

## **BOEM ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies**

**Region:** Alaska

**Planning Area(s):** Beaufort Sea, Chukchi Sea

**Title:** Chukchi Acoustic, Oceanography and Zooplankton Study:  
Hanna Shoal (Extension of CHAOZ) (AK-13-02)

**BOEM Information Need(s) to be Addressed:** Information from this study will document the physical and biological dynamics in the Hanna Shoal region, including the temporal and spatial distribution of marine mammals. Findings may be used for evaluating potential deferral areas and other potential limitations on OCS leasing, exploration, and development, such as the January 2015 Presidential Withdrawal of Hanna Shoal. This study will provide useful information to support NEPA analysis and documentation for Beaufort and Chukchi Sea Lease Sales, exploration plans, development and production plans, consultations under the ESA, supporting authorizations by sister agencies under MMPA, and monitoring protocols for adaptive management.

**Total Cost:** \$3,933,671  
plus Joint Funding (~\$1,644,000)

**Period of Performance:** FY 2013-2017

**Conducting Organization:** NOAA-NMML

**BOEM Contact:** [Dr. Heather Crowley](#)

### **Description:**

**Background:** The western Arctic physical climate is rapidly changing. The summer minimum sea ice extent in 2007, 2008 and 2011 covered an area which was 37% less than the areal coverage of two decades ago and 20% less than the previous minimum coverage in 2005. The reduction in sea ice coverage also opens up vast new regions of the Arctic Ocean to increased absorption of sunlight and storage of heat. The rapidity of these changes was unexpected, as the consensus of the climate research community just a few years ago was that such changes would not be seen for another 30 years. The observed northward retreat of the minimum extent of summer sea ice has the potential to allow expansion of oil and gas-related exploration and development into previously closed seasons and localities in the U.S. Arctic.

Baleen whales (bowheads [*Balaena mysticetus*], gray whales [*Eschrichtius robustus*], fin whales [*Balaenoptera physalus*], humpbacks [*Megaptera novaeangliae*], and minke [*Balaenoptera acutorostrata*]) are subject to changes in environmental variables such as oceanographic currents, sea temperature, sea ice cover, prey availability, and anthropogenic impacts. Furthermore, extreme ice-retreat and climate warming in the western Arctic over the last decade are expected to lead to changes in species composition and distribution, evidenced already through local knowledge and opportunistic observations.

Hanna Shoal in the northeast Chukchi Sea is an area of special biological concern bordering the boundary between Chukchi Sea and Arctic Ocean waters. The reason for this, however, is poorly understood. The shallower waters of the shoal have long been known as traps for grounding of sea ice, and a reoccurring polynya is created down current of the grounded ice. In most recent years, floating pack ice in summer persists in this area longer than elsewhere in the Chukchi, often surrounded by open water even to the north. Biological “hot spots” in the Chukchi Sea are thought to be related to coupled pelagic and benthic productivity. The importance of the Hanna Shoal region to bowhead, gray and other whales, as well as walruses and ice seals, is not well known.

The study “COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales” combines passive acoustic detection and tracking of whales, active acoustic detection of zooplankton, and biophysical measurements from long-term moorings on the Chukchi Shelf to examine relationships between primary production, zooplankton biovolume and the presence/absence of whales. Passive acoustic detection and tracking is a proven tool for assessment of large whales in U.S. seas. Specifically, acoustic detection has proven a key addition to the census of bowhead whales (*Balaena mysticetus*) during their spring migration past Barrow, and in relation to oil and gas development activities offshore Prudhoe Bay. The proposed study will refocus this monitoring to the region of Hanna Shoal. These measurements will complement the biological, oceanographic and contaminant data collected by the “Hanna Shoal Ecosystem Study.”

**Objectives:** This study will to refocus the acoustic and biophysical monitoring begun under the study “COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales” to the region of Hanna Shoal. Specific objectives include:

- Assess the spatial and temporal distribution of marine mammals near Hanna Shoal.
- Implement a tonal detector/classifier for all marine mammal species of interest to BOEM in the Arctic.
- Describe patterns of current flow, hydrography, ice thickness, light penetration, and concentrations of nutrients, chlorophyll and large crustacean zooplankton.
- Evaluate the extent to which variability in environmental conditions such as sea ice, oceanic currents, water temperature and salinity, and prey abundance influence whale distribution and relative abundance.
- Develop a quantitative description of the Chukchi Sea’s noise budget, as contributed by biotic and abiotic sound sources, and continuous, time-varying metrics of acoustic habitat loss for a suite of arctic marine mammal species.

