

BOEM ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies

Study Area(s): Chukchi Sea

Administered By: Alaska OCS Region

Title: Distribution of Fish, Crab and Lower Trophic Communities in the Chukchi Sea Lease Area (AK-11-08a; AK-11-08b)

BOEM Information Need(s) to be Addressed: This project continues collection of marine fish baseline in the Chukchi Sea, and will provide information on the abundance and distribution of fish, crab, and lower trophic communities in the Chukchi Sea lease area. The study will provide the basis for a better understanding of distribution and relative importance of fish communities. The Alaska OCS Region identified a need for continued fish and invertebrate baseline monitoring during the 2007 MMS-sponsored “Chukchi Sea Information Status and Research Planning Meeting” to support NEPA analyses for lease sales, EPs, and DPPs.

Total Cost: \$2,695,000
plus Joint Funding (~\$6,000,000)

Period of Performance: FY 2012-2017

Conducting Organization: University of Alaska Fairbanks; NOAA

BOEM Contact: [Catherine Coon](#)

Description:

Background: This study proposes to develop a broader understanding of abundance and distribution of demersal and pelagic fish, crab, and lower trophic communities needed to evaluate and mitigate the effects of OCS oil and gas development. Interim results from a current BOEM funded Coastal Marine Institute (CMI) project, “Current and Historic Distribution and Ecology of Demersal Fish in the Chukchi Sea Planning Area,” have identified temporal, seasonal, and spatial gaps in data on fish in the Chukchi Sea in particular to sampling on or near the lease areas. This proposal was designed specifically to fill these information needs. It will build upon recent information on invertebrate communities in the Chukchi offshore lease area obtained by the 2009 study “Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemistry and Benthos (CAB).” This will also complement the 2010 LGL component of COMIDA CAB that undertook midwater and benthic fishery samples at 20 sites within the COMIDA CAB sample design. This study would utilize these data and create a similar survey design such that data sets were compatible, comparable, and extend the time series. This study would contribute to further knowledge of pelagic fishes in the northeast Chukchi Sea. Data from this study will provide abundance and distribution information for NEPA analysis on fish and invertebrate species.

In the well-studied Bering Sea, it is apparent that the distribution and community composition of fish has changed in recent decades and many species are shifting their distributions northward. A MMS Beaufort Sea fish survey in 2008 indicated presence of

common Bering Sea species, such as walleye pollock and dense aggregations of snow crab in the western Beaufort Sea. These species are also likely to be present in the adjacent Chukchi Sea. This study will increase the extent of fisheries information within the lease area and extend a baseline for further studies linking species distributions between the Bering and Beaufort Seas.

The demersal fish and invertebrate community of the Chukchi Sea is thought to be less dense and diverse than in the Bering Sea and does not support major commercial fisheries at this time. The Chukchi Sea, however, is critical to the existence of many protected species of marine mammals and birds. Alaskans living in coastal Chukchi villages depend on the sea for many of the subsistence foods critical to their way of life. Although the Chukchi has historically been considered a benthic dominated system, available data indicate that there is a large biomass of pelagic fish in the area that has not been adequately sampled. This pelagic fish community seems to be dominated by forage fish, including Arctic cod, sand lance and capelin. These species serve as an important mechanism of energy transfer to top predators such as birds, ice-dependent seals, and cetaceans.

Objectives:

- Document, characterize and understand the distribution of pelagic and demersal fish and invertebrate communities in the Chukchi Sea lease area for the open water season.
- Estimate the geographic range of fish, invertebrates, and lower trophic biomass in the lease area by comparing recent and historic fishery databases.
- Provide a comparison of these communities with that of prior studies, as well as adjacent regions (Beaufort and Bering Seas) and relate the data to oceanographic fronts.
- Provide an updated mass-balance food web model of the eastern Chukchi Sea with collected diet information from the bottom trawl and surface trawl surveys, and sensitivity analyses of the model using ranges of uncertainty measured in the data.
- Collect tissue samples of fish, crab, and zooplankton for genetic, energetic, isotopic, and other biological analyses.
- Collect information on ichthyoplankton and juvenile fish, including ecological and life history information, to support Essential Fish Habitat analysis.
- Provide GIS based maps and attribute tables of marine fish and lower trophics for NEPA and other analyses into the AOOS Arctic Portal.

Methods: Conduct a two year field study with fisheries and lower trophic survey in the Chukchi Sea region to obtain baseline data on the structure and function of these ecosystems and on the ecology of important fish species. Samples locations will be determined such that it compliments and extends recent work in the COMIDA CAB. The abundance of pelagic fish, jellyfish, and large zooplankton (e.g., euphausiids) will be estimated with a multi-frequency echo-sounder and ground-truthed using pelagic gear.

The results will be directly comparable to historic surveys conducted by COMIDA CAB, RUSALCA, Conoco/Shell, and Beaufort surveys which will allow them to be placed into a broader latitudinal context. A series of coordinated bottom trawls would use the same survey methodology used by in the 1990/1991 Chukchi Sea Survey, and the RUSALCA surveys 2004-2008. The results will extend the time series (2004-2008) and build upon the earlier surveys (1990, 1991) of demersal fish and invertebrate communities. To interpret the distribution of fishes and their importance as prey, water column properties (temperature, salinity, light level, chlorophyll fluorescence) will be measured at all trawl stations. This study will coordinate with other ongoing BOEM or other agency or university studies in oceanography and biology to maximize data needs and study design. Food web model will be based on the Ecosim modeling framework as extended by NOAA and UAF PIs to include perturbation analysis and statistical analysis of uncertainty. This study is also known as the Arctic Ecosystem Integrated Survey (Arctic EIS).

