

Environmental Studies Program: Ongoing Studies

Study Area(s): Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Identifying Sources of Organic Matter to Benthic Organisms in the Beaufort and Chukchi OCS (AK-13-03-15)

BOEM Information Need(s) to be Addressed: This study will track organic matter sources to benthic consumers on the OCS of the Beaufort and Chukchi Seas. NEPA analysts evaluate the potential effects of oil and gas activities both within and along with the cumulative in these two OCS planning areas. NEPA analysts need quantitative information and tools to assess the contribution of various organic matter sources to marine food webs, sources that can be directly contribution of various influenced by oil and gas extraction activities. The baseline data will also allow for comparison to monitor potential future developments on the OCS.

Total BOEM Cost: \$246,082
plus Joint Funding (\$246,082)

Period of Performance: FY 2016-2019

Conducting Organization: CMI, UAF

Principal Investigator(s): Dr. Matthew Wooller

BOEM Contact: [Sean Burrell](#)

Description:

Background: Benthic invertebrate communities in the Arctic are an essential ecosystem component in terms of mineralization and energy transfer to higher trophic levels. Understanding the baseline sources of energy flow is essential for management and mitigation in light of the potential for climatic and anthropogenic alterations to the Arctic, many of which are likely to happen through food web links. Development impacts may influence or alter marine environment the way invertebrates process the baseline organic matter sources for marine consumers, potentially changing energy pathways that ultimately support sentinel higher trophic levels of great ecological and subsistence importance. Results from prior BOEM-funded food web work in the Beaufort Sea indicate, terrestrial carbon may have to undergo microbial degradation before it becomes a viable food source. In addition dramatic Arctic climatic changes including melting sea ice cover, increased storm activities, and permafrost and coastal erosion, contribute to changing carbon sources available to marine food webs (e.g., sea ice to phytoplankton production and possibly an increase in microphytobenthos production), likely changing proportions of organic matter sources and perhaps changing the overall marine primary production occurring in Arctic shelf seas.

The essential amino-acid-specific stable carbon isotope approach in this study is a particularly powerful tool to quantify the proportional contribution of microbial,

terrestrial plant, and marine primary producers consumed by benthic organisms. Essential amino acids cannot be synthesized *de novo* by consumers, but rather originated from the organisms that synthesized them (e.g., photosynthetic or microbial organisms). These essential amino acids, with their specific isotope values, are then incorporated into and conserved within a consumer. Essential amino acids within a consumer create a pattern, termed “stable isotope fingerprint,” can be statistically compared with the fingerprints of essential amino acids from primary producers. This method has been tested in marine ecosystems, but not yet applied to Arctic marine food webs.

This study will complement much of the bulk isotope research that has been and is being applied in OCS regions by using existing, archived samples from previous BOEM-funded projects provide novel, quantitative baseline food web information by filling a gap identified in previous work on benthic food webs in these Arctic OCS systems and provide an important benchmark for comparison with future samples.

Objectives:

- Identify the stable carbon isotope compositions of essential amino acids from benthic organisms that contribute substantially to benthic biomass and have a variety of feeding types and mobility in the Beaufort Sea OCS and are common prey for higher trophic levels.
- Perform essential amino acid fingerprinting of archived ecological equivalent benthic samples from the Chukchi Sea OCS.
- Quantify the proportional contribution of marine photosynthetic (sea ice, phytoplankton, microphytobenthos), terrestrial photosynthetic, and microbial-derived essential amino acids in Beaufort and Chukchi seas benthic organisms.
- Compare the Beaufort Sea and Chukchi Sea results with published database of production sources (Larsen et al., 2009; Larsen et al., 2013) to identify amino acid sources for the tested benthic organisms.

Methods: This project will measure the stable carbon isotope composition of individual essential amino acids for approximately 400 bivalve, shrimp and echinoderm samples from the Beaufort and Chukchi Seas. The samples are derived from a collection of more than 5,000 samples of benthic marine invertebrates that have been archived from the BOEM-funded *U.S.-Canada Transboundary Fish and Lower Trophic Communities*, *AMBON*, and *Hanna Shoal Ecosystem Study* projects. Isotope signatures will be compared to a published database of signatures from primary producers using discriminant analyses to determine whether amino acid fingerprints are characteristic of algal, microbial, or terrestrial sources. Researchers will use the normalized isotope values to calculate proportional contributions of essential amino acids from sources to consumers.

Current Status: Awaiting final report

Final Report Due: July 2019

Publications Completed: None

Affiliated WWW Sites: <http://www.boem.gov/akstudies/>
<http://www.cfos.uaf.edu/cmi/>
<https://marinecadastre.gov/epis/#/search/study/100131>

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