

Bureau of Ocean Energy Management  
**Environmental Studies Program**

# Quarterly Report

Latest Reports and Study Profiles Posted to the  
Environmental Studies Program Information System (ESPIS)



FY 2019 First Quarter



**BOEM**  
Bureau of Ocean Energy  
Management

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The Environmental Studies Program (ESP) Quarterly Reports include summaries of the Bureau of Ocean Energy Management (BOEM) environmental studies completed each quarter. These studies inform BOEM’s policy decisions on the development of energy and mineral resources on the Outer Continental Shelf (OCS).

Visit ESPIS at <https://marinecadastre.gov/espis/#/>

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# Development and Testing of a Low-cost Satellite-tracked Ice Drifter for Arctic Alaska

ALASKA REGION

**ESPIS Link:** <https://marinecadastre.gov/espis/#/search/study/26908>

**Conducted by:** University of Alaska Fairbanks, Coastal Marine Institute

**National Studies List:** AK-13-03-07 (2016–2018)

**Study Products (available in ESPIS):** Final report

## Purpose/Information Use:

Sea ice covers the waters of Arctic Alaska for up to nine months of the year, and patterns of sea ice movement can be very complex, especially near the coasts. Ice motion impacts the ocean below as well as industrial activities in the region. Prior to this study, technologies for tracking sea ice movement and deformation, which are needed to understand and predict this motion, were too costly for large-scale use. This study is the first instance of deliberately tagging and tracking landfast ice, with the goal of demonstrating the suitability of using a low-cost buoy for scientific and emergency response-type situations.

## Findings/Results:

- This study successfully used a new method for ice tracking and proved the durability, longevity, and utility of simple, low-cost ice-tracking buoys.
- This technology could be developed further for Arctic emergency responses applications, such as an oil spill in mixed ice conditions or small vessel recovery from Arctic sea ice.
- The study also contributed to a University of Alaska, Museum of the North university-credit course, a video broadcast produced for public television, and material for a children's book, *Frontier Scientists*.



*Ice conditions at the site of IceTracker 0016 on May 23, 2015. Significant surface melting had taken place between deployment and the time that this picture was taken. There was no river overflowing present at the location of the IceTrackers (as indicated by MODIS imagery and CTD measurements taken at the same time as the photo above).*

## Final Report:

Kasper JL, Mahoney AR, Arsenau J, Winsor P, Sybrandy A, Dobbins E, Irving B. 2018. Development and testing of a low-cost satellite-tracked ice drifter for Arctic Alaska. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-076. 47 p

# Fate and Persistence of Oil Spill Response Chemicals in Arctic Seawater

ALASKA REGION

ESPIS Link: <https://marinecadastre.gov/espis/#/search/study/100129>

Conducted by: University of Alaska Fairbanks, Coastal Marine Institute

National Studies List: AK-13-03-13 (2015–2017)

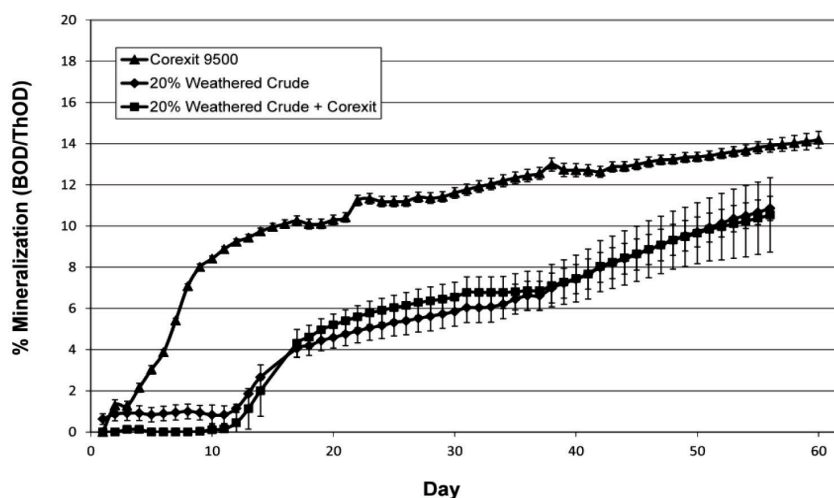
Study Products (available in ESPIS): Final report

