

## **Environmental Studies Program: Ongoing Studies**

**Study Area(s):** Chukchi Sea

**Administered By:** Alaska OCS Region

**Title:** Hanna Shoal Ecosystem Study (AK-11-03)

**BOEM Information Need(s) to be Addressed:** This study will constitute a key component of Chukchi Sea environmental studies pertinent to Chukchi Sea oil and gas activity. The highest oil industry interest is in the area just to the south of Hanna Shoal. The BOEM analysts and decision-makers will use the information for NEPA analysis and documentation for lease sales, EPs and DPPs in the Chukchi Sea.

**Total BOEM Cost:** \$5,692,571  
plus Joint Funding (~\$750,000)

**Period of Performance:** FY 2011-2018

**Conducting Organization:** CESU-University of Texas at Austin

**Principal Investigator(s):** Dr. Ken Dunton (Project Manager)

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

### **Description:**

**Background:** The recently COMIDA CAB study highlighted the importance of Hanna Shoal in the NE Chukchi Sea as a biological oasis bordering the boundary between Chukchi and Arctic Ocean waters. The reason for the high productivity in this area is poorly understood, however. The shallower waters of the shoal have long been known as traps for grounding of bergy bits and deep-keeled sea ice, and a reoccurring polynya is created down current of the grounded ice.

Bering Sea water entering the Chukchi Sea and flowing north is thought to flow both to the east and west of the shoal. Historically, the transport of this warmer Bering Sea water past Hanna Shoal has resulted in melt out of open water “bays” in the ice cover on either side of Hanna Shoal. In most recent years with global warming, floating pack ice in summer persists in this area longer than elsewhere in the Chukchi, often surrounded by open water even to the north. This persistence strengthens the vertical stratification over Hanna Shoal as this residual summer ice melts and freshens the surface layer. Taylor columns may be responsible for maintaining ice in the regions of Herald and Hanna shoals. Circulation processes around Hanna Shoal are poorly understood, but the circulation here is part of a broader circulation field that connects the Chukchi and Beaufort. Waters draining through Herald Valley to the western Chukchi shelf and slope regions are carried to the eastern Chukchi, where outer shelf and slope waters are very likely brought back onto the shelf.

Biological “hot spots” in the Chukchi Sea are thought to be related to coupled pelagic and benthic productivity. A high abundance of bottom fauna is correlated with high pelagic primary production, possibly associated with the ice edge that reached the

seabed mostly ungrazed. However, the mechanisms that must explain the productivity at Hanna Shoal are relatively poorly understood. With the retreat of the summer ice-edge to deeper, more northern waters in recent years, this pelagic/benthic coupling may be weakening at Hanna Shoal. The ongoing productivity of this region depends on the timing and position of the ice edge. Other BOEM projects in the Chukchi are showing sustained benthic productivity in the area of Hanna Shoal accompanied by high concentrations of water birds, walrus, and whales. Ongoing BOEM studies looking at ocean heat transport across the central U.S. Chukchi Sea, to the south and at circulation to the east, toward Barrow Canyon will provide context to this study.

#### Objectives:

- Refocus the ecological monitoring started under COMIDA CAB to the region of Hanna Shoal, including nearby biological “hot spots.”
- Verify and enhance the food web/contaminant bioaccumulation structure developed in the COMIDA CAB study.
- Measure water column and benthic primary and secondary productivity and biomass, and determine the relation to oceanographic processes.
- Document annual circulation and density fields, as well as ice conditions, at Hanna Shoal throughout the year and examine important chemical, physical and biological interactions with the unique ecological regime in this highly productive area.
- Better understand the physical processes controlling circulation patterns in the region through analyses of numerical ocean process model results.
- Integrate effort and findings with recent and ongoing BOEM and other NE Chukchi Sea studies of higher trophic levels.
- Participate in the Distributed Biological Observatory for the Northeast Chukchi Sea