**Methods:** This study will deploy long-term passive acoustic recorder moorings in the vicinity of Hanna Shoal to provide information on marine mammal distribution. Researchers will also opportunistically deploy sonobuoys to monitor vocalizing marine mammals while the ship is underway. Annual data will be analyzed for whale calls to estimate: seasonal occurrence by species, inter-annual differences in occurrence by species, variation in occurrence due to changes in ice extent, and types and strengths of

anthropogenic noise in the study area. Biophysical moorings and active acoustic moorings for zooplankton deployed on the flanks of Hanna Shoal will collect information on currents, hydrography, ice, nutrient and chlorophyll concentrations, etc. These instruments will be refurbished and redeployed annually.

The study will also use autonomous and real-time passive acoustic recording systems to monitor the Chukchi acoustic ecosystem and quantify changes in its acoustic habitat as a function of natural and man-made noise contributors. The systems will automatically collect, detect and report via satellite species-specific sounds from a broad suite of marine mammals in the Chukchi Sea, including: beluga, bowhead, fin, humpback and killer whales; bearded, ribbon and ringed seals; walrus; and fishes. These data will populate models of the acoustic environment that are currently under development.

**Current Status:** Ongoing

**Final Report Due:** August 2017

**Publications Completed:**

- Berchok, C.L. 2015. Marine Mammal Visual and Passive Acoustic Data. Oral presentation at the BOEM Chukchi Sea Whale Ecology Workshop (Alaska Marine Science Symposium), Anchorage, AK, 23 January, 2015.
- Berchok, C.L. 2015. What makes the Chukchi Sea so rich with marine life? Oral presentation at the UAF Northwest Campus as part of their Expand Your Horizon/Strait Science Series. Nome, AK, Sept 8, 2015.
- Berchok, C.L., C.W. Clark, J.L. Crance, E.C. Garland, J.A. Mocklin, S.E. Moore, P.J. Stabeno, B.K. Rone, A.H. Spear, and M. Wang. 2016. CHAOZ in a nutshell: Five years of work in sixteen square feet. Poster presentation at the Alaska Marine Science Symposium, 25-29 January, Anchorage, AK.
- Berchok, C.L., J. Clarke, C. Coon, A. Kennedy, K. Kuletz, L. Logerwell, S. Moore, and K. Stafford. 2016. Upper Trophics: Marine mammals, birds, fish, and other things large. Oral presentation at the 3rd DBO Workshop: Data synthesis and 10-year plan. 9-10 March 2016, Seattle, WA.
- Berchok, C.L., Crance, J.L., Rone, B.K., and Moore, S.E. 2015. Marine mammal occurrence in the Distributed Biological Observatory (DBO) from ship-based visual and passive acoustic surveys. Poster presented at the Alaska Marine Science Symposium, Anchorage, AK, 19-23 January, 2015.
- Berchok, C.L., Rone, B., Napp, J., Stabeno, P., Wang, M., and Clark, C. 2016. CHAOZ in a nutshell: Five years of work in eight minutes. Presented to the IARPC Chukchi & Beaufort Sea Ecosystem Collaboration Team, March 2, 2016.
- Clapham, P.J. 2015. Theme 4: Large Cetacean Science, Large Whales. Oral presentation at the Alaska Fisheries Science Center Protected Species Science Program Review, Seattle, WA. 16-20 March, 2015. (Available at: <http://tinyurl.com/o8cyrkz>).
- Clark, C. 2015. Noise Modeling and Auto-detection Buoy. Oral presentation at the BOEM Chukchi Sea Whale Ecology Workshop (Alaska Marine Science Symposium), Anchorage, AK, 23 January, 2015.
- Crance, J.L., C.L. Berchok, E.C. Garland, J. Napp, and P.J. Stabeno. 2016. Finding the calls in the CHAOZ: Marine mammals and oceanographic conditions off Alaska's northern slope. Oral presentation for EcoFOCI Spring Seminar Series, 13 January, Seattle, WA.
- Crance, J.L., C.L. Berchok, E.C. Garland, J. Napp, and P.J. Stabeno. 2016. Finding the calls in the CHAOZ: Marine mammals and oceanographic conditions off Alaska's northern slope.

- Poster presentation at the Alaska Marine Science Symposium, 25-29 January, Anchorage, AK.
- Crance, J.L., C.L. Berchok, E.C. Garland, J. Napp, P.J. Stabeno. 2016. Five years of CHAOZ in the Arctic: Results from a multi-disciplinary study in the Alaskan Chukchi Sea. Presented to the IARPC Chukchi & Beaufort Sea Ecosystem Collaboration Team, June 1, 2016.
- Garland, E.C., Berchok, C.L. and M. Castellote. 2015. Temporal peaks in beluga whale (*Delphinapterus leucas*) acoustic detections in the northern Bering, northeastern Chukchi, and western Beaufort Seas: 2010–2011. *Polar Biology*, doi:10.1007/s00300-014-1636-1.
- Garland, E.C., Castellote, M., and Berchok, C.L. 2015. Beluga whale (*Delphinapterus leucas*) vocalizations and call classification from the eastern Beaufort Sea population. *The Journal of the Acoustical Society of America* 137: 3054-3067.
- Garland, E., Berchok, C. and Castellote, M. 2015. Beluga whale (*Delphinapterus leucas*) vocalizations from the eastern Beaufort Sea population. Oral presentation at the BOEM Chukchi Sea Whale Ecology Workshop (Alaska Marine Science Symposium), Anchorage, AK, 23 January, 2015.
- Kennedy, A. 2015. Whale Tagging. Oral presentation at the BOEM Chukchi Sea Whale Ecology Workshop (Alaska Marine Science Symposium), Anchorage, AK, 23 January, 2015.
- Ladd, C., C. Mordy, S. Salo, and P. Stabeno. (In Press). Winter water properties and the Chukchi polynya. *J. Geophys. Res. - Oceans*. Available online 13 July 2016.
- Ladd, C., Stabeno, P., Mordy, C., and Salo, S. Oral presentation at the Alaska Marine Science Symposium, January 2016, Anchorage, AK, Time series of currents and water masses on the Chukchi Shelf.
- Ladd, C., Salo, S., Stabeno, P., and Mordy, C., AGU Ocean Sciences Meeting, February 2016, New Orleans, LA, Atlantic Water and the Chukchi Polynya.
- Martini, K.I., P.J. Stabeno, C. Ladd, P. Winsor, T. Weingartner, C.W. Mordy, and L. Eisner. 2016. Dependence of subsurface chlorophyll on seasonal water masses in the Chukchi Sea. *J. Geophys. Res.* 121, doi:10.1002/2015JC011359
- Mordy, C.W., Martini, K., Proctor, P., Stabeno, P., Ladd, C., Salo, S., Wisegarver, E., Eisner, L., Winsor, P., 2016. Variability of flow, nutrients and chlorophyll in the eastern Chukchi Sea. Oral presentation at the Alaska Marine Science Symposium, Anchorage, AK.
- Mordy, C.W., Stabeno, P., Ladd, C., Eisner, L., Sullivan, M.W., Martini, K., 2016. Spatiotemporal variability of nutrients and chlorophyll in the Chukchi Sea. Ocean Sciences, New Orleans, LA.
- Napp, J. 2015. Zooplankton. Oral presentation at the BOEM Chukchi Sea Whale Ecology Workshop (Alaska Marine Science Symposium), Anchorage, AK, 23 January, 2015.
- Roch, M.A., S. Baumann-Pickering, H. Batchelor, D. Hwang, A. Širović, J. A. Hildebrand, C. L. Berchok, D. Cholewiak, L. M. Munger, E. M. Oleson, S. V. Parijs, D. Risch, and M. S. Soldevilla. 2013. Tethys: A workbench and database for passive acoustic metadata. *Proc. IEEE Oceans*, San Diego, CA, 5pp., October, 2013.
- Spear, A., J.M. Napp, J. Duffy-Anderson, S. Salo, and P.J. Stabeno. 2016. Spatial and Temporal Variability of Zooplankton Community Structure in the Chukchi Sea (2010-2012). Poster presentation at the 2016 Ocean Sciences Meeting, New Orleans, LA., February 21-26.
- Spear, A., J.M. Napp, J. Duffy-Anderson, S. Salo, and P.J. Stabeno. 2016. Spatial and Temporal Variability of Zooplankton Community Structure in the Chukchi Sea (2010-2012). Poster presentation at ICES/PICES 6th Zooplankton Production Symposium "New Challenges in a Changing Ocean," May 9-13, Bergen, Norway.
- Stabeno, P. 2014. US Arctic Present and Future. Pacific Marine Environmental Laboratory. Seattle, WA. 12 August 2014. Presentation to the NOAA Senior Research Council.
- Stabeno, P. 2015. Oceanography. Oral presentation at the BOEM Chukchi Sea Whale Ecology Workshop (Alaska Marine Science Symposium), Anchorage, AK, 23 January, 2015.

- Stabeno, P. 2015. Five Years of Ecosystem Data from the Northeastern Chukchi Sea. Arctic Observing Open Science Meeting. Seattle, WA. November 18, 2015.
- Stabeno, P.J., C.L. Berchok, B.K. Rone, J.M. Napp, M. Wang, and C.W. Clark. 2016. CHAOZ, CHAOZ-X and ARCWEST: An Overview. Presented at the Arctic IERP kickoff meeting, June 21-23, Anchorage, AK.
- Wang, M. 2015. Climate Modeling. Oral presentation at the BOEM Chukchi Sea Whale Ecology Workshop (Alaska Marine Science Symposium), Anchorage, AK, 23 January, 2015.

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

**Revised Date:** April 2016

**ESPIS: Environmental Studies Program Information System**

**All *completed* ESP studies can be found**

**here:** [http://www.data.boem.gov/homepg/data\\_center/other/espis/espisfront.asp](http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp)