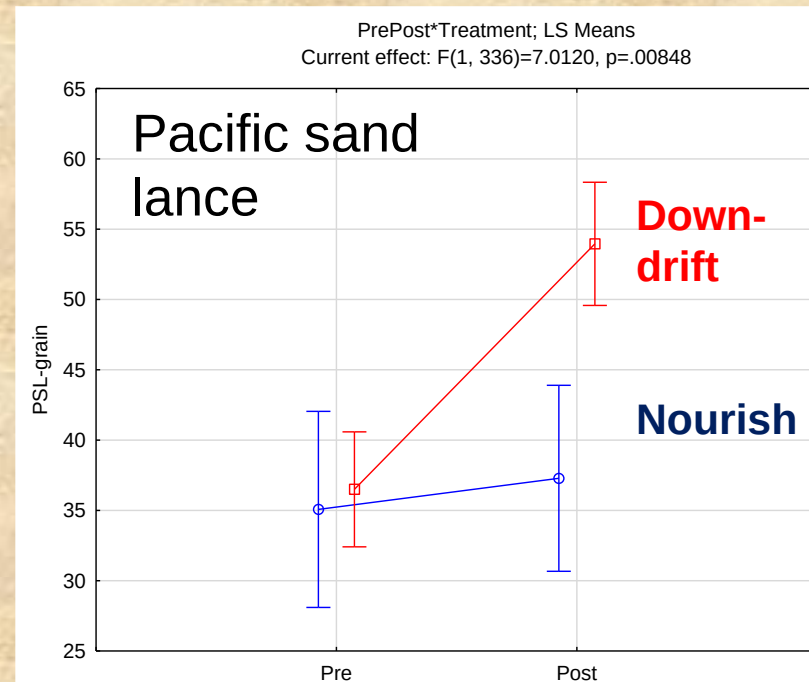
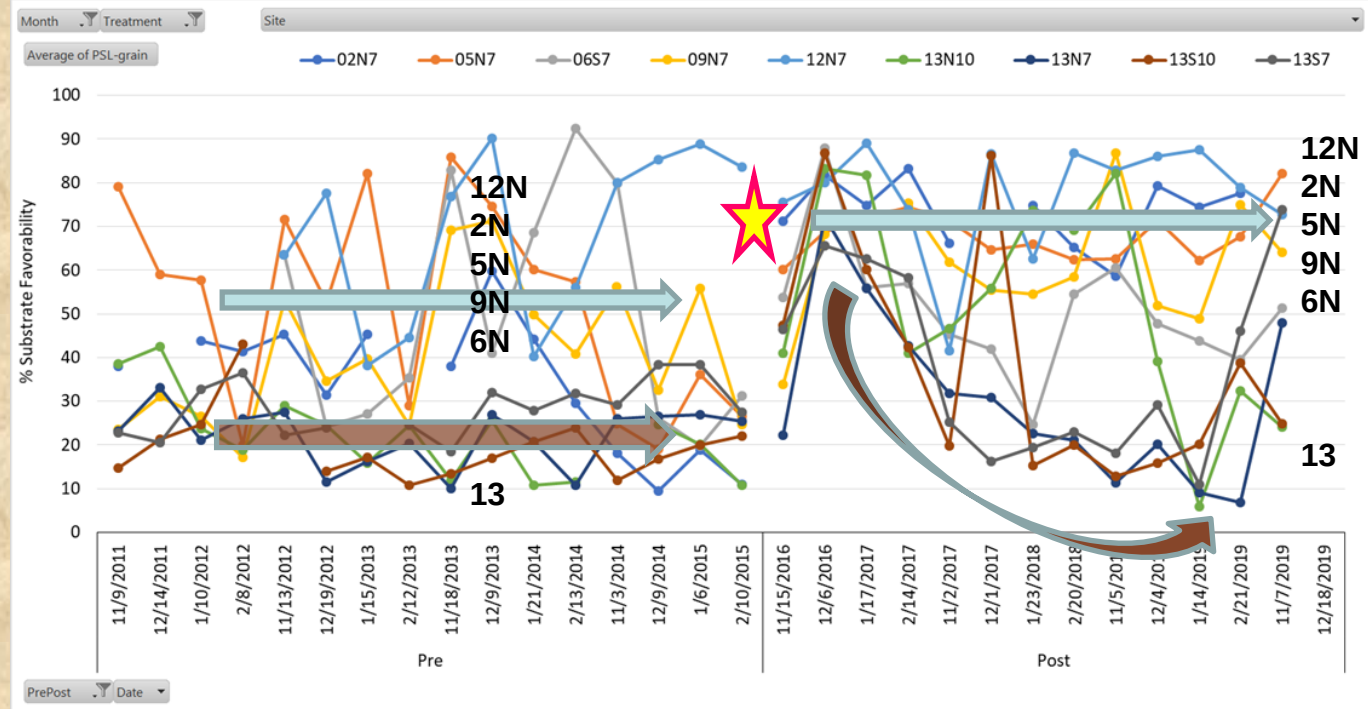
Nov 2018



