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

Sarah K. Henkel

Oregon State University

BOEM
BUREAU OF OCEAN ENERGY MANAGEMENT

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**

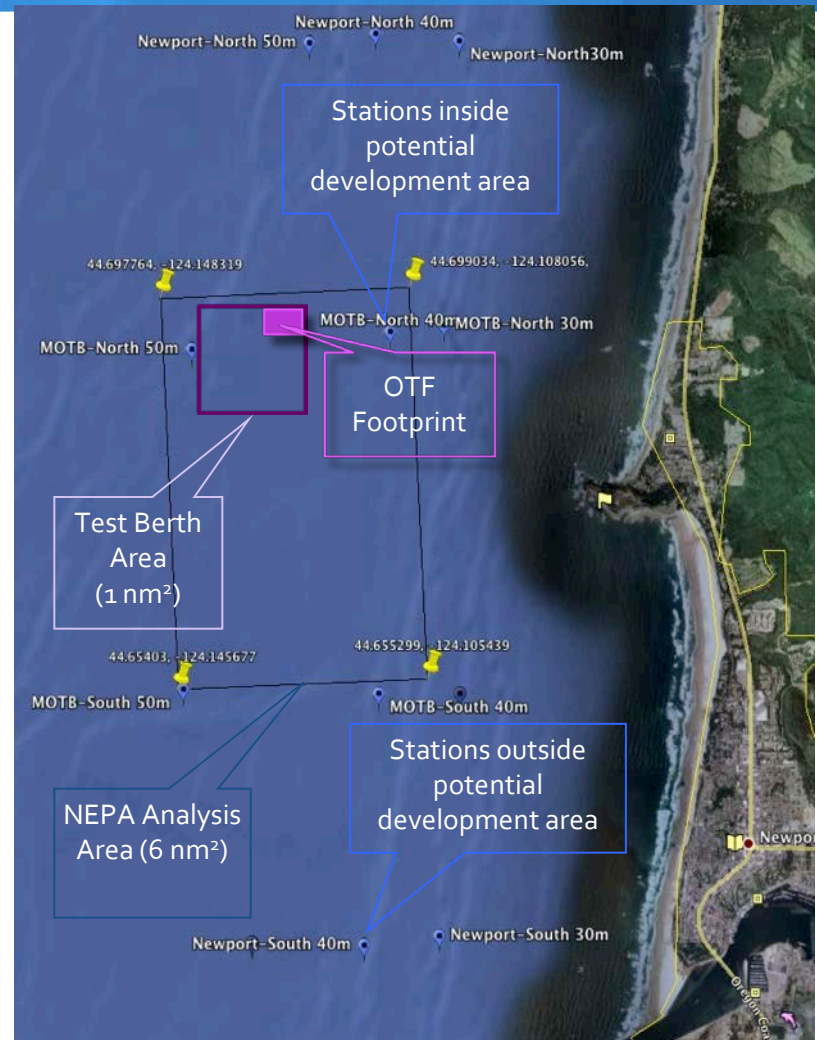❖**Compare reef data to 1990s *Delta* surveys**

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)	✔	✔	

Stations inside potential development area

Newport-North 40m
Newport-North 50m
Newport-North 30m

44.697764, -124.148319
44.699034, -124.108056,

MOTB-North 40m   MOTB-North 30m
MOTB-North 50m

OTF Footprint

Test Berth Area (1 nm²)

44.65403, -124.145677
44.655299, -124.105439

MOTB-South 50m
MOTB-South 40m

NEPA Analysis Area (6 nm²)

