Field	Study Information
Title	High performance Computing and Technical Support for BOEM's Aerial Imagery Monitoring Surveys (NT-25-04)
Administered by	Office of Environmental Programs
BOEM Contact(s)	Timothy White (timothy.white@boem.gov)
Procurement Type(s)	Interagency Agreement
Performance Period	FY 2025–2029
Final Report Due	TBD
Date Revised	May 20, 2024
Problem	In FY25, BOEM intends to expand this partnership to surveys in the Gulf of Mexico and the Caribbean. BOEM's aerial imagery monitoring surveys require continued support from USGS to archive, process, and serve aerial imagery to ongoing BOEM Wind Energy Area (WEA) site characterization studies in the Atlantic, Caribbean, and Gulf of Mexico.
Intervention	We continue to partner with the USGS UMESC. UMESC successfully developed and continues to update imagery annotation software for BOEM's aerial imagery libraries, serves imagery to project partners, and executes artificial intelligence/machine learning (AI/ML) detection and classification algorithms on USGS high-performance computing clusters for BOEM projects NT-19-04 and NT-22-04.
Comparison	This method will use marine wildlife images collected on BOEM-funded studies to train the algorithm and compare classification efficiency across species and dynamic survey conditions.
Outcome	This project will support transferrable computer vision algorithms for identifying and counting marine wildlife in imagery collected on aerial survey operations and for rapid dissemination of site characterization products concerning the distribution and abundance of marine wildlife near WEA and lease areas.
Context	All OCS planning areas

BOEM Information Need(s): Our continued collaboration with USGS UMESC is needed to continue BOEM's work to develop and evaluate strategies for efficiently automating wildlife counts in aerial photographs for site characterization WEAs, lease areas, and the U.S. Territories. Rapid data processing will reduce the costs of long-term monitoring programs, especially in new collection areas, such as the Caribbean and Gulf of Mexico. Expanding the detection and classification modeling framework will also improve species identification, particularly species challenging to identify by observers on conventional aerial surveys.

Background: Airborne surveys are a key tool for measuring avian population abundance and distribution and are a critical component to planning for offshore energy development and monitoring its effects. To increase pilot safety, data reproducibility and survey accuracy, traditional low-level observer-based

surveys are increasingly being supplanted by aerial image-based surveys. When combined with machine learning systems, image-based surveys can rapidly and accurately predict bird locations and taxonomy at broad spatial scales. BOEM's Environmental Studies Program, the U.S. Fish and Wildlife Service's Division of Migratory Bird Management, and USGS UMESC are advancing the science of remote sensing and machine learning integration for aerial wildlife population surveys and a priority of this collaboration is to better coordinate diverse efforts to more rapidly advance toward better data, systems, and models.

In phase one of this project, we developed automated convolutional neural networks to filter out empty water imagery from large volumes of data and to accurately detect wildlife objects within the filtered results (Ke et al. 2021). In phase II, developed classification models for seabird, marine mammals, sea turtle, fish and artificial object classification (Miao et al. 2023). This project will continue to partner with USGS UMESC for AI/ML support using USGS high-performance computing resources. As BOEM's aerial imagery surveys expand to new regions our priority is that high model prediction accuracy in detecting and classifying wildlife from aerial imagery transfers well to new geographic, temporal, or taxonomic domains. Active collaboration between model development and human review is critical for all parts of the workflow. Well-performing models are important but it's equally critical that they are readily transferable or generalizable without ongoing large investments in data collection and human annotation.

Objective(s): The goal of this project is to continue support of automated detection and classification algorithms for marine wildlife (e.g., cetaceans, seabirds, and sea turtles) in digital aerial imagery. USFWS-BOEM have developed an initial machine learning workflow that based on a CVAT annotation tool. A critical need is to advance and coordinate multiple ongoing agency efforts to establish public datasets of images and annotations in order to support in-house model development that can be used to improve detection and classification accuracy. To advance these efforts, this study will:

1. Continue development and annotation of BOEM's digital aerial imagery archive to be used to train computer vision and machine learning algorithms.
2. Develop computer vision and machine learning algorithms for detection, taxonomic classification, and counting of the target species in open water environments.
3. Provide recommendations and guidance on image and environmental characteristics that maximize detection and classification accuracy.

Methods:

- Leverage USGS high computing resources and expertise to support existing workflows developed on BOEM studies NT-19-04 and NT-22-04.
- Continue development and training of detection and classification algorithms in new survey areas.
- Apply computer vision and machine learning algorithms to classify target wildlife species across a range of conditions affecting difficulty in classification.

Specific Research Question(s): N/A

Current Status: N/A

Publications Completed: N/A

Affiliated WWW Sites:

Deep Learning for Automated Detection and Classification of Waterfowl, Seabirds, and other Wildlife from Digital Aerial Imagery | U.S. Geological Survey (usgs.gov)

References:

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Miao Z, Yu SX, Landolt KL, Koneff MD, White TP, Fara LJ, Hlavacek EJ, Pickens BA, Harrison TJ, Getz WM. 2023. Challenges and solutions for automated avian recognition in aerial imagery. Remote Sens Ecol Conserv. 9(4)439–453. https://doi.org/10.1002/rse2.318.