

Environmental Studies Program: Ongoing Study

Study Area(s): Southern California, Northern California, Washington-Oregon

Administered By: Pacific OCS Region

Title: Archaeological and Biological Assessment of Submerged Landforms off the Pacific Coast (NSL #PC-14-04)

BOEM Information Need(s) to be Addressed: BOEM is required under multiple statutes (e.g., Outer Continental Shelf Lands Act, NEPA, Endangered Species Act, and National Historic Preservation Act) to consider the impacts of OCS activities on archaeological and biological resources. Currently, BOEM requires avoidance of areas identified through remote sensing data as having potential to be associated with submerged cultural landscape features. No ground-truthing, however, of any of these possible features has been conducted on the Pacific OCS. Additionally, submerged landforms may be associated with essential fish habitat (EFH) or other biologically sensitive areas, although it is unknown what geomorphological characteristics drive this sensitivity. The purpose of this study is to use existing data of the seafloor to:

- (1) identify potential submerged landforms that could indicate the presence of prehistoric archaeological sites on the Pacific OCS,
- (2) identify potential submerged landforms and habitats that could indicate high productivity sites on the Pacific OCS,
- (3) collect fine-scale survey, coring, and biological data to ground-truth these features,
- (4) analyze and describe archaeological resources and high productivity habitats and their subsequent subsidy flows associated with the subject features,
- (5) evaluate the influence of high-productivity landforms and coastal processes on the structure of coastal food webs, and
- (6) develop a model that can be used to interpret remote sensing data and seafloor maps in other areas along the Pacific Coast in order to better identify submerged prehistoric and high productivity sites and classify their associated resources.

BOEM will use this information in NEPA documents, and NHPA, ESA, and EFH consultations, as well as government-to-government consultations with Native American tribes. Further, this information will inform decisions regarding lease sales, notices to lessees, information to lessees, and will be useful in developing mitigation measures.

Total BOEM Cost: \$1,399,414

Period of Performance: FY 2015–2019

Conducting Organization(s): San Diego State University

Principal Investigator(s): [Dr. Todd Braje](#)

BOEM Contact(s): [David Ball](#) and [Donna Schroeder](#)

Description:

Background: Because the spatial jurisdiction of BOEM lies entirely offshore beneath the surface of the water, a fundamental starting point that aids all phases of BOEM decisionmaking on the OCS is to characterize the seafloor. USGS and NOAA have conducted extensive hydrographic surveys along the Pacific Coast. Additionally, a recently completed BOEM study, *Inventory and Analysis of Coastal and Submerged Archaeological Site Occurrence on the Pacific OCS* (POCS Inventory), will provide a digital elevation model of the Pacific OCS paleolandscape and an analysis of where potential offshore paleocultural landforms might be expected. The next step in the process is to identify areas that suggest a high potential for the presence of submerged prehistoric sites and ground-truth some of these target areas. This study will attempt to determine if landforms and sites are being identified correctly from the geophysical data acquired under guidelines published in NTL 2006-P03, and if these buried landforms actually are preserved prehistoric sites.

Objectives: The overall objective of this study is to develop a process that will enhance the ability of BOEM to detect and avoid affecting potential submerged cultural landforms and high productivity areas on the Pacific OCS.

Methods: Six tasks will be performed.

1. *Evaluate existing remote sensing data and review current theories on sea level rise during the Last Glacial Maximum (LGM) to identify high probability areas for further testing.* Extensive seafloor mapping data collected by BOEM, NOAA, and USGS, historical information on sea level changes, modeling from the POCS Inventory, and anthropological and biological information in the scientific literature will be used to identify submerged relict features that could represent paleolandforms and may function as loci for sensitive ecological resources.
2. *Identify potential submerged landforms and habitats that could indicate high productivity sites on the Pacific OCS.* After synthesizing available information on seafloor character, bathymetry, etc. into a geographic information system that outlines submerged landforms in the area of interest, ecological productivity and subsidy flows will be summarized and overlaid on the spatial information.
3. *Conduct fine-scale survey and ground-truth at least four submerged landform features in each of the targeted areas (offshore southern California and central Oregon).* Various methods will be used to ground-truth identified features, including state-of-the-art remote sensing technology (e.g., bathymetric echo sounders; side-scan and high-resolution [CHIRP] sub-bottom sonar; high penetration sub-bottom sonar; and magnetometers [for targeted application], remotely operated vehicles, and core samples). Cores will be taken from each site and analyzed to identify, date, and characterize potential archaeological sites and to assist in reconstructing the region's paleoenvironment. Biological sampling will identify high productivity habitats.
4. *Analyze new data for possible indicators of prehistoric human activity and high productivity habitats and their subsequent subsidy flows associated with submerged*

landforms. Analysis for identifying potential submerged cultural landforms will include, at a minimum, remote sensing and coring data collected through this effort, a review of existing theories on sea level rise during the LGM, human migration patterns, and terrestrial analogs, among others. Assessment of biological resources will include a seafloor habitat description according to the Coastal and Marine Ecological Classification Standard, and an estimate of the species richness and density of important species, including corals and managed fish species.

5. *Evaluate the influence of high-productivity landforms and coastal processes on the structure of coastal food webs.* Once identified, the trophic footprint of productivity “hotspots” across habitats will be evaluated using (1) field surveys to document biodiversity and relative densities of characteristic fauna, and (2) isotopic analyses which will reveal the spatial extent of trophic subsidy due to the unique signature of highly productive areas (e.g., hydrocarbon seeps and macrophyte detritus concentrations) when compared to primary production from phytoplankton.
6. *Develop and refine a model that can be used to interpret remote sensing data and seafloor maps in other areas along the Pacific Coast in order to better identify submerged prehistoric and high productivity sites and classify their associated resources.* Analyses will include recommendations for processing future remote sensing data collected to support BOEM-permitted activities on the Pacific OCS and for appropriate survey parameters to better identify these resources as well as a ranking of coastal habitats and landform features by productivity.

Current Status: The cooperative agreement between BOEM and SDSU was awarded August 18, 2015. Geophysical surveys and coring around the Northern Channel Islands and central Oregon coast have been completed. Analysis of the cores will be completed over the next several months, at which point, work will begin on drafting the final report of findings.

Final Report Due: August 31, 2019

Publications Completed:

Marris, E. 2015. Fishing for the first Americans. In *Nature*, International Weekly Journal of Science. 08 September 2015. <http://www.nature.com/news/fishing-for-the-first-americans-1.18334>

Wade, L. 2017. On the Trail of Ancient Mariners. In *Science*, 357 (6351), 542-545. 11 August 2017. <http://www.sciencemag.org/news/2017/08/most-archaeologists-think-first-americans-arrived-boat-now-they-re-beginning-prove-it>

Affiliated WWW Sites: <https://marinecadastre.gov/espis/#/search/study/100088>

Revised Date: July 13, 2018