Stations outside potential development area

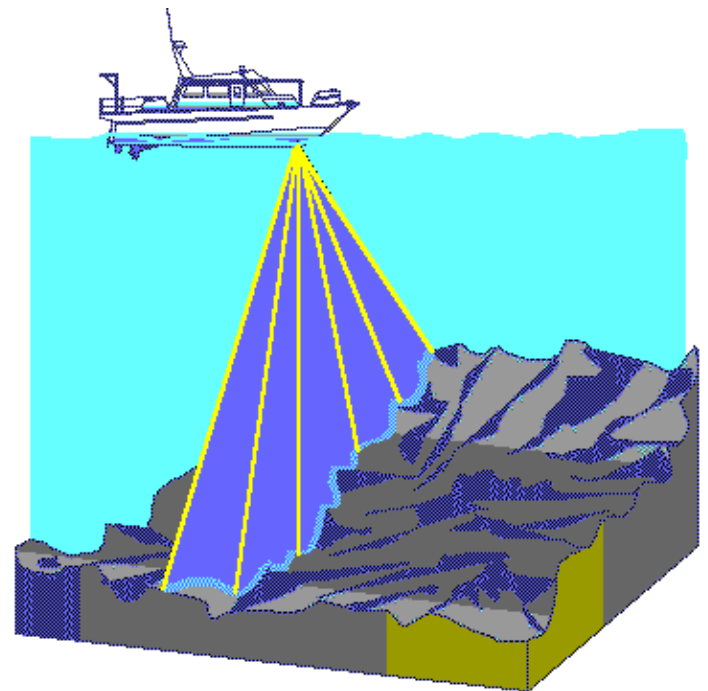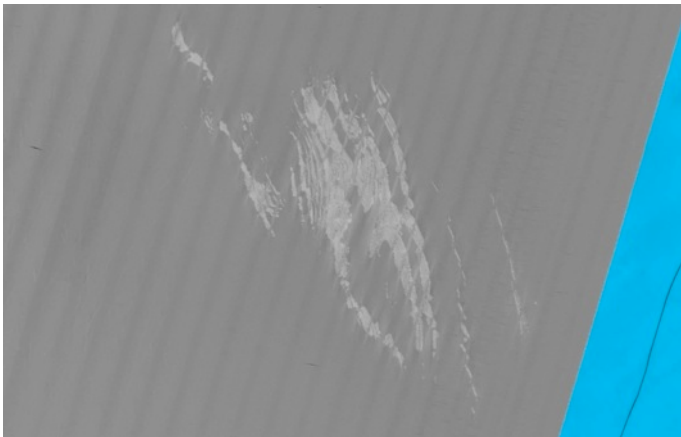Newport-South 40m
Newport-South 30m

High Resolution Mapping

Conducted by C. Goldfinger lab (OSU-CEOAS)

Multi-beam sonar mapping (bathymetry)
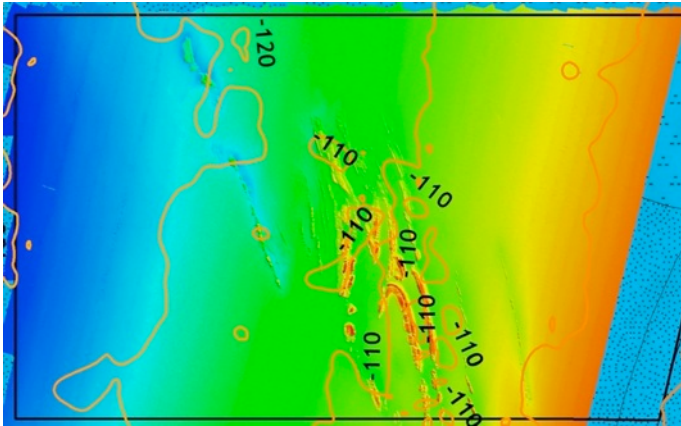
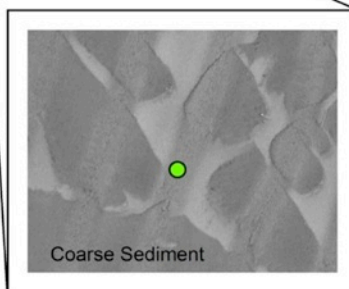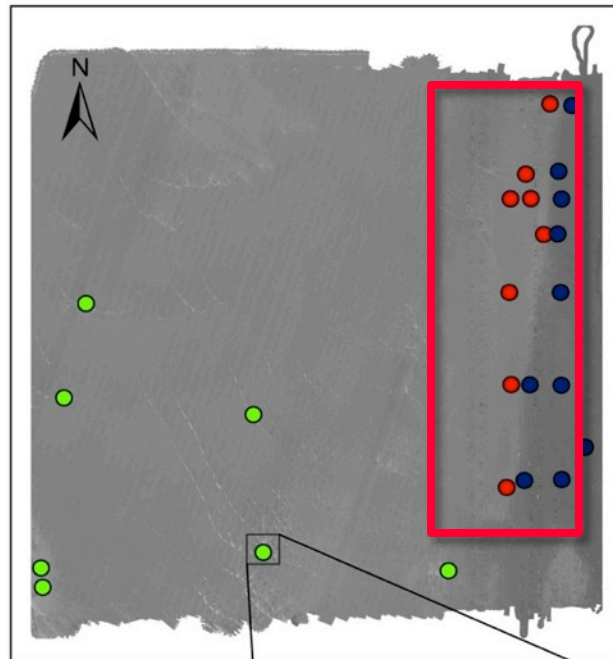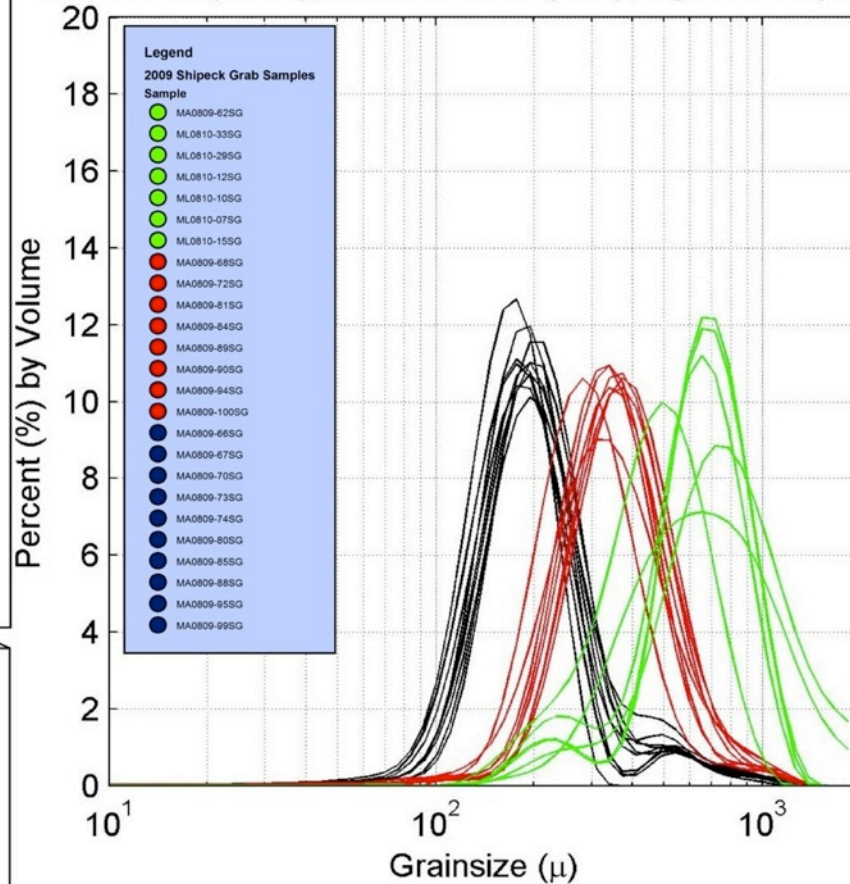

