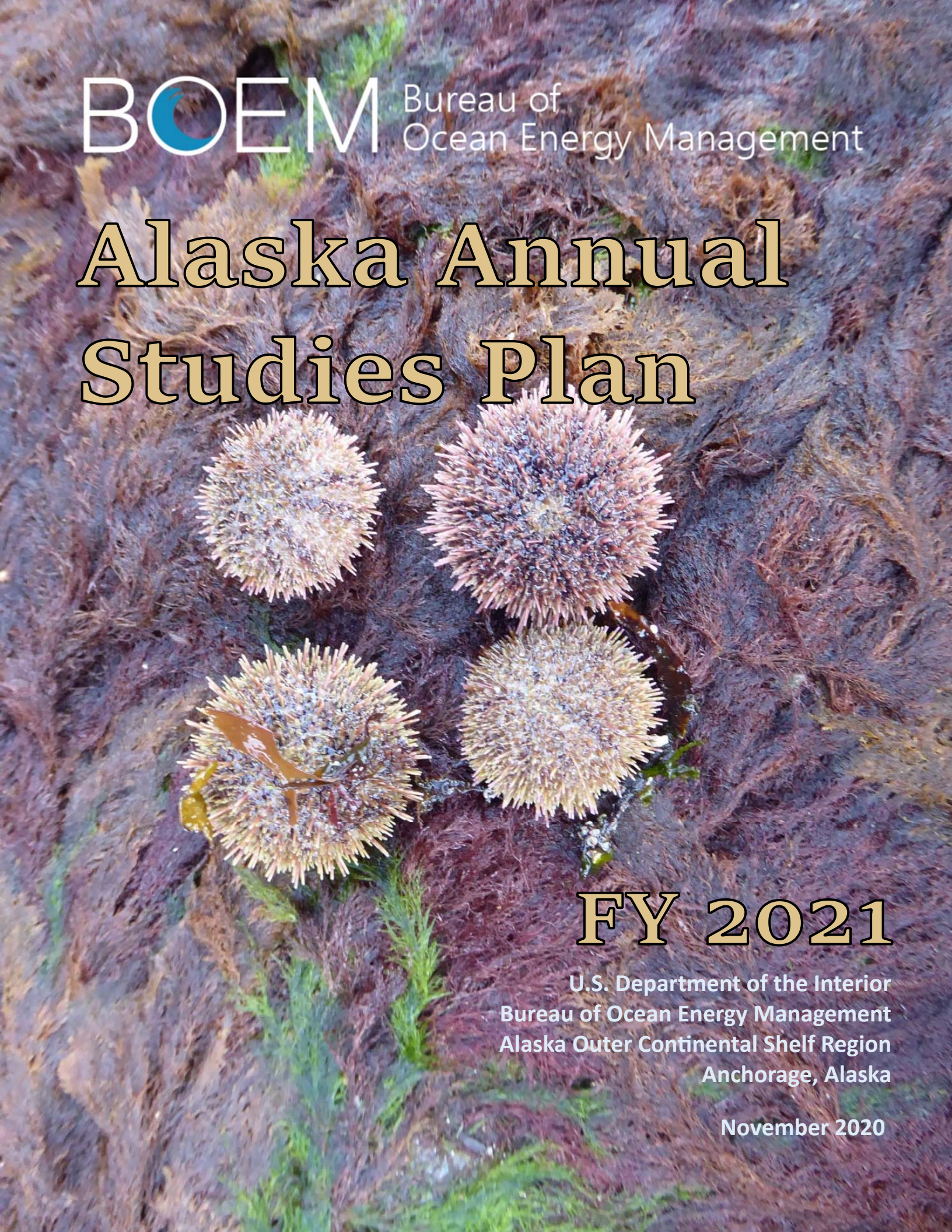

BOEM Bureau of Ocean Energy Management

Alaska Annual Studies Plan

FY 2021

U.S. Department of the Interior
Bureau of Ocean Energy Management
Alaska Outer Continental Shelf Region
Anchorage, Alaska

November 2020

Prepared by
U.S. Department of the Interior
Bureau of Ocean Energy Management
Anchorage, Alaska Office
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823

November 2020

The Environmental Studies Program has chosen to "go green." This document can be accessed in electronic format at http://www.boem.gov/akstudies/. For assistance accessing the document or for further information about the Studies Program and our planning process, please contact Alaska.Studies@boem.gov or Dr. Heather Crowley at heather.crowley@boem.gov.