PrePost*Treatment; LS Means
Current effect: $F(1, 489)=22.753, p=.00000$

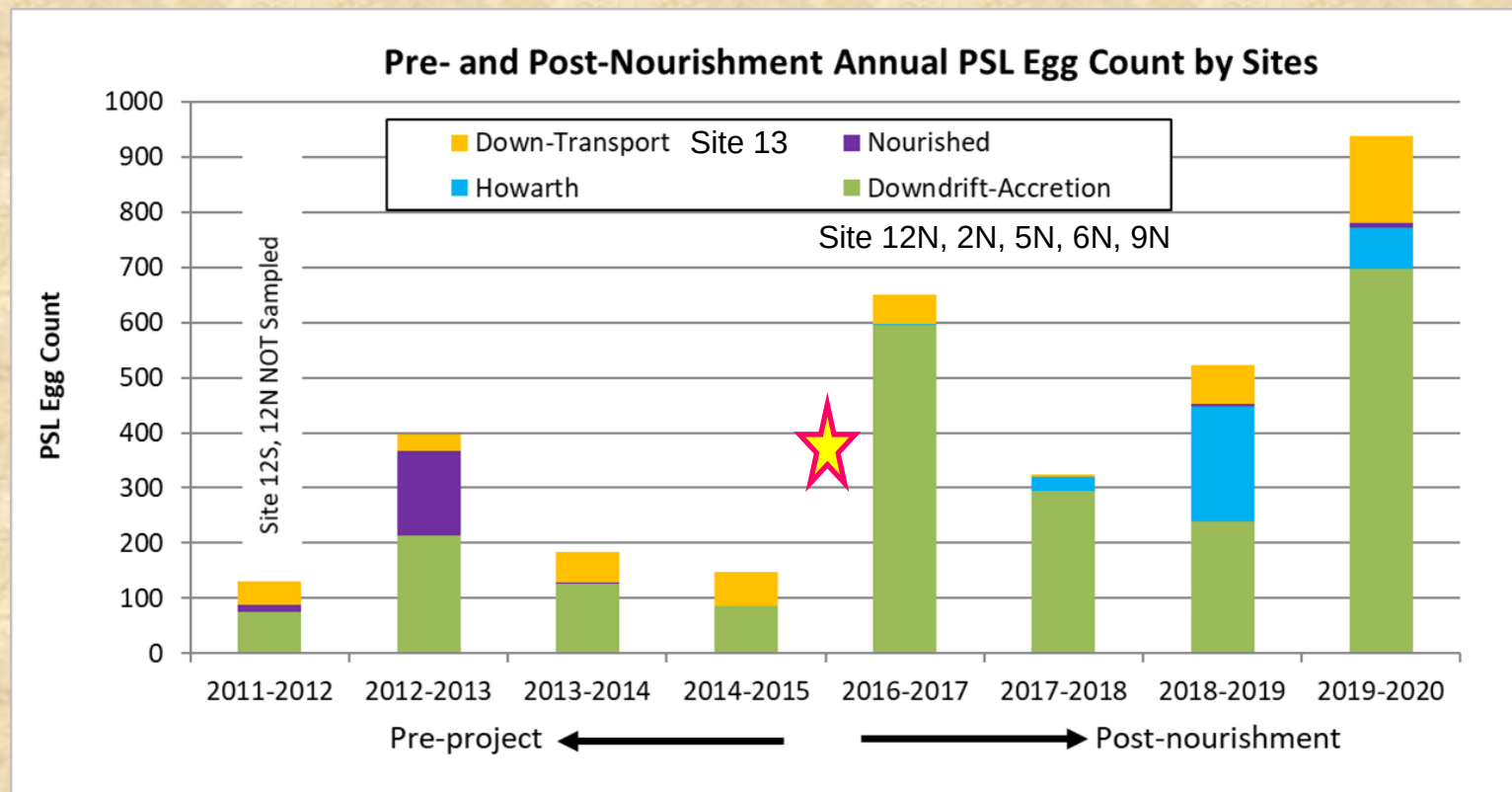
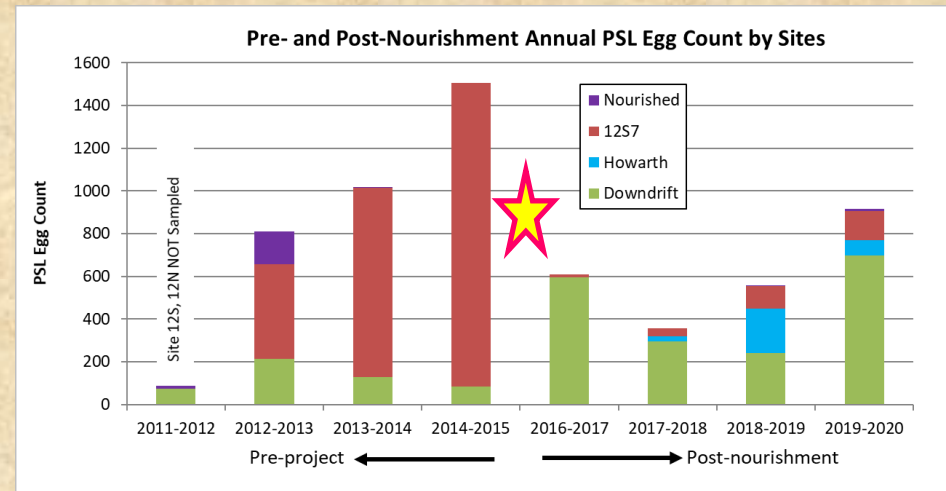


PSL monthly suitability at down-drift sites



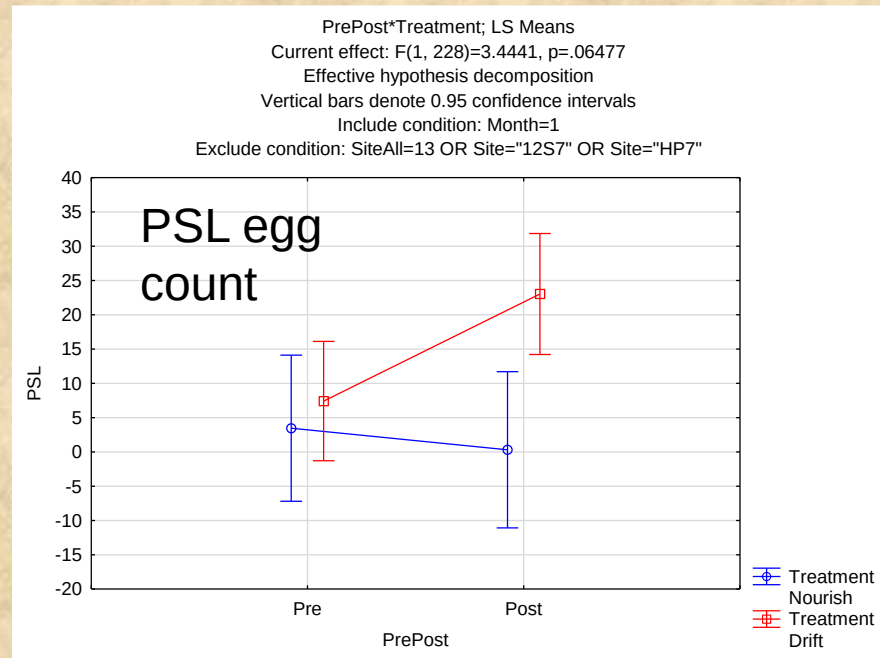
PSL egg count

- PSL eggs / suitability declined at 12S
- Egg count rose in downdrift sites w/ Howarth also in out-years



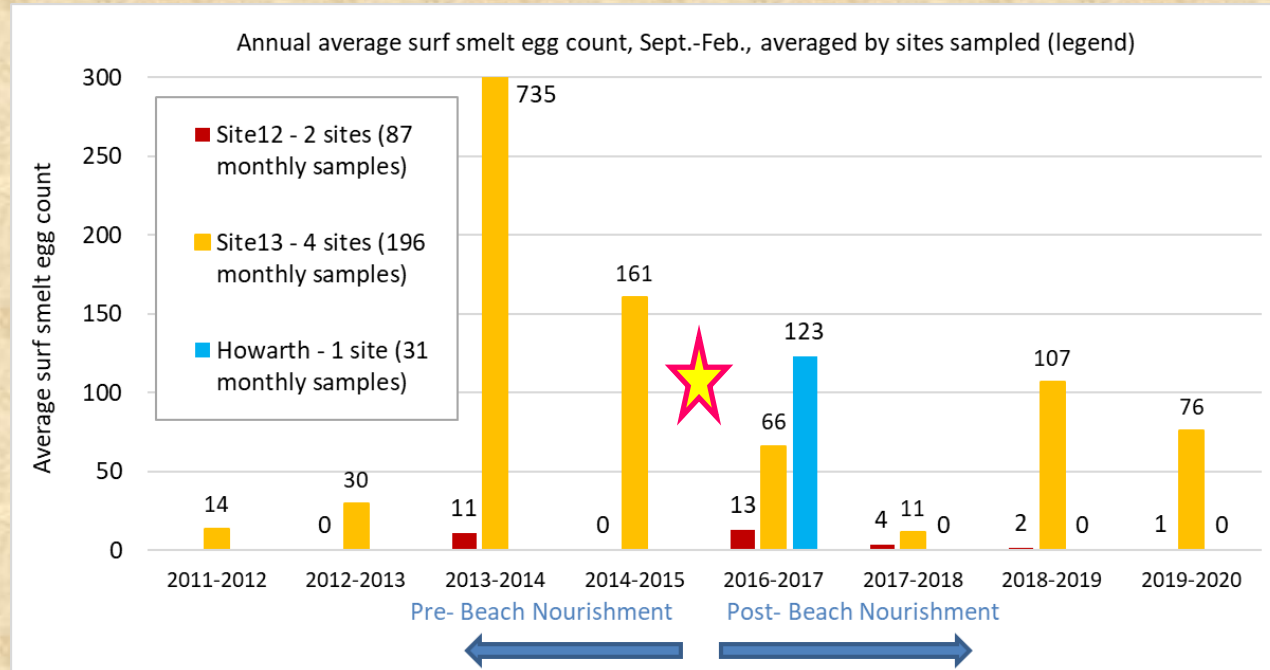
PSL Egg Count

- Pre*Post & Nourish*Drift interaction effect $p=0.065$



Surf smelt

- Initial Howarth response w/ increase in substrate size
- Apparent affinity for Site 13 w/ lower suitability



Beach Wrack, Logs, Wrack Invertebrates

ensia

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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.



