Bureau of Ocean Energy Management | Environmental Studies Program

# Quarterly Report

**FY 2018 Third Quarter**

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

BOEM Bureau of Ocean Energy Management

**September 2018**



# Contents

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/#/.

# Synthesis of Arctic Research (SOAR) Physics to Marine Mammals in the Pacific Arctic

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/20001

**Conducted by:** National Oceanic Atmospheric Administration (NOAA)

**National Studies List:** AK-11-05 (2011–2018)

**Study Products (available in ESPIS):** Final project report and 2012 Workshop final report


## Purpose:

This study gathered and analyzed scientific information from biological and oceanographic research in the Pacific Arctic region.

## Findings/Results:

- Following a workshop on March 14–16, 2012, two peer-reviewed journals published a total of 33 multi-author papers in two special volumes with information collected by BOEM, other Federal and state agencies (e.g., NOAA, USGS, NSF), and the oil and gas industry.
- The findings enhanced our understanding of the relationships among oceanographic conditions, benthic organisms, lower trophic prey species (forage fish and zooplankton), and marine mammal distribution and behavior in the region, with particular emphasis on the northeastern Chukchi Sea.
- This project enhanced BOEM's ability to predict future changes in oceanographic features (e.g., currents, upwelling, and ice leads) and associated changes in the behavior of marine mammals and their prey in the region.

**Final Report:** Moore SE, Stabeno PJ, Sheffield Guy LM, Van Pelt TI. 2018. Synthesis of Arctic Research (SOAR): physics to marine mammals in the Pacific Arctic. Anchorage (AK): US Dept. of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region. OCS Study BOEM 2018-0017. 61p.

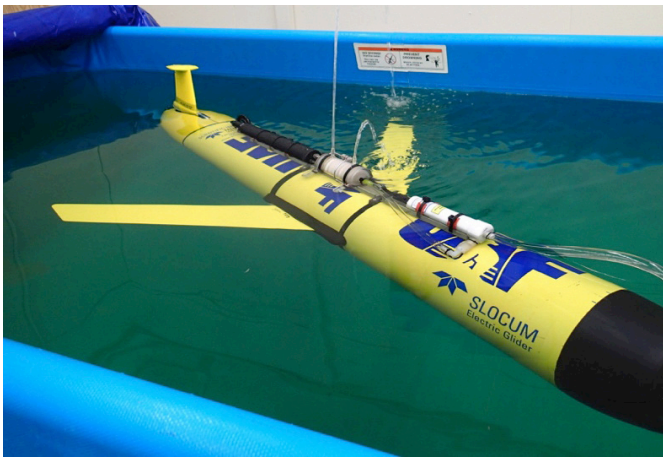
# Development of an Autonomous Carbon Glider to Monitor Sea-Air $CO_2$ Fluxes in the Chukchi Sea

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/100128

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

**National Studies List:** AK-13-03-12 (2015–2018)

**Study Products (available in ESPIS):** Final report, data from glider in the Gulf of Alaska in May 2016




*Carbon glider in a tank at the UAF glider facilities during ballast testing.*

## Purpose:

The waters around Alaska are undergoing unprecedented environmental change, which could impact carbon cycling in the Arctic at a fast pace. Continued development of oil and gas resources will result in increasing carbon dioxide ($CO_2$) emissions and additional changes in ocean carbon chemistry. Traditional ship-based observations are operationally expensive and insufficient to provide the coverage of dissolved $CO_2$ measurements required to understand the region's carbon cycle. Moreover, ocean acidification and climate change are altering the chemical and physical environment in the ocean, and conventional observational techniques are not efficient methods for detecting this change. The goal of this project was to develop and test a carbon glider that could autonomously measure partial pressure of carbon dioxide ($pCO_2$) throughout the water column at high resolution.

## Findings/Results:

- The researchers developed a carbon glider, brought it to a Technology Readiness Level of 6 (TRL-6 per NASA), and demonstrated its capacity to collect $pCO_2$ data at sea.
- The researchers also designed a customized $pCO_2$ sensor; integrated the sensor's physical, power, communication, and software systems with the glider; and developed glider hover missions that allowed for full sensor equilibration and the use of sensors with slower response times.
- The study identified additional work that needs to be done to bring the carbon glider to full operational level.

