

Environmental Studies Program: Ongoing Study

Field	Study Information
Title	Bowhead Whale Migration Patterns along the Alaskan Beaufort Shelf During a Period of Rapid Environmental Change (AK-21-04)
Administered by	Alaska Regional Office
BOEM Contact(s)	Dr. Heather Crowley (heather.crowley@boem.gov)
Procurement Type(s)	Cooperative Agreement
Conducting Organization(s)	University of Alaska Fairbanks, Woods Hole Oceanographic Institution
Total BOEM Cost	\$2,747,838
Performance Period	FY 2021–2024
Final Report Due	August 2024
Date Revised	February 22, 2023
Problem	Evolving environmental conditions on the Beaufort Shelf appear to be changing the utilization of the shelf by bowhead whales and the bowhead whale migration path may be shifting farther offshore. Very few bowheads were seen on the Beaufort Shelf during the 2019 fall migration and only one whale was landed during the 2019 fall bowhead hunt at Utqiagvik, Alaska, prompting community concern. However, the lack of contemporary measurements of hydrographic and whale prey conditions create challenges for diagnosing the changes near Pt. Barrow and across the Beaufort Shelf that may have influenced the bowhead whale migration.
Intervention	This study would renew and geographically expand annual hydrographic and plankton sampling conducted under the “BOWFEST” study (Shelden and Mocklin 2013).
Comparison	Collected data will be examined in the context of an 11-year (2005-2015) record of late August-early September biophysical (hydrography, currents, zooplankton) conditions in the NE Chukchi and western Beaufort seas.
Outcome	This project will provide new basic information on hydrography, circulation, and zooplankton prey fields encountered by migrating bowhead whales to improve understanding of the recent behavioral changes of the whales. Results from this effort also will provide context for assessing ongoing changes to the ecosystem and establish a baseline for the “new normal” that is currently being observed.
Context	Northeast Chukchi Sea and Beaufort Sea shelf

BOEM Information Need(s): This project will provide information on how biological and physical characteristics in the Beaufort and Chukchi seas may be transforming in response to ongoing climate change and how they may influence bowhead whale utilization patterns, such as migration pathways and feeding locations, on the Beaufort Shelf. Results from the project will support ESA Section 7 consultations and NEPA analyses for potential future lease sales and DPPs. The information obtained

from these surveys may assist in development of mitigation measures and strategies to reduce potential impacts on bowhead whales.

Background: The rate of change of summer-fall conditions in the Arctic has accelerated in recent years. The fall of 2016 saw almost no upwelling winds along the Beaufort Shelf and the bowhead whale migration path lay offshore of the shelf, almost out of range of the Utqiagvik hunters. The summer of 2019 was extremely warm along the entire Alaskan coast, with numerous die-offs of seabirds attributed to starvation because of a paucity of the large crustacean prey (copepods, krill). Fall 2019 saw the unprecedented failure of the fall bowhead hunt at Utqiagvik, with migrating bowhead whales not being seen within the safe operating zone for the hunters. The first and only fall whale was landed 16 November. Moreover, few or no bowhead whales were observed on the western Beaufort Shelf through Oct. 30, 2019 by survey flights of the Aerial Surveys of Arctic Marine Mammals (ASAMM) program. The absence of the bowhead whales has been hypothesized to be caused by warm ocean temperatures or a lack of bowhead prey in the region that resulted in a delayed fall migration of the whales or in the whale's fall migration path lying much further offshore. In order to diagnose underlying causes contributing to recent dramatic changes in bowhead migration, contemporaneous measurements of the hydrographic and whale prey conditions are needed.

Objectives: This study will examine recent ecosystem changes in the Beaufort Sea and how they may be influencing bowhead whale migration patterns. Specific objectives include:

- Describe the biological (zooplankton prey and bowhead whales) and physical (temperature, salinity) environments in the western and central Beaufort Sea shelf, including upwelling-induced introduction of krill through shelf-edge depressions
- Describe the year-round associations among biological and physical conditions at different locations along the shelf and the occurrence of bowhead whales.
- Evaluate whether environmental and biological conditions near Pt. Barrow have changed in recent years, since the BOWFEST study, and whether recent conditions on the Beaufort Shelf will occur more frequently
- Quantify temporal and spatial variability in zooplankton prey based on acoustic measurements and the linkages of that variability to short-term and longer-term physical drivers
- Describe the current population genetic structure of krill and *Calanus spp.* and compare with the genetic structures from previous work.

Methods: Researchers will conduct vessel-based *in situ* sampling to monitor hydrography and zooplankton conditions in late summer along transects in Barrow Canyon, the western Beaufort shelf, and the shelf near Prudhoe. Seasonal and year-round moorings will monitor circulation and acoustic backscatter (zooplankton proxy) in Barrow Canyon and on the Beaufort shelf. Researchers will use a combination of historical data, including long-term monitoring programs, and model output to examine longer-term trends in Beaufort Shelf conditions and provide context to the mechanisms identified from the fieldwork. Acoustic monitoring will detect and classify marine mammal vocalizations.

Specific Research Question(s):

1. Are unusual/extreme conditions in the Chukchi and Beaufort seas becoming more common?
2. What factors contribute to interannual variability of zooplankton available to bowhead whales during their fall migration?

3. Are there environmental cues that influence timing of fall bowhead migration?
4. What is the relationship between availability of zooplankton on the Beaufort Shelf and local and regional physical forcing mechanisms?

Current Status: Ongoing, fieldwork and analysis underway.

Publications Completed:

Ashjian C, Okkonen S. 2022. Bio-physical drivers of bowhead whale distribution on the Alaskan Beaufort Shelf during a period of rapid environmental change. Oral presentation to the Alaska Eskimo Whaling Commission. February 2022.

Ashjian C, Okkonen S, Campbell B, Alatalo P. 2022. Lingering Chukchi Sea ice driven by seasonal winds influences water mass distributions and population age structure of euphausiids (krill) found in the bowhead whale feeding hotspot near Pt. Barrow, Alaska. Oral Presentation, Ocean Sciences Meeting 24 February – 4 March 2022.

Ashjian C. 2023. Bio-physical drivers of bowhead whale distribution on the Alaskan Beaufort Shelf during a period of rapid environmental change. Oral presentation to the Interagency Arctic Region Policy Committee post-field season meeting. January 2023.

Ashjian C, Okkonen S, Campbell B, Sato M, Stafford S. 2023. Bio-physical drivers of bowhead whale distribution on the Alaskan Beaufort Shelf during a period of rapid environmental change. Oral presentation to the Alaska Eskimo Whaling Commission. February 2023.

Ashjian C, Okkonen S, Campbell B, Sato M, Stafford S, Alatalo P, Sawyer H. 2023. Bio-physical drivers of bowhead whale distribution on the Alaskan Beaufort Shelf during a period of rapid environmental change. Poster presentation, Alaska Marine Science Symposium. February 2023.

Affiliated WWW Sites: <http://www.boem.gov/akstudies/>

References:

Shelden, K.E.W., and J.A. Mocklin, Editors. 2013. Bowhead Whale Feeding Ecology Study (BOWFEST) in the western Beaufort Sea. Final Report, OCS Study BOEM 2013-0114. National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115-6349.