Environmental Studies Program: Completed

Field	Study Information
Title	Arctic Integrated Ecosystem Survey, Phase II (AK-16-07)
Administered by	Alaska Regional Office
BOEM Contact(s)	Sean Burril (sean.burril@boem.gov)
Procurement Type(s)	Interagency Agreement; Cooperative Agreement
Conducting Organization(s)	NOAA; USFWS; UAF
Total BOEM Cost	$2,500,041 plus Joint Funding
Performance Period	FY 2017-2022
Final Report Due	September 2022
Date Revised	February 23, 2023
Problem	Limited information exists on the distribution abundance and life history of Arctic Marine fish species in the Chukchi and Beaufort Seas.
Intervention	A comprehensive assessment of demersal and pelagic fish communities in the Chukchi and Beaufort Seas to improve
Comparison	Differences in the Arctic fish community structure based on our most recent understanding
Outcome	A comprehensive assessment of the demersal and pelagic fish species in the Chukchi and Beaufort Seas, with a plan for a long-term monitoring protocol.
Context	Beaufort and Chukchi Seas

BOEM Information Need(s): BOEM needs a comprehensive assessment of both demersal and pelagic fish communities in the Chukchi and Beaufort Seas to improve benchmark information about the distribution, abundance, and life history of Arctic marine fish species. In particular, systematic surveys of the midwater fish community are currently lacking for the western Beaufort Sea. There is also a need for monitoring fish communities on a regular basis at least every 3-5 years to document variability and long-term changes. This information is needed to enhance environmental impact assessments, particularly with respect to early life history stages of key species such as Arctic cod (*Boreogadus saida*) and forage fishes, to develop indices and benchmarks against which to compare future changes, and to identify the distribution of the vulnerable life stages to facilitate development of effective mitigation measures.

Background: The goal of Arctic IES Phase II is to improve understanding of processes that structure the Arctic ecosystem and influence the distribution, abundance, and life history of lower (phytoplankton, zooplankton) and upper trophic level species (invertebrates, fishes, seabirds, mammals), and their vulnerability to a rapidly changing environment. The lower trophic level component aims to better understand the climatological, physical, chemical, and biological processes that influence energy flow from primary producers to zooplankton and ichthyoplankton, and the upper trophic level component will work to describe and understand how lower trophic processes reverberate through the food web to influence invertebrate, fish, and seabird communities. Additionally, BOEM needs a comprehensive

assessment of both demersal and pelagic fish communities in the Chukchi and Beaufort Seas to improve benchmark information about the distribution, abundance, and life history of Arctic marine fish species. There is also a need for monitoring fish communities on a regular basis at least every 3-5 years to document variability and long-term changes. This information is needed to enhance environmental impact assessments, particularly with respect to early life history stages of key species such as Arctic cod (*Boreogadus saida*) and forage fishes, their prey and predators and to identify the distribution of the vulnerable life stages to facilitate development of effective mitigation measures.

Objectives:

- Quantify the distribution, abundance, and condition of demersal fishes and shellfishes throughout the U.S. shelf waters of the Chukchi Sea and Western Beaufort Sea.
- Quantify the distribution, abundance, and condition of mid-water marine fishes, in particular young-of-the year Arctic gadids and forage fishes, throughout the U.S. shelf waters of the Chukchi Sea and Western Beaufort Sea.
- Combine results from previous Arctic surveys (Arctic EIS, Phase 1, BASIS) and planned surveys (Arctic IES Phase 2) to assess variability in pelagic and demersal fish ecology over time relative to ocean conditions.
- Establish the relative abundance, size, and condition of juvenile salmonids that utilize the coastal regions of the Pacific Arctic Region and establish whether juvenile salmon utilize the coastal waters of the Beaufort Sea during late summer and determine their likely origin.
- Develop spatially explicit bioenergetics models for Arctic cod and saffron cod as well as juvenile pink and chum salmon and test the impact of warming summer temperatures on their growth and distribution.
- Provide a geodatabase including base maps and attribute tables of marine fish and lower trophic communities.
- Facilitate collaboration for an integrated ecosystem analysis with other researchers including the partnership with the NPRB Arctic Program.
- (Part B) Test the hypothesis that a large under-ice spawning aggregation of Arctic cod in the northern Chukchi Sea serves as a source for Arctic cod in the Beaufort Sea, whereas saffron cod form local populations in the coastal waters of the Chukchi and Beaufort Seas.
- (Part C) Quantify the distribution, abundance, and prey association of seabirds in the PAR in relation to oceanographic conditions, prey abundance, and feeding guilds.