**Final Report:** Hauri C. 2018. Development of an autonomous carbon glider to monitor sea-air $CO_2$ fluxes in the Chukchi Sea. OCS Study BOEM 2018-016. Anchorage (AK): U.S. Department of the Interior, Bureau of Ocean Energy Management. 28 p.

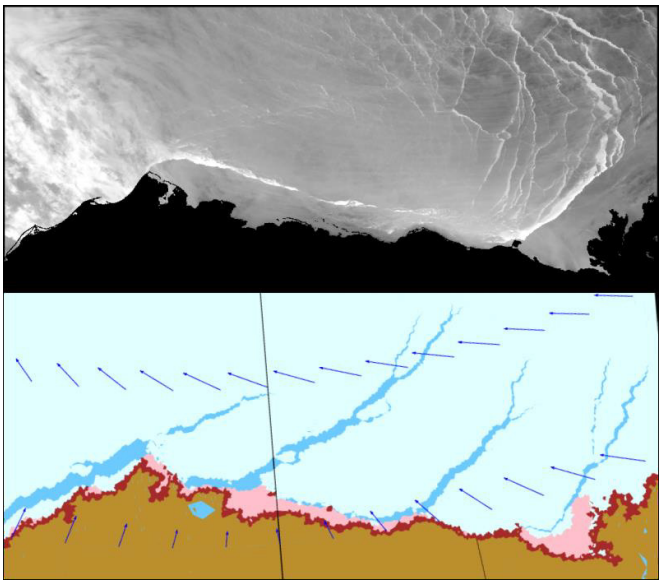
# Development of an Accurate Model of the Beaufort and Chukchi Ice Drift and Dispersion for Forecasting Spill Trajectories and Providing Decision Support for Spill Response

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/26899

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

**National Studies List:** AK-13-03-03 (2013–2017)

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



*Observations and simulation comparison for April 2, 2003 lead formation.*

## Purpose:

Predicting sea ice motion in the Beaufort and Chukchi Seas is important for marine commercial operations and rescue activities when sea ice is present. This project developed an open-source computational framework and software library for discrete element modeling of sea ice mechanics ("Siku").

## Findings/Results:

- Comparison of Siku-predicted locations and patterns of ice openings in the leads (large fractures in sea ice) indicated good correlation with satellite observations for the same wind field.
- Siku simulations showed that large fractures (leads) in the sea ice begin at promontories along the coastline and landfast ice edge, and that the pattern of leads is tied strongly to wind direction and confinement along the shore boundary.
- Future improvement to Siku will include fine-tuning the criteria to reproduce shear failure at Point Barrow and the Beaufort Sea shore lead.

**Final Report:** Lewis B, Johnson J, Hutchings J, Kulchitsky A. 2018. Siku Sea ice discrete element method model. Anchorage (AK): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-043. 47 p.

# Real-Time Opportunity for Development Environmental Observations (RODEO) Task 3: Field Observations During Wind Turbine Foundation Installation

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/100084

**Conducted by:** HDR

**National Studies List:** AT-14-01-03 (2015–2018)

**Study Products (available in ESPIS):** Final report and additional appendices

*Block Island Wind Farm Facility Wind Turbine 3 Foundation Construction. Courtesy of HDR RODEO Team.*

## Purpose:

With the first offshore wind facilities being built along the Atlantic Coast, there is the opportunity to make direct, real-time measurements of the nature, intensity, and duration of potential stressors during the construction and initial operations of selected proposed offshore wind facilities. The first facility to be constructed is the Block Island Wind Farm, consisting of five turbines 2.8 miles off the coast of Rhode Island. HDR monitored the installation of the wind turbine foundations in the summer and fall of 2015, including visual monitoring of construction activities from onshore and offshore locations; onshore and offshore airborne noise monitoring; near- and far-field underwater sound monitoring; seafloor disturbance and recovery monitoring; and turbine foundation scour monitoring.

## Findings/Results:

- Airborne noise monitoring data analyses indicated that the noise from the pile driving was clearly audible at the Southeast Lighthouse (3 miles away) but was not detected at Point Judith (17 miles away) on the mainland.
- Results from preliminary data analyses show that pile driving sound was above background sound levels at ranges in excess of 12.4 miles.
- The seafloor recovered observably within months from the disturbance caused by anchoring and lift boat legs, and recovery rates generally corresponded to seabed mobility.
- Testing of scour monitors provided a long-term time series (16 months) of seabed elevations near the foundation that showed minor scour around the observed legs.

