



Benthic Habitat Surveys for Informing Renewable Energy Development in the Pacific Northwest

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Objectives for Baseline Benthic Research

1. Describe the benthic habitats and communities of organisms in areas of potential marine renewable energy development in the Pacific Northwest
2. Develop an understanding of species-habitat relationships
3. Determine variation in habitat characteristics and benthic species **across space** in the region
4. Determine variation in benthic species **over time**

Spatial (and quasi-Temporal) Study: BOEM Regional

❖ Infaunal invertebrates in sedimentary habitats and macro-inverts in rocky habitats

- ❖ 2010 - 2012
- ❖ Northern California to central Washington
- ❖ Federal waters only
- ❖ Depth range of ~40 to 130 m
- ❖ All sites approximately the same area sampled
- ❖ Sampling intensity represents depth proportion

❖ Compare infaunal data to 2003 EPA survey

❖ Compare reef data to 1990s *Delta* surveys

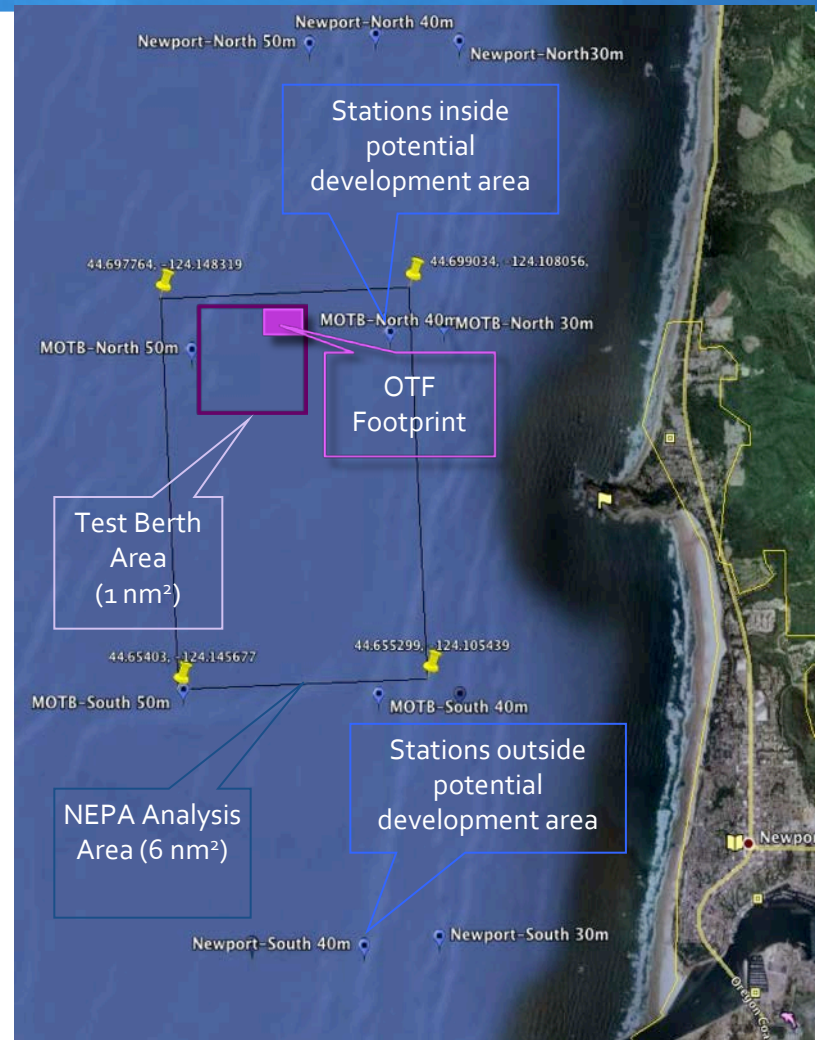


Temporal Study:

Benthic Monitoring at the OSU-OTF Site

❖ Infaunal & epifaunal invertebrates and fish in sedimentary habitats

	Core	Trawl	Video
May 2010			✓
June 2010	✓	✓	
August 2010	✓	✓	✓
October 2010	✓	✓	
February 2011		✓	✓
April/May 2011	✓	✓	✓
June 2011	✓	✓	✓
August 2011	✓	✓	
October 2011	✓	✓	✓
December 2011	✓	✓	
June/July 2012 (Before)	✓	✓	✓
Aug/Sept 2012 (During)	✓	✓	✓
October/Nov 2012 (After)	✓	✓	