The inclusion of study profiles in this document does not constitute a commitment by the U.S. Department of the Interior, Bureau of Ocean Energy Management to conduct or fund any or all of the studies. Method of procurement may be selected at the discretion of BOEM. The scope of the studies is subject to change prior to initiation of any work.

Any use of trade names is for descriptive purposes only and does not constitute endorsement of these products by the Bureau of Ocean Energy Management.

Cover Image: Sea urchins in the intertidal zone, Cook Inlet, Alaska.

Photo credit: "ShoreZone Imaging and Mapping along the Alaska Peninsula" project team; OCS Study BOEM 2018-037.

United States Department of the Interior
BUREAU OF OCEAN ENERGY MANAGEMENT
Alaska Regional Office
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823

November 2, 2020

Dear Stakeholder:

Thank you for your interest in the Environmental Studies Program (ESP) of the Bureau of Ocean Energy Management (BOEM). As BOEM's priorities evolve, we continue to assess our information needs and identify new study ideas each year to meet these needs. We are providing this *Alaska Annual Studies Plan FY 2021* as a convenient reference describing our recent programmatic updates and our plans for fiscal year (FY) 2021 and beyond.

We have worked to restructure and streamline the *Alaska Annual Studies Plan* while continuing to focus on input we receive from our partners within and outside of the Federal Government. We are interested to know your perspectives and to receive any suggestions you may have for the BOEM *Alaska Annual Studies Plan FY 2022*, which we are now beginning to formulate. We assess information needs and develop new study profiles each year, following a well-established process that involves a role for both stakeholder input and scientific peer review.

To assist us in processing suggestions for new studies, we ask that you follow the formatting guidance for a study profile shown on the next page. Please keep in mind that studies proposed for our consideration must address specific BOEM mission and decision needs. Suggestions may be submitted via email to Alaska.Studies@boem.gov, and must be received by us no later than December 4, 2020, to ensure consideration for the 2022 fiscal year (October 1, 2021– September 30, 2022). Following revisions to this plan, we will issue a final *Alaska Annual Studies Plan FY 2022* in the autumn of 2021.

We sincerely appreciate your participation in this process, and we look forward to receiving your suggestions. If you have any questions about the submission process, you are urged to contact Dr. Heather Crowley, Alaska Studies Coordinator, at heather.crowley@boem.gov.

Sincerely,

Catherine Coon
Chief, Environmental Sciences Management

Bureau of Ocean Energy Management
http://www.boem.gov/akstudies/
Alaska.Studies@boem.gov

Proposed Study for FY 2022

Formatting Guidance: We recommend study profiles be less than 2 pages. Profiles are not a detailed scope of work; BOEM will prepare a detailed scope of work if one is needed. Please keep in mind that studies proposed for consideration must address specific BOEM mission and decision needs as described in Section 2.0 of this document. The method of procurement for any funded study shall be selected at the discretion of BOEM.

Title: Enter a brief, descriptive title

Administered by: BOEM Alaska Regional Office

Period of Performance: FY 2021-202X

Study Framework: *(Provide one or two sentences for each of the following elements, as appropriate)*

Problem: Who or what is potentially affected? This includes baseline studies.

Intervention: What is your solution to the problem? How do you measure potential interactions and/or change?

Comparison: What is the intervention measured against? Consider in terms of hypothesis testing, control vs. treatment, and/or natural change.

Outcome(s): What is the expected outcome and understanding?

Context: What are the circumstances and/or geographic domain(s)?

BOEM Information Need(s): Provide brief and conclusive reason(s) why BOEM needs the information. Explain how this information will be used to manage Outer Continental Shelf (OCS) resources. The specific decision or document relying on the information should be stated.

Background: Provide a brief narrative of relevant issues. Explain what information is required and provide pertinent background. Include details about whether this study ties in with other efforts, and if so, how. Include a description of the current status of information. That is, what is the level of adequacy of existing information, does any exist, does it need to be more geographically specific?

Objectives: Clearly and succinctly state the overall purpose of the study by identifying one or more specific objectives.

Methods: Provide a brief description of how the objectives of the study will be accomplished, including what information, techniques or methods are available that could be used. Also note expected study products in this section (e.g. technical reports, database, model, bibliography)

Specific Research Question(s): Identify specific research questions this study will address.

Additional information: Provide additional relevant information, such as dates when products would be most useful and for what purpose, such as “Final report is needed by November 2024 to support NEPA analysis for exploration or development activities at current and potential future leases in Cook Inlet.”

TABLE OF CONTENTS

LIST OF STUDY PROFILES

STUDIES PLANNED FOR FY 2021

STUDIES TO BE CONSIDERED FOR FY 2022

ACRONYMS AND ABBREVIATIONS

ADF&G	Alaska Department of Fish and Game
ANIMIDA	Arctic Nearshore Impact Monitoring in Development Area
ANTHC	Alaska Native Tribal Health Consortium
ASP	Alaska Annual Studies Plan (BOEM)
AOOS	Alaska Ocean Observing System
BOEM	Bureau of Ocean Energy Management
BSMP	Beaufort Sea Monitoring Program
BSEE	Bureau of Safety and Environmental Enforcement
CESU	Cooperative Ecosystem Studies Unit
CIRCAC	Cook Inlet Regional Citizens Advisory Council
CMI	Coastal Marine Institute
COMIDA	Chukchi Offshore Monitoring in Drilling Area
COSA	Committee on Offshore Science and Assessment of the National Academies of Sciences, Engineering, and Medicine
DPP	Development and Production Plan
DWM	Department of Wildlife Management (North Slope Borough)
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EP	Exploration Plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESP	Environmental Studies Program (BOEM)
ESPIS	Environmental Studies Program Information System
FY	Fiscal Year
G&G	Geological and Geophysical
IARPC	Inter-agency Arctic Research Policy Committee
MML	Marine Mammal Laboratory
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOPP	National Oceanographic Partnership Program
NPRB	North Pacific Research Board
NSB	North Slope Borough

OCS	Outer Continental Shelf
OCSEAP	Outer Continental Shelf Environmental Assessment Program
OCSLA	Outer Continental Shelf Lands Act
PSD	Prevention of Significant Deterioration
SOAR	Synthesis of Arctic Research
UAF	University of Alaska Fairbanks
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

SECTION 1.0 PROGRAM OVERVIEW

1.1 Introduction

The U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM) uses high-quality scientific information to manage the responsible exploration and development of offshore energy and marine mineral resources on the U.S. Outer Continental Shelf (OCS). The Alaska OCS consists of approximately 1 billion acres of federal jurisdiction lands submerged under the ocean seaward of state boundaries, generally beginning three nautical miles off the coastline and extending for 200 miles.

Mandated by Section 20 of the Outer Continental Shelf Lands Act, BOEM's Environmental Studies Program (ESP) develops, funds, and manages scientific research used to support environmental analysis under the National Environmental Policy Act (NEPA) that informs policy decisions on the development of energy and mineral resources on the Outer Continental Shelf (OCS). The ESP has provided over $1.2 billion for research since its inception in 1973; nearly $500 million of that amount has funded studies across Alaska's 15 planning areas in the Arctic, Bering Sea and Gulf of Alaska sub-regions (Figure 1) to produce more than 1,000 technical reports and innumerable peer-reviewed publications.

The original focus of the ESP to obtain baseline information on the vast biological resources and physical characteristics of the Alaskan environment has evolved to include topical studies in smaller areas to answer specific questions and fill identified information needs. Currently, the ESP in Alaska manages 50-60 ongoing study projects in disciplines such as physical oceanography, air quality, fate and effects of pollutants, protected species, marine ecology, and the social sciences, including traditional knowledge. BOEM analysts use final reports, data, and peer-review journal articles from ESP-funded studies to prepare NEPA documents, such as Environmental Impact Statements (EISs) and Environmental Assessments (EAs), and to develop documentation for consultations and other requirements under other Federal laws, including but not limited to the Marine Mammal Protection Act (MMPA); Endangered Species Act (ESA); Magnuson-Stevens Fishery Conservation and Management Act; Marine Protection, Research and Sanctuaries Act; and Clean Air Act.

Completed study reports are posted on the Environmental Studies Program Information System (ESPIS) at http://www.boem.gov/ESPIS/. BOEM Alaska Regional Office study reports can also be found at http://www.boem.gov/AKpubs. Project data are typically delivered to Federal data repositories such as the National Centers for Environmental Information (NCEI) and posted to the Alaska Ocean Observing System (AOOS) and customized project websites.