## Purpose/Information Use:

Chemical dispersants are a potential option for oil spill response in the Arctic. Corexit 9500A is currently the principal chemical dispersant likely to be used. However, before the environmental impacts of using this dispersant can be assessed, its fate and persistence in the Arctic marine environment needs to be examined. This study quantified the biodegradation of Corexit 9500A and determined how the presence of crude oil alongside dispersants affects the biodegradation of both the dispersants and oil. The researchers performed an analysis of the microbial communities to identify microbes that may be involved in dispersant and oil biodegradation. Findings from the study will inform the oil spill response community decisions regarding the appropriate use of Corexit 9500A in Arctic waters.

## Findings/Results:

- The study found that crude oil and certain components of Corexit 9500A can undergo substantial biodegradation within 28 days in near-shore and offshore Arctic seawater.
- Microbes that are typically present in the Chukchi Sea in the summer and fall can perform substantial oil and dispersant biodegradation, although further examination is needed to better assess the longer-term fate of residual components.



Percent mineralization of Corexit 9500A and weathered ANS crude oil +/- dispersant in Arctic seawater at -1°C. Sealed respirometer experiments contained Corexit 9500A (50 ppm) alone or 20% weathered ANS crude (15 ppm) with and without Corexit 9500A (1:20 dispersant to oil ratio). Reprinted from McFarlin et al., 2014.

## Final Report:

Leigh MB, McFarlin K, Gofstein T, Perkins M, Field J. 2018. Fate and persistence of oil spill response chemicals in Arctic seawater. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-036. 52 p.

# Migration Trends for King and Common Eiders and Yellow-billed Loons Past Point Barrow in a Rapidly Changing Environment

ALASKA REGION

**ESPIS Link:** <https://marinecadastre.gov/espis/#/search/study/100130>

**Conducted by:** University of Alaska Fairbanks, Coastal Marine Institute

**National Studies List:** AK-13-03-14 (2016–2018)

**Study Products (available in ESPIS):** Final report

## Purpose/Information Use:

Many king eiders (*Somateria spectabilis*), common eiders (*S. mollissima v-nigra*), and yellow-billed loons (*Gavia adamsii*) pass Point Barrow (Utqiagvik), Alaska, during spring and fall migrations. Spring migration counts of eiders at Point Barrow conducted since 1976 indicate that this species' population declined by approximately 50% between 1976 and 1996, and that the declines had stabilized by 2004. Similar estimates have not been performed previously for yellow-billed loons, which are an international species of concern. This study conducted spring counts of eiders and loons in 2015 and 2016 to compare with eider counts from 1996 and 2002–2004 and loon counts from 2003 and 2004. BOEM and other agencies will be able to use this information in conservation and subsistence management and continued long-term monitoring in a rapidly changing environment. Environmental changes include increases in storm surges, rising sea levels that impact the birds' breeding areas, a warming Arctic, and an increase in human activities.

## Findings/Results:

- King and common eider populations have stabilized since the 50% declines seen between the 1970s and the 1990s and may be rebounding slightly.
- Population estimates for king eiders varied greatly between 2015 and 2016, possibly due to a very short and intense peak migration in 2016 that was difficult to capture.
- The numbers of common eiders were similar between the two years and the counts in 2003–2004.
- Estimates of yellow-billed loons were variable and likely low as the number of loons still migrating was high when counts ended in May.



*Example of a flock photo used in the photo analysis, Point Barrow, Alaska, 2016. Photo credit: Wildlife Conservation Society staff photo.*

## Final Report:

Powell A, Bentzen R, Suydam R. 2018. Migration trends for king and common eiders and yellow-billed loons past Point Barrow in a rapidly changing environment. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-059. 25 p.

# Characterizing Bacterial Communities in Beaufort Sea Sediments in a Changing Arctic

ALASKA REGION

**ESPIS Link:** <https://marinecadastre.gov/espis/#/search/study/100135>

**Conducted by:** University of Alaska Fairbanks, Coastal Marine Institute

**National Studies List:** AK-13-03-19 (2016–2018)

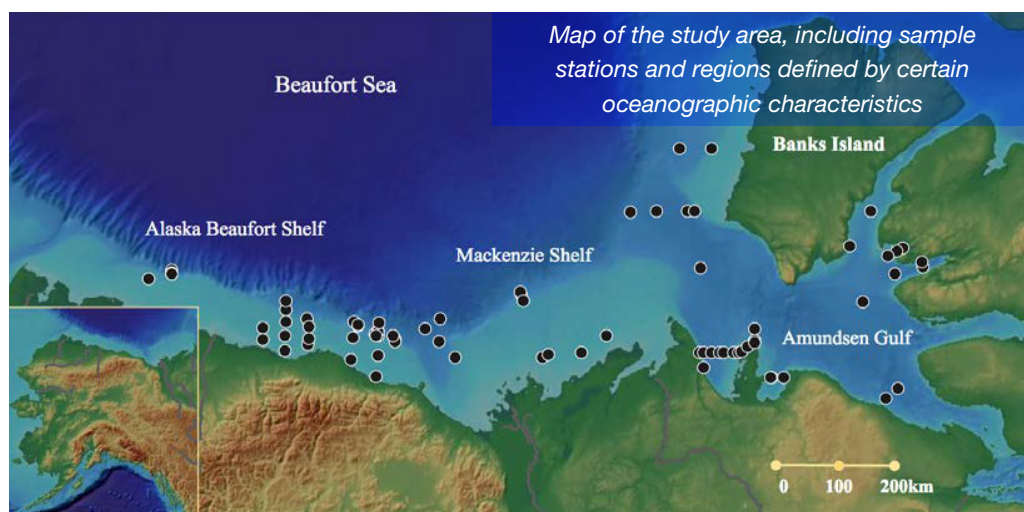
**Study Products (available in ESPIS):** Final report

## Purpose/Information Use:

Bacteria in seafloor sediment are the biogeochemical engineers of the benthos (flora and fauna at or near the bottom of the ocean) and play a vital role in the quality and quantity of organic matter deposited on the seafloor. Sediment bacteria are largely understudied in the Beaufort Sea benthos. The overall goals of this study were to 1) assess the diversity and community structure of sediment bacteria at 79 locations distributed across the Beaufort Sea continental shelf and slope, 2) examine correlations between bacterial diversity/community composition and 10 environmental conditions, and 3) test sediment samples for potential oil-degrading bacteria. This information will enable BOEM to monitor possible increased contaminant exposure in previously ice-covered Arctic waters as they become more accessible for human activities, particularly petroleum and gas exploration.

## Findings/Results:

- Overall, bacterial communities are more similar within Beaufort subregions, including the Alaskan Beaufort Shelf, Mackenzie Shelf, Amundsen Gulf, and Banks Island.
- Of the 14 potential oil-degrading species investigated, three species were distributed across all samples. The study found a majority of potential oil-degrading bacteria sporadically throughout the study area, with more species on the Alaskan Beaufort Shelf and in the Amundsen Gulf than on the Mackenzie Shelf.
- Bacterial community structure and biodiversity showed correlations with environmental parameters, especially depth, salinity, and  $\delta^{15}\text{N}$  (a measure of the ratio of two stable isotopes of nitrogen).



## Final Report:

Walker A, Yang Y, Johnson G. 2018. CMI graduate student projects: volume 1. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-021. 81 p.

# Changes in Beaufort-Chukchi Seas Intense Storms Activity and Impacts on Surface Climate and Ocean Properties

ALASKA REGION

ESPIS Link: <https://marinecadastre.gov/espis/#/search/study/100134>

Conducted by: University of Alaska Fairbanks, Coastal Marine Institute

National Studies List: AK-13-03-18 (2016–2018)

