

Environmental Studies Program: Ongoing Study

Field	Study Information
Title	BOEM-MARINe (Multi-Agency Rocky Intertidal Network) (PC-23-01)
Administered by	Pacific OCS Regional Office
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Procurement Type(s)	Cooperative Agreement
Conducting Organization(s)	University of California, Santa Cruz
Total BOEM Cost	\$2,574,804
Performance Period	FY 2023–2028 (funding requested for FY 2023–2027)
Final Report Due	November 6, 2028
Date Revised	April 14, 2025
Problem	Active offshore oil and gas operations can significantly impact sensitive rocky intertidal habitats, which are home to a diversity of species, including the endangered black abalone. Monitoring rocky shores annually is the only way to determine if there are impacts from Outer Continental Shelf (OCS) operations and to be able to understand the cumulative impacts to this sensitive habitat.
Intervention	These funds will support ongoing monitoring studies which date back to 1975. Statistical analyses of repeated species abundance and size-structure data are a powerful way to detect change over time. Additional site-wide protocols are conducted to understand changes among sites and differentiate between OCS oil and gas-related activities and other anthropogenic effects.
Comparison	The MARINe program makes regional comparisons by relying on monitoring outside of OCS activity areas, which is done with identical methods and funded by 40 universities and agency partners in the program. These data have also been utilized in Before/After/Control/Impact- (BACI-) based analyses of non-OCS oil spills, water pollution, and Marine Protected Area assessments.
Outcome	Trends impacting rocky shore species—such as human trampling, disease, and climate change—are expected to intensify. In addition, potential offshore resource development activities along with continued oil and gas production may impact rocky intertidal habitats and communities. Comparing community metrics inside and outside of potential OCS-related impact areas enables us to differentiate impacts from OCS activities versus changing environmental conditions. The public engagement with this program will continue to be strong, and results will directly inform National Environmental Policy Act and Endangered Species Act (ESA) consultations as well as significantly benefit state partners.
Context	California, Oregon, Washington, Alaska.

BOEM Information Need(s): Current and planned OCS operations are a strong public concern because of previous oil spills along the Pacific coastline. As required by the OCS Lands Act, BOEM needs to regularly monitor vulnerable and sensitive resources adjacent to ongoing OCS activities. Rocky shore communities were chosen 20 years ago as key resources to monitor because they are rare and unique to ocean-upwelling regions in the world. Also, multiple species are long lived and an important resource to many fishes, birds, and mammals.

BOEM and U.S. West Coast partner States need rocky shore community metric data for evaluating oil spill impacts, water quality discharges, and adjacent Marine Protected Areas. We anticipate this type of information will continue to be needed to inform decisions relating to oil and gas decommissioning and other development activities. In particular, BOEM has a specific continual need for black abalone count and size data as well as abalone habitat quality assessments for ESA consultations. This is the only source of data available for the endangered black abalone on the mainland of California and in the past, these data were utilized for the listing and establishment of critical habitat for black abalone (Miner et al. 2006).

Background: BOEM's support for the MARINe program provides funding to monitor 32 rocky shore sites of interest to BOEM, of which 24 sites are adjacent to OCS operations in California and 8 sites are off the Oregon coast, where an OCS offshore wave energy facility is planned. MARINe also collects data at sites in Washington and Alaska with funds from partners such as the National Park Service. MARINe was formally established in 1997 after the Exxon Valdez oil spill and the realization that oil spill impacts can only be assessed when baseline data are available. MARINe needs to continue to facilitate detection of new trends in a regional context across the U.S. West Coast over time, such as sea-level rise (Kaplanis et al. 2020), tracking decline in ochre stars (Miner et al. 2018; Moritsch and Raimondi 2018), and recording current conditions as baseline data prior to the inception of offshore renewable energy installations.