Acoustic backscatter (substrate type)
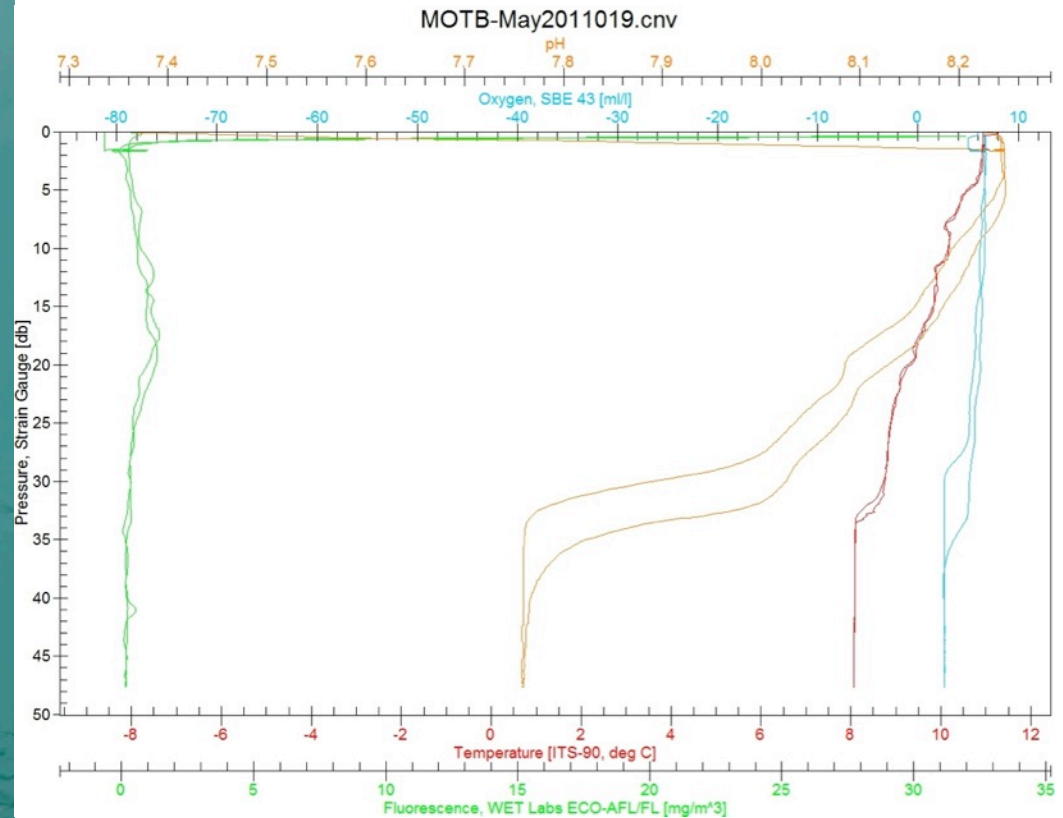
Groundtruth with Grab Samples

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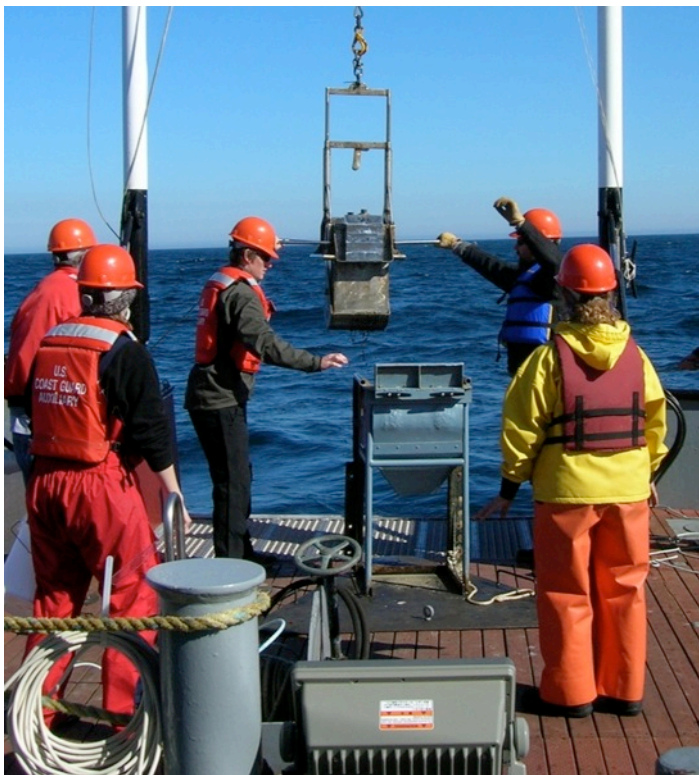
Coarse Sediment

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
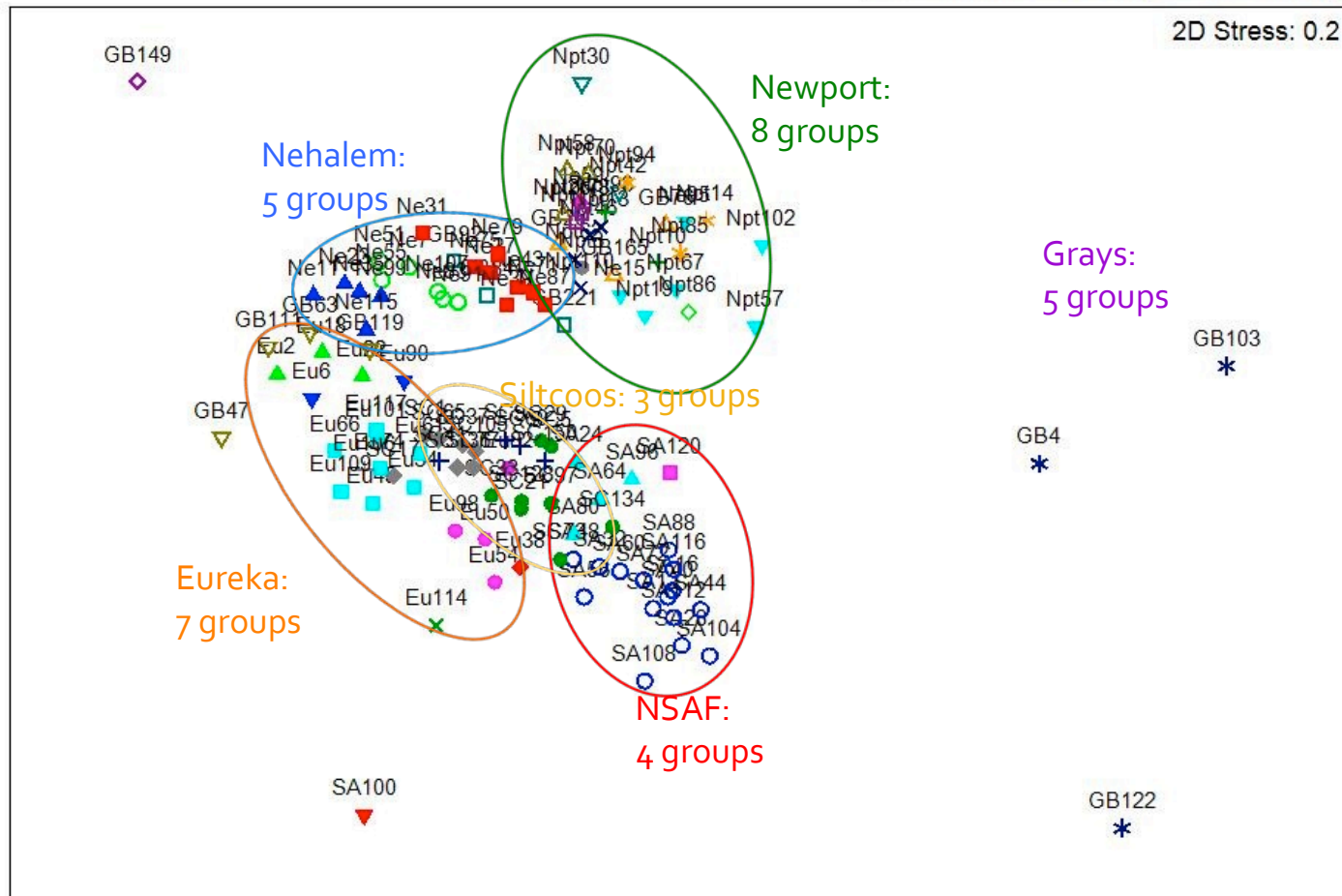

Sieve through 1.0 mm mesh
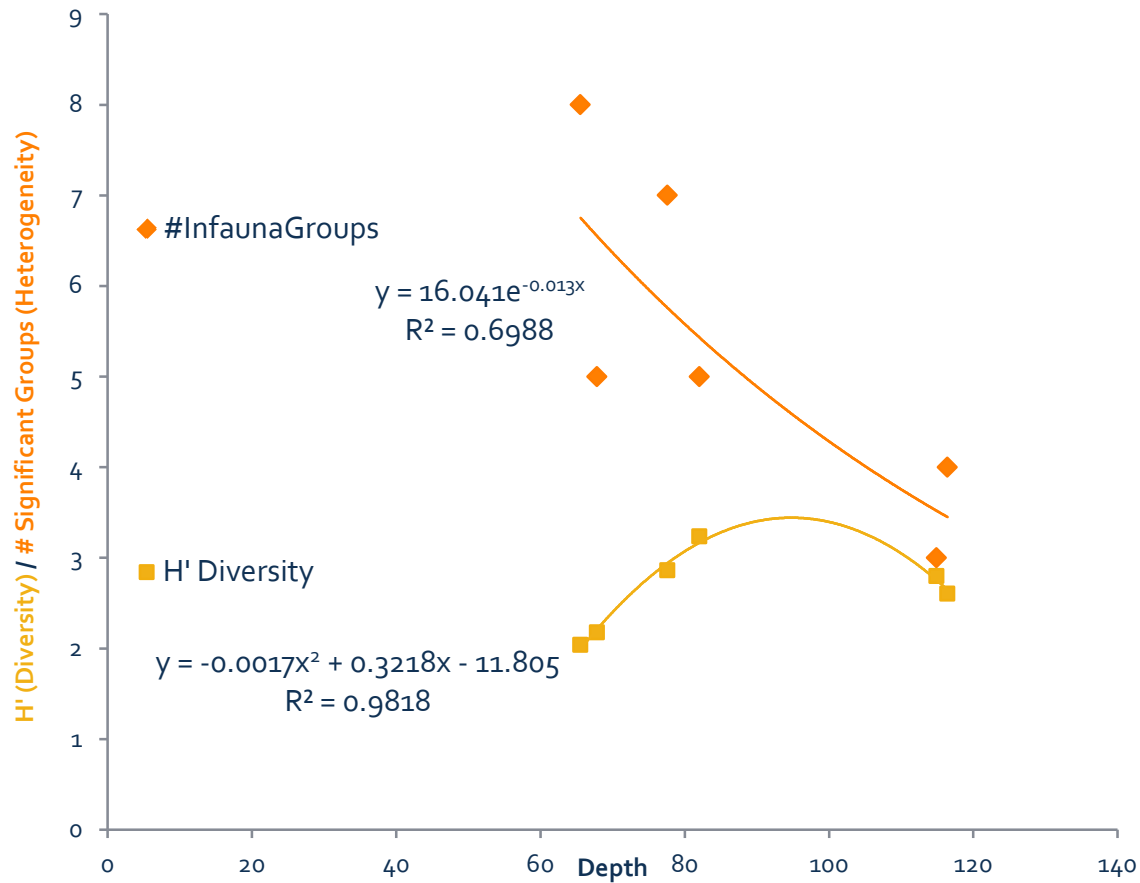

Identify infauna in the lab

Community Analysis (SIMPER)

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

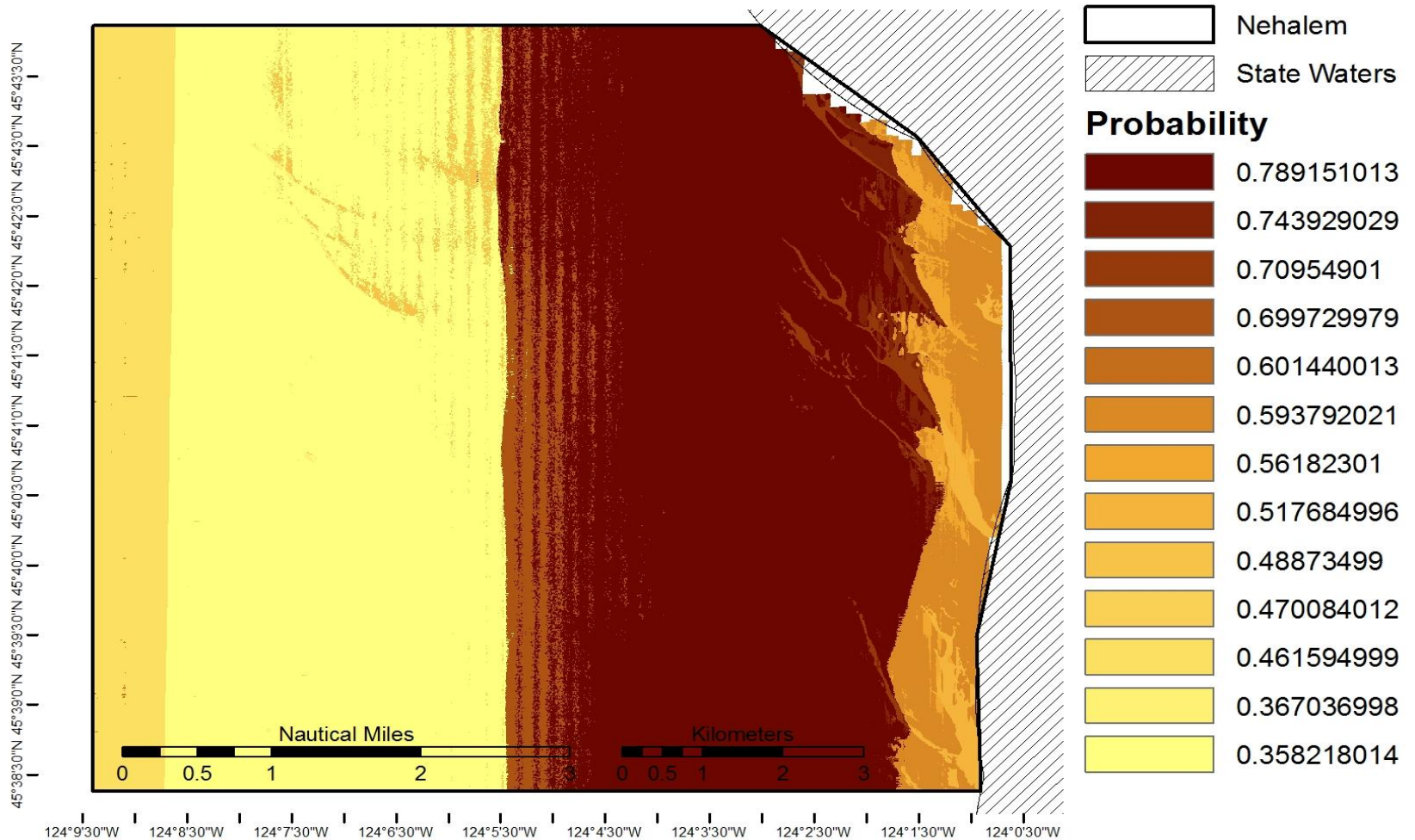# Community Patterns with Depth

H' (Diversity) / # Significant Groups (Heterogeneity)

Depth

◆ #InfaunaGroups

$y = 16.041e^{-0.013x}$
$R^2 = 0.6988$

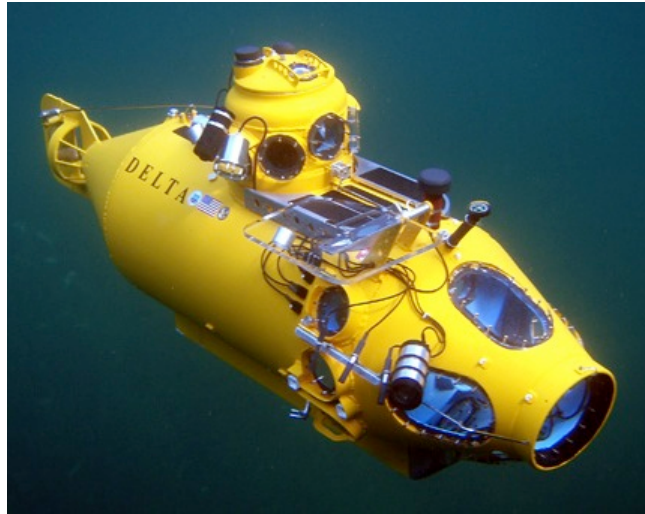■ H' Diversity

$y = -0.0017x^2 + 0.3218x - 11.805$
$R^2 = 0.9818$

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*

Remotely operated vehicle (ROV)
Hammerhead
- Used for dives in 2011&12
- Two cameras: forward & downward
- Sizing lasers
- Equipped with CTD
- Equipped with navigator beam

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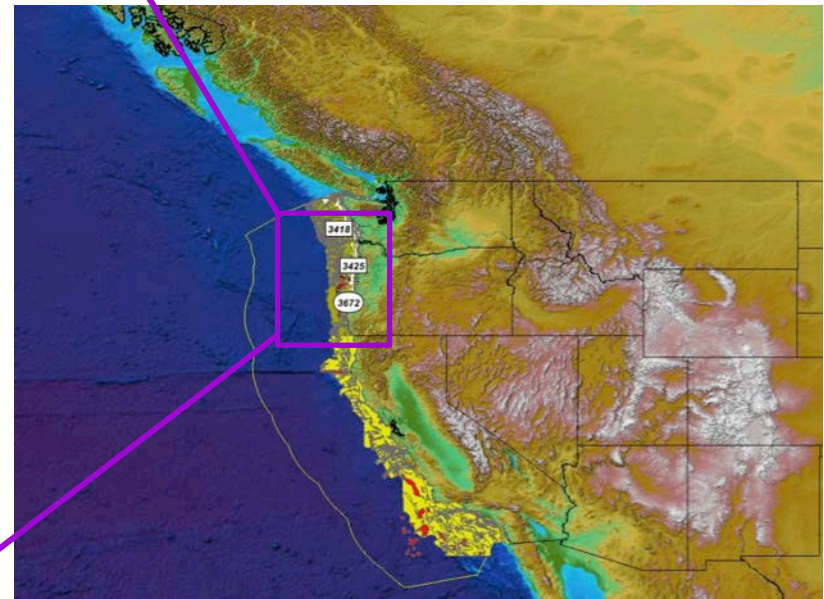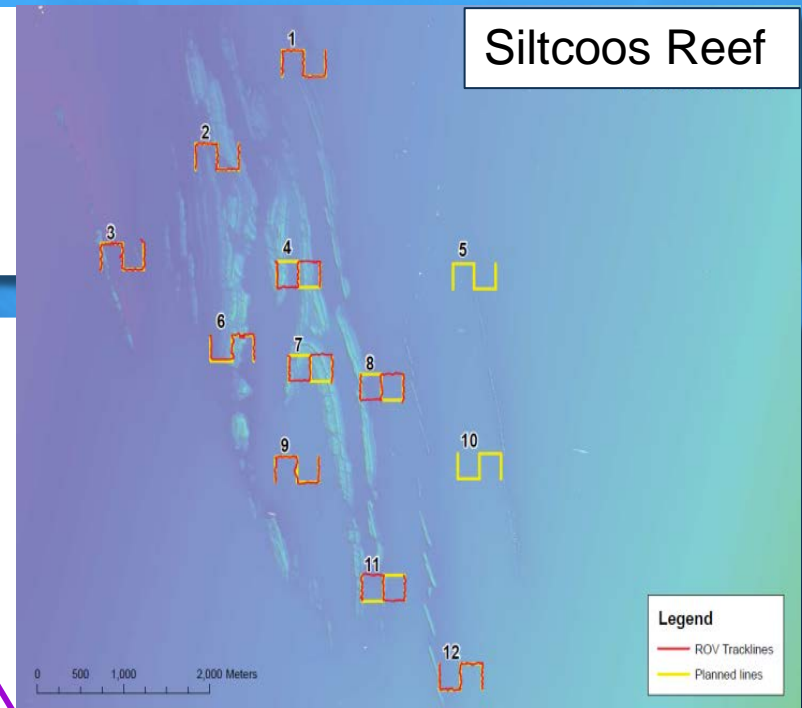- Equipped with sensor that measured temperature & depth every second

