Title	Automated Detection and Classification of Wildlife Targets in Digital Aerial Imagery
Administered by	HQ
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Procurement Type(s)	Contract, Inter-agency agreement, Cooperative Agreement
Approx. Cost	$500 (in thousands)
Performance Period	FY 2019–2021
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PICOC Summary	
Problem	A major challenge to integration of remote sensing methods for population surveys is the tremendous volume of data that is collected during image-based surveys and the lack of suitable tools for automated detection, classification, and counting of wildlife targets collected on at-sea transects. Current methodology requires experts to manually identify all species on an image-by-image basis, a strategy that will soon be untenable due to the magnitude of datasets required to process by a limited number of expert teams.
Intervention	Artificial Intelligence (AI) in the form of computer vision and machine learning has potential to relieve the manual workload of experts by automating the identification and count process.
Comparison	This method will use images of marine wildlife collected on BOEM-funded studies to train the algorithm and compare classification efficiency across species and dynamic survey conditions.
Outcome	A transferrable computer vision algorithm that can be used to identify and count marine wildlife collected on aerial survey operations.
Context	This proof of concept will be applied to digital imagery collected the Atlantic shelf and shelf break systems.

BOEM Information Need(s): High-resolution camera systems are now deployed on nearly all aerial surveys to capture transect-level imagery of seabirds, sea turtles, and marine mammals. This method will develop and/or evaluate methods for efficiently automating counts of wildlife in aerial photographs, and may reduce costs of long-term monitoring programs through rapid data processing. This approach may also improve species identification, particularly of species difficult to identify by observers on aerial surveys.

Background: Federal, State, and Provincial wildlife management agencies in North America have a long history of using aircraft to monitor population abundance of marine wildlife at sea. Improved sensor, computing, and image processing technologies offer promise in enhancing the safety of marine animal population surveys while improving the quality of data derived and creating a permanent, georeferenced record of

observations. A major challenge to integration of remote sensing methods for population surveys is the tremendous volume of data that is collected during image-based surveys and the lack of suitable tools for automated detection, classification, and counting of at-sea wildlife targets. In some cases, individual low-level surveys collect data on dozens of marine species, are regional or continental in scope, and involve the simultaneous operations of up to a dozen aircrews for a month-long time period. Automation of marine animal detections and classification is critical if remote sensing solutions are to be cost-efficient (Groom et al. 2013, Chabot et al. 2016).

Objectives: The goal of this project is to initiate development of automated detection and classification algorithms for marine wildlife (e.g., cetaceans, seabirds, and sea turtles) in digital aerial imagery.

- Develop and annotate a digital aerial imagery archive to be used to train computer vision and machine learning algorithms.
- Develop computer vision and machine learning algorithms for detection, taxonomic classification, and counting of the target species in open water environments
- Provide recommendations and guidance on image and environmental characteristics that maximize detection and classification accuracy.

Methods:

- Acquire currently accessible digital aerial imagery from BOEM funded studies, and partners (e.g., FWS).
- Begin developing and training algorithms using extant imagery
- Develop and apply computer vision and machine learning algorithms to detect and classify target wildlife species across a range of conditions affecting difficulty in classification.

Specific Research Question(s): Can an efficient and reliable algorithm be developed to accurately detect, classify, and count a wide variety marine species in digital imagery collected by offshore aerial surveys?

References:

Chabot, D. and C. M. Francis. 2016 (in press). Computer-automated bird detection and counts in high-resolution aerial images: a review. Journal of Field Ornithology.

Groom, G., M. Stjernholm, R. D. Nielsen, A. Fleetwood, and I.B. Petersen. 2013. Remote sensing image data and automated analysis to describe marine bird distributions and abundances. Ecological Informatics 14:2-8.