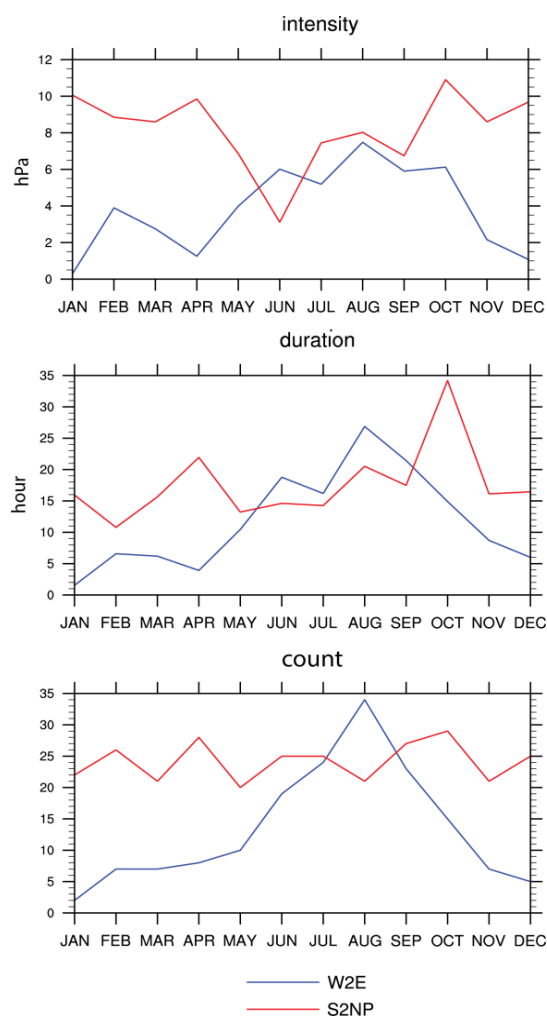
Study Products (available in ESPIS): Final report

## Purpose/Information Use:

The storms that enter the Chukchi and western Beaufort Seas originate predominantly in the Pacific Ocean, as far south as the subtropical Pacific region, or from the East Siberian Sea region. These storms take two primary pathways into the Chukchi and western Beaufort Seas: south to north from the Pacific Ocean (S2NP storms) and west to east from the East Siberian Sea (W2E storms). These storm types have distinct characteristics and can produce substantially different local and regional changes in surface atmospheric and oceanic properties. In this study, the researchers analyzed the climatology of these two types of storms using the Chukchi-Beaufort High-Resolution Atmospheric Reanalysis (CBHAR) dataset. BOEM’s understanding of the linkages between sea ice anomalies and frequency of S2NP storms over the region is important to obtain accurate sea forecasts. The local coastal communities could be subjected to the effects of these extreme weather events, which increase the potential for coastal erosion and flooding.

## Findings/Results:

- S2NP storms are generally stronger than the W2E storms, and both storm types have the most influence on surface climate and ocean properties in August and October, respectively.
- W2E storms change prevailing weak northeasterly winds to strong southerly winds over the Bering and Chukchi Seas.
- S2NP storms bring warm and moist air from the Pacific Ocean into the Arctic, and southerly surface winds on the northern coast of Alaska.
- Storms may reduce sea ice concentration substantially in the ice areas through a combination of factors. Sea ice retreat (northward) and sea ice advancement (southward) occur with southerly and northerly winds induced by the storms entering the study domain. The study suggested possible linkages between sea ice anomalies and frequency of the S2NP storms over the region.



Seasonal cycle of intensity, duration, and count for the W2E (blue line) and the S2NP (red line) storms from 1979 to 2009

## Final Report:

Walker A, Yang Y, Johnson G. 2018. CMI graduate student projects: volume 1. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-021. 81 p.

# Using Genotyping-by-Sequencing (GBS) Population Genetics Approaches to Determine the Population Structure of Tanner Crab (*Chionoecetes bairdi*) in Alaska

ALASKA REGION

**ESPIS Link:** <https://marinecadastre.gov/espis/#/search/study/100136>

**Conducted by:** University of Alaska Fairbanks, Coastal Marine Institute

**National Studies List:** AK-13-03-20 (2016–2018)

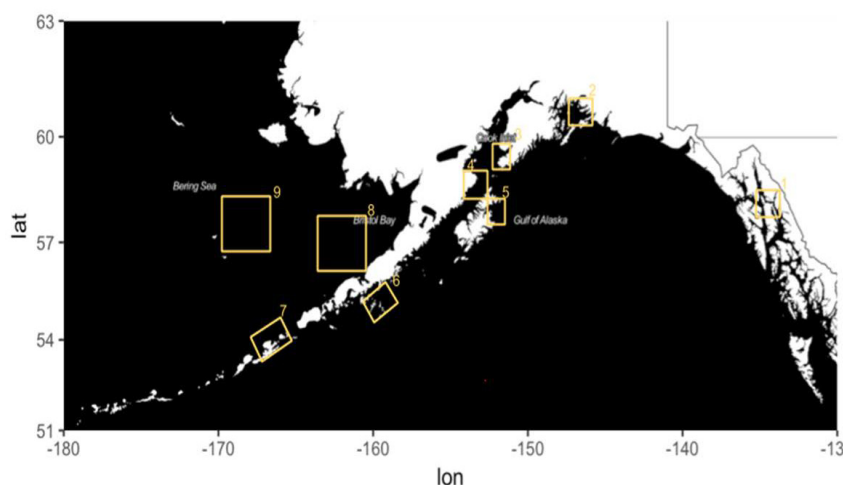
**Study Products (available in ESPIS):** Final report

## Purpose/Information Use:

This study developed baseline estimates of the genome-wide variation and population structure of Tanner crab (*Chionoecetes bairdi*), a commercial species that is important to Alaska's economy and communities. The Tanner crab is targeted in commercial use, personal use, and subsistence fisheries in Alaska. Previously strong crab fisheries in Prince William Sound, Kodiak, and the Bering Sea have faced major uncertainties over the past few decades due to declines and mixed recoveries that may be linked to environmental changes and both anthropogenic and biological factors. In this study, the researchers attempted to apply genomic sequencing techniques to investigate the population structure of *C. bairdi* in Alaska, focusing on the connectivity of Cook Inlet and Shelikof Strait populations with populations in Southeast Alaska, Prince William Sound, Kodiak Island, the Alaska Peninsula, the Aleutian Islands, and the Bering Sea shelf. BOEM will be able to use information from this study to monitor the migration, structure and size of wild populations, which are important components of natural resource

## Findings/Results:

- Technical issues limited the sample sizes from Southeast Alaska, Prince William Sound, and the Bering Sea shelf and restricted the geographical regions that could be compared.
- No significant distinction between regions could be detected based on individuals' genotypes.
- The researchers are continuing to test population structure models and estimates of genome-wide variation and diversity.



Map of sampling regions. Southeast Alaska, Prince William Sound, Kachemak Bay, Shelikof Strait, Kodiak Island, Alaska Peninsula, Aleutian Islands, SE eastern Bering Sea, and NW eastern Bering Sea.

## Final Report:

Walker A, Yang Y, Johnson G. 2018. CMI graduate student projects: volume 1. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-021. 81 p.



# Functional Diversity of Epibenthic Communities on the Chukchi and Beaufort Sea Shelves

ALASKA REGION

ESPIS Link: <https://marinecadastre.gov/espis/#/search/study/100195>

Conducted by: University of Alaska Fairbanks, Coastal Marine Institute

National Studies List: AK-13-03-27 (2017–2081)

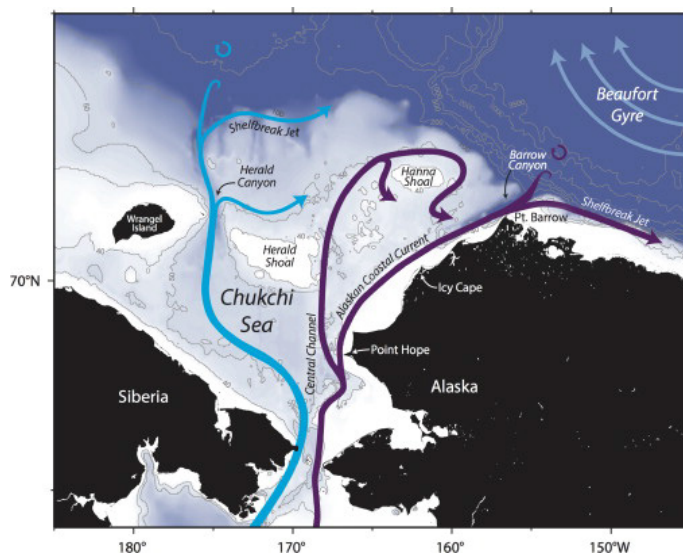
Study Products (available in ESPIS): Final report