Methods: This project will continue COMIDA CAB benthic sampling, food web analysis, and contaminant measurements, focusing on the Hanna Shoal region. Water column primary and secondary production and biomass also will be measured. Cruise zooplankton data will be supplemented by data from moored zooplankton-sensing ADCP units capable of distinguishing copepod and euphausiid biomass signatures. Appropriate moored and shipboard measurements of currents, sea ice drift, and hydrography (including geochemistry) will examine circulation and density fields. Moorings will be used for long term profiling of temperature and salinity, including under ice measurements in winter. Additional oceanographic data may be obtained from other projects in the Chukchi, these data include: HF radar, moored acoustic Doppler current profilers (ADCP), meteorological buoys, gliders and moored zooplankton-sensing ADCP units capable of distinguishing copepod and euphausiid biomass signatures. Taxonomic information and vouchers for newly identified species will be provided to the National Museum at the Smithsonian Institution.

This study will use numerical ocean circulation model results for the Chukchi Sea to better understand the physical processes controlling circulation patterns in the region. Analyses will be performed on the model results to examine interactions of the flow field and density structure with the topography and their relation to productivity and biomass distribution. Formal integration with other BOEM projects will be made through the “Marine Mammal/Physical Oceanography Synthesis.” Coordination will occur with other international, NSF, NOAA, ADEC, and industry research in the Chukchi Sea.

**Current Status:** Completed

**Final Report Due:** Completed in September 2016

**Publications Completed:**

- Ashjian, C., R. Campbell, C. Gelfman, P. Alatalo, and S. Elliott. 2017. Mesozooplankton abundance and distribution in association with hydrography on Hanna Shoal, NE Chukchi Sea, during August 2012 and 2013. Poster, Alaska Marine Science Symposium, Anchorage, AK, January 2017.
- Ashjian, C. J., R. G. Campbell, C. Gelfman, P. Alatalo, and S. M. Elliott. 2017. Mesozooplankton abundance and distribution in association with hydrography on Hanna Shoal, NE Chukchi Sea, during August 2012 and 2013. *Deep Sea Research Part II: Topical Studies in Oceanography*, 144:21-36. Available online 20 August 2017. <https://doi.org/10.1016/j.dsr2.2017.08.012>
- Brower, A. A., M. C. Ferguson, S. V. Schonberg, S. C. Jewett, J. T. Clarke. 2017. Gray whale distribution relative to benthic invertebrate biomass and abundance: Northeastern Chukchi Sea 2009–2012. *Deep Sea Research Part II: Topical Studies in Oceanography*, 144:156-174. Available online 15 December 2016. <https://doi.org/10.1016/j.dsr2.2016.12.007>.
- Cooper, L. and J. Grebmeier. 2016. Sedimentation Deposition Patterns on the Chukchi Shelf Using Radionuclide Inventories. Poster, Alaska Marine Science Symposium, Anchorage, AK, January 2016.
- Dunton, K.H., C. Ashjian, R.G. Campbell., L.W. Cooper, J.M. Grebmeier, H.R. Harvey, B. Konar, D. M. Maidment, J.H. Trefry, and T.J. Weingartner. 2016. Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Hanna Shoal Ecosystem Study. Final Report. OCS Study BOEM 2016-047. Prepared for the Bureau of Ocean Energy Management, Anchorage, AK, by The University of Texas Marine Science Institute, Port Aransas, TX. 352 pp.
- Dunton, K. H., J. M. Grebmeier, J. H. Trefry. 2017. Hanna Shoal: An Integrative Study of a High Arctic Marine Ecosystem in the Chukchi Sea. *Deep Sea Research Part II: Topical Studies in Oceanography*, 144:1-5. Available online 5 October 2017. <https://doi.org/10.1016/j.dsr2.2017.09.001>.
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- Elliott, S., C. Ashjian, Z. Feng, B. Jones, C. Chen, and Y. Zhang. 2017. Physical Control of the Distributions of a Key Arctic Copepod in the Northeast Chukchi Sea. *Deep Sea Research Part II: Topical Studies in Oceanography*, 144:37-51. Available online 15 October 2016. <https://doi.org/10.1016/j.dsr2.2016.10.001>.