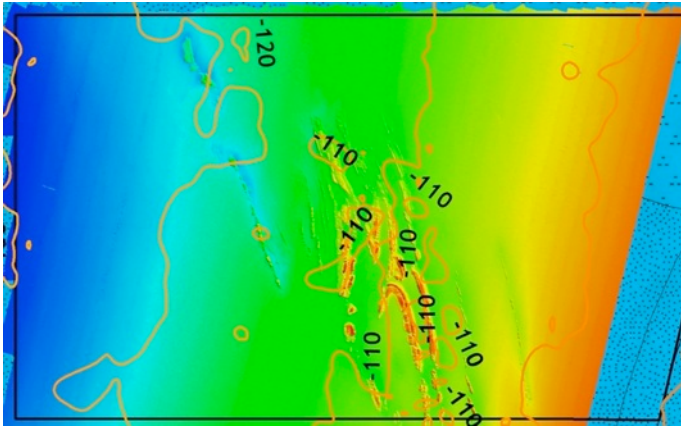


Baseline Study (2010 – 2011 data) Complete and Available at www.oregonwave.org

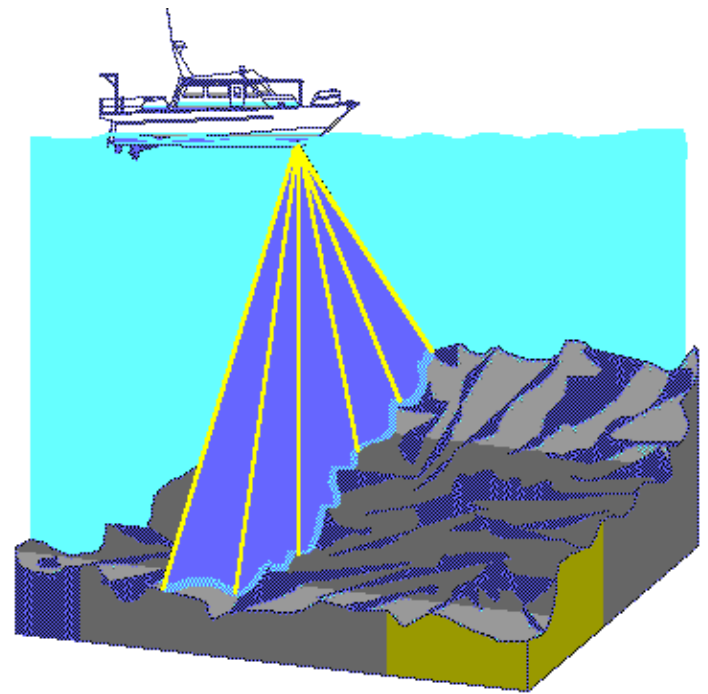
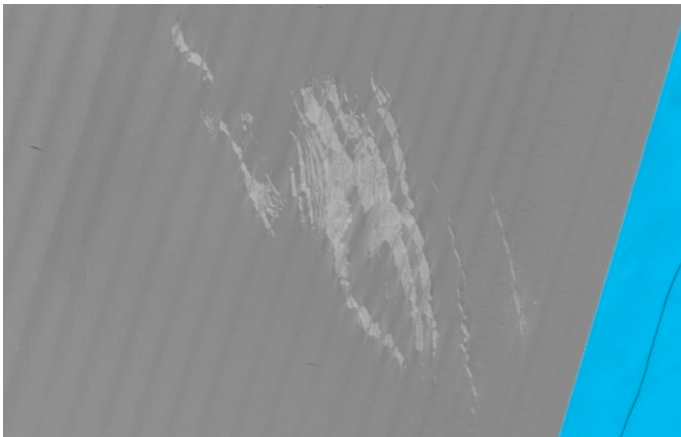
High Resolution Mapping

Conducted by C. Goldfinger lab (OSU-CEOAS)

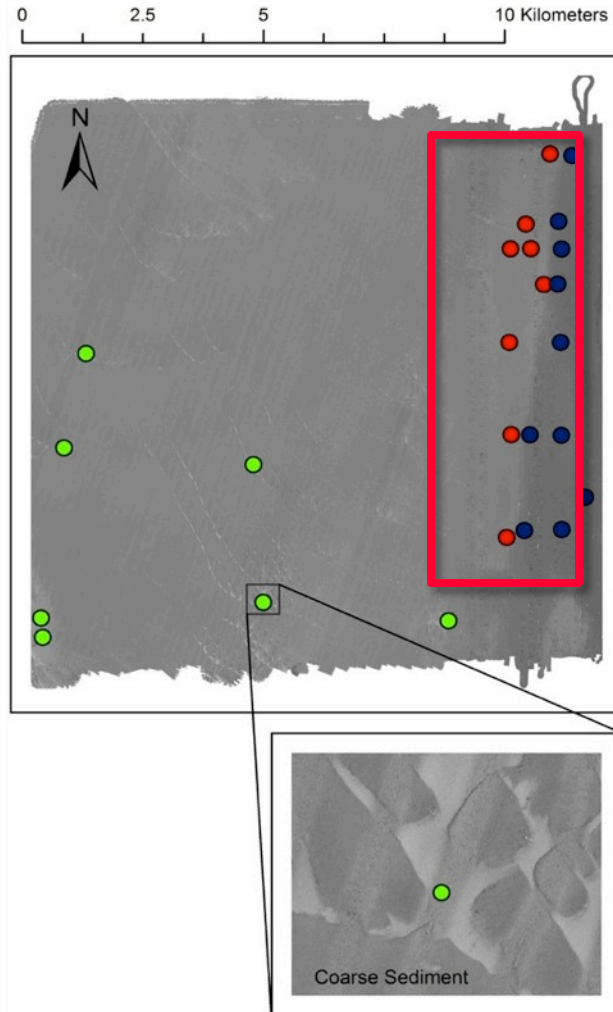
Multi-beam sonar mapping (bathymetry)



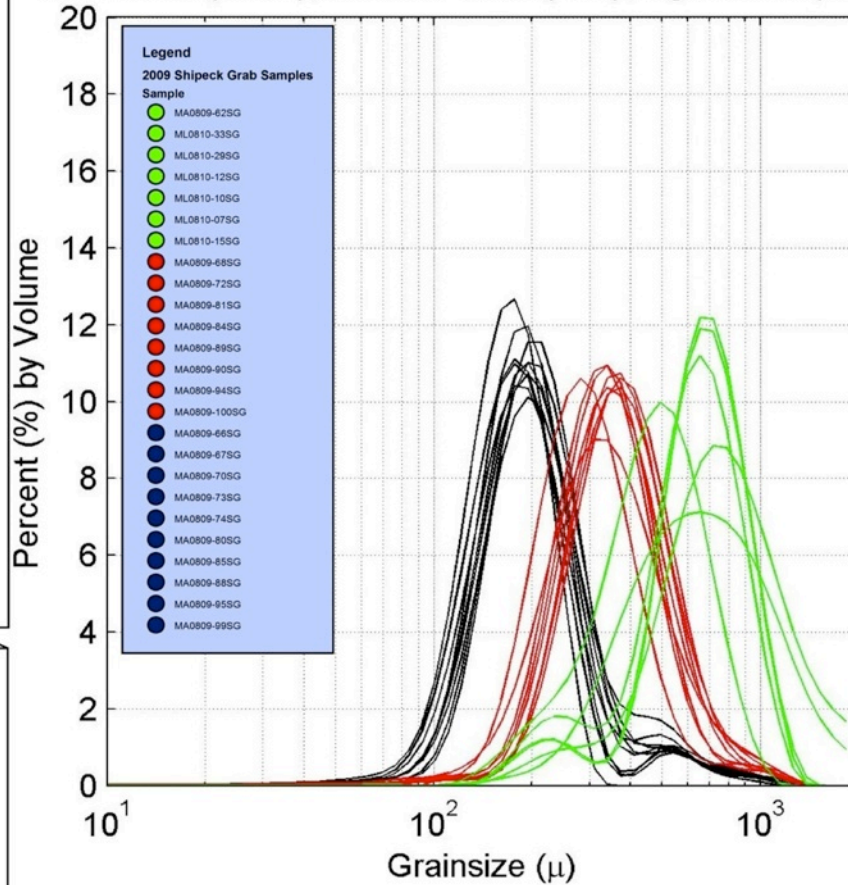
Acoustic backscatter (substrate type)



Groundtruth with Grab Samples

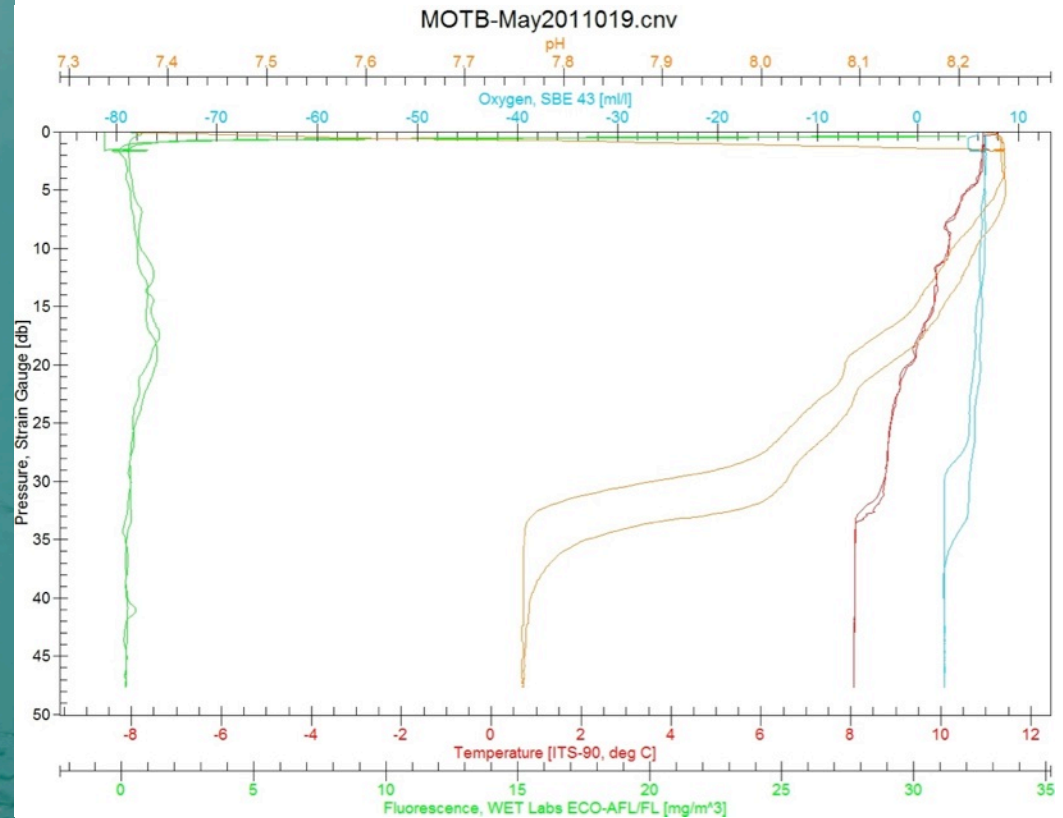
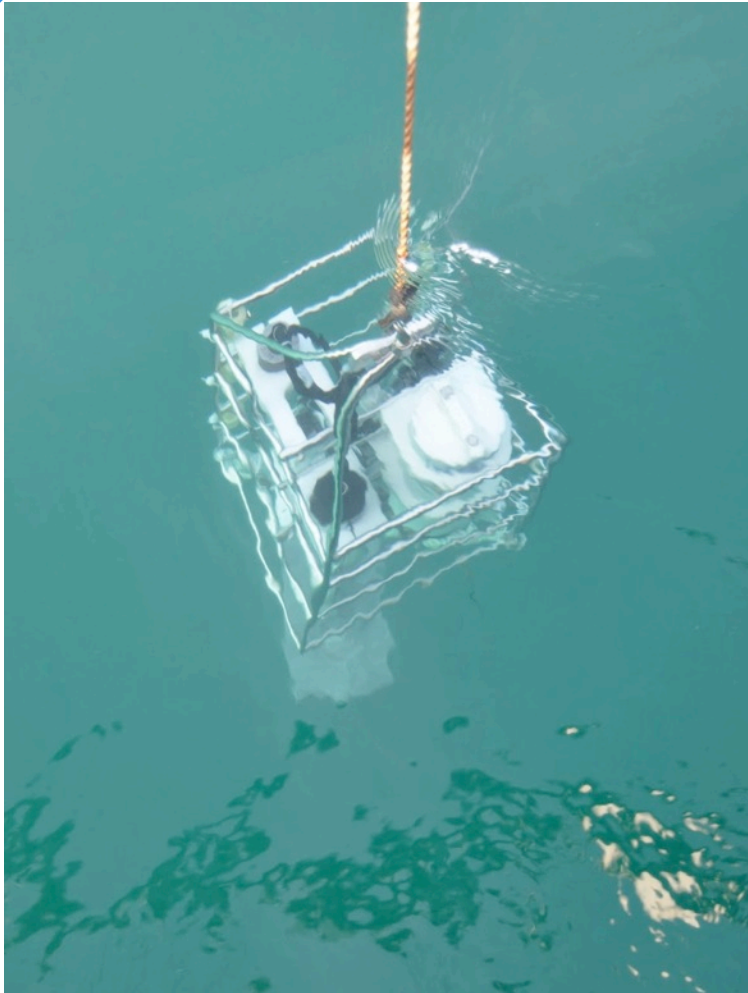


Dark Sand (Black), Medium Sand (Red), Light Sand (Green)



Water Column Sampling

CTD cast at each station measures depth, temperature, salinity, dissolved oxygen, chl fluorescence, pH



Infauna and Sediment Sampling

0.1 m² Grey-O'Hare box core



Analyze sediment for grain size, total organic carbon



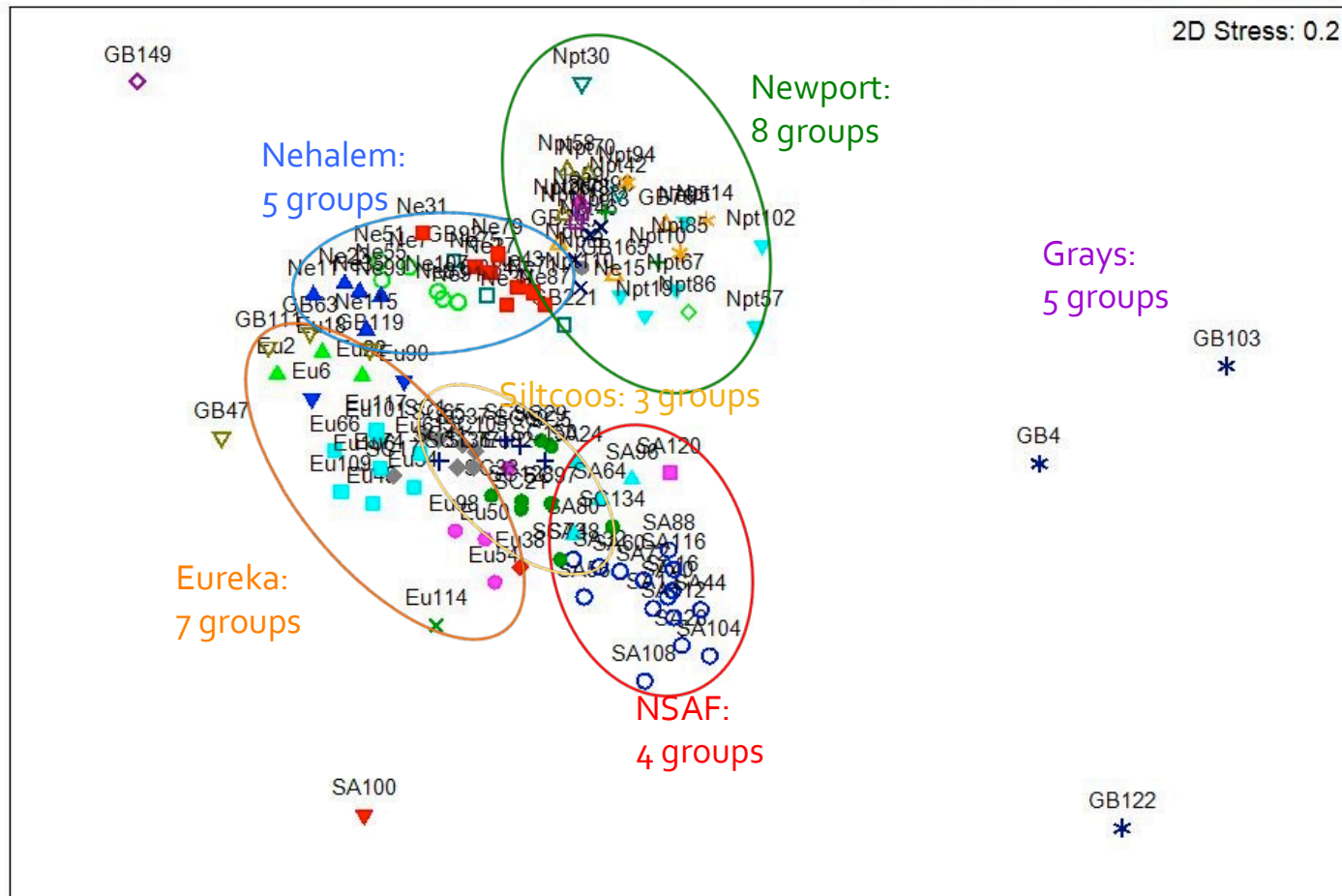
Sieve through 1.0 mm mesh

Identify infauna in the lab

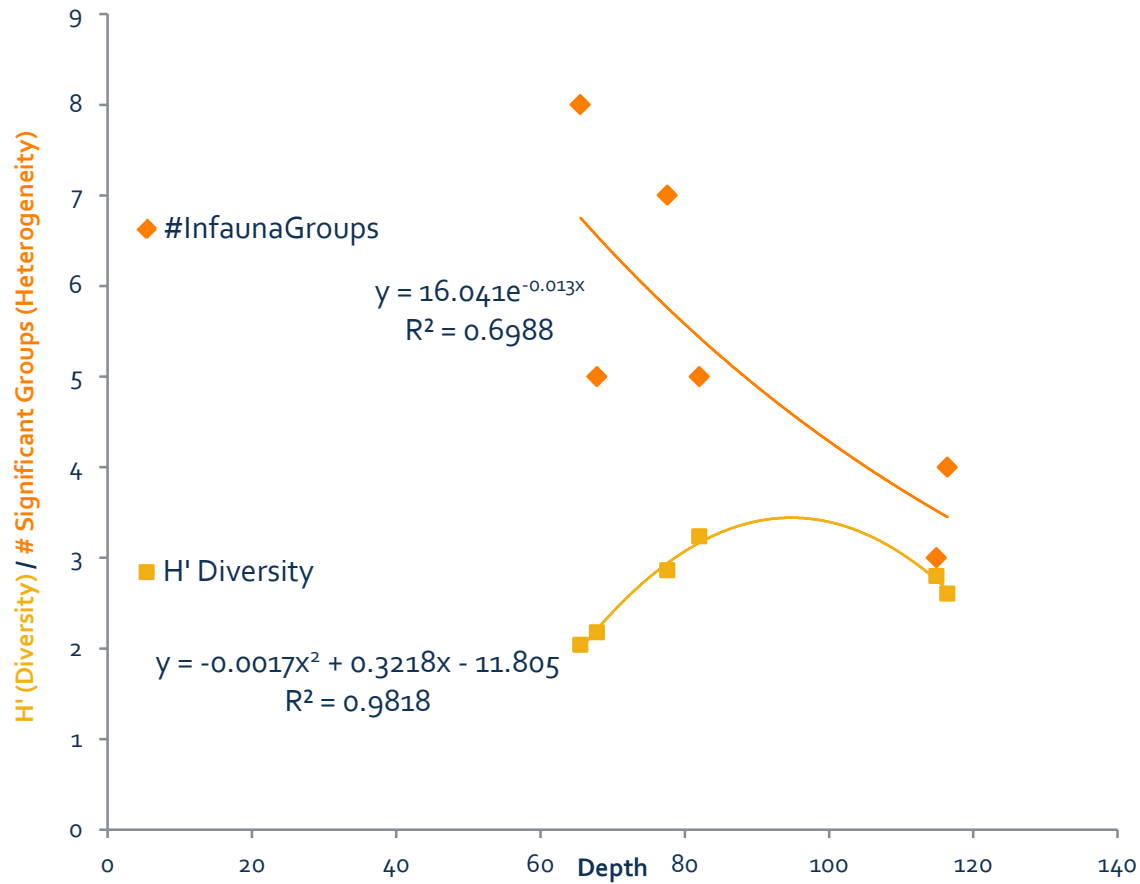
Community Analysis (SIMPER)

BEST Bio-Env = 0.702: lon, z, % sand, % gravel, mgs

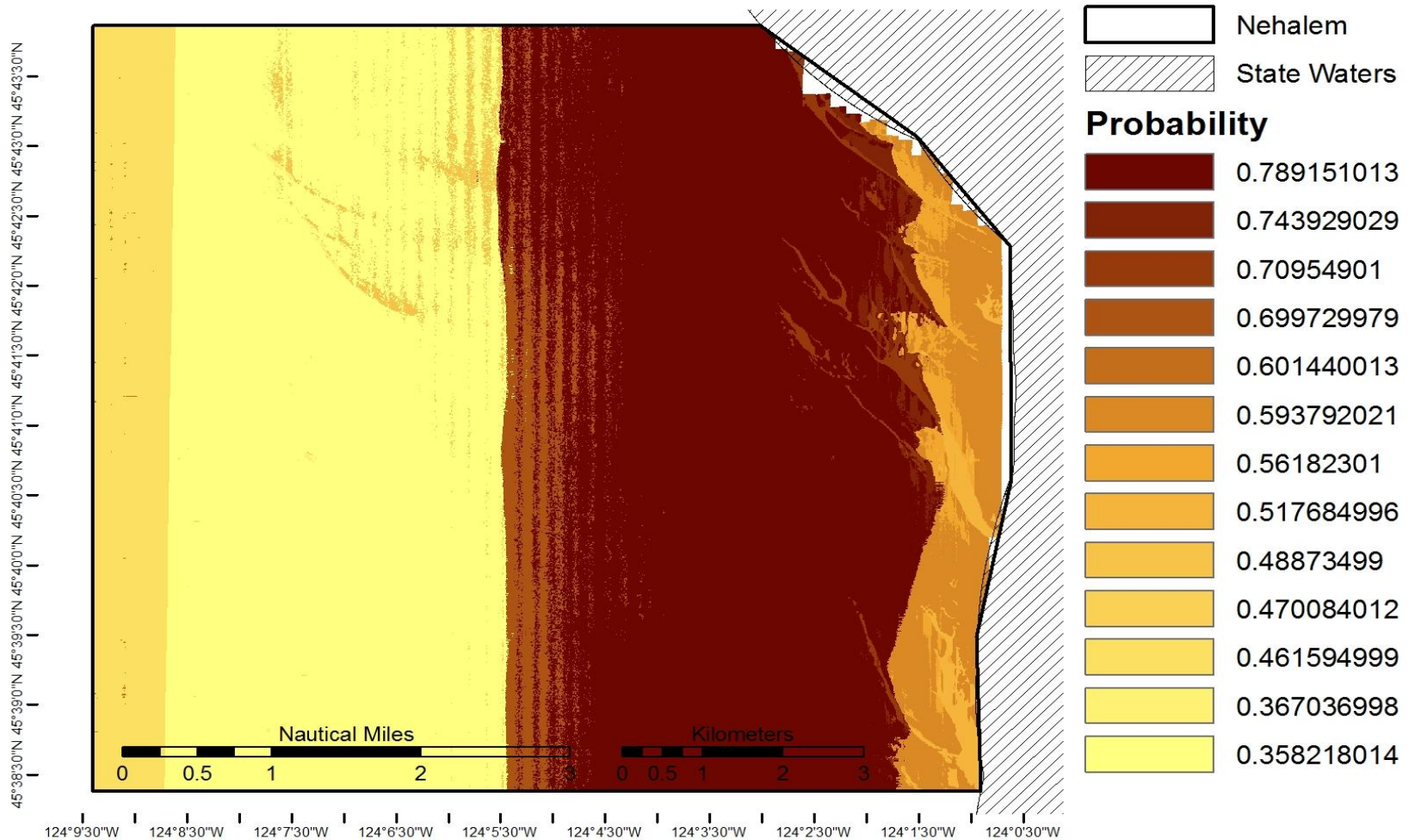
Transform: Square root
Resemblance: S17 Bray Curtis similarity



Community Patterns with Depth



Habitat Suitability Modeling

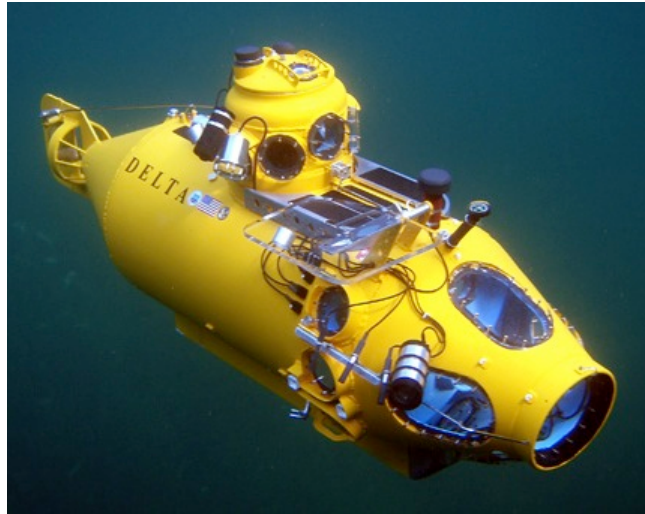


Infaunal Invertebrate Summary

- ✧ There appears to be a break in the infaunal community at 70–80 m depth
- ✧ Species diversity peaked at ~95 m depth and ~120 μm median grain size
- ✧ Local spatial heterogeneity was higher at shallower sites (usually with larger grain size)
- ❖ If the depth and grain size of a site are measured, one may be able to make good predictions of the species assemblage likely to be found there, within a region

- ✧ *In central Oregon state waters, **infaunal invertebrate** assemblages have not varied across seasons (but may have longer term variability)*
- ❖ *Baseline/monitoring sampling may be conducted 1x/year*

Epifaunal Sampling - *Reef Surveys*



Submersible *Delta*

- Used for historic dives of the 1990s
- Camera attached on starboard
- Camera equipped with two 20 cm-apart sizing lasers
- Equipped with sensor that measured temperature & depth every second

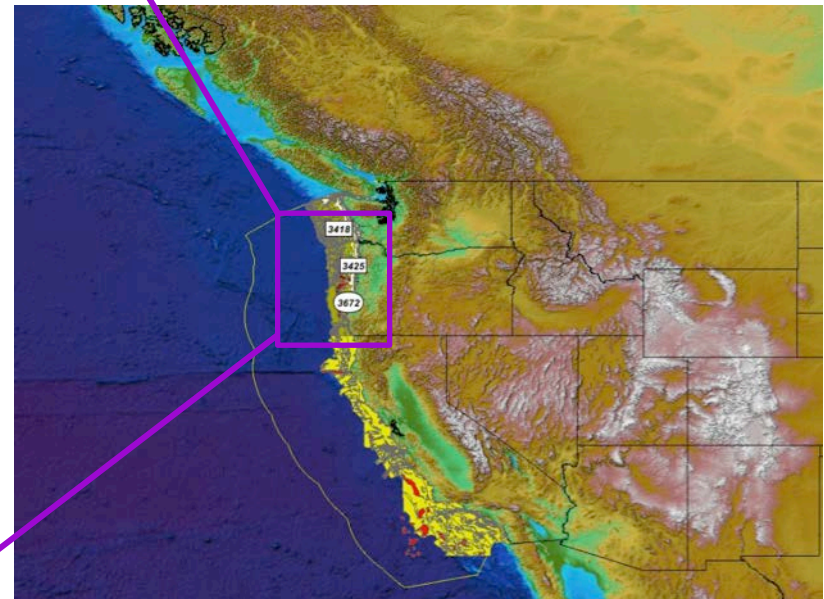
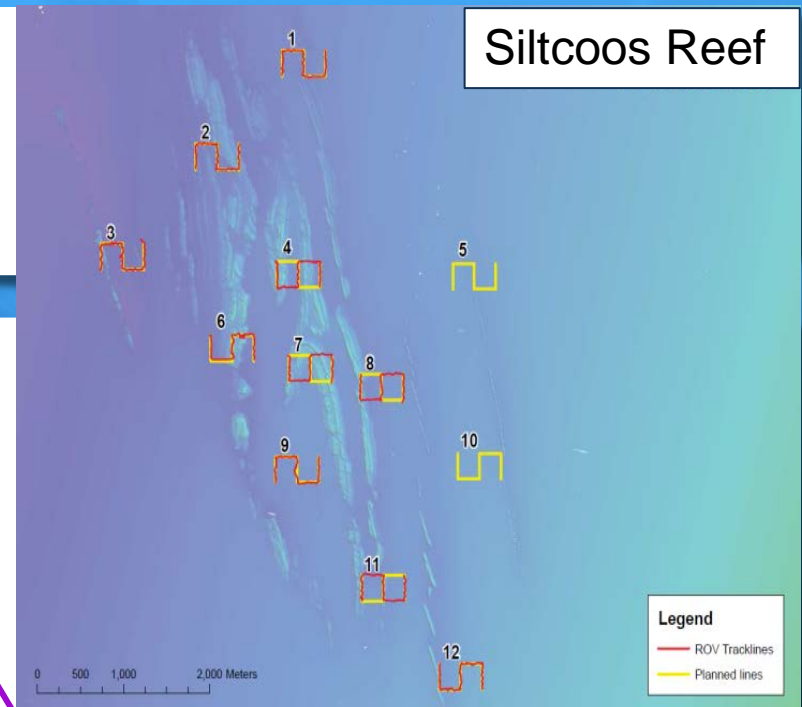
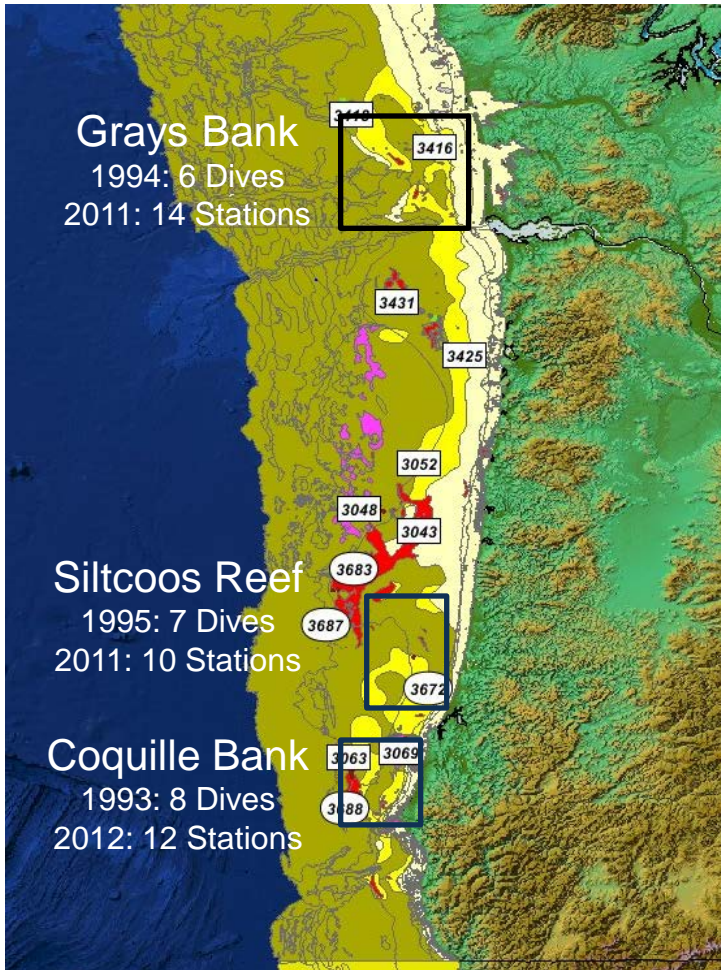
Remotely operated vehicle (ROV) *Hammerhead*