## Purpose/Information Use:

This study compared the functional diversity of the Chukchi and Beaufort Seas shelf communities using biological trait analysis (BTA), which characterizes organisms based on morphology, life history, and behavior. Given the distinct hydrographic settings of the two seas, the hypothesis was to determine whether the epibenthic communities of the Chukchi and Beaufort Sea shelves differed in biological trait composition and, therefore, ecosystem functional diversity. The information is useful to BOEM because benthic communities support bottom-up food webs and are excellent indicators of longer-term impacts instead of short-term fluctuations that are more prominent in the Arctic. Understanding the functional diversity of communities is important because it could be disrupted by ecosystem stressors due to resource extraction and climate change. The project contributed to a pan-Arctic effort to create an on-line database for biological traits of Arctic benthic organisms

## Findings/Results:

- This study showed that overall epibenthic functional diversity was higher on the Chukchi Sea shelf compared with Beaufort Sea shelf communities.
- Many biological traits were found in both areas in similar proportions. However, the Chukchi Sea communities differed from the Beaufort Sea communities in reproductive strategy, larval development, body form, depth range, and substrate affinity.
- The Chukchi Shelf communities had more planktotrophic (i.e., feeding on plankton) larval development, dorso-ventrally compressed (i.e., flat) organisms and organisms that prefer soft substrate. The Beaufort Sea shelf communities had more lecithotrophic (i.e., feeding on egg yolk) larval development, organisms with a globose (i.e., rounded or globular) body form, and organisms that prefer hard substrate.
- Outreach for the project included a hands-on activity with first and second-grade classes at Anne Wien Elementary School in Fairbanks and other activities in the Fairbanks-area.



*The Chukchi and Beaufort Seas are influenced by different water currents, bathymetry, and primary production regimes (adapted from Gong and Pickart 2015)*

## Final Report:

Sutton L, Clark C. 2018. CMI graduate student projects: volume 2. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOCM 2018-058. 63 p.

# Using Trace Elements in Pacific Walrus Teeth to Track the Impacts of Petroleum Production in the Alaskan Arctic

ALASKA REGION

**ESPIS Link:** <https://marinecadastre.gov/espis/#/search/study/100196>

**Conducted by:** University of Alaska Fairbanks, Coastal Marine Institute

**National Studies List:** AK-13-03-26 (2017–2018)

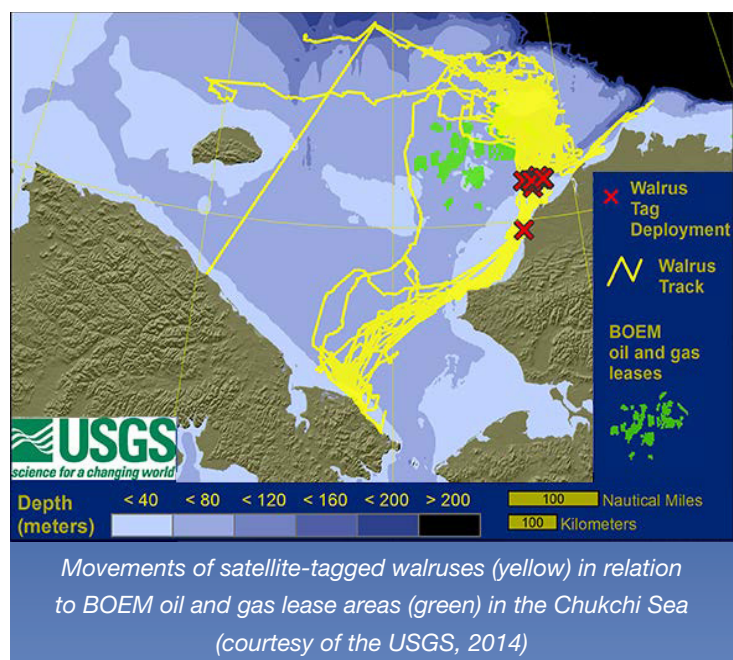
**Study Products (available in ESPIS):** Final report

## Purpose/Information Use:

Offshore oil and gas exploration and extraction have the potential to introduce harmful materials into marine food webs. These pollutants are typically associated with sediments and are most likely to have an impact on benthic communities. Trace element analysis is an effective tool for determining the presence of these materials in the marine environment. Pacific walrus (*Odobenus rosmarus divergens*) are benthic foragers, consuming a wide variety of prey items across broad areas of the seafloor. For this reason, walrus are considered a sentinel species for benthic communities. Walrus teeth grow continually and incorporate trace elements in concentrations proportional to those in the body of the walrus, and these teeth can act as archives of element exposure. This study measured concentrations of 15 trace elements in the teeth of 99 female Pacific walrus collected between 1933 and 2016. For BOEM, the concentrations of the trace elements typically associated with oil and gas exploration and extraction in Pacific walrus teeth provide baseline values for monitoring the impacts of petroleum production on benthic systems and benthic predators in Alaska.

## Findings/Results:

- Overall, most trace elements typically associated with oil and gas exploration and extraction did not change during the study period. In some cases, concentrations of these elements were lowest during the decades coinciding with the most intense petroleum-related activities (1970s–1980s, 1990s).
- The element concentrations presented in this study can serve as baseline values for future studies, with the exception of vanadium, arsenic, and iron, which changed substantially within the study period.
- Some elements showed consistent patterns within the teeth of individual walrus.
- This technique has the potential to become a valuable tool for managers to track the status of the Pacific walrus population.



## Final Report:

Sutton L, Clark C. 2018. CMI graduate student projects: volume 2. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOCM 2018-058. 63 p.

# Understanding the Role of Offshore Structures in Managing Potential *Watersipora* Invasions

PACIFIC REGION

ESPIS Link: <https://marinecadastre.gov/espis/#/search/study/26977>

Conducted by: University of California, Santa Barbara

National Studies List: PC-13-04 (2013–2018)

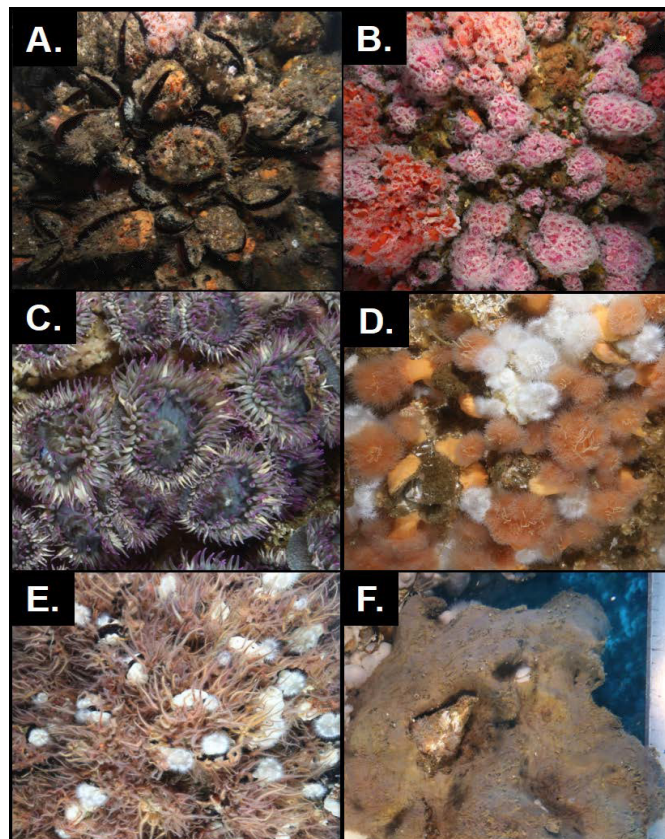
Study Products (available in ESPIS): Final report

## Purpose/Information Use:

Previous BOEM-funded studies found the non-native species, *Watersipora*, on two of seven offshore oil and gas platforms in the Santa Barbara Channel. This study surveyed *Watersipora subatra* on offshore oil and gas platforms, other artificial structures, and natural reefs in the Santa Barbara Channel, Santa Maria Basin, and San Pedro Basin; the study also examined the role of offshore artificial structures in the establishment and spread of this non-native species. The findings may inform BOEM and Bureau of Safety and Environmental Enforcement (BSEE) decisions on maintenance cleaning and decommissioning of offshore oil and gas platforms.