MARINe is a cost-effective program that heavily relies on leveraged funds shared across partners including the States of California and Oregon, the U.S. Navy, and five National Park Service units (Gilbane et al. 2021). Although BOEM specifically supports monitoring in areas adjacent to OCS activities, BOEM uses data collected from other sites for use as comparative reference condition. BOEM supports approximately one-third of the overall database and website costs. MARINe's shared methods and database are valuable to state agencies and are used as a model for other ecological programs. Analyses are not limited by access to data or constraints of joining separate methods. This structure also enables a framework for resource-limited groups such as Tribal Nations, local municipalities, or local environmental groups to get involved in rocky reef monitoring, fostering positive interactions, and facilitating learning opportunities with the public. MARINe jointly publishes 1–3 papers in scientific journals per year, averages 25–35 data requests per year, and averages 2,000 hits per month on its website, <https://marine.ucsc.edu/>.

Objective(s): This study provides for the continued monitoring of 32 rocky intertidal sites on the mainland shore immediately adjacent to OCS oil and gas facilities offshore southern California and a potential OCS wave energy facility offshore Oregon. The following objectives are necessary to meet this goal:

- Determine spatial and temporal trends for selected species and communities at 32 sites along the U.S. West Coast.
- Determine species diversity and other community metrics and compare among sites, in particular between OCS and non-OCS sites.

- Measure size-structure (as a proxy for age class) of black abalone, owl limpets, and sea stars change over time and in response to punctuated impacts.
- Proactively engage with Native American Tribal Nations by providing resources such as a salary for part-time coordination, facilitated meetings, and funding to Tribes to better understand their practices of coastal harvest. Provide funding sources for Tribes fosters engagement with capacity-limited communities. Multiple Tribal Nations are known to have current or ancestral ties to coastal areas and possess multi-generational knowledge of these habitats.

Methods: MARINe employs standardized field protocols, a shared database, and a website (www.rockyintertidal.org). Sites are monitored by four teams of field biologists, including the BOEM Pacific Regional Investigations Survey and Monitoring (PRISM) team. The long-term protocol determines the percent cover and count of selected species within fixed plots, including barnacles, mussels, sea stars, black abalone, and surfgrass. This protocol is implemented each fall and provides a high confidence for detecting small changes in abundances of targeted species. A second biodiversity protocol is implemented each spring. The biodiversity protocol allows BOEM to extrapolate beyond the spatial constraints of the core monitoring program and evaluate species changes across the site, identify rare species, and provide clues to movement of species in relation to changes in the physical environment. Biodiversity is the more time-consuming protocol, so the four teams combine to sample four sites per year, completing all the sites within a five-year rotation. Temperature is recorded at 10-minute intervals at all sites. Data are placed in a common database and are accessible through graphing, downloads, and map visualizations, as well as through specific requests to the database manager.

Improving public data access is a goal. Improved access is linked to data assurance measures; database management includes quality control measures for data entry such as updates to web and app-based forms and scripts to detect errors. To ensure that future groups know which species MARINe sampled, data collectors archived representative species from each field group with the Smithsonian. This vouchering and archival effort will be continued at the remaining unsampled sites and species in California and in Oregon in coordination with partners pursuing eDNA library development primarily through a collaboration with Channel Islands National Park personnel. To make our data more accessible to the public and involve citizen science programs, we will produce identification guides and improve our online photo database. Improved quality assurance and control of this long-term program will also include better and public documentation of field and database protocols.

Specific Research Question(s):

1. What is the trend over time (in percent cover or counts sampled once a year) for selected species and communities in fixed plots at 32 sites along the U.S. West Coast?
2. What is the species diversity at a site and how do community metrics vary among sites?
3. How does the size-structure (as a proxy for age class) of black abalone, owl limpets, and sea stars change over time and in response to an impact?
4. How does proximity to OCS activities in California and Oregon affect communities and selected species?

Current Status: The cooperative agreement between BOEM and University of California, Santa Cruz was awarded on November 7, 2023. 2024 fieldwork was completed successfully, and 2025 fieldwork is ongoing.

Publications Completed: See <https://marine.ucsc.edu/explore-the-data/publications/index.html>.

Affiliated WWW Sites: <https://www.pacificrockyintertidal.org>

References:

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