WRITER
Maria Dolan

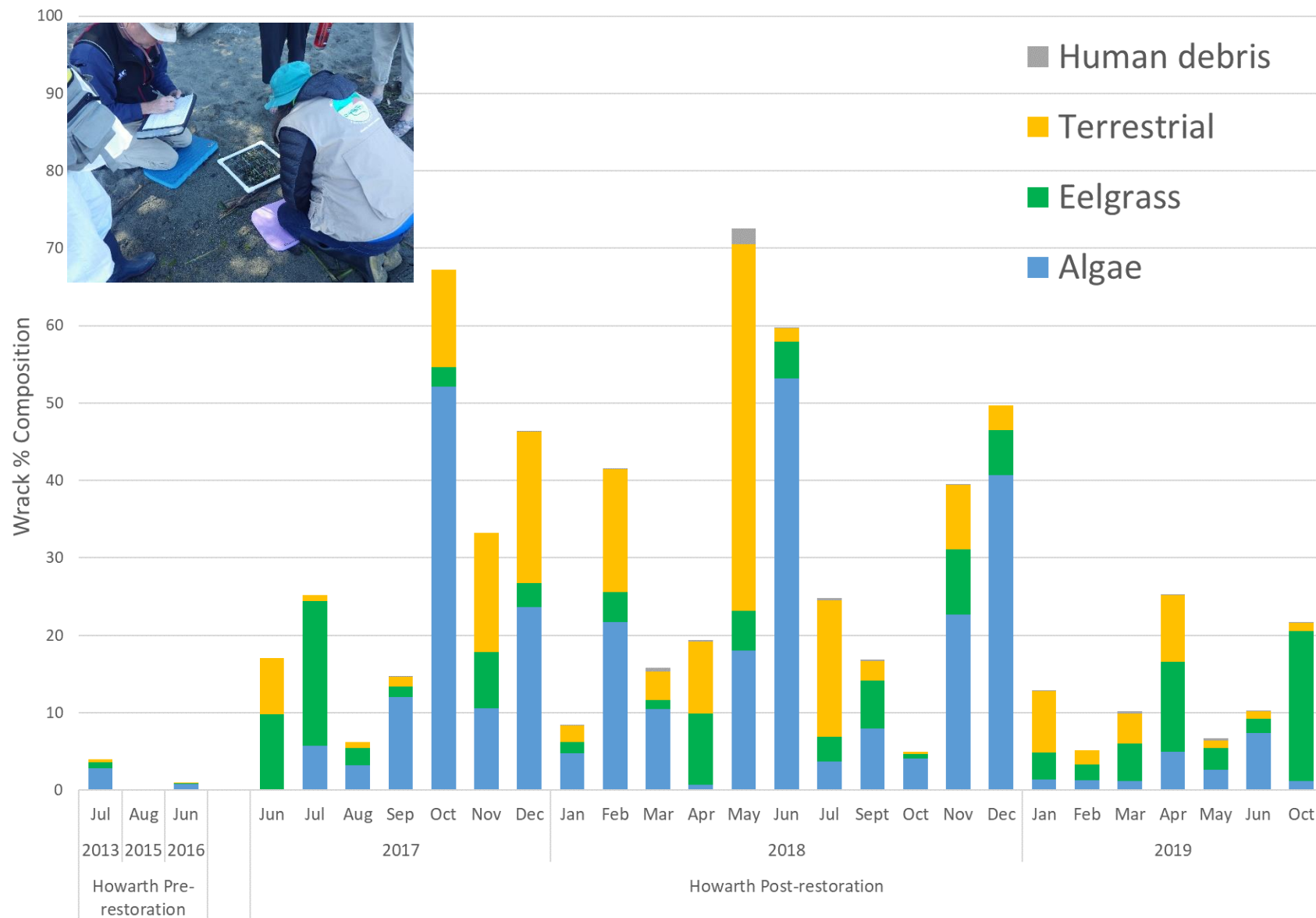
March 5, 2018 — On a blustery January day at Seahurst Park, a tree-fringed shoreline in the town of Burien just south of Seattle, Jason Toft searches for a promising beach log among the many specimens at hand. Beachgoers sit or climb on top of these washed-up pieces of wood, but Toft, a research scientist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

