



Overview of BOEM-funded Research about Benthic Habitats and Geohazards on the West Coast

West Coast Renewable Energy Science Exchange
September 9, 2020

Lisa Gilbane | Environmental Analysis Section Chief, Pacific Regional Office
Jennifer Miller | Geophysicist, Office of Renewable Energy Programs



Today's Speakers

Benthic Habitats

(Seafloor geology and associated algae and animals)



Lisa Gilbane

Environmental Analysis Section Chief, Pacific Region

Geohazards

(Seafloor and sub-bottom geology)

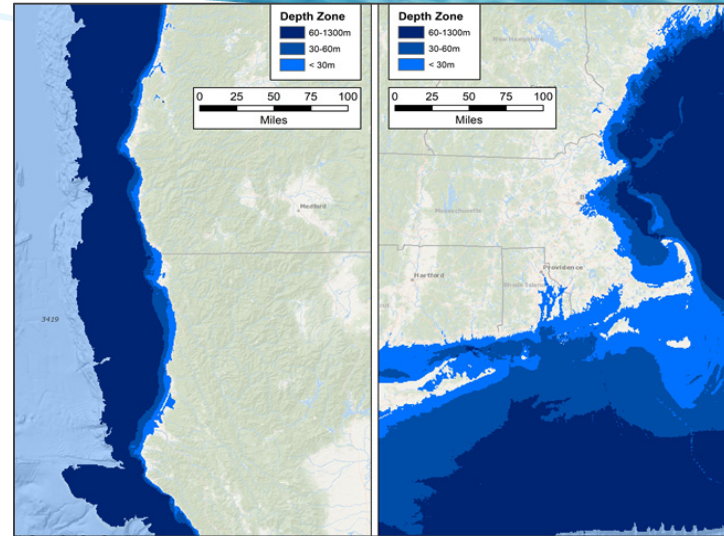


Jen Miller

Geophysicist, Office of Renewable Energy Programs

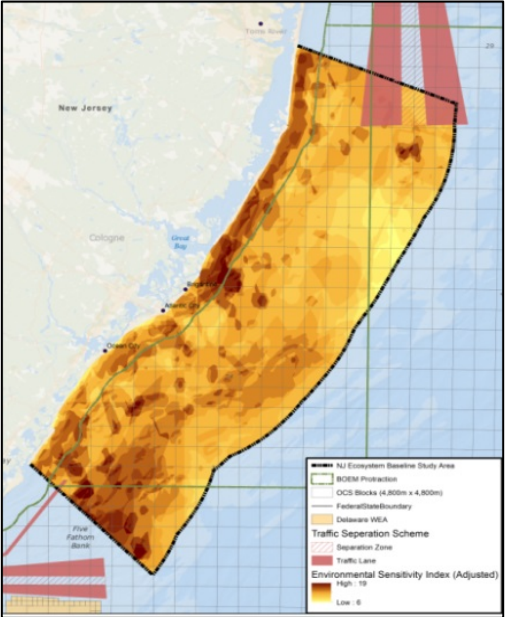
Offshore Wind in the Pacific

- A high wind energy resource offshore
- The Pacific coast is deep
- Floating wind is operational
- National Renewable Energy Laboratory (NREL):
www.youtube.com/watch?v=58EYcYbRKqk&feature=youtu.be



Overview of the BOEM's Renewable Energy Process

Planning & Analysis



Leasing



Site Assessment



Construction & Operations



Regional Data Informs the Planning Process

Planning
& Analysis

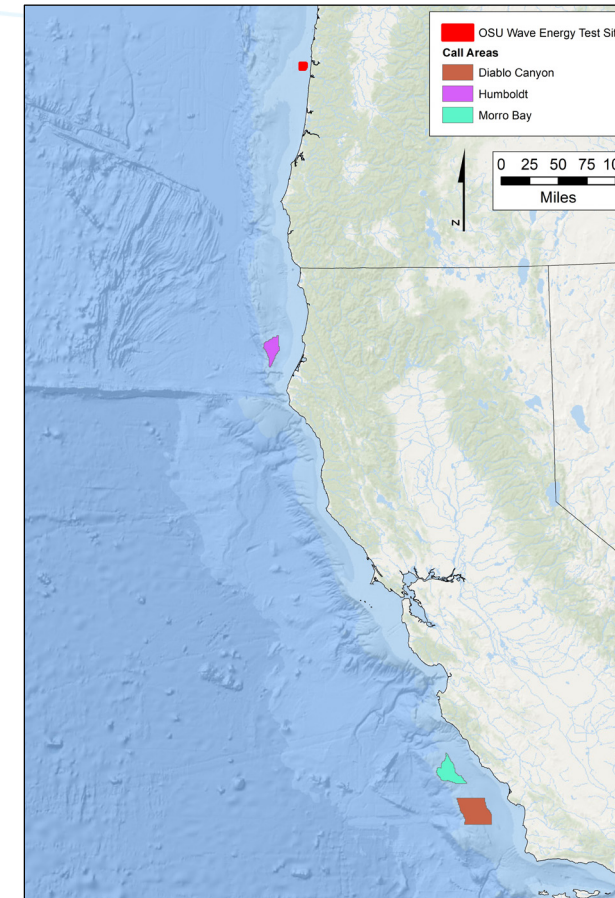
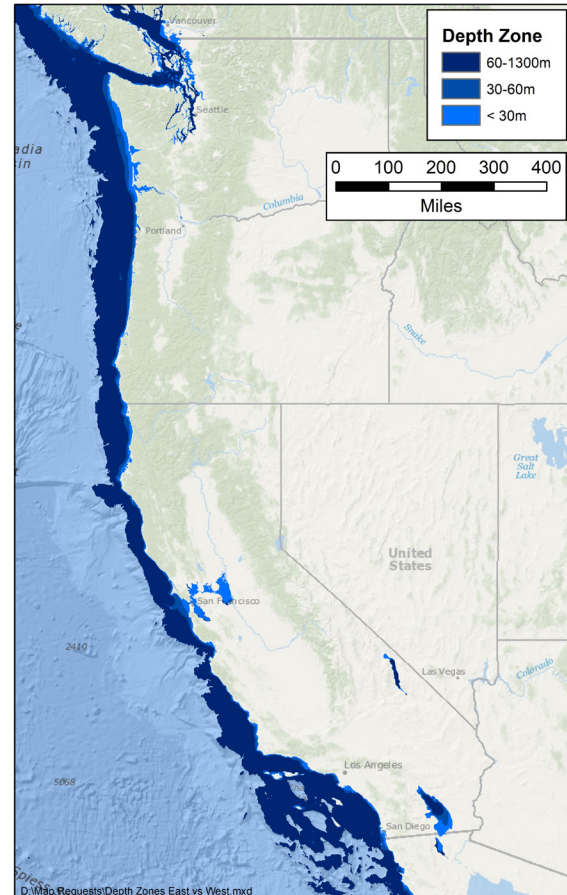
2 Years

Intergovernmental
Task Force

Call for Information &
Nominations (Call)

Area Identification

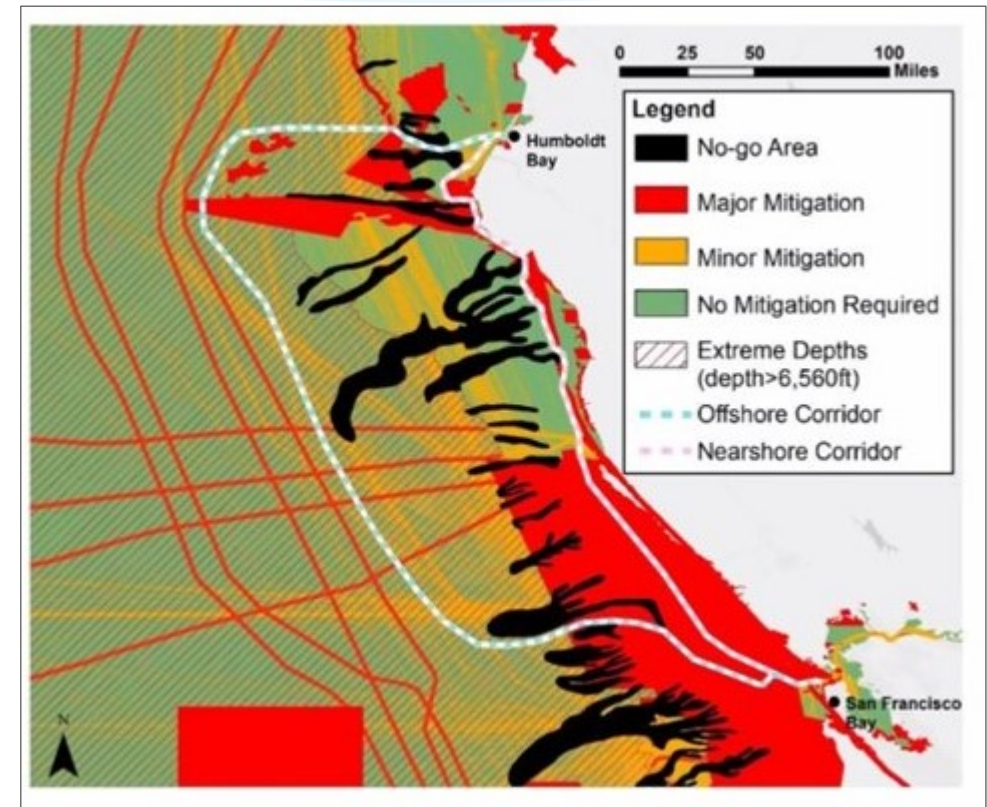
Environmental
Reviews



How Benthic Habitat & Geohazard Data Are Used

- **Compilation of different datasets**
Example is from a draft report estimating feasible options and costs for transmission to load centers (radial or network), not an actual project.
- **Seafloor bathymetry (10 to 25-meter grid resolution) is the foundational dataset**
- **Biological species should be considered at this stage**

