

Environmental Studies Program: Ongoing Study

Field	Study Information
Title	ADRIFT: Spatial and Temporal Distribution of Cetaceans in the California Current Ecosystem Using Drifting Archival Passive Acoustic Monitoring (PC-20-04)
Administered by	Pacific OCS Regional Office
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Procurement Type(s)	Interagency Agreement
Conducting Organization(s)	National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Southwest Fisheries Science Center
Total BOEM Cost	\$2,715,410 (includes Environmental Studies Program and Pacific Region funds)
Performance Period	FY 2020–2024
Final Report Due	June 8, 2024
Date Revised	November 2, 2023
Problem	BOEM's ability to accurately assess the potential impacts from offshore renewable energy development on protected species, as required by the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA), is restricted by a lack of ambient soundscape and seasonal cetacean habitat use data.
Intervention	Collect and analyze passive acoustic data in the California Current Ecosystem to gain comprehensive spatial and temporal insight into the occurrence and distribution of protected cetacean species, while simultaneously collecting ambient soundscape data.
Comparison	This data would complement and advance our existing knowledge and provide the foundation for any effects analysis of future operational monitoring data. This data can also be compared to data collected by the National Oceanic and Atmospheric Administration's (NOAA's) Ocean Noise Reference stations in the Olympic Coast and Channel Islands National Marine Sanctuaries.
Outcome	Description of the spatial and temporal occurrence of cetacean species and ambient soundscapes in the California Current Ecosystem.
Context	California, Oregon

BOEM Information Need(s): Provide BOEM needs to continually improve our understanding about the occurrence and distribution of protected cetacean (whale, dolphin, and porpoise) species within the California Current Ecosystem (CCE). In addition, BOEM needs to continually improve our understanding about the ambient soundscapes in these areas. These data will allow BOEM to more accurately assess the potential impacts and overall acoustic contribution of BOEM-related activities in the dynamic marine environment. This information will allow for compliance with BOEM's regulatory responsibilities under the MMPA, ESA and National Environmental Policy Act. This information is applicable to all BOEM Programs and is especially applicable to current efforts directed towards the identification of wind

energy areas and the general types of mitigation strategies required to minimize potential impacts to these marine mammals from any of BOEM's future offshore energy related activities.

Background: Cetacean distribution and abundance data are traditionally collected by large vessels and aircraft conducting surveys in offshore areas. These surveys (e.g., Pacific Marine Assessment Partnership for Protected Species [PacMAPPS] California (BOEM, 2020a) provide important visual and acoustic data; but due to the expense and difficulty in collecting data in remote offshore areas, during bad weather or during times of low visibility, the surveys are generally conducted intermittently during the summer and fall seasons. As such, additional data are needed to fill these spatial and temporal (e.g., seasonal) gaps.

Passive acoustic monitoring (PAM) techniques are well established in the scientific community (Sousa-Lima et al. 2013; Booth et al. 2017) as a data collection technique that complements past and current visual survey efforts and can be deployed in the ocean for protracted periods of time. This study will employ a novel sampling method of using drifting autonomous spar buoys (DASBRs; Griffiths and Barlow, 2015; 2016) as opposed to using traditional bottom-mounted systems. This validated methodology supported other BOEM-funded study efforts (BOEM, 2020b; BOEM, 2020a). This study will transition this technology into operations to fulfill critical gaps in monitoring for both cetacean species and contiguous baseline soundscape data in the CCE.

DASBRs are low-cost drifting buoys that can record for 30+ days. Their low cost allows deployment of more instruments, providing improved geographic and temporal data collection. While drifting, the acoustic recorders will record the sounds of the ocean, including: whales, dolphins, fish, and ships. The hydrophones are neither at the surface nor at the seafloor: their positioning in the water column where the animals are vocalizing allows them to collect data of the highest quality without affecting their behavior. These data can then be used to study animal populations and the potential impact of human activities and environmental change on these protected species, in the present and as a reference for the future.

In addition, it is anticipated that this study will be a highly collaborative effort between federal and state agencies that will emphasize partnerships with local communities as well as public engagement in science.