Current Status: Awaiting final report

Final Report Due: September 2017

Publications Completed:

- Danielson, S. L.; Eisner, L.; Ladd, C.; Mordy, C.; Sousa, L.; Weingartner, T. J. In press. A comparison between late summer 2012 and 2013 water masses, macronutrients, and phytoplankton standing crops in the northern Bering and Chukchi Seas, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 8 June 2016, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.05.024>.
- De Robertis, A. and Taylor, K. 2014. In situ target strength measurements of the scyphomedusa *Chrysaora melanaster*. Fisheries Research. 153:18-23.
- De Robertis, A.; Taylor, K.; Williams, K.; Wilson, C. D. 2017. Species and size selectivity of two midwater trawls used in an acoustic survey of the Alaska Arctic, Deep Sea Research Part II 135:40-50 : Topical Studies in Oceanography, Available online 1-4-17) ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2015.11.014>.
- De Robertis, S.; Taylor, K.; Wilson, C. D.; Farley, E.V. 2017 Abundance and distribution of Arctic cod (*Boreogadus saida*) and other pelagic fishes over the U.S. Continental Shelf of the Northern Bering and Chukchi Seas, Deep Sea Research Part II: Topical Studies in Oceanography, Deep-Sea Res. II, 135:51-65. (added 1-4-17)., ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.03.002>.
- Divine, L. M.; Bluhm, B. A.; Mueter, F. J; Iken, K. In press. Diet analysis of Alaska Arctic snow crabs (*Chionoecetes opilio*) using stomach contents and $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotopes, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 22 November 2015, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2015.11.009>.
- Farley, E. R.A. Heintz, A.G. Andrews and T.P.Hurst. 2016. Size, diet, and condition of age-0 Pacific cod (*Gadus macrocephalus*) during warm and cool climate states in the eastern Bering Sea. Deep-Sea Res. II. 134:247-254. <http://dx.doi.org/10.1016/j.dsr2.2014.12.011> Online.
- Gray, B. P.; Norcross, B. L.; Beaudreau, A. H.; Blanchard, A. L.; Seitz, A. C. 2016. Food habits of Arctic staghorn sculpin (*Gymnocanthus tricuspis*) and shorthorn sculpin (*Myoxocephalus scorpius*) in the northeastern Chukchi and western Beaufort Seas, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 28 May 2016, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.05.013>.

- Helser, T. E.; Colman, J. R.; Anderl, D. M; Kastle, C. R. In press. Growth dynamics of saffron cod (*Eleginus gracilis*) and Arctic cod (*Boreogadus saida*) in the Northern Bering and Chukchi Seas, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 18 December 2015, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2015.12.009>.
- Marsh, J. M.; Mueter, F. J.; Iken, K.; Danielson, S. 2017. Ontogenetic, spatial and temporal variation in trophic level and diet of Chukchi Sea fishes, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 22 July 2016, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.07.010>.
- Mueter, F. M.; Weems, J.; Farley, E. V.; Sigler, M. F. In press. Arctic Ecosystem Integrated Survey (Arctic Eis): Marine ecosystem dynamics in the rapidly changing Pacific Arctic Gateway, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 12 November 2016, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.11.005>.
- Pinchuk, A. I.; Eisner, L. B. In press. Spatial heterogeneity in zooplankton summer distribution in the eastern Chukchi Sea in 2012–2013 as a result of large-scale interactions of water masses, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 11 November 2016, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.11.003>.
- Vega, S. L.; Sutton, T. M; Murphy, J. M. 2017. Marine-entry timing and growth rates of juvenile Chum Salmon in Alaskan waters of the Chukchi and northern Bering seas, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 8 February 2016, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.02.002>.
- Wechter, M. E.; Beckman, B. R.; Andrews III, A. G.; Beaudreau, A. H.; McPhee, M. V. 2017. Growth and condition of juvenile chum and pink salmon in the northeastern Bering Sea, Deep Sea Research Part II: Topical Studies in Oceanography, Available online 18 June 2016, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.06.001>.
- Whitehouse, G. A.; Buckley, T. W.; Danielson, S. L. 2017. Diet compositions and trophic guild structure of the eastern Chukchi Sea demersal fish community, Deep Sea Research Part II 135:95-110: Topical Studies in Oceanography, Available online January 4, 2017, ISSN 0967-0645, <http://dx.doi.org/10.1016/j.dsr2.2016.03.010>.

Affiliated WWW Sites: <http://www.boem.gov/akstudies/>
<http://commerce.state.ak.us/dnn/dcra/PlanningLandManagement/CCIAP/PublicSolicitationProgram/ArcticEcosystemIntegratedSurvey.aspx>
<https://web.sfos.uaf.edu/wordpress/arcticeis/>

Revised Date: June 29, 2017

ESPIS: Environmental Studies Program Information System

All *completed* ESP studies can be found here: <https://www.boem.gov/ESPIS/>