<http://schatzcenter.org/wind/>



M. Severy, A. Younes, A. Jacobson (2020 draft). Offshore Wind Generation and Load Compatibility Assessment. Bureau of Ocean Energy Management Cooperative Agreement #M19AC00005. Schatz Energy Research Center. Humboldt State University Arcata, CA 95521



Benthic Habitat

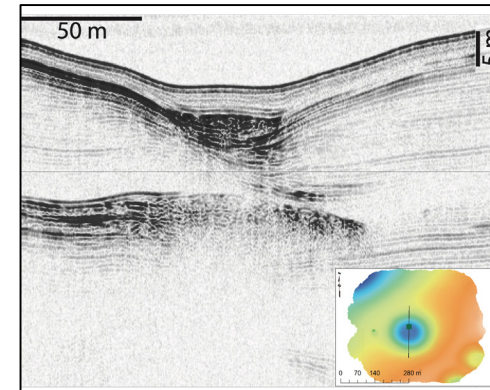
Washington, Oregon, and California



What is a Benthic Habitat?

A benthic habitat type is defined as “a particular environment which can be distinguished by its **abiotic** characteristics and associated **biological assemblages**, operating at particular, but dynamic spatial and temporal scales in a recognizable geographic area (ICES 2006).”

- Physical (abiotic) – Depth, Slope, Consolidation, Grain Size, Oxygen, pH
 - High-resolution geophysical surveys (remote sensing)
 - Sampling sediments and water
- Biological – Invertebrates in the substrate (macrofauna), fishes and invertebrates associated with the seafloor (epifauna)
 - Video, diving
 - Sampling by fishing/trawling, ROV arm for selected samples

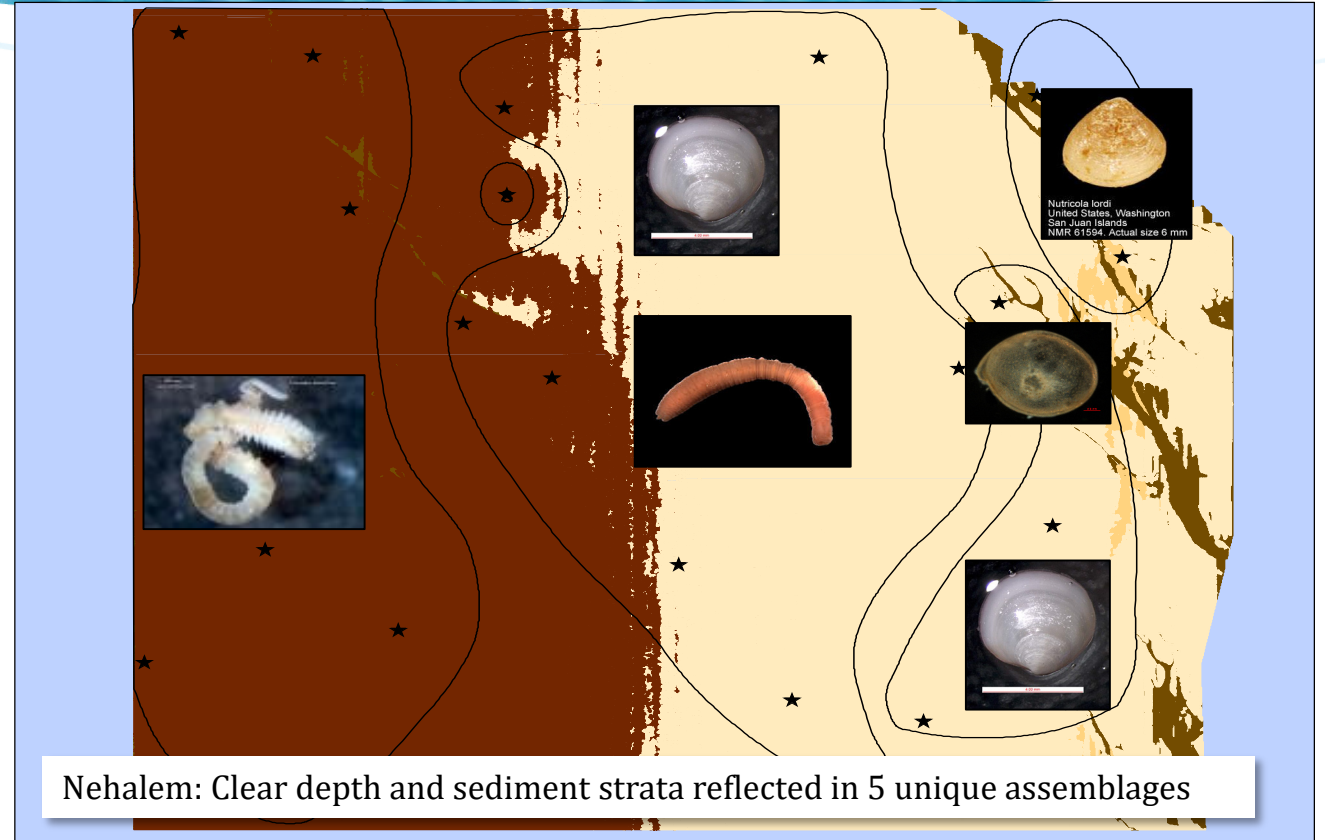
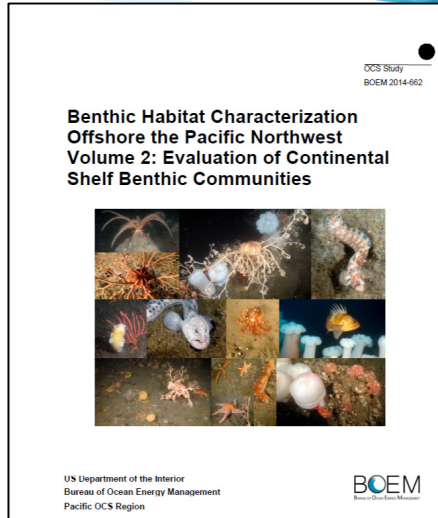
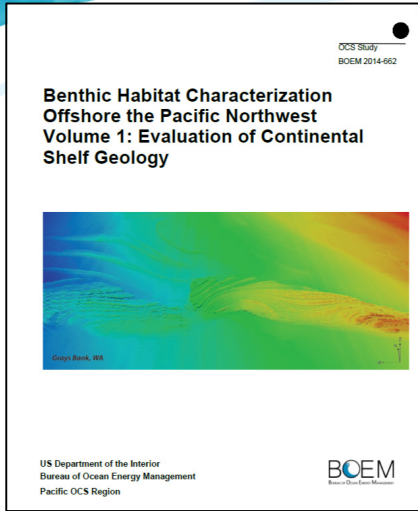


Images courtesy of Monterey Bay Aquarium Research Institute (MBARI) and Oregon State University (OSU).