Figure 1. BOEM Alaska OCS Planning Areas

1.2 Issues to Be Addressed

1.2.1 Strategic Science Questions

BOEM's research mandate under Section 20 of the Outer Continental Shelf Lands Act (OCSLA; 43 U.S.C. 1346) is to conduct studies that will provide the information needed to assess and manage the impacts on the human, marine, and coastal environments from offshore energy and marine mineral development. As discussed in the ESP's Strategic Framework (USDOI, BOEM, ESP 2020a), BOEM seeks to achieve this mandate through research that addresses the following Strategic Science Questions:

- How can BOEM best assess the affected environment and changing baselines within the framework of environmental assessments?
- What are the acute and chronic effects of sound from BOEM-regulated activities on marine species and their environment?
- What are the acute and chronic effects of exposure to hydrocarbons or other chemicals on coastal and marine species and ecosystems?

- What is the effect of habitat or landscape alteration from BOEM-regulated activities on ecological and cultural resources?
- What are the air emissions impacts of BOEM-regulated activities to the human, coastal, and marine environment and compliance with the National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments?
- How will future ocean conditions and dynamics amplify or mask effects of BOEM-regulated OCS activities?
- How does BOEM ensure the adequate study and integrated use of social sciences in assessing the impacts of OCS activities on the human environment?
- How can BOEM better use existing or emerging technology to achieve more effective or efficient scientific results?
- What are the best resources, measures, and systems for long-term monitoring?

Studies in Alaska must also address the changing Arctic environment and how it will interact with OCS activities over the next 25–50 years:

- What role will ocean currents and sea ice play in distribution of anthropogenic pollutants near exploration and development prospects?
- How are ocean currents and biota affected by reduced sea ice conditions?
- How do cold temperatures and presence of sea ice alter the fate of spilled oil?

In addition to the physical and biological environment, the ESP in Alaska needs to consider many socioeconomic issues entrained by the observed changes. For example, increased shoreline erosion and permafrost melt threatens Arctic communities and infrastructure. Furthermore, the people of Alaska's remote arctic and subarctic communities rely heavily on subsistence resources and are especially concerned about changes in distribution and availability of hunted subsistence species, as well as industrial activities that may affect hunting success or the habitats of important subsistence species. In addition to subsistence, the people of Cook Inlet are also concerned about potential effects of OCS activities on commercial fishing, sport fishing, and tourism.

1.2.2 NEPA Analysis for OCS Activities in Alaska

The Lease Sale Stage

BOEM develops the National Outer Continental Shelf Oil and Gas Leasing Program (National OCS Program) for oil and gas development in accordance with OCSLA. The National OCS Program establishes a five-year schedule of oil and gas lease sales proposed for the OCS. Currently, BOEM is working under the approved Proposed Final OCS Oil & Gas Leasing Program 2017–2022 (USDOI, BOEM 2016).

The Alaska Regional Office typically prepares an EIS for each specific lease sale described in the National Program. Studies at this stage often are focused at a regional scale. Updating past studies to address current information needs and changing conditions is also important to support these environmental analyses and to help facilitate informed leasing decisions. Alaska is a frontier region with large, remote planning areas and extreme environmental conditions, however. These challenges require long planning lead-time and complex logistics to conduct adequate environmental studies.

The Exploration and Development and Production Stages

BOEM typically prepares site-specific EISs and EAs to consider the impacts of Geological and Geophysical (G&G) Survey permits, Exploration Plans (EPs), or Development and Production Plans (DPPs). Studies at these stages tend to have a more specific focus and may consider individual resources or areas and related monitoring needs to supplement the broader studies that are the focus of the pre-lease stage. In addition to the requirements of OCSLA, BOEM has jurisdiction to regulate air emissions associated with oil and gas activities on portions of the Alaska OCS adjacent to the North Slope Borough.

1.3 Scientific Studies are Developed and Conducted in Partnership

Research planning follows an annual cycle (Figure 2) that begins with the autumn distribution of the *Alaska Annual Studies Plan* (ASP) to more than 200 partner and stakeholder groups across Federal, State, Alaska Native, Tribal, academic, and industry sectors. The ASP describes ongoing research, reveