Environmental Studies Program: Ongoing Study

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 Region
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Procurement Type(s)	Inter-agency 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 Note: BOEM funding is from the Environmental Studies Program ($1,325,000) and the Pacific OCS Office ($1,390,410).
Performance Period	FY 2020–2024
Final Report Due	June 8, 2024
Date Revised	June 29, 2023
PICOC Summary	
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

BOEM Information Need(s): 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.

Objectives: 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 area easily deployed from vessels of opportunity, including research ships, fishing & 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 March 1, 2023 through June 1, 2023:

1. This quarter's highlight is the successful deployment of drifting recorders off Oregon. Our Oregon State University (OSU) partners have initiated a pilot study to determine if ADRIFT survey methods are appropriate for the Oregon coast. These initial efforts bode well for future collaboration with OSU and expansion to other regions off Oregon.
2. Data Collection:
    a. Humboldt: While environmental conditions continue to complicate fieldwork in winter/spring, successful field data collection efforts were successful in March and May.
    b. Morro Bay: In March 2023 we completed a successful survey, deploying 8 drifting buoys in the Morro Bay wind energy lease areas for ~ 5 days. Our next survey will be in July 2023. These surveys are in collaboration with 6 Federal and State partners. These surveys are excellent opportunities for BOEM personnel to participate in the scientific research. We look forward to hosting a BOEM scientist on our July 2023 survey and are open to making space on the October survey as well.
    c. San Francisco: 2 buoys were deployed off SF Bay in May 2023, and the next deployment will be in July 2023. These surveys are in collaboration with NOAA Sanctuaries.
    d. Oregon: Our OSU partners have conducted a total of 4 short (<5 d) deployments in the waters offshore Newport, Oregon since mid-March 2023. Each deployment consists of 4 drifting recorders. Deployments during the intense spring upwelling season bode well for future year-round data collection efforts.
3. 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 additional data collection in all regions and initiation of data archiving processes for all of our data. Over the next few months, we will prepare an initial plan for ADRIFT 2.0 which will expand partnerships, incorporate lessons learned during these initial surveys, and lead to more cohesive data collection and analysis efforts between ADRIFT and other PAM data collection efforts currently underway in the Pacific.

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. 2020a. Pacific Marine Assessment Partnership for Protected Species. Bureau of Ocean Energy Management. https://marinecadastre.gov/espis/#/search/study/100179

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. https://marinecadastre.gov/espis/#/search/study/100116

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.