- Fang, Y-C, T. Weingartner, R. Potter, C. Stoudt, and E. Dobbins. 2016. The Circulation Structure Around Hanna Shoal on the Northeastern Chukchi Sea Shelf. Poster, Alaska Marine Science Symposium, Anchorage, AK, January 2016.
- Fox, A., J. Trefry, R. Trocine, K. Dunton, S. Schonberg, N. McTigue, B. Konar, B. Lasorsa, C. Ashjian, L. Cooper. 2014. Patterns Of Mercury Biomagnification at Lower Trophic Levels in the Northeastern Chukchi Sea. Poster, Alaska Marine Science Symposium, Anchorage, AK, January 2014.
- Fox, A. L., J. H. Trefry, R. P. Trocine, K. H. Dunton, B. K. Lasorsa, B. Konar, C. J. Ashjian, L. W. Cooper. 2017. Mercury biomagnification in food webs of the northeastern Chukchi Sea, Alaskan Arctic. *Deep Sea Research Part II: Topical Studies in Oceanography*, 144:63-77. Available online 26 April 2017. <https://doi.org/10.1016/j.dsr2.2017.04.020>.
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- Gonsior, M., J. Luek, P. Schmitt-Kopplin, J. M. Grebeier, L. W. Cooper. 2017. Optical properties and molecular diversity of dissolved organic matter in the Bering Strait and Chukchi Sea. *Deep Sea Research Part II: Topical Studies in Oceanography*, 144:104-111. Available online 4 January 2017. <https://doi.org/10.1016/j.dsr2.2017.01.003>.
- Groß, J., B. Konar, T. Brey, and J. M. Grebmeier. 2017. Size-frequency distribution, growth, and mortality of snow crab (*Chionoecetes opilio*) and arctic lyre crab (*Hyas coarctatus*) in the Chukchi Sea from 2009 to 2013. *Deep Sea Research Part II: Topical Studies in Oceanography*. 144:142-155. Available online 29 April 2017. <https://doi.org/10.1016/j.dsr2.2017.04.021>.
- Hardison, A. K., N. D. McTigue, W. S. Gardner, K. H. Dunton. 2017. Arctic shelves as platforms for biogeochemical activity: Nitrogen and carbon transformations in the Chukchi Sea, Alaska. *Deep Sea Research Part II: Topical Studies in Oceanography*, 144:78-91. Available online 18 August 2017. <https://doi.org/10.1016/j.dsr2.2017.08.004>
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- McTigue, N. D., K. H. Dunton. 2017. Trophodynamics of the Hanna Shoal Ecosystem (Chukchi Sea, Alaska): connecting multiple end-members to a rich food web. *Deep Sea Research Part II: Topical Studies in Oceanography*, 144:175-189. Available online 24 August 2017. <https://doi.org/10.1016/j.dsr2.2017.08.010>.
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- Powell, K., B. Konar. 2015. Interannual variation of epibenthic communities in the Chukchi Sea, Alaska. Poster, Alaska Marine Science Symposium, Anchorage, AK, January 2015.

- Powell, K., B. Konar, A. Ravelo. 2014. Temporal Variation Of Epibenthic Communities In The Chukchi Sea, Alaska. Poster, Alaska Marine Science Symposium, Anchorage, AK, January 2014.
- Ravelo, A., B. Konar, B. Bluhm, K. Iken. 2014. Size Distribution And Abundance Of The Dominant Arctic Shelf Brittle Stars: *Ophiura Sarsii* And *Ophiocten Sericeum*. Poster, Alaska Marine Science Symposium, Anchorage, AK, January 2014.
- Weingartner, T., Y.-C. Fang, P. Winsor, E. Dobbins, R. Potter, H. Statscewich, T. Mudge, B. Irving, L. Sousa, K. Borg. 2017. The summer hydrographic structure of the Hanna Shoal region on the northeastern Chukchi Sea shelf: 2011–2013. Deep Sea Research Part II: Topical Studies in Oceanography, 144:6-20. Available online 17 August 2017. <https://doi.org/10.1016/j.dsr2.2017.08.006>.
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**Affiliated WWW Sites:** <http://www.boem.gov/akstudies/>  
<http://arcticstudies.org/>  
<https://marinecadastre.gov/espis/#/search/study/26833>

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