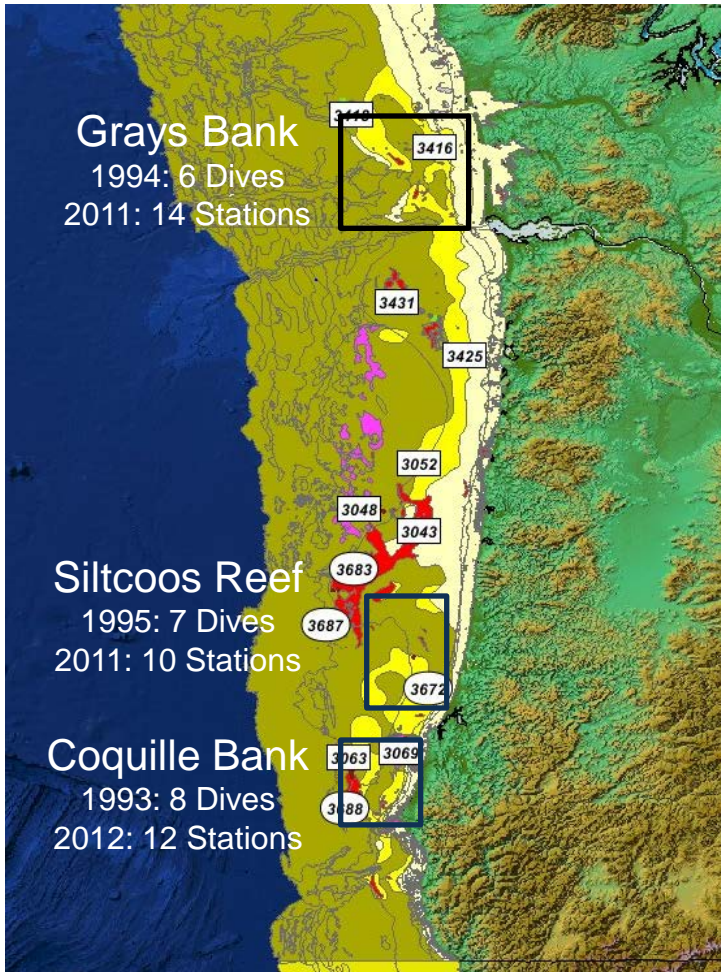# Epifaunal Sampling

Siltcoos Reef

Grays Bank
1994: 6 Dives
2011: 14 Stations

Siltcoos Reef
1995: 7 Dives
2011: 10 Stations

Coquille Bank
1993: 8 Dives
2012: 12 Stations

Legend
ROV Tracklines
Planned lines

0   500   1,000   2,000 Meters

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
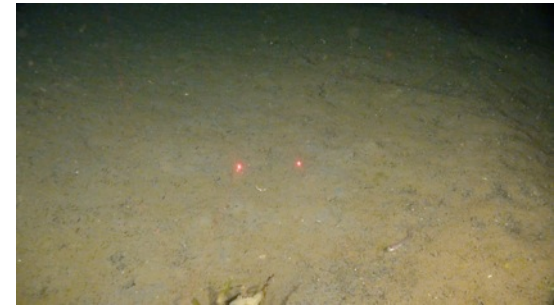
Epifaunal Invertebrate Summary

✧ 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

Acknowledgements

Funding:

Collaborators: Chris Goldfinger (OSU) & Brian Tissot (WSU)

Field and Lab Assistance:

- Kristin Politano
- Tim Lee
- Nate Lewis
- Stephanie Labou
- Elizabeth Lopez
- Danny Locket
- Chris Romsos
- Bob Hairston-Porter

- MARE ROV Team
- R/V Elakha
- R/V Pacific Storm