**Final Report:** Amaral JL, Beard R, Barham RJ, Collett AG, Elliot J, Frankel AS, Gallien D, Hager C, Khan AA, Lin Y, et al. 2018. Field observations during wind turbine foundation installation at the Block Island Wind Farm, Rhode Island. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2018-029. 175 p.

# Inter-Disciplinary Study of the Possible Link Between Space Weather, Geomagnetic Storms and Cetacean Mass Strandings

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/100145

**Conducted by:** NASA Goddard Space Flight Center

**National Studies List:** AT-16-x22 (2016–2018)

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

*NASA Goddard Space Flight Center, Science Visualization Studio.*

## Purpose:

Cetacean mass strandings are one of the long-standing mysteries in marine biology, and many explanations have been proposed for the often-fatal animal behavior. Geomagnetic activity is one of the proposed explanations, and, in this study, we investigated whether there is statistical evidence for a possible connection. This investigation used mass stranding records from Cape Cod, U.S., New Zealand, and the United Kingdom, together with global geomagnetic indices and local geomagnetic observations.h resolution.

## Findings/Results:

- No statistical link is found in shorter time frames (30 days or less), which are the time frames believed to be relevant for possible animal response to changes in geomagnetic conditions.
- If geomagnetic activity plays any role in mass strandings, the connection is likely very subtle and coupled with a complex combination of multiple environmental factors.
- The importance of various environmental factors likely depends on the stranding locations and individual cetacean species, and consequently, the reported findings apply only to the locations studied.

**Final Report:** Pulkkinen A, Moore K, Zellar R, Uritskaya O, Karakoylu E, Uritsky V, Reeb D. 2018. Inter-disciplinary study of the possible link between cetacean mass strandings, geomagnetic storms and space weather. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-030. 48 p.

# Integrative Statistical Modeling and Predictive Mapping of Seabird Distribution and Abundance on the Atlantic Outer Continental Shelf

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/100065

**Conducted by:** U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service

**National Studies List:** AT-13-03 (2013–2018)

**Study Products (available in ESPIS):** Final report and appendices, Phase I final report

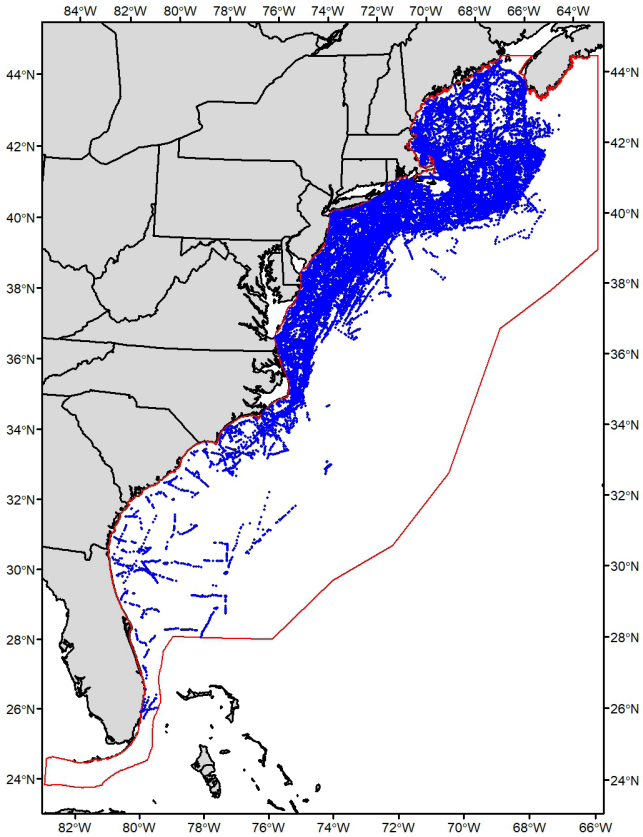
*Cover photo (Herring Gull) courtesy of David Pereksta (BOEM). Used with permission.*

## Purpose:

This study developed maps of marine bird species distributions in U.S. Atlantic Outer Continental Shelf (OCS) waters. These maps can be used to inform planning for offshore wind energy development and to guide future data collection efforts.