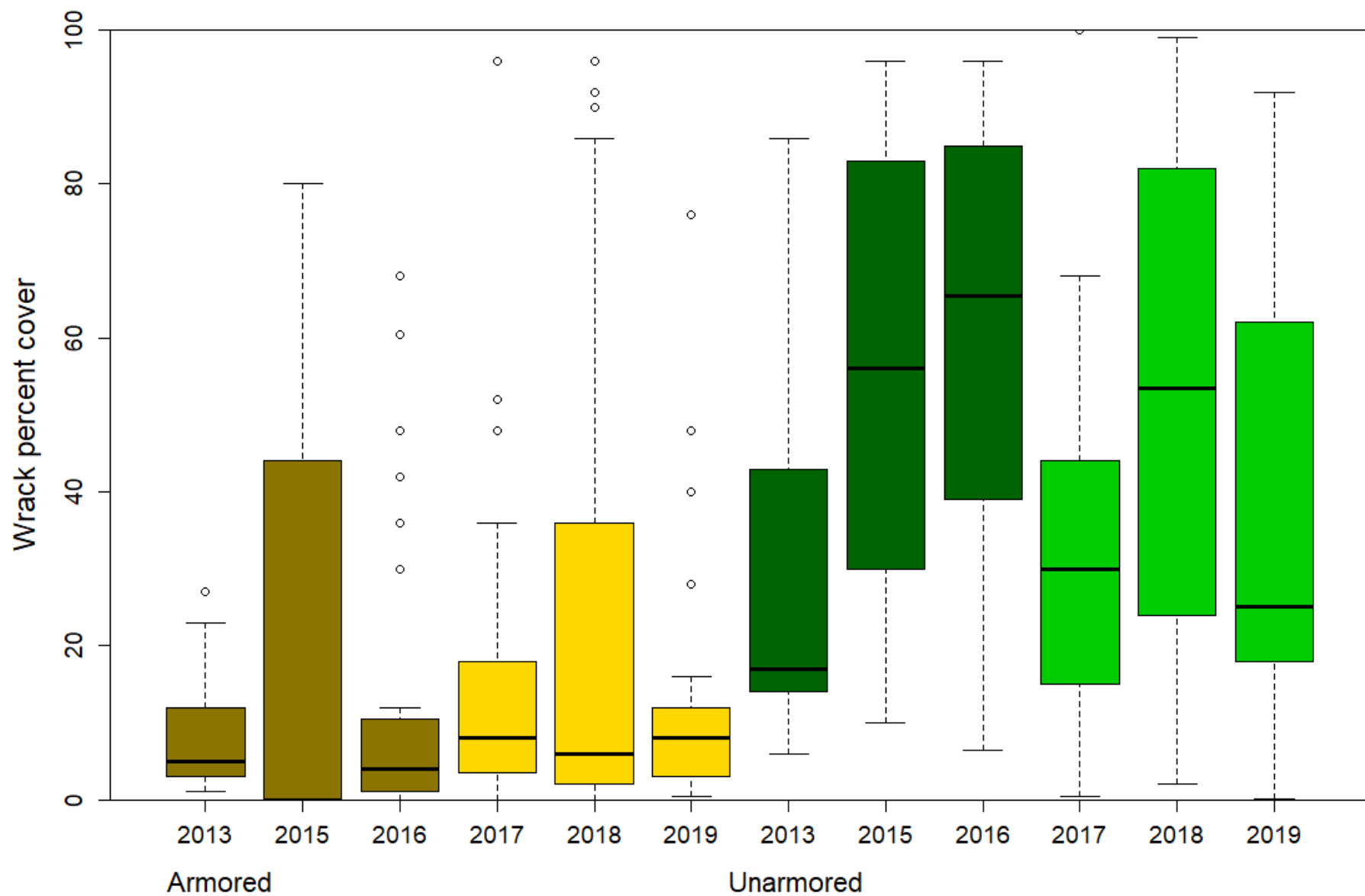




Howarth Park – Monthly sampling of the wrack line post-restoration by Beachwatcher volunteers



Wrack Total Percent Cover at Nourished Sites



Summary of Statistical Tests

Table 9. Summary of statistical evidence of sediment nourishment effectiveness for wrack and log measured parameters, comparing armored versus unarmored and before versus after nourishment. Blue shading or font indicates a positive response, orange negative, and white no effect.

Over all 4 sites	Specific site responses
Total % wrack	Site 13, Site 2
Wrack width	
Wrack depth	Site 13
Log number	Site 13, Site 6
Log width	
Wrack total inverts*	Site 9, Site 6, Site 2
Pitfalls total inverts	
Sediments, %sand	Sites 13 and 6

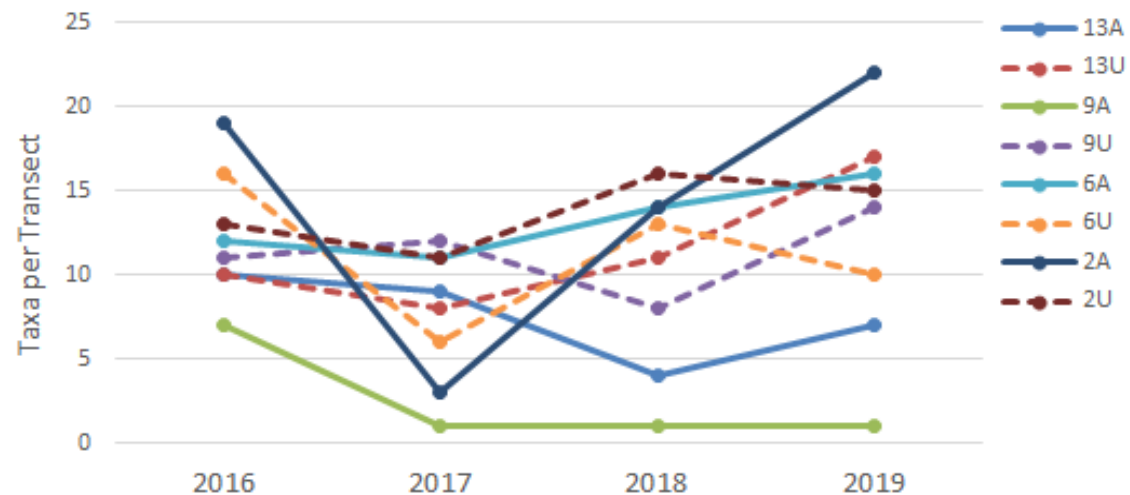
*not colored as negative, as southern sites saw the same response

Transect work at MLW:

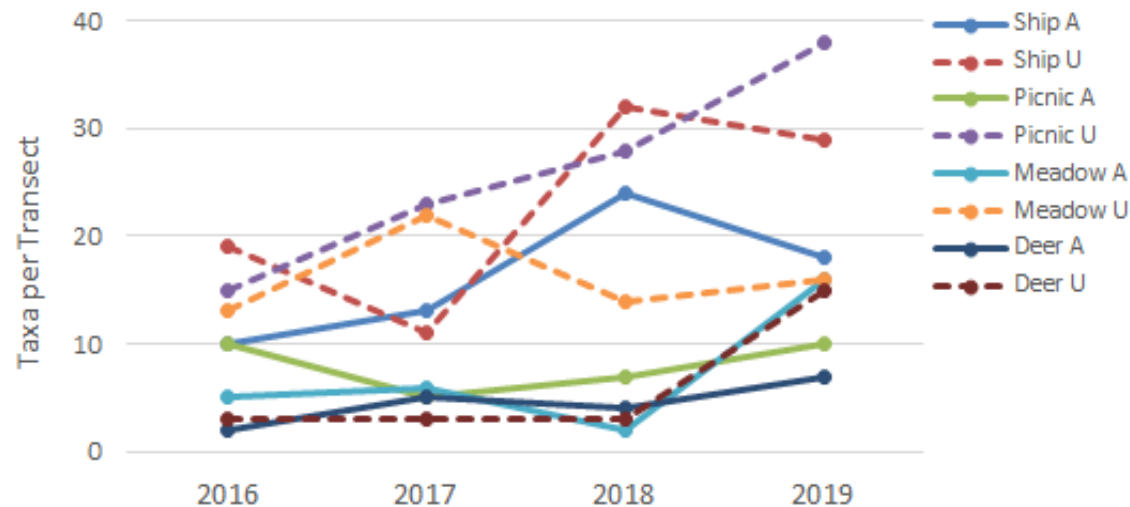
In Nourished area,
dramatic drop in
species richness in
areas inundated by
sand

In Southern area, no
similar trend;
unexplained increase
in richness through
time at several sites

Species Richness per Transect, Nourished Sites

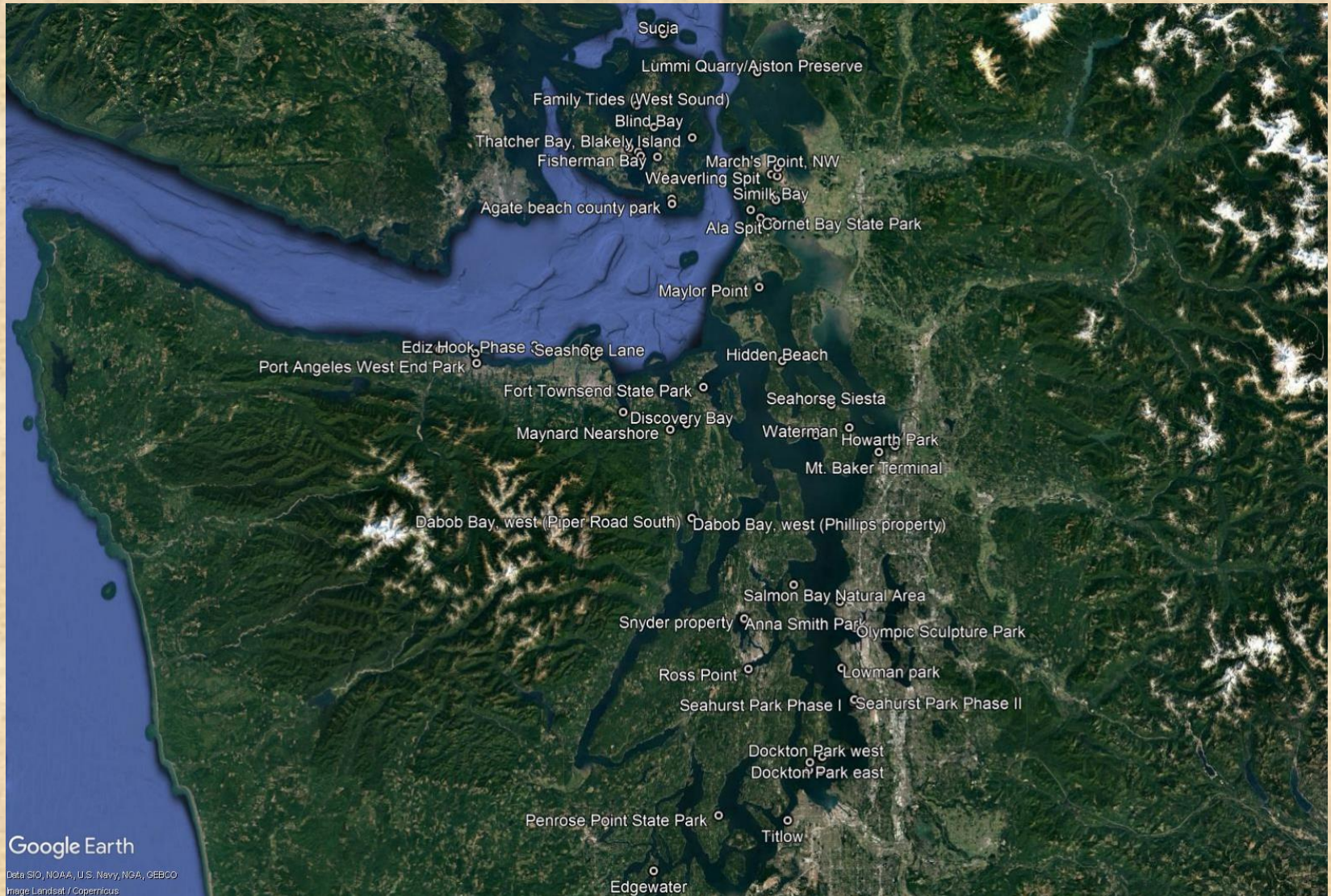


Species Richness per Transect, Southern Sites



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](#), also referenced in a memo on [Shoreline Restoration Effectiveness in Puget Sound](#).