BOEM-funded Regional Characterizations of Benthic Habitats

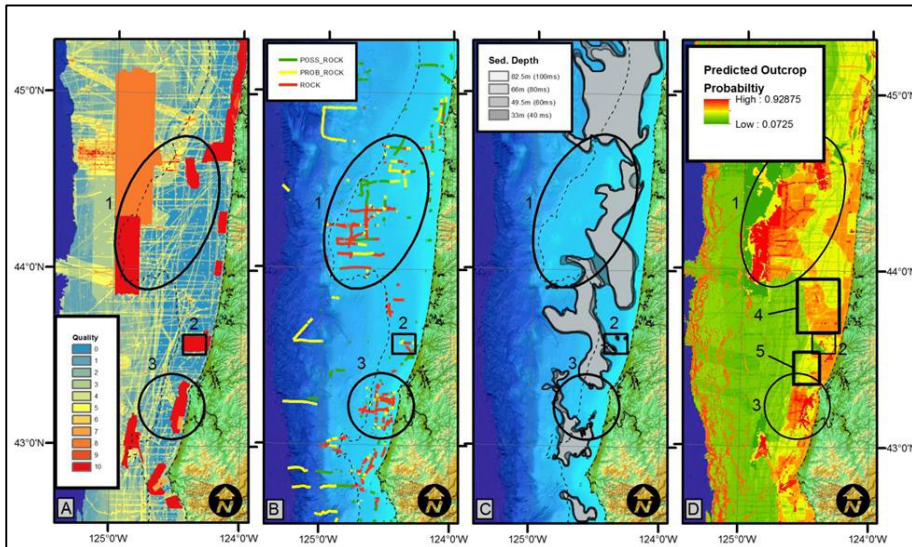
Study Title (offshore extent)	Dates	Methodology	Online Information	Partners
Survey of Benthic Communities Near Potential Renewable Energy Sites Offshore the Pacific Northwest (WA, OR, Northern CA)	2010-2014	<ul style="list-style-type: none"> High-resolution geophysical surveys ROV surveys 	https://marinecadastre.gov/espis/#/search/study/27103	Oregon State University (OSU)
Oregon OCS Seafloor Mapping: Selected Lease Blocks Relevant to Renewable Energy (Coos Bay, OR)	2014-2017	<ul style="list-style-type: none"> High-resolution geophysical survey Video camera sled survey 	https://www.boem.gov/2017-018/	US Geological Survey (USGS), OSU
Cross-Shelf Habitat Suitability Modeling (WA, OR, CA)	2017-2020	<ul style="list-style-type: none"> NOAA deep sea coral and sponge database and NMFS video validation SCCWRP and OSU macrofauna database and validation 	<p>Modeling report in press; Macrofauna:</p> https://marinecadastre.gov/espis/#/search/study/100171	National Oceanic and Atmospheric Administration (NOAA - NMFS, NCCOS), OSU, Southern California Coastal Water Research Project
EXPRESS - Morro Bay California Deepwater Investigations and Groundtruthing (Cal DIG I)	2017-2021	<ul style="list-style-type: none"> High-resolution geophysical surveys (AUV, towed) ROV surveys Piston and push cores 	Reports in press 2021	USGS, NOAA (NOS, OAR), Monterey Bay Aquarium Research Institute (MBARI)
EXPRESS – Humboldt Cal DIG II	2019-2023	<ul style="list-style-type: none"> High-resolution geophysical surveys (AUV, towed) ROV surveys Piston and push cores 	In Prep	USGS, MBARI, NOAA (NOS, NMFS, OAR)

Benthic Habitat Characterization (WA, OR, Northern CA)



Henkel SK, Politano KK (2017) Small proportions of silt linked to distinct and predictable differences in marine macrofaunal assemblages on the continental shelf of the Pacific Northwest. Cont Shelf Res 144:38–49. doi: 10.1016/j.csr.2017.06.016

Oregon State University partners lead by S. Henkel and C. Goldfinger.



Oregon OCS Seafloor Mapping: Selected Lease Blocks Relevant to Renewable Energy

USGS
science for a changing world

Prepared in cooperation with the Bureau of Ocean Energy Management

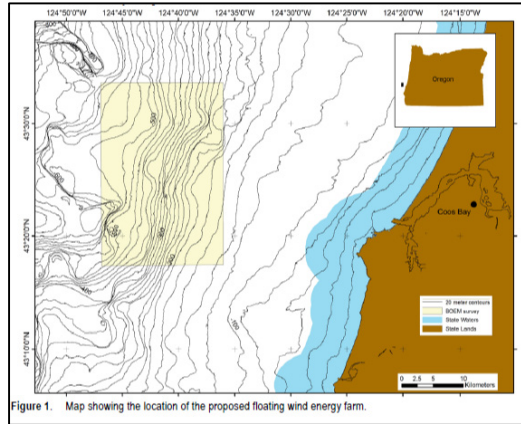
Oregon OCS Seafloor Mapping: Selected Lease Blocks Relevant to Renewable Energy

BOEM Intra-agency Agreement M13P000037

By Guy R. Cochrane, Lenaxig G. Hemery, and Sarah K. Henkel

Open-File Report 2017-1045
Bureau of Ocean Energy Management OCS Study BOEM 2017-018

U.S. Department of the Interior
U.S. Geological Survey
Bureau of Ocean Energy Management



L.G. Hemery et al.

Continental Shelf Research 159 (2018) 24-32

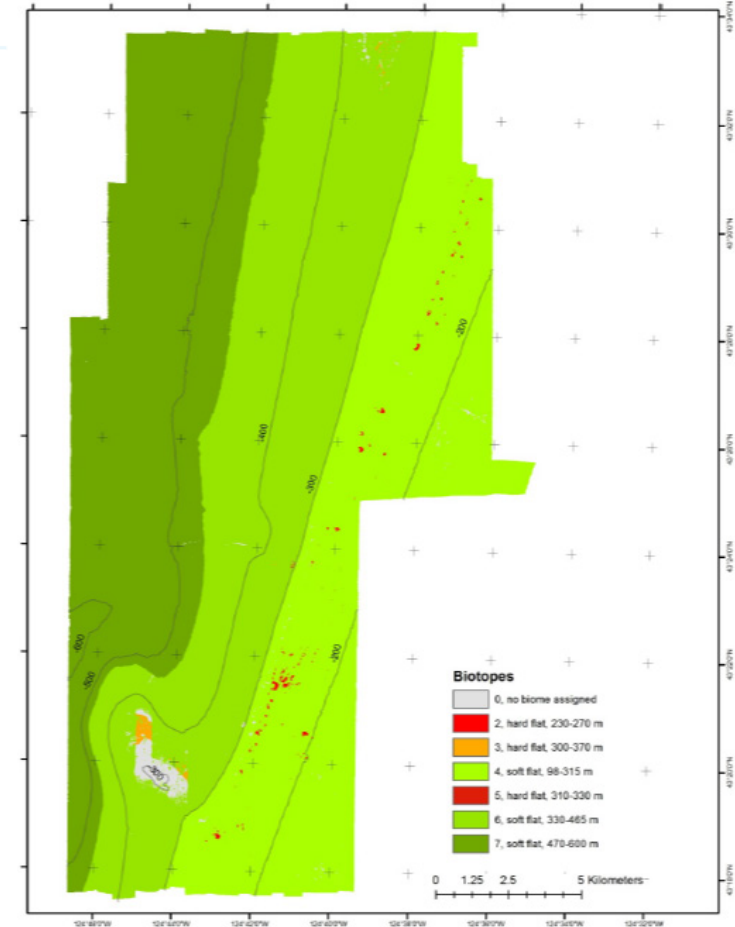
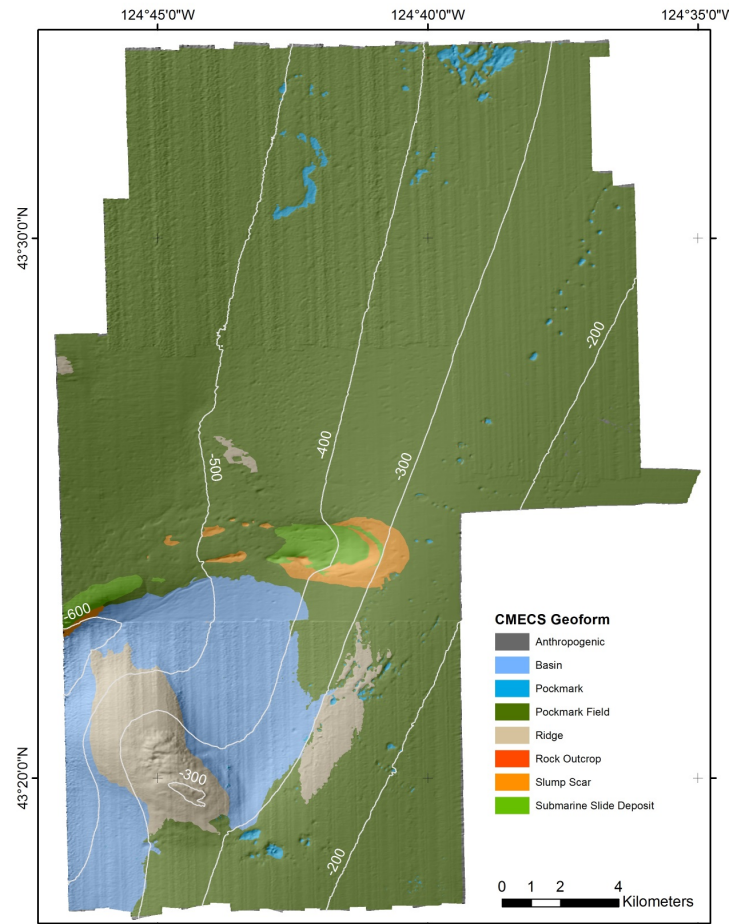
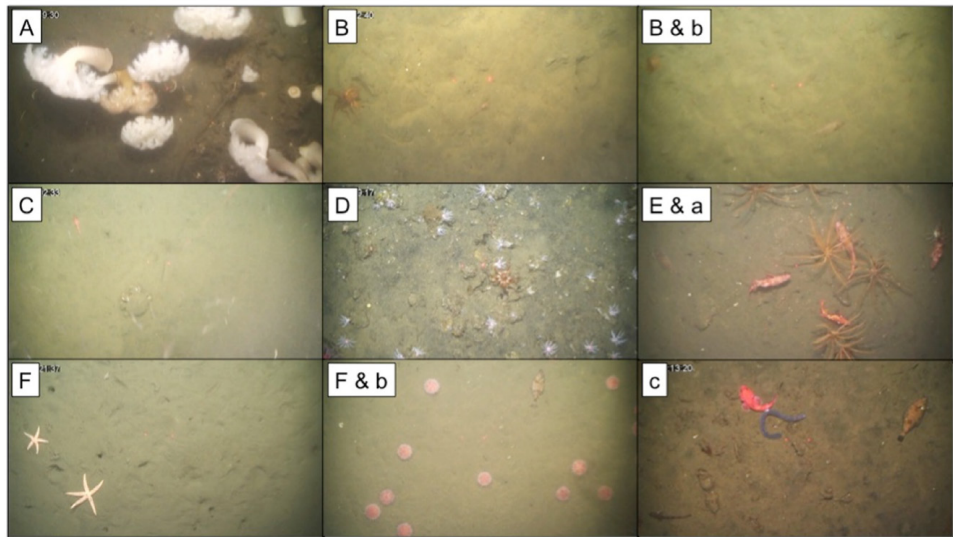


Figure 19. Image of biotope raster.

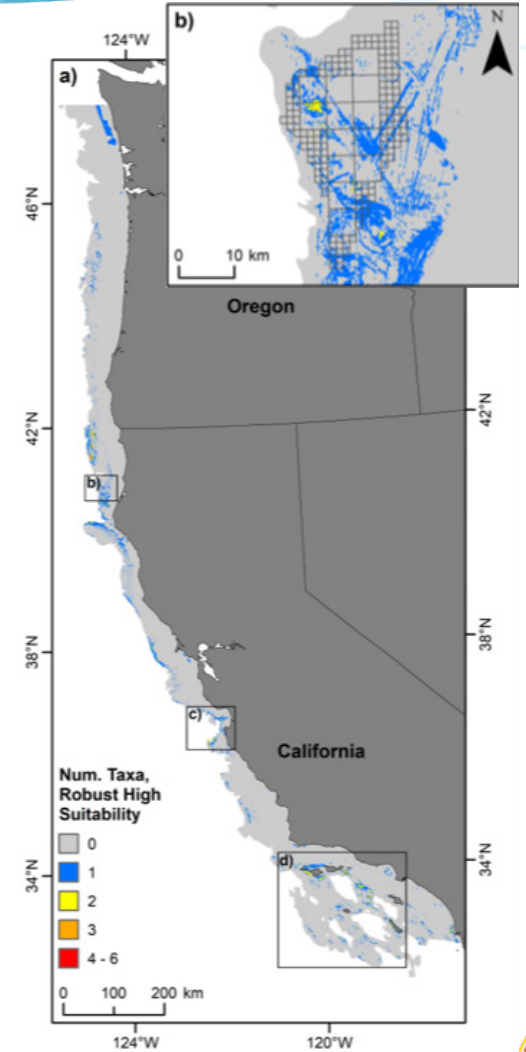
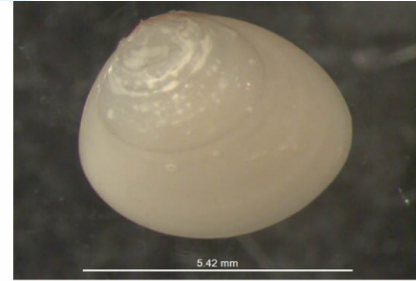
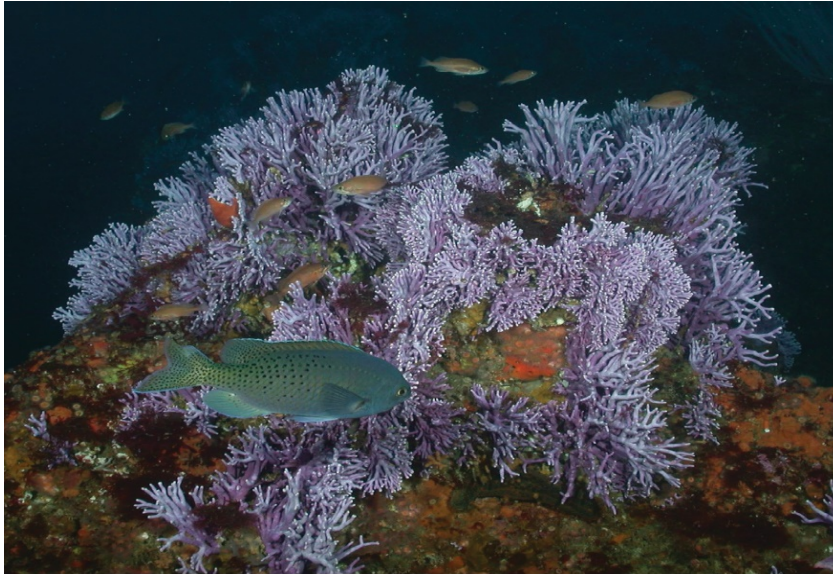
Cross-shelf Habitat Suitability Modeling (WA, OR, CA)

OCS Study
BOEM 2020-008

**Cross-Shelf Habitat Suitability Modeling
for Benthic Macrofauna**

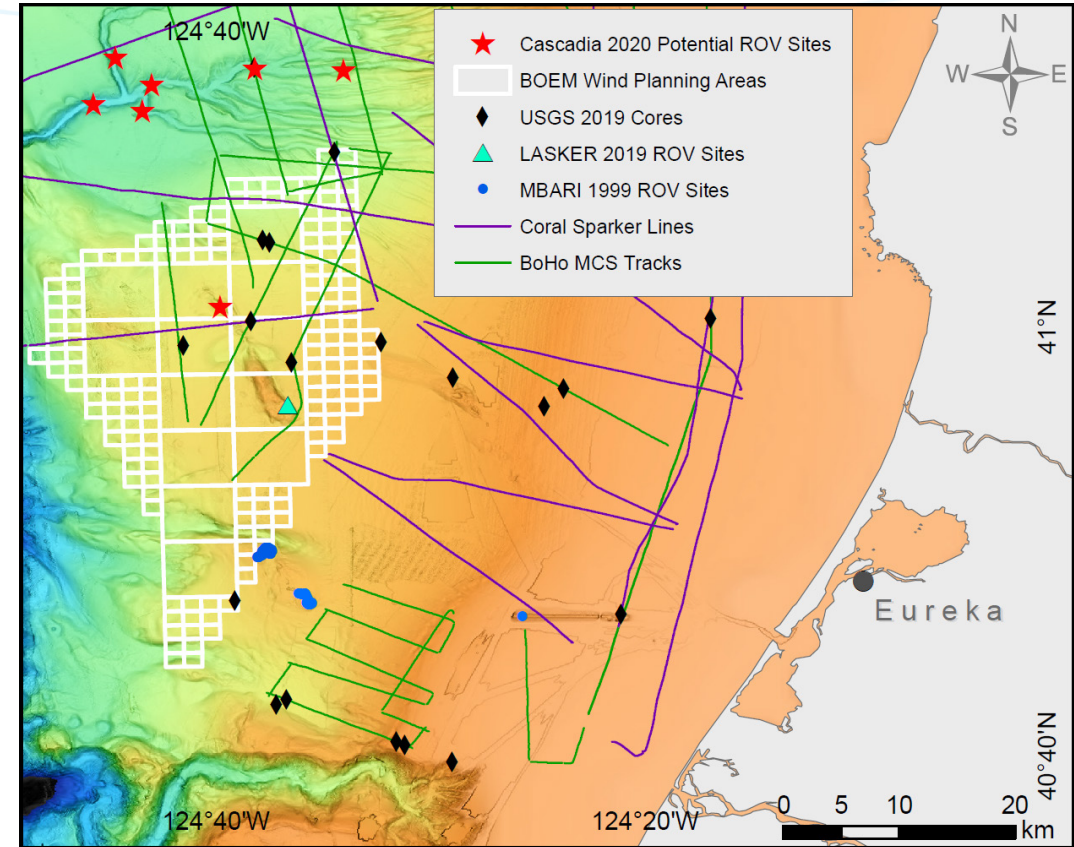
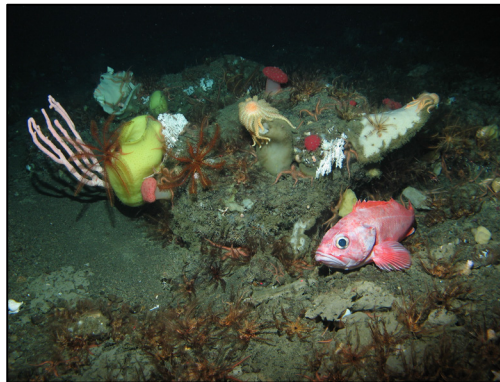
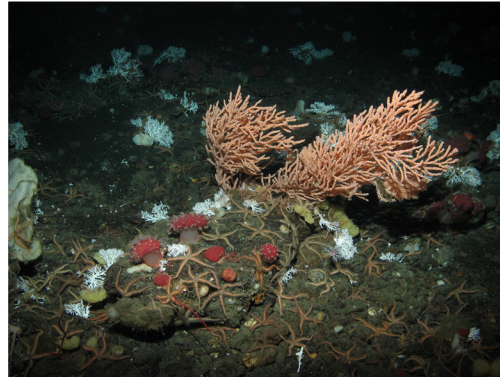


US Department of the Interior
Bureau of Ocean Energy Management
Pacific OCS Region



EXPRESS – Northern California (Cal DIG II)

Expanding Pacific Research and Exploration of Submerged Systems (EXPRESS)

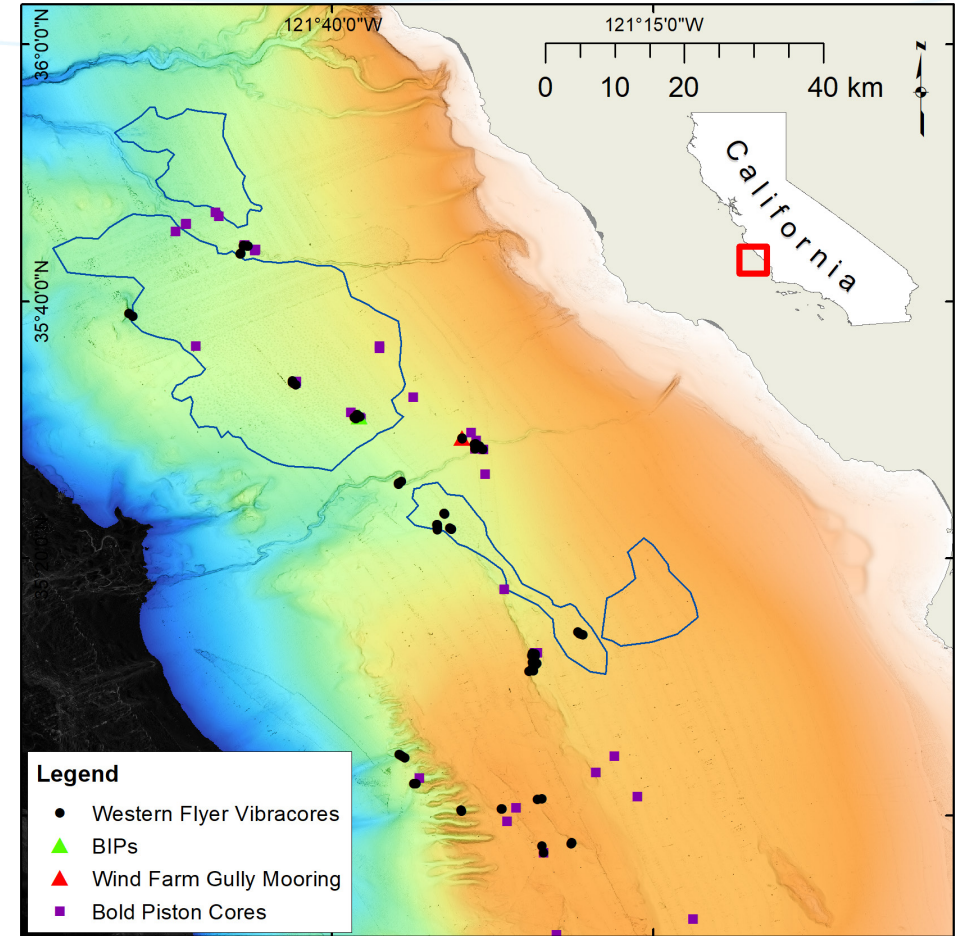
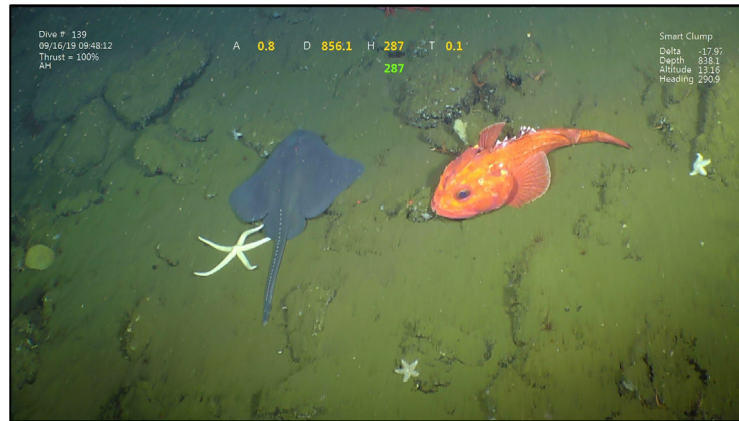


https://www.usgs.gov/centers/pcmssc/science/express-expanding-pacific-research-and-exploration-submerged-systems?qt-science_center_objects=0#qt-science_center_objects

Images courtesy of D. Waters (NOAA), N. Prouty (USGS) and E. Lundsten (MBARI).

EXPRESS – Morro Bay (Cal DIG I)

Expanding Pacific Research and Exploration of Submerged Systems (EXPRESS)



https://www.usgs.gov/centers/pcm/science/express-expanding-pacific-research-and-exploration-submerged-systems?qt-science_center_objects=0#qt-science_center_objects

Images courtesy of L. Kuhnz, R. Gwiazda (MBARI, <https://annualreport.mbari.org/2018>)

Geohazard Analysis

Floating Offshore Wind in California, Oregon, and Hawaii



Jennifer Miller | Geophysicist, BOEM Office of Renewable Energy Programs



Introduction to Geohazards

What is a geohazard?

- Landslides
- Tsunami
- Earthquakes
- Volcanic activities
- Seismic activity
- Gas seeps
- Liquefaction




Introduction to Geohazards

Why are geohazards regulated?

- **Operational Impacts:** damage to facilities
- **Safety Impacts:** damage makes operations unsafe
- **Mitigation solutions:** designs or operational methods to reduce risks



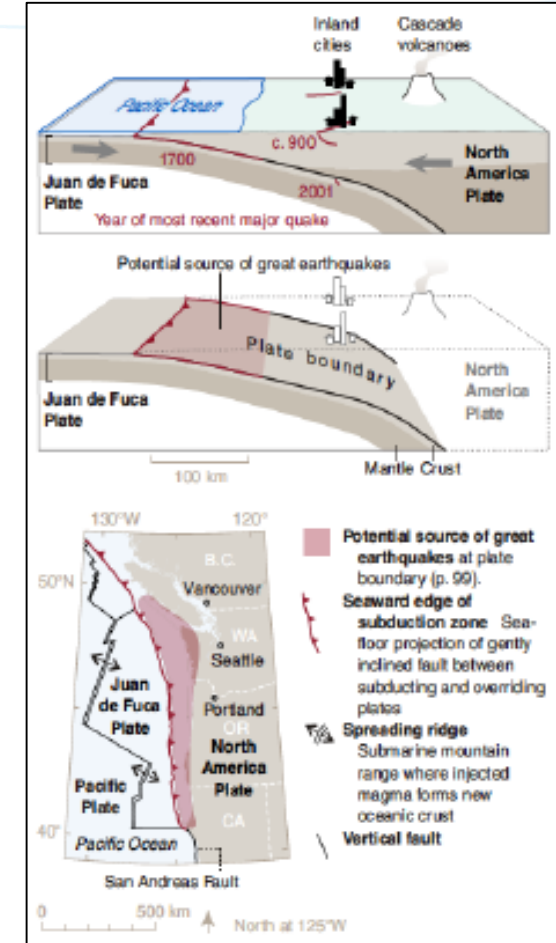
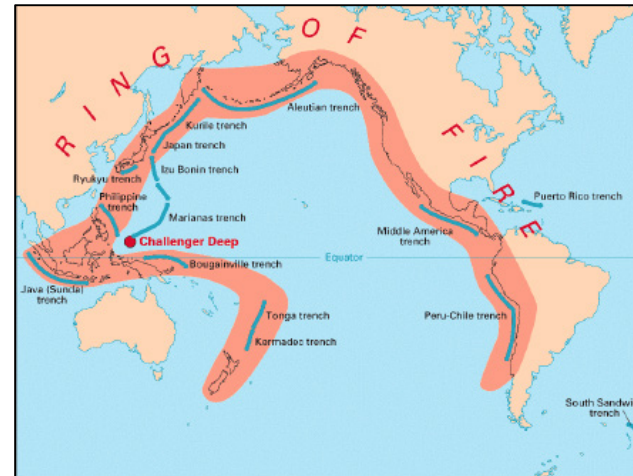
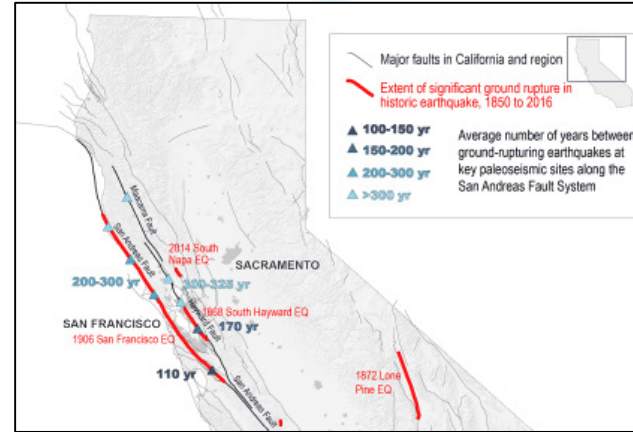
<i>Primary geological effects</i>	- Fault scarps	
	- Seismic Uplift / subsidence	
<i>Secondary geological effects</i>	- Liquefactions and dike injections	
	- Landslides	
	- Rock fall	
	- Tsunamis/Seiches	

Rodriguez-Pascua, et al., 2009

Geohazards in the Pacific

Regional Geology

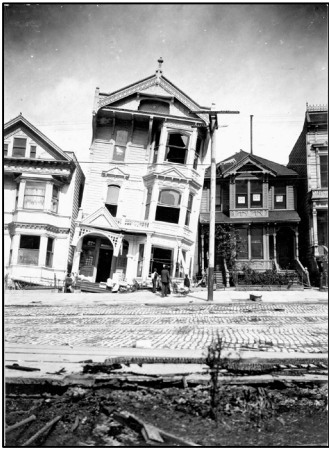
- High seismic activity
- Complex geology
- Faulting
- Volcanic islands



Geohazards in California, Oregon, and Hawaii

Local Geohazards

Earthquakes, volcanic activity, slope stability, tsunamis, turbidity currents, gas, liquefaction



7.9 San Francisco Earthquake, 1906



6.9 Loma Prieta Earthquake, 1989



6.7 Northridge Earthquake, 1994



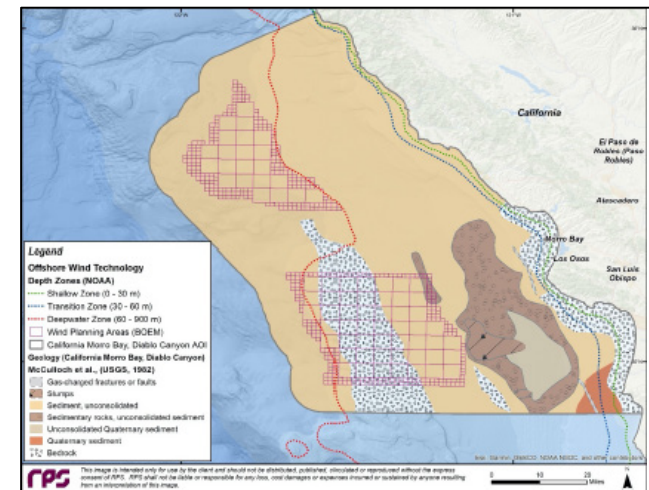
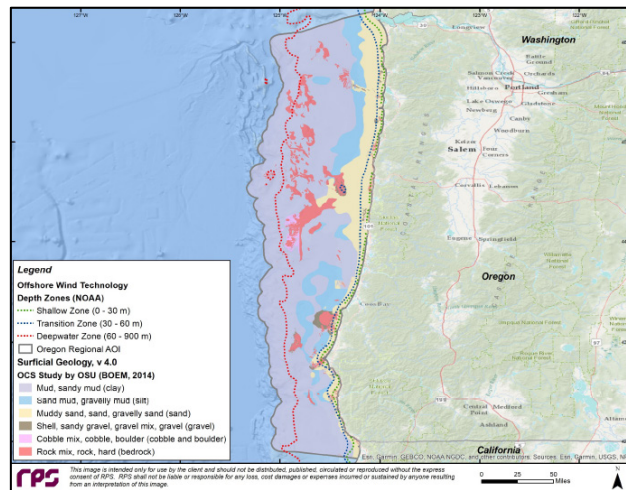
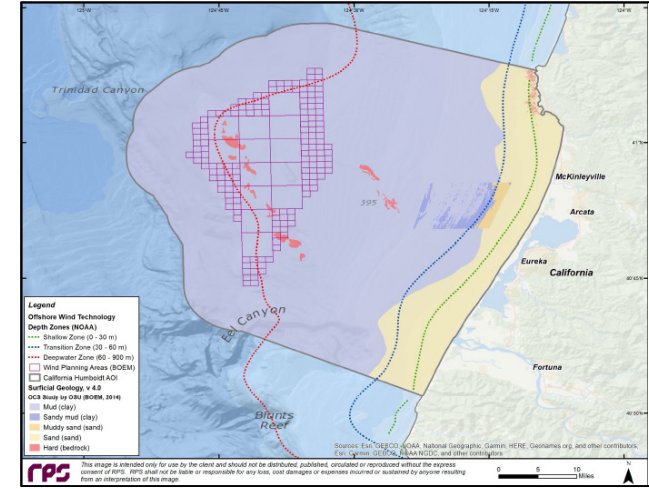
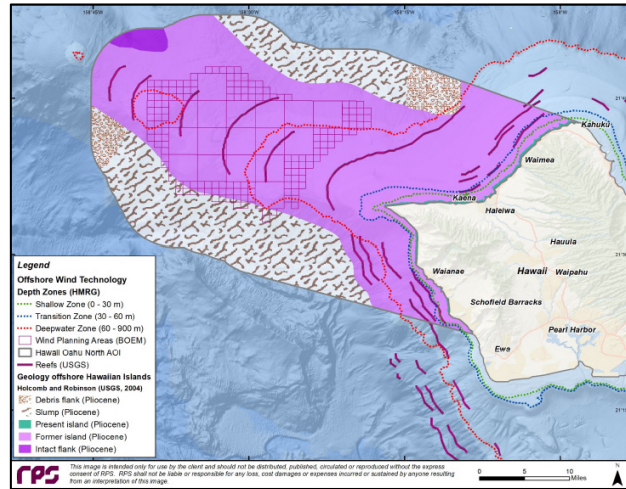
Crescent City Tsunami from **9.2** Earthquake in Alaska, 1964

BOEM-funded Pacific Geohazards Study

Geologic Model – Data Inputs

Soil conditions

- Liquefaction – clean sands and gravels
- Thin sediment / shallow bedrock
- Slope failures (slumps, slides, etc.)

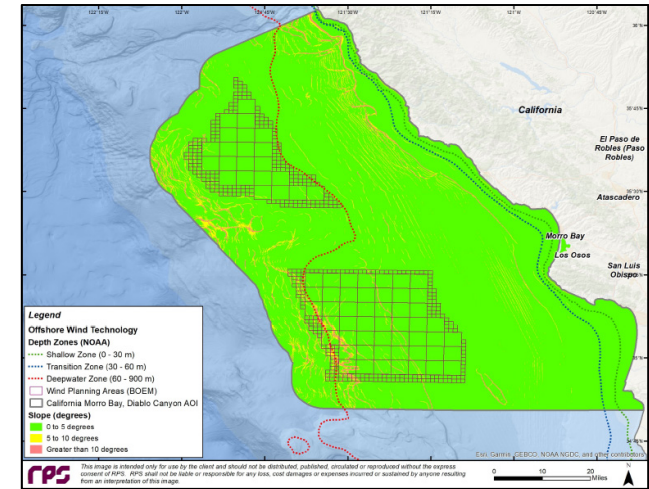
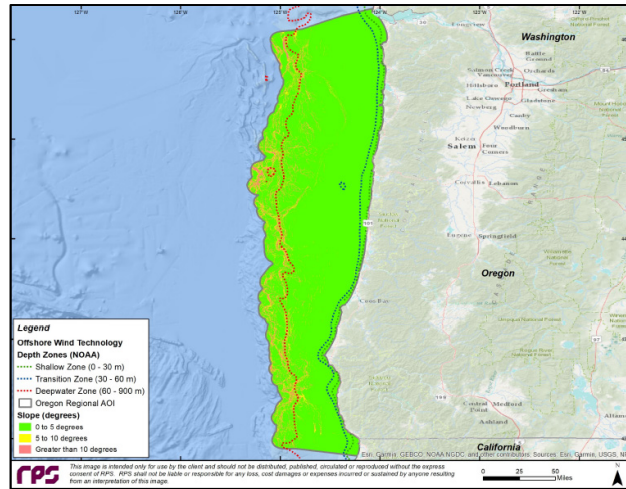
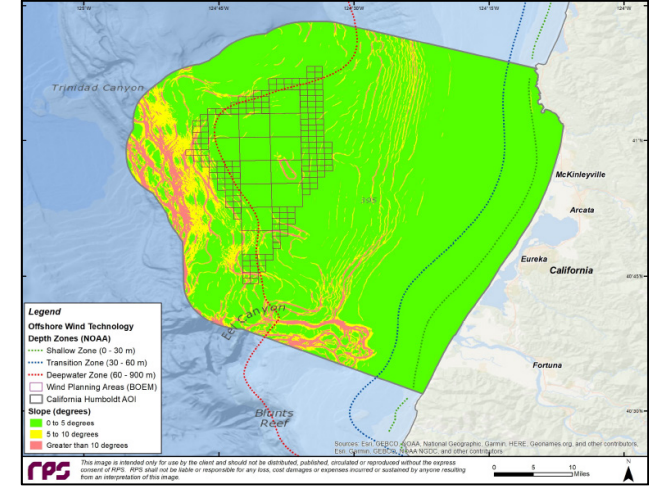
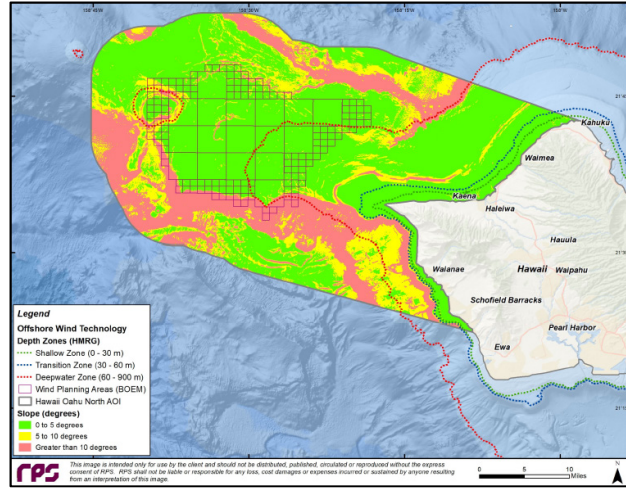


Pacific Geohazards Study

Geologic Model – Data Inputs

Slope

- Green $<5^\circ$
- Yellow $5^\circ-10^\circ$
- Red $>10^\circ$

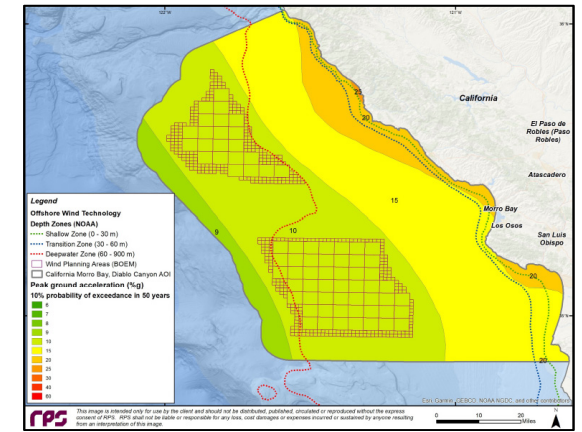
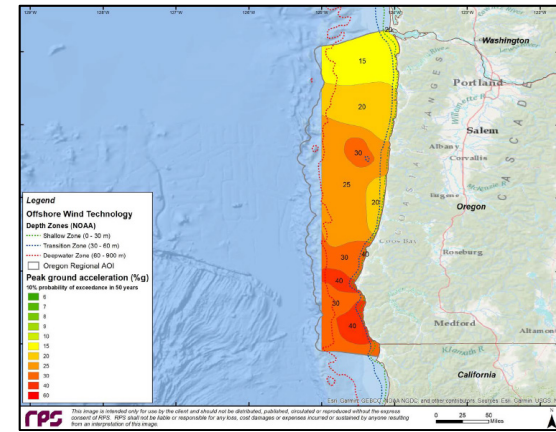
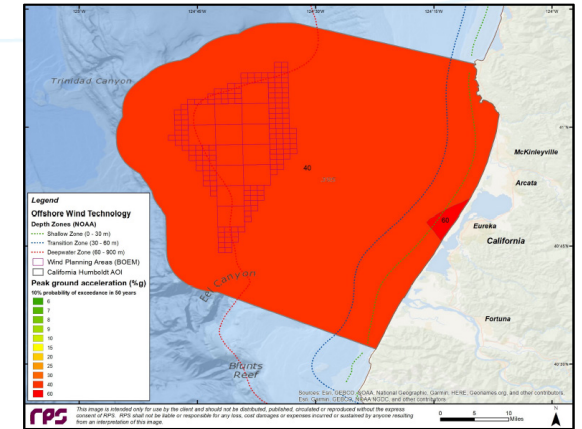
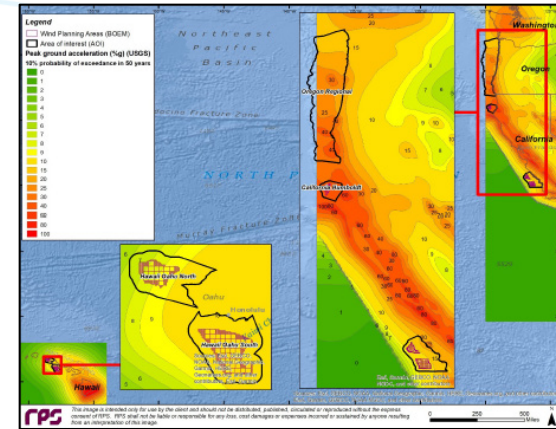
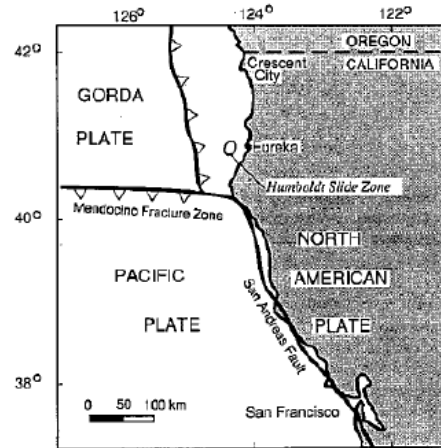


Pacific Geohazards Study

Geologic Model – Data Inputs

Seismic Activity (pga)

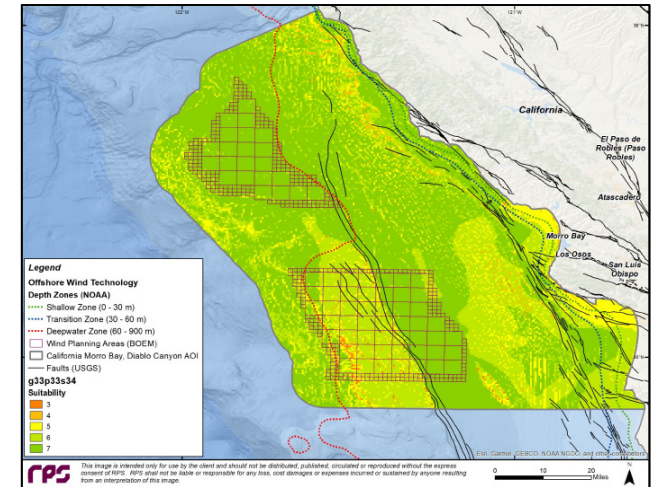
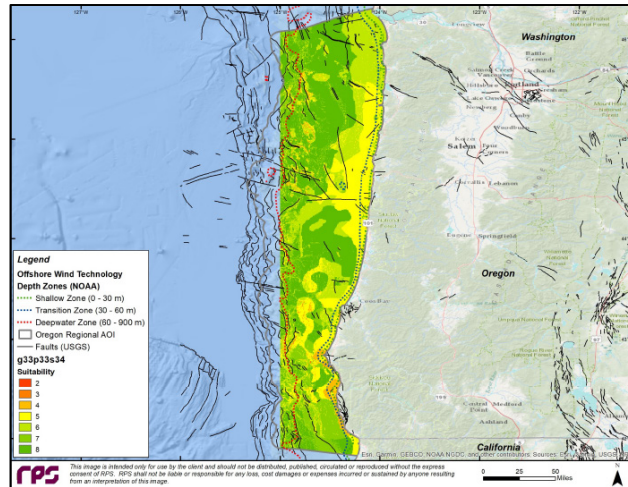
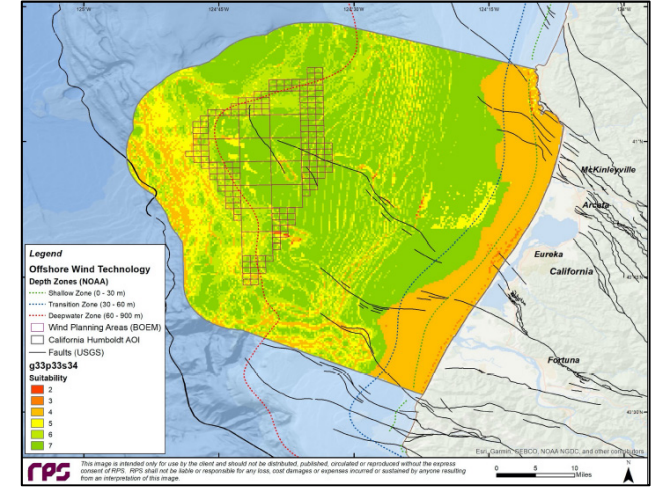
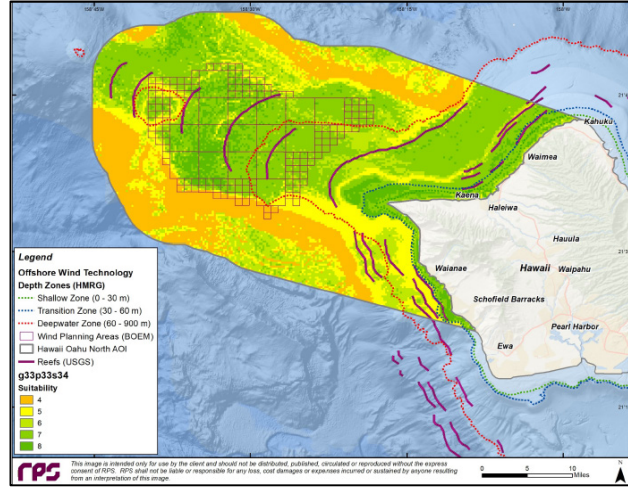
- Risk – earthquakes, landslides, turbidity currents, liquefaction
- High risk – Humboldt
- Triple Junction
 - Mendocino Ridge
 - Gorda Ridge
 - San Andreas Fault



Pacific Geohazards Study

Results

- Suitability Analysis
- Different weights for inputs
 - soil conditions
 - slope
 - seismic risk/pga



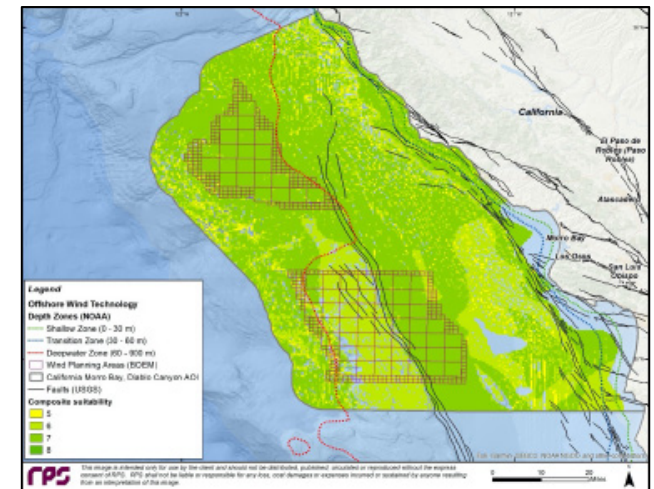
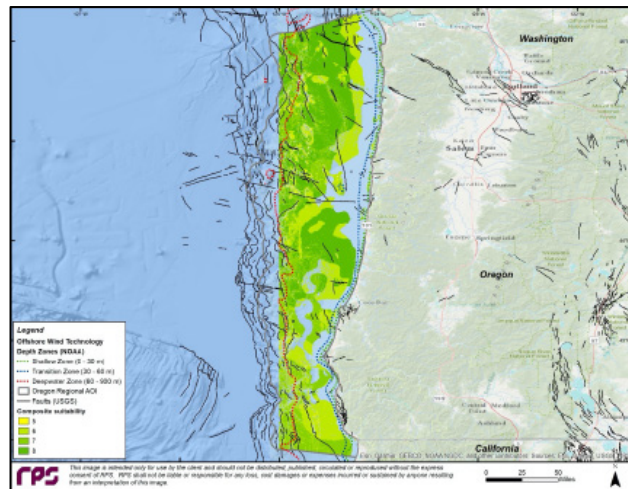
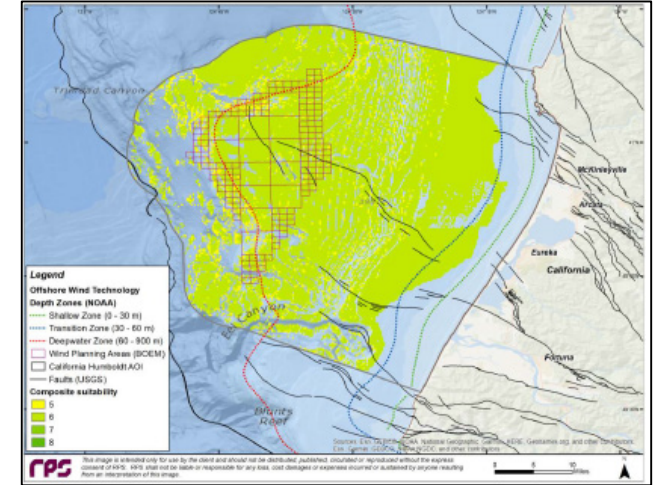
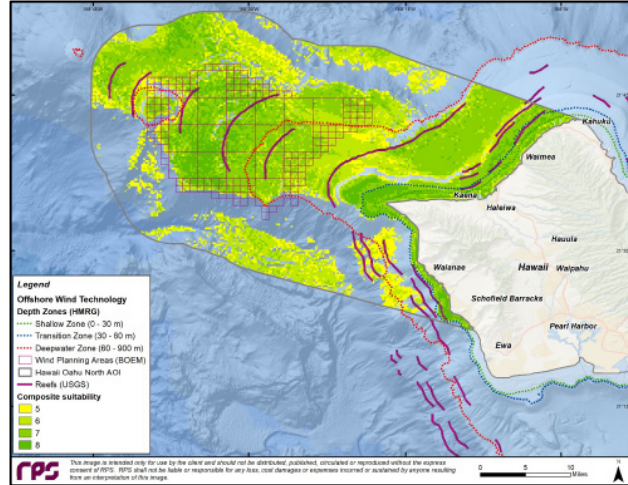
Pacific Geohazards Study

Results

- Composite Suitability Analysis

Project Website:

<http://boem-oceansmap.s3-website-us-east-1.amazonaws.com/>



Pacific Geohazards Study

Identification of Data Gaps

- All California Study Areas:
 - Low quality / widely spaced bathymetry data
- Diablo Canyon/ Morro Bay:
 - Very little soil data



Pacific Geohazards Study Update – Cal DIG Data

- **Recent Data Collection:** bathymetry, seismic, geotechnical data
- **Incorporate Interagency Data Products:** bathymetry, backscatter imagery/ seabed interpretation, subsurface structure, vibracores / geotechnical data
- **Update Data Inputs:** soil conditions, slope, seismic activity
- **Update Suitability Analysis**

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