## Findings/Results:

- This study analyzed sighting survey data from over three decades to develop seasonal maps for 47 marine bird species in U.S. Atlantic OCS and adjacent waters from Florida to Maine.
- The survey effort used habitat-based spatial predictive modeling.
- Model predictions are presented as seasonal maps of the relative density of each study species throughout the study area. These maps identify areas where the densities of marine bird species are likely to be higher or lower on a seasonal basis.




*Cetacean and Seabird Assessment Program (CSAP) surveys of seabirds, marine mammals, and sea turtles conducted by the Manomet Bird Observatory for the NOAA Northeast Fisheries Science Center.*

**Final Report:** Winship AJ, Kinlan BP, White TP, Leirness JB, Christensen J. 2018. Modeling at-sea density of marine birds to support Atlantic marine renewable energy planning: final report. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Program. OCS Study BOEM 2018-010. 81 p plus appendices.

# Sperm Whale Acoustic Prey Study (SWAPS)

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/100098

**Conducted by:** National Atmospheric and Oceanic Administration, National Marine Fisheries Service, Southeast Fisheries Science Center

**National Studies List:** GM-09-05 (2009–2012)

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


*Photo of two sperm whales taken during the 2012 tagging cruise (NOAA/SEFSC MMPA Permit # 779-1633).*

## Purpose:

Sperm whales are protected by both the Endangered Species Act and the Marine Mammal Protection Act. These whales are present throughout the Gulf of Mexico (GOM) year-round. This study investigated the prey field available to sperm whales in the Northern GOM and the spatial and vertical distribution of prey at depths between 300–800 m (984 to 2,624 feet). BOEM partnered with the National Marine Fisheries Service, Southeast Fisheries Science Center to conduct large vessel surveys in the northern GOM during 2009 (summer) and 2010 (winter and spring).

## Findings/Results:

- Concurrent marine mammal surveys and midwater trawl sampling demonstrated strong associations between mesoscale physical features, sperm whales, and their prey.
- The researchers collected squid from 32 taxa and processed 536 individual animals for stable isotope analysis of carbon and nitrogen.
- Squids with mantle lengths between 31 and 150 millimeters were found to be the sperm whale's dominant prey, likely because these smaller squids are more abundant and easier to capture.
- The current study included a number of unique specimens, in particular a specimen of the "pocket shark," which is the second specimen from this genus collected to date globally, and a specimen of the giant squid *Architeuthis dux*.

**Final Report:** Garrison LP, Glenn III DW, Karrigan H. 2018. Sperm whale acoustic prey study in the northern Gulf of Mexico. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-035. 94 p.

# Marine Arctic Ecosystems Study (MARES) Pilot Program Task 3; Biophysical and Chemical Observations

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/100232

**Conducted by:** Stantec Consulting Services Inc.

**National Studies List:** NT-13-05-02 (2015–2018)

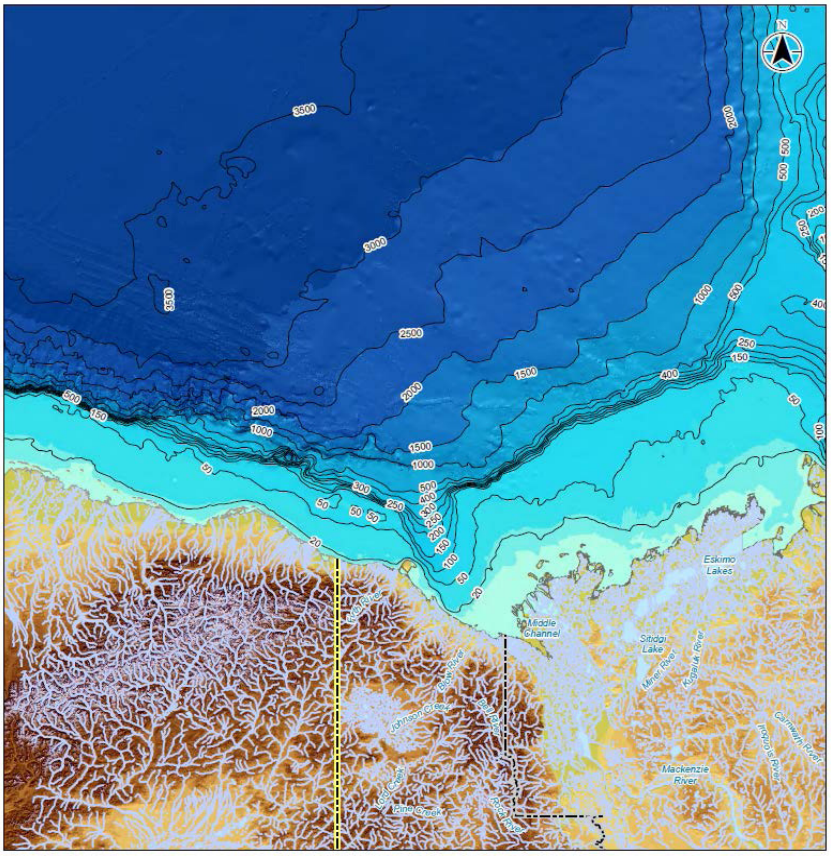
**Study Products (available in ESPIS):** Final report

**Purpose:**

To study the ecosystem drivers and influence of Canada's Mackenzie River plume on the Beaufort Sea shelf, this program deployed five moorings along the shelf and an autonomous underwater vehicle (AUV) glider, and conducted benthic and water sampling to measure the biophysical and chemical characteristics.

**Findings/Results:**

- The study identified four general flow behaviors of the Mackenzie plume, largely influenced by winds, which have significant impacts on the final destination of plume waters, its retention within Arctic waters, and its influence on biological communities.
- Mid-shelf regions receive higher contributions of marine carbon than shallower or deeper sections along the eastern Beaufort Sea shelf. These inputs are reflected by increased diversity and abundance of small invertebrates at and near the seafloor.
- Most of the carbon at mid-shelf and slope locations stems from localized marine primary production rather than from terrestrial carbon sources carried by the Mackenzie outflow.




*Map of the Mackenzie Trough. Bathymetry from the National Oceanic and Atmospheric Administration (NOAA) and bathymetry contours from Geological Survey of Canada.*

**Final Report:** Wiese FK, Harvey HR, McMahon R, Neubert P, Gong D, Wang H, Hudson J, Pickard R, Ross E, Fabijan M, Gryba RD. 2018. Marine arctic ecosystem study—biophysical and chemical observations from glider and benthic surveys in 2016. Anchorage (AK): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-024. 98 p.

# Expanded Guide to Some Common Fouling Invertebrates of Alaska With Focus on Known and Potential Marine Invasive Species of Kachemak Bay National Estuarine Research Reserve

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/100182

**Conducted by:** University of Alaska Anchorage

**National Studies List:** NT-17-x10 (2017–2018)

**Study Products (available in ESPIS):** Final report, related publications

## Purpose:

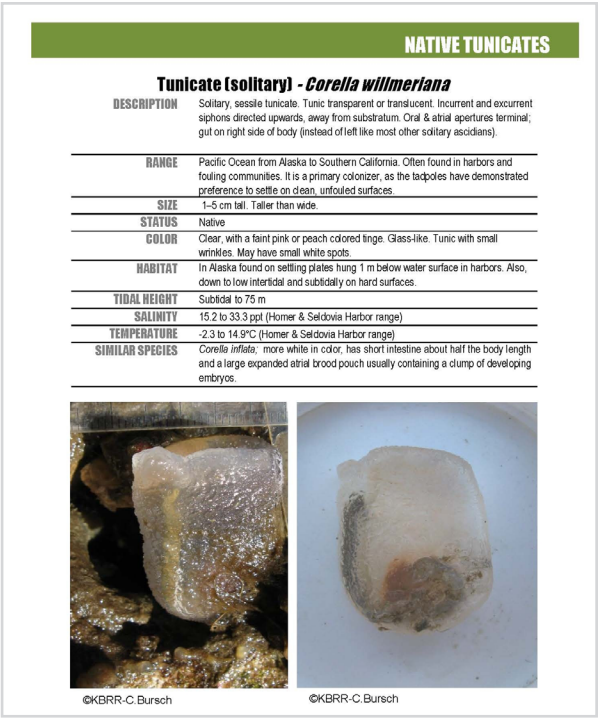
The purpose of the project was to update the *Guide to Some Common Fouling Invertebrates of Alaska*. The initial guide, which describes 22 tunicate species, was started in 2010, when the Kachemak Bay National Estuarine Research Reserve began to look for marine invasives and started to collect and preserve local tunicates in south central Alaska. At the time, little information was available on Alaskan tunicates and other fouling organisms.

## Findings/Results:

- The guide expanded under a partnership with the Smithsonian Environmental Research Center as stakeholders repeatedly asked for a guide to help people tell the difference between native and non-native species on the Alaskan coast.
- With the 2018 update, seven more species are added to the guide.

**Final Report:** Bursch C, Shepherd J. 2018. Expanded guide to some common fouling invertebrates of Alaska with a focus on known and potential marine invasive species of Kachemak Bay National Estuarine Research Reserve, final report. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-012. 7 p.

*Above: Tunicates of Kachemak Bay, Alaska, Illustration © Catie Bursch. Below: Sample guide page.*



NATIVE TUNICATES

**Tunicate (solitary) - *Corella willmeriana***

| | |
|---|---|
| DESCRIPTION | Solitary, sessile tunicate. Tunic transparent or translucent. Incurrent and excurrent siphons directed upwards, away from substratum. Oral & atrial apertures terminal; gut on right side of body (instead of left like most other solitary ascidians). |
| RANGE | Pacific Ocean from Alaska to Southern California. Often found in harbors and fouling communities. It is a primary colonizer, as the tadpoles have demonstrated preference to settle on clean, unfouled surfaces. |
| SIZE | 1–5 cm tall. Taller than wide. |
| STATUS | Native |
| COLOR | Clear, with a faint pink or peach colored tinge. Glass-like. Tunic with small wrinkles. May have small white spots. |
| HABITAT | In Alaska found on settling plates hung 1 m below water surface in harbors. Also, down to low intertidal and subtidally on hard surfaces. |
| TIDAL HEIGHT | Subtidal to 75 m |
| SALINITY | 15.2 to 33.3 ppt (Homer & Seldovia Harbor range) |
| TEMPERATURE | -2.3 to 14.9°C (Homer & Seldovia Harbor range) |
| SIMILAR SPECIES | *Corella inflata*; more white in color, has short intestine about half the body length and a large expanded atrial brood pouch usually containing a clump of developing embryos. |

# Maritime Cultural Landscape Summit

**ESPIS Link:** https://marinecadastre.gov/espis/#/search/study/100094

**Conducted by:** National Park Service

**National Studies List:** NT-15-x10 (2015–2018)

**Study Products (available in ESPIS):** Proceedings of the Maritime Cultural Landscape Symposium, Volumes 1 and 2, and links to presentations

## Purpose:

A maritime cultural landscape (MCL) is an archaeological site that may include a shipwreck, coastal historic district, or collection of ceremonial stones. What distinguishes an MLC from another archaeological site is the historical significance of the "landscape" that constitutes its broader setting. There is a growing awareness of these landscapes, which has stimulated discussion on their recognition and protection under Federal regulations related to the National Historic Preservation Act. Therefore, state and Federal agencies, tribes, scholars, and interest groups can contribute to a fuller appreciation of MLCs and appropriate measures for their protection.


*Cover of ymposium proceedings.*

## Findings/Results:

- In the fall of 2015, the Maritime Cultural Landscape Symposium was held on the campus of the University of Wisconsin-Madison.
- Forty presentations discussed wide range of topics, including a variety of MCL types and case studies; management and protection of MCLs; characterizing MCLs; non-submerged prehistoric MCLs; and Native American, Alaskan, and Hawaiian MCLs and legal considerations.

**Citation:** Wyatt, B (editor). 2018. Volume 1: presentation papers. Proceedings of the Maritime Cultural Landscape Symposium; 2015 Oct 14–15; University of Wisconsin-Madison. Washington (DC): U.S. Department of the Interior, National Park Service.

# BOEM's Environmental Studies Program

develops, funds, and manages rigorous scientific research specifically to inform policy decisions on the development of energy and mineral resources on the Outer Continental Shelf (OCS).

Research covers physical oceanography, atmospheric sciences, biology, protected species, social sciences (such as economics and submerged cultural resources) and environmental fates and effects of oil and gas in the sea. Mandated by Section 20 of the Outer Continental Shelf Lands Act, the Environmental Studies Program is an indispensable requirement informing BOEM's decisions on offshore oil and gas, offshore renewable energy, and the marine minerals program for coastal restoration.

The ESP has provided over $1 billion for research to this end since 1973.

**Visit our webpage** @ www.boem.gov/studies/

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