## Environmental Studies Program: Ongoing Study

| Field | Study Information |
|---|---|
| Title | Next Generation of Animal Telemetry: Pathway to Implementation (NT-20-03) |
| Administered by | Office of Environmental Programs |
| BOEM Contact(s) | Jacob Levenson (jacob.levenson@boem.gov), Jennifer Bosyk (jennifer.bosyk@boem.gov) |
| Procurement Type(s) | Contract, Interagency Agreement, Cooperative Agreement |
| Conducting Organization(s) | National Aeronautics and Space Administration (NASA); University of Colorado, Boulder |
| Total BOEM Cost | $2,057,770 |
| Performance Period | FY 2020–2026 |
| Final Report Due | September 2026 |
| Date Revised | July 10, 2024 |
| Problem | Spatial and temporal coverage limitation of telemetry receiving stations lead to data loss and cost ineffectiveness for animal movement studies. |
| Intervention | Leveraging growing small satellite industry, anticipated to be as many as 18,000 orbiting assets by 2028, to augment current limitations. Change is measured by increased accuracy and bandwidth available to telemetry needs. |
| Comparison | This is measured against the intervention. Think of hypothesis testing, control vs. treatment, and/or natural change. |
| Outcome | Improved data quality with reduced costs for animal telemetry needs. |
| Context | Nationwide |

BOEM Information Need(s): This study implements BOEM's Outer Continental Shelf (OCS) Lands Act mandate to monitor the marine environment adjacent to U.S. OCS operations. Understanding animal movement in the OCS is required for nearly everything under BOEM's purview. Telemetry is an important tool to support animal movement and behavior studies to supplement survey effort. Additionally, animal telemetry can be used to infer movements related to activities in the OCS, such as geophysical surveys, platform construction and demolition. Animal telemetry can provide relevant information for National Environmental Policy Act, Marine Mammal Protection Act, and Endangered Species Act consultations across program areas such as wind and hydrokinetic placement locations, oil/gas leasing, and even used in monitoring impacts of climate change. Internal reports, such as BOEM's *Effects of Offshore Energy Sound Producing Activities on Fish and Invertebrates*, as well as public comments on a variety of environmental impact statements, from the Arctic to Atlantic, call for a need for improved data on animal movement, behavioral, and foraging ecologies.

Background: Tracking of highly mobile marine megafauna is typically accomplished by Advanced Research & Global Observation Satellite (ARGOS). This study proposes development of supplemental/alternative method of OCS marine animal tracking by leveraging the National Aeronautics & Space Administration (NASA's) CubeSat Launch Initiative low earth-orbiting small satellite programs.

Animal movement studies face several technological factors due to proprietary technology, limited radio transmission range, overhead satellite time limitations and most importantly, cost. Cumulatively, these factors limit opportunity to gather information on animal movements throughout the U.S. Exclusive Economic Zone. An open-source receiving network, which does not depend on the ARGOS satellite system, significantly lowers costs by enabling use of a constellation of low-cost, open-source data relay CubeSats.

The CubeSat small-satellites community can be leveraged to invest in a CubeSat alternative to the current ARGOS system. CubeSats are a class of small research-class spacecraft. NASA's CubeSat Launch initiative (CSLI) provides opportunities for small satellite payloads to hitch-hike on rockets planned for upcoming launches. This program engages engineering schools across the United States to develop low-cost micro satellite experiments and has been developing and launching these CubeSats at an increasing rate each year. Additional transceivers can be placed easily on the future CubeSats, as well as autonomous underwater vehicles, ocean going vessels, aircraft, and existing buoys to create a truly wireless ocean.

Marine Mammals, fishes, and invertebrates of particular interest for impact analysis include those species that are commercially or recreationally important, are threatened or endangered, or are keystone (for example, important prey) species. Data collected by these tags can be relayed in real-time (or delayed mode) via satellite. Due to limited bandwidth in these transmissions not all of the data can be relayed. This results in a need for some data processing on the tag and only a subset or summary of the data being recovered. However, as the instrument does not have to physically be recovered, these tags can be deployed on animals not suitable for archival tags alone.

The planet is changing quickly, through this study BOEM can be a catalyst for a truly wired ocean. Though the implementation of this project, BOEM achieves improved tools for OCS monitoring and Science-Technology-Engineering-Mathematics partners are engaged in an innovative program, together leading to a tech savvy workforce while filling in gaps in OCS data cost effectively.

Objectives:

- Develop and demonstrate an OCS tracking/monitoring network for geographically and taxonomically diverse marine megafauna leveraging CubeSat open-source tracking through a near space balloon and software defined radio.
- Demonstrate multi-agency utility using a low earth orbit example vehicle.
- Convene workshop of agency stakeholders and chart path forward for implementation.

Methods: Using NASA's CubeSat launch initiative network we will utilize space-based transceivers aboard CubeSats and the International Space Station as well as ocean and terrestrial based transceivers to demonstrate the feasibility of tracking various marine megafauna. Accomplishing this will be done through the following:

- Develop and launch CubeSats for data link characterization.
- Convene a workshop of the CubeSat community as well as ocean telemetry engineering experts to establish a standardized communication platform for low orbital pico-satellites.

- Convene a public competition to create a coding algorithm for managing big data associated with visualizing movements accurately.
- Ground-truth CubeSat animal tags in diverse scenarios.

Specific Research Question(s): Can SmallSats be used as a cost-effective supplement improving improve ocean megafauna monitoring?

Current Status: Currently working with NASA's Advanced Exploration Division to leverage the Starling satellite constellation for movement monitoring. Cooperative agreement about to be awarded to University of Colorado Boulder for the development of a time of arrival transmitter.

Publications Completed: None

Affiliated WWW Sites: None

References: None