Environmental Studies Program: Ongoing Studies

Study Area(s): Beaufort Sea, Chukchi Sea

Administered By: Anchorage, Alaska Office

Title: Field Evaluation of an Unmanned Aircraft System (UAS) for Studying Cetacean Distribution, Density, and Habitat Use in the Arctic (AK-15-07)

BOEM Information Need(s) to be Addressed: Gray whale, bowhead whales, and belugas are seasonal residents of the northeastern Chukchi Sea and western Beaufort Sea, regions that provide important feeding grounds and migration pathways for all three species. While all three species are protected under the Marine Mammal Protection Act, the bowhead whale is given added protection as an endangered species under the ESA, and bowhead whales and belugas are granted additional management consideration as the targets of subsistence hunts by Alaska Natives. Under the NEPA and the ESA, BOEM is required to evaluate if and how Federal actions associated with oil and gas exploration and development may affect these species. Aerial surveys are one standard methodology for conducting studies of cetacean distribution required to understand the effects of oil and gas exploration. In recent years, there has been increasing interest in using Unmanned Aircraft Systems (UAS) to survey cetaceans in the Arctic to decrease risk to personnel, increase survey efficiency, reduce survey costs, and minimize disturbance of marine wildlife. The performance of UAS relative to human observers in manned aircraft is not well understood and must be more thoroughly investigated prior to accepting UAS as an alternative to manned aircraft for conducting these investigations.

Total BOEM Cost: $1,000,000 plus Joint Funding (~$1,235,000) **Period of Performance:** FY 2015-2019

Conducting Organization: NOAA-MML; Naval Surface Warfare Center Dahlgren Division

Principal Investigator(s):

BOEM Contact: Rick Raymond

Description:

Background: Manned aircraft are a common platform for studying wildlife because they are relatively cost-effective for surveying large geographic areas and take advantage of humans' ability to quickly integrate sensory information on the biological and physical environment in order to detect, identify, and count species of interest. In recent years, there has been increasing interest in using UAS to study wildlife populations. In particular, UAS have been suggested as an alternate survey platform for studying the distribution and density of the Bering-Chukchi-Beaufort stock of bowhead whales in the western Arctic, which has been investigated using manned aircraft since 1979. The primary advantage of using UAS to survey marine wildlife in the Arctic is the elimination of the risks associated with sending humans far from shore on small aircraft

in areas prone to extreme weather. Furthermore, UAS have the potential to be cheaper to operate than conventional aircraft, and some have the advantage of prolonged flight times. Finally, field work conducted by NMML in the Arctic has shown that UAS are less likely to disturb pinnipeds than conventional aircraft.

The FAA's Reauthorization Act of 2012 designated airspace for UAS operations in the Arctic, making UAS a more viable platform for use in marine mammal monitoring. For surveying cetaceans, the ability of UAS methodology to detect cetaceans, identify individuals to species, estimate group size, identify sensitive age classes, and estimate density must be understood relative to the proven capabilities of human observers in conventional aircraft. A small number of limited field tests have been conducted to assess the effectiveness of UAS for surveying cetaceans in the Arctic, the results of which warrant further investigation. Additional insight will be gained only through direct comparisons of UAS and human observers in the field, with cetaceans (bowhead whales, gray whales, and belugas) as the primary targets.

Objectives:

- Evaluate the ability of UAS methodology to detect cetaceans and compare encounter rates, identify individuals to species, estimate group size, identify calves, and estimate density in arctic waters relative to conventional aerial surveys.
- Describe improvements needed in UAS technology (e.g., payloads, cameras, environmental sensors) to operate in arctic conditions for a large-scale survey program.
- Provide recommendations for the types of monitoring or mitigation requirements that can likely be met using UAS.

Methods: Planning and permit application will occur during the first year. Fine-scale aerial line-transect surveys will occur in the second year in the northeastern Chukchi and western Beaufort Seas during the open water season, when bowhead whales, gray whales, and belugas have reliably been found feeding in and migrating through the region. Marine mammal observers will conduct a line-transect survey from an aircraft flying between 1000-1500 ft. A ship-based or land-based UAS will operate concurrently in the same area, with a marine mammal observer on the UAS team, viewing digital video in real-time to detect, identify, and count cetaceans visible in the video feed. Because the effective strip width for the UAS will be narrower than that of human observers in the aircraft, UAS transects will be placed closer together than those for the conventional aircraft. Digital video footage and digital photographs from the UAS will be archived to enable post-flight analyses into UAS performance. Metrics that will be used to compare performance between platforms may include: 1) encounter rates made by each platform; 2) precision of the resulting density estimates; 3) relative efficiency of each platform, measured by length of trackline and duration of survey effort required to achieve a target precision in the density estimate; 4) cost to conduct the survey; and 5) fuel consumption. This study will be integrated with other ongoing BOEM studies in the region, including the "Aerial Surveys of Arctic Marine Mammals (ASAMM)" (AK-16-01) studying the distribution, density, and behavior of marine mammals. Joint-funding opportunities may be available for this project (e.g. ONR and NSB).

Current Status: Completed

Final Report Due: January 2019

Publications Completed:

Angliss, R., M. Ferguson, A. Brower, J. Clarke, P. Hall, C. Helker, A. Kennedy, B. Lynch, and T. Sformo. 2019. Arctic aerial calibration Experiments (Arctic ACEs): Comparing manned aerial surveys to Unmanned aerial surveys for cetacean monitoring in the arctic. Draft Final Report, OCS Study BOEM AK-15-07. 176 pp.

Angliss, R., M. Ferguson, P. Hall, V. Helker, A. Kennedy, T. Sformo, and Naval Surface Warfare Center Dahlgren Division. 2016. Comparing Manned Aerial Surveys to Unmanned Aerial Surveys for Cetacean Monitoring in the Arctic: Field Report. Prepared for Office of Naval Research. 57 pp. https://www.onr.navy.mil/reports/FY15/mbanglis.pdf.

Angliss, R., M. Ferguson, P. Hall, V. Helker, A. Kennedy, T. Sformo, and Naval Surface Warfare Center Dahlgren Division. 2016. Operating UAS in the Arctic: Comparing Manned and Unmanned Surveys of Cetaceans. Poster presentation at the Alaska Marine Science Symposium, 25-29 January 2016, Anchorage, AK. https://access.afsc.noaa.gov/pubs/posters/pdfs/pAngliss01_uas-arctic.pdf.

Ferguson, M. C., R. P. Angliss, V. Helker, A. Kennedy, B. Lynch, A. Willoughby, A. A. Brower, J. T. Clarke. 2017. Comparing Estimates of Arctic Cetacean Density Derived from Manned and Unmanned Aerial Surveys. Poster presentation at the Alaska Marine Science Symposium, 23-27 January 2017, Anchorage, AK. https://access.afsc.noaa.gov/pubs/posters/pdfs/pFerguson_AMSS2017_20170117-FINAL.pdf

Ferguson, M.C., R.P. Angliss, A. Kennedy, B. Lynch, A. Willoughby, V. Helker, A.A. Brower and J.T. Clarke. 2017. Performance of Manned and Unmanned Aerial Surveys for Estimating Arctic Cetacean Density and Associated Uncertainty. Journal of Unmanned Vehicle Systems. https://doi.org/10.1139/juvs-2018-0002.

Affiliated WWW Sites: http://www.boem.gov/akstudies/
https://marinecadastre.gov/espis/#/search/study/100077

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