Chair(s): Tish Conway-Cranos (ESRP) Tish.Conway-Cranos@dfw.wa.gov

Coordinator: [Jason Toft](#) (UW SAFS) tofty@uw.edu

Shoreline Monitoring Database

A resource to upload data from standardized protocols

Shoremonitoring.org

Inbox - toftbot@gmail.com - Gmail x Google Calendar - September 20 x Shoreline Monitoring Toolbox - x +

shoreline-monitoring.herokuapp.com/protocols/map

Shoreline Monitoring Database

Home Protocols and Data ▾ Map User Guide Contact Downloads Users Jason Toft | Log Out

Map

Key

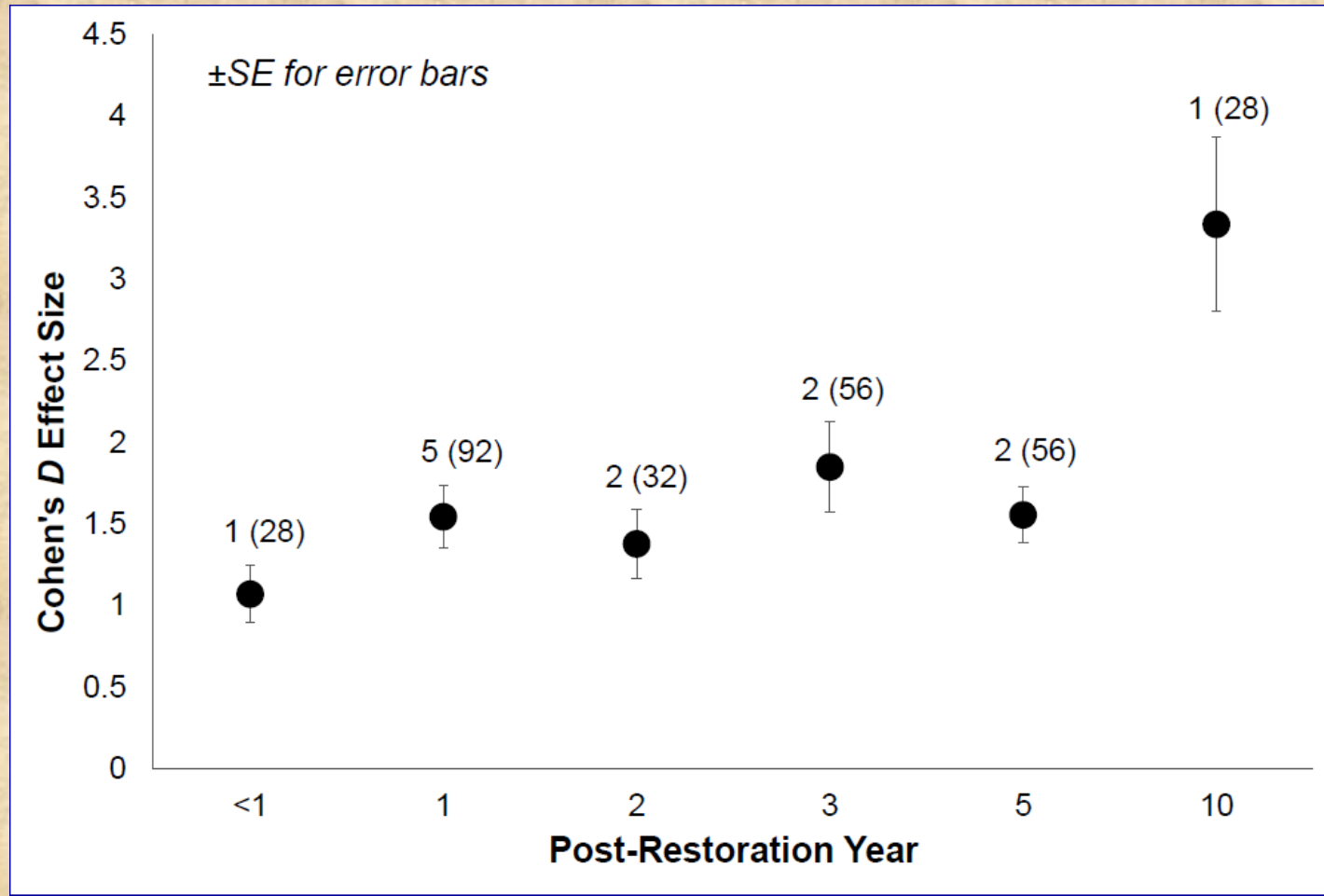
- Beach wrack
- Epibenthic Invertebrates
- Insects
- Logs
- Riparian vegetation
- Surface epifauna and algae
- Multiple protocols

Click on a marker to see all surveys near that location.

Zoom in to see more granular survey information.

Restoration Trajectories

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.

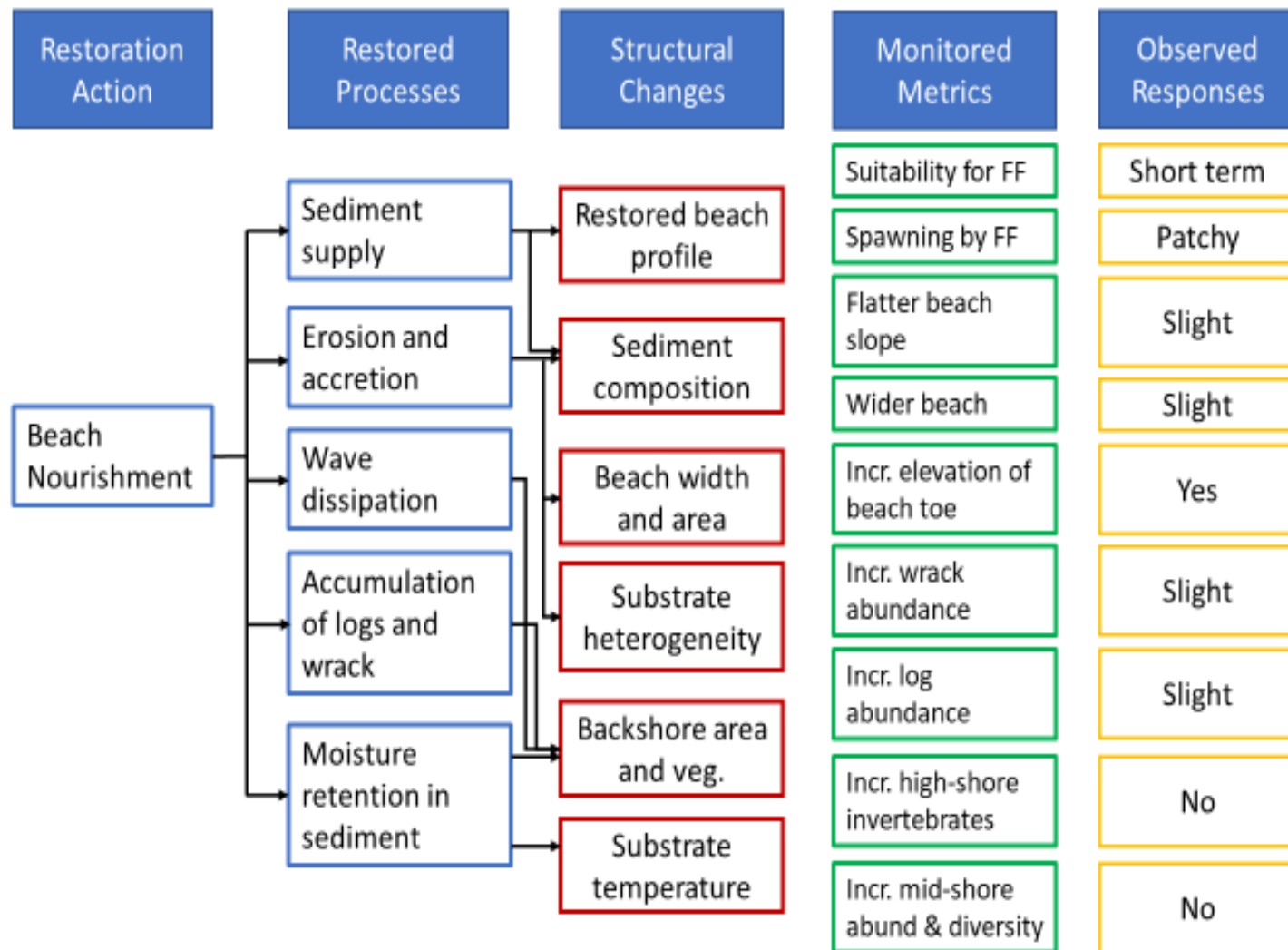
Restoration Techniques

Marine Shoreline Design Guidelines: (1) Removal, (2) Nourishment, (3) Logs, and (4) Vegetation.

How effective, solo vs combined? And for different beach functions?

Sediment nourishment on its own may have mixed results:
A recent study from southern California found that at beaches with intense maintenance regimes of sediment filling and grooming (done to create wider beaches for human recreation), invertebrates are negatively impacted especially in the upper intertidal wrack zone (Schooler et al. 2019).

Wrap Up



Site 6

Armored/ Pre-project



Site 6 – As-built



Restoration Trajectories, Techniques, Responses – Depends on Scale?

Woodway Slide - 1997



Acknowledgements

WA RCO funding (Project design/construction)
Beachwatchers (SnoCo WSU Extension) – Craig Wollam
ESRP – Tish, Jay, Mike R., Kay –
Dan Penttila (Salish Sea Biological)
Jamie Selleck (NRC)
Kathleen Pozarycki + Dave Lucas (PM SnoCo SWM)
Luke Hanna + Snohomish County staff, past interns
SnoCo Geotech Lab
City of Everett – Bob Hillmann
Anchor QEA (Kathy Ketteridge, Paul Schlenger, Tracy Drury)
NW Straits Comm. /NW Straits Found./ SnoCo MRC
Cast of hundreds - UW and WDFW assistants and volunteers

More information on this project can be found at snocomrc.org
PRISM #13-1106