## Findings/Results:

- The variation in abundance of *Watersipora* appears to be a factor affecting the differences in the type and number of organisms found on offshore oil and gas platforms included in this study.
- *Watersipora* appears to be expanding in distribution and abundance in the Santa Barbara Channel.
- Disturbance (such as maintenance cleaning) that removes the invertebrates attached to the platform can increase *Watersipora*'s introduction and coverage.
- *Watersipora* occurs on some natural reefs, as well as offshore oil platforms and harbors.



Examples of common native space-holding invertebrate taxa on oil and gas platforms in the Southern California Bight. A) sea mussel *Mytilus californianus*, B) strawberry anemone *Corynactis californicus*, C) anemone *Anthopleura elegantissima*, D) white and brown color morphs of the anemone *Metridium senile*, E) brittlestar *Ophiothrix spiculata* and *Metridium senile*, and F) sponge *Spheciospongia confoederata*

## Final Report:

Page HM, Dugan JE, Miller RJ, Simons R, Viola SM. 2018. Understanding the role of offshore structures in managing potential *Watersipora* invasions. Camarillo (CA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2019-001. 113 p.

# Propagation Characteristics of High-Frequency Sounds Emitted During High-Resolution Geophysical Surveys: Open Water Testing

NATIONAL

**ESPIS Link:** <https://marinecadastre.gov/espis/#/search/study/100185>

**Conducted by:** CSA Ocean Sciences Inc.

**National Studies List:** NT-14-03b (2015–2018)

**Study Products (available in ESPIS):** Final report, raw and processed acoustic data, other field data, and metadata provided on external hard drives

## Purpose/Information Use:

Marine geophysical data is critical both for industry and for BOEM to make informed leasing decisions. High frequency marine acoustic sources are used to acquire this data for infrastructure siting, geological or environmental characterization, and shallow hazard or archaeological cultural surveys. The acoustic sources currently in use include boomers; sparkers; sub-bottom (chirp or other) profilers; side-scan sonar; and single, swath, and multibeam bathymetric fathometers. This study is the second of three related studies designed to characterize and predict the sound fields of these sources in shallow water. The first study calibrated measurement of the sound field of 17 sources by the Naval Undersea Warfare Center, Newport, Rhode Island, at their facilities and in controlled environments. This study expanded the at-sea measurement of those same sources (plus several hull-mounted sonars) in shallow waters (10, 30, and 100 meters deep) off Virginia and Maryland. BOEM will use this information in regulating the sound source impacts from high-resolution geophysical surveys in open water testing.

## Findings/Results:

- This study presented acoustic results from 17 high-resolution geophysical sources and 40 different operational modes.
- For each source, the data provide signal characteristics, received levels at varying ranges from the source, estimated source levels, and estimated propagation conditions at each site.
- Due to some technical equipment issues at sea, this report should be viewed as an interim report, and the data should be used with caution. For more details, refer to the related memorandum (Labak 2019), which can be found on the above-linked ESPIS page.
- The final calibration for this data is currently ongoing and will be completed with the third phase of this project, the propagation modeling and recommendations study, which is scheduled to be completed in 2021.



*Photo of an acoustic data acquisition buoy. Photo courtesy of CSA Ocean Sciences, Inc.*

## Final Report:

Halvorsen MB, Hearney KD. 2018. Propagation characteristics of high-resolution geophysical surveys; open water testing. OCS Study BOEM 2018-052. 806 p.



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The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.



## **The Bureau of Ocean Energy Management**

The mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

## **The BOEM Environmental Studies Program**

The mission of the Environmental Studies Program (ESP) is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments. The proposal, selection, research, review, collaboration, production, and dissemination of each of BOEM's Environmental Studies follows the DOI Code of Scientific and Scholarly Conduct, in support of a culture of scientific and professional integrity, as set out in the DOI Departmental Manual (305 DM 3).

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