

## Environmental Studies Program: Ongoing Study

Field	Study Information
Title	BOEM-MARINe (Multi-Agency Rocky Intertidal Network) (PC-19-01)
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	\$1,842,885 (includes Environmental Studies Program and Pacific Region funds)
Performance Period	FY 2019–2024
Final Report Due	June 30, 2024
Date Revised	November 21, 2023
Problem	Active oil and gas operations can significantly impact rocky intertidal resources. The public visits and cares about his habitat because rocky shorelines are a sensitive habitat and home to a diversity of species, including the endangered black abalone. Monitoring rocky shores annually determines impacts from OCS operations and cumulative impacts to this sensitive habitat.
Intervention	Continue to support long-term monitoring of this habitat. Statistical analyses show this protocol is a powerful way to detect change over time. Additional site-wide protocols are conducted to understand changes among sites. Prior efforts indicate that OCS oil and gas-related activities are not a primary impacting factor and that can be distinguished against several other anthropogenic effects.
Comparison	This program can only make regional comparisons by relying on monitoring outside of OCS activity areas, which is done with identical methods and funded by our 40 universities and agency partners. These data have also been utilized in 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 and disease, are expected to intensify along with continued oil and gas production. We will continue to monitor community metrics as well as the abundance and size-structure of protected species and key physical factors inside and outside of potential OCS-related impact areas. This design enables us differentiate OCS activities impacts from changing environmental conditions. The public engagement with this program will continue to be strong and results will directly inform NEPA and ESA consultations as well as significantly benefit the State of California.
Context	California, Oregon, Washington, Alaska BOEM's support of this program is an example of our long-term commitment to being environmental stewards on a topic that is important to the public and

in areas at risk from OCS activities. It is important to continuing this program in the context of proposed expanded OCS leasing on the U.S. West Coast.

**BOEM Information Need(s):** Current and Planned Outer Continental Shelf (OCS) operations are very visible little more than three miles from shore and a strong public concern because of previous oil spills to this region. Tar naturally and regularly shows up on shorelines throughout California. As required from 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 only to the three ocean-upwelling regions in the world. Also, multiple species are long lived and an important resource to many fishes, birds, and mammals.

BOEM and the State of California 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 for decommissioning and new leasing projects. BOEM has a specific continual need for black abalone count and size data as well as abalone habitat quality assessments for Endangered Species Act and Essential Fish Habitat consultations. This 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:** This study, Multi-Agency Rocky Intertidal Network (MARINe), provides funding to monitor all 32 BOEM long-term monitoring rocky shore sites, with 24 adjacent to OCS operations in California and 8 sites off the Oregon coast where an OCS offshore wave facility is planned. MARINe began formally in 1997 after the Exxon Valdez spill and the realization that oil spill impacts can only be assessed when baseline data are available. MARINe supports important Federal and State management decisions not envisioned in 1997. In addition to the black abalone endangered species listing described above, these data were critical to the State of California for analyses of non-OCS oil spills, water pollution, and Marine Protected Areas. MARINe needs to continue to facilitate detection of new trends, such as determining the 90 percent decline in ochre stars along the U.S. West Coast (Miner et al. 2018; Moritsch and Raimondi, 2018).

MARINe is a cost-effective program that heavily relies on leveraged funds. Primary long-term partners include the State of California, the US Navy, and five National Park Service groups. BOEM only supports monitoring in areas adjacent to OCS activities but BOEM uses data collected from these partners as reference conditions. BOEM supports approximately one-third of the overall database and website costs. MARINe's shared methods and data pipeline are praised by the States and are used as a model for other ecological programs. The payoff of BOEM's long-term support is that rocky intertidal data on the U.S. West Coast can be accessed and analyzed by interested stakeholders. Analyses are not limited by access to data or constraints of joining separate methods. Although MARINe partners benefit, this structure also enables citizen groups to get involved, thus 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 a month on its website.

**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 and potential wave facilities. The following objectives are necessary to meet this goal:

- Determine 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.
- Determine the species diversity and other community and compare among 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.
- Analyze communities and selected species near to and away from OCS activities in California and Oregon.

Methods: MARINE employs standardized field protocols, a shared database, and website ([www.rockyintertidal.org](http://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 a 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 over on 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, the prior five-year effort successfully collected and 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 the Channel Islands Park Service and collection of material at the Channel Islands. To make our data more accessible to the public and involve citizen science programs, we will produce identification guides available to the public and improve our photo database online. Improved quality assurance and control of this long-term program will also include better and public documentation of field and database protocols. BOEM continues to participate actively in the management and oversight of MARINE, to access the data critical to our ongoing operations, and to fulfill our responsibility to monitor OCS platforms and pipeline operations.

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 do communities and selected species differ among sites that are near to and away from OCS activities in California and Oregon? Evaluate the cumulative impacts to this resource.

Current Status: The cooperative agreement with University of California, Santa Cruz was awarded on September 23, 2019. The post-award meeting was held on October 17, 2019. Year 1 funds were used to pilot an online photo-database and deep learning model. Year 2 began on May 1, 2020, and fall field work was completed in 2020 despite increased costs and time due to the pandemic. Field work planned for February 2021 was delayed to March 2021. Field work operations in 2022 and 2023 resumed their standard course following the pandemic. The MARINe 2024 Annual Meeting is scheduled for April 15, 2024.

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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- Miner CM, Burnaford JL, Ammann K, Becker BH, Fradkin SC, Ostermann-Kelm S, Smith JR, Whitaker SG, Raimondi PT. 2021. Latitudinal variation in long-term stability of North American rocky intertidal communities. *J Anim Ecol.* 2021;00:1–17. <https://doi.org/10.1111/1365-2656.13504>
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