Objective(s): The primary objective of this study is to gain a better understanding of the seasonal occurrence and distribution of cetacean species in the CCE, and within BOEM's wind energy lease areas. Abundance estimates of cetacean species will also be explored. The ambient soundscape will be described and the major contributors to the soundscape will be identified wherever possible.

Methods:

- Deploy DASBR acoustic recorders in pre-determined locations in the CCE, with array clusters focused in the northern and central California wind energy lease areas.
- Collect ambient and biological acoustic data from cetacean species, including but not limited to blue, humpback, fin, minke, killer and beaked whales, dolphins, and porpoises.
- Analyze recorded data to describe the spatial and temporal distribution of cetacean species and ambient soundscapes in the CCE as a whole, with additional quantitative analyses in the northern and central California wind energy lease areas.

The first phase, ADRIFT in Northern California, will consist of DASBR deployments between San Francisco and Eureka, California. During this first year, data collection and analysis methods will be streamlined and partnerships critical for incremental expansion of the ADRIFT study to the greater CCE will be developed. The second phase, ADRIFT in Central California, will consist of DASBR deployments between Point Conception and Monterey Bay and the inclusion of these data in the analyses. The third phase includes additional deployments in central California, as well as a pilot study offshore Oregon that includes an extension of the study by one year, from June 2023 to June 2024.

This study benefits from the fact that DASBRs are easily deployed from vessels of opportunity, including research ships, fishing and whale-watching boats. DASBRs are autonomous, meaning that once they are deployed—they do not require oversight. The buoys will drift at sea for 30+ days, with shore side monitoring of their drift via satellite messenger. Coordinating data collection with vessels already in the area provides significant cost savings. These opportunities will also provide valuable partnerships and increased community engagement in this science.

Approximately 50 DASBR units will be assembled for this study, incorporating three clusters of 15 units each. One cluster will be deployed within each wind energy lease area during each seasonal (spring, summer, fall and winter) period.

Researchers at NOAA's Southwest Fisheries Science Center are developing FOSSA, a series of open-source software packages that can be used to efficiently process and analyze passive acoustic data. Built on the open source, multi-platform language, R, these three packages will consist of: (1) functions to extract acoustic metadata, integrate it with ancillary data, and generate summaries and output for downstream analyses (PAMr, in development), (2) a powerful and systematic method for cetacean species classification using passive acoustics (BANTER, complete), and (3) a package for the coordination of acoustic cetacean population assessment tools (PAMde, 2020). These are being designed to work seamlessly with acoustic data collected and analyzed with Pamguard software; however, its utility applies broadly to acoustic data. Ultimately, the analytical advancements provided by BANTER, PAMr, and PAMde will allow for efficient, standardized results that can be quickly produced with minimal human intervention.

Automatic acoustic detectors will be parameterized to identify and quantify the vocalizations of the key marine mammal species (and the methods for this process will be captured using the Tethys metadata system). For soundscape-level analyses, the data will be processed using the Atlantic Deepwater Ecosystem Observatory Network (ADEON) data standards in order to ensure that the information is comparable to similar data collected in other areas (e.g., the Atlantic). In order to inform the design of the array(s), a basic propagation model will be run inputting species parameters of certain species (e.g., fin whales) to get a sense about the characteristics of the whale calls and what will be detected and at what distances.

Specific Research Question(s):

1. What is the seasonal occurrence/distribution of marine mammal species in the CCE and wind energy lease areas?
2. If localization is possible, what can be said about the abundance of the various marine mammal species?
3. What is the ambient noise level in the CCE and wind energy lease areas?
 - a. What are the major contributors to the soundscape?

Current Status: From June 1, 2023 through September 1, 2023:

1. This quarter's highlight includes continued successful partnership with Central Coast Collaborative Acoustic Monitoring Survey (CCC-PAM) to conduct surveys off Morro Bay, a team meeting to focus on data products for final report, and identification of next steps for future ADRIFT in combination with other PAM sampling off the US West Coast. These surveys are in collaboration with NOAA Sanctuaries, MBARI, Naval Post-Graduate School, PMEL, SFSU, and Cal Poly SLO.
2. Data Collection:
 - a. Humboldt: While environmental conditions continue to complicate fieldwork, successful field data collection efforts were successful in August. Team members traveled to Humboldt to identify new partners and opportunities for continued PAM monitoring in the region.
 - b. Morro Bay: In March we completed a successful CCCPAM survey, deploying 6 drifting buoys in the Morro Bay WEA for ~ 5 days. One instrument suffered what appeared to be catastrophic failure and could not be retrieved during the small weather window. Our next CCC-PAM survey will be in November 2023. CCC-PAM provides excellent opportunities for BOEM personnel to participate and see the science in action. We look forward to hosting a BOEM scientist on our November survey.
 - c. San Francisco: The July ACCESS deployment was cancelled due to inclement weather; the next deployment will occur during the September ACCESS Survey. These surveys are in collaboration with NOAA Sanctuaries.
 - d. Oregon: Our OSU partners have conducted a total of 2 short (<5 d) deployments of in the waters offshore Newport, Oregon since June. Each deployment consists of 3 drifting recorders. One of our team members will travel to Newport to coordinate adoption of the newer recorders and identify ways to expand our partnership.
3. Data Analysis:

Continued development of streamlined methods to efficiently archive our Data/Metadata (NCEI), Detection Data (OBIS/PACM), and methods (Github repositories with version control). One of our team has begun to coordinate archiving data with NCEI. Detection and validation of blue, fin, humpback, gray, and minke whales is ongoing. Automatic delphinid, sperm whale, beaked whale, and NBHF echolocation click, whistle, and burst pulse detectors are ongoing. Soundscape analysis is ongoing. As part of a project co-funded by NOAA's Ocean Acoustics Program, we developed a software tool for summarizing soundscape data in the open-source software package in R.
4. Educational Product:
 - a. Sound Bytes: New blog (<https://www.fisheries.noaa.gov/taxonomy/term/1000356091>) to share stories about how we develop tools, build partnerships, and make discoveries using acoustic data.
 - b. Data Nugget: We will be working with datanuggets.org to develop a series of classroom activities designed to bring contemporary research and authentic data into the classroom. This platform was recommended by public school teachers as being highly accessible to teachers.

Next quarter we look forward to finalizing our data collection efforts, continue archiving data at NCEI, and to continue analyzing data for soundscape and presence of marine mammals. If there is an intention to continue ADRIFT beyond this current project, we will identify ways we can focus our limited remaining time to best benefit a smooth and successful transition.

Publications Completed: None

Affiliated WWW Sites:

<https://www.fisheries.noaa.gov/taxonomy/term/1000356091>

<https://ngss.sdcoe.net/Environmental-Literacy/Environmental-Literacy-Resources>

References:

[BOEM] Bureau of Ocean Energy Management. 2020a. Pacific Marine Assessment Partnership for Protected Species. Bureau of Ocean Energy Management.

BOEM. 2020b. California Current Cetacean and Ecosystem Assessment Survey and Use of Data to Produce and Validate Cetacean and Seabird Density Maps. Bureau of Ocean Energy Management.

Booth CG, Oedekoven CS, Gillespie D, Macaulay J, Plunkett R, Joy R, Harris D, Wood J, Marques TA, Marshall L, Verfuss UK, Tyack P, Johnson M, and Thomas L. 2017. Assessing the viability of density estimation for cetaceans from passive acoustic fixed sensors throughout the life cycle of an offshore E&P field development. Report number SMRUC-OGP-2017-001. Submitted to IOGP Sound and Marine Life Joint Industry Programme (Unpublished).

Griffiths ET, Barlow J. 2015. Equipment performance report for the Drifting Acoustic Spar Buoy Recorder (DASBR), in NOAA Tech. Memo. NMFS-SWFSC-543 (U.S. Department of Commerce, Washington, DC), 36 p.

Griffiths ET, Barlow J. 2016. Cetacean acoustic detections from free-floating vertical hydrophone arrays in the southern California Current. *The Journal of the Acoustical Society of America* 140, EL399 (2016). <https://doi.org/10.1121/1.4967012>

Sousa-Lima RS, Norris TF, Oswald JN, Fernandes DP. 2013. A review and inventory of fixed autonomous recorders for passive acoustic monitoring of marine mammals. *Aquatic Mammals*. 39(1): 23–53.