- Used for dives in 2011&12
- Two cameras: forward & downward
- Sizing lasers
- Equipped with CTD
- Equipped with navigator beam



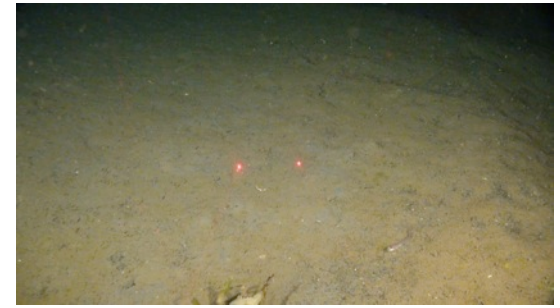
Epifaunal Sampling

Siltcoos Reef



Video Analysis

- + Each *Delta* dive was watched three times:
 1. Substratum Identification based on grain size class and relief
 - Each patch was coded with two letters – first letter indicating primary (50 – 80% of cover) and second letter indicating secondary (20 – 50% of cover)
 2. Sessile Invertebrate Identification and Count
 3. Motile Invertebrate Identification and Count
- + Each ROV *Hammerhead* video was watched twice (steps 2 and 3 were combined for these videos)
- + All invertebrates ≥ 5 cm were counted and identified to lowest possible taxonomic classification



Epifaunal Invertebrate Summary

- ✧ Two major substratum groups held different macroinvertebrate assemblages: moderate to high relief rocky habitats and low-relief fine sediment habitats
 - ✧ The majority of macroinvertebrate taxa (highest diversity) was associated with high-relief rocks
 - ✧ These taxa were further differentiated between flat versus ridge rocks
- ✧ Low-relief fine sediment habitat was most often associated with motile invertebrates
 - ✧ Within this habitat it appeared that fine-sediment substrata mixed with mud, boulders, or gravel each yield unique macro-invertebrate associations versus those found on uniformly mud or sand substrata.
- ✧ Latitude/temperature also were correlated with variation in assemblages, indicating regionally distinct macroinvertebrate communities along the continental shelf

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