Methods: Survey protocols will follow established methods such as those employed during the Arctic Ecosystem Integrated Survey (Arctic EIS) with sampling conducted from at least two platforms (bottom trawl survey, mid-water/acoustic survey and surface trawl survey). Sampling will be adapted based on Arctic EIS results and experience. Mid-water/acoustic surveys will be the primary surveys in the northern Chukchi Sea and Beaufort Sea for assessing young-of-the-year and forage fish, while surface trawl sampling for juvenile salmon will be adaptive and exploratory as it is unknown if juvenile salmon utilize the Beaufort Sea. Oceanographic and plankton sampling in the Chukchi Sea will be coordinated with the recently funded Arctic Marine Biodiversity Observation Network (AMBON) project. However, the sampling design in the Chukchi Sea will likely differ from the transect-based AMBON design to more closely match the 2012 bottom trawl survey and 2012/13 oceanographic and fisheries surveys. The appropriate sampling design for the Beaufort Sea remains to be determined, but it may proceed either

along a grid or along a series of onshore-offshore transects. If resources permit, acoustic transects will be extended offshore to detect possible aggregations of Arctic cod along the slope and into the basin, based on similar surveys conducted in the Canadian Beaufort Sea.

Seabird surveys will be conducted using visual observations and standardized strip transects, with adjustments used for previous Alaska surveys. Surveys will be conducted during daylight hours while transiting between sample stations. The observer records all marine bird and mammal sightings within 300m and a 90° arc forward from the 'center line' (line of travel). Standard transect width will be 300m, with individual sightings recorded in distance bins (0-50m, 50-100m, 100-200m, 200-300m, >300m), and angle from the observer in 5-degree increments. Birds in the water or actively foraging are recorded continuously, while flying birds are recorded during quick 'scans' of the transect window at intervals of approximately 1 min-1 (depending on vessel speed) to avoid overestimating. The observer records observations directly into a laptop computer using survey software DLog3 (A.G. Ford, Inc., Portland, OR), recording species, number of individuals, behavior (on water, in air, on ice, foraging), distance bin, and angle. Environmental variables such as sea state (Beaufort scale), glare, weather, and sea ice cover (proportion in tenths) are recorded at first entry and automatically thereafter unless updated as necessary.

Survey data will be combined with recent laboratory results on the growth of Arctic gadids and results from modeling possible transport pathways of particles from the Chukchi Sea to resolve the connectivity of Arctic cod and saffron cod between the Chukchi Sea and the Beaufort Sea. In addition, specimens collected during the surveys may be shared with a variety of researchers to further improve understanding of the biology of Arctic fishes (age & growth, genetic structure, energetics, trophic dynamics). Integration will occur from the benthos to the pelagic and the near surface waters, and will include fish, oceanography, and plankton sampling, coupled with seabird observations. All components will provide inputs into an Integrated Ecosystem Assessment.

Specific Research Question(s): What is the current composition, distribution, relative abundance and condition of the demersal and pelagic fish communities in the Chukchi and Beaufort Seas?

Current Status: Completed

Publications Completed:

Dickson, D.M.S. (North Pacific Research Board, Anchorage, AK). 2022. Collaboration with the North Pacific Research Board, Arctic Marine Research Program. Anchorage (AK): U.S. Department of the Interior, Bureau of Ocean Energy Management. 16 p. Report No.: OCS Study BOEM 2022-039. Contract No.: M16AC00016.

Kuletz, K.J., E.A. Labunski, T.C. Morgan, A. Bankert, and A.E. Gall. 2022. Arctic Ecosystem Integrated Survey, Phase II: Seabird Community Structure and Seabird-Prey Dynamics Final Report. US Dept. of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region. OCS Study BOEM 2022_020. Provided to BOEM by the U.S. Fish and Wildlife Service, xxi + 147 pp.

Affiliated WWW Sites:

http://www.boem.gov/akstudies/

https://blog.arctic.nprb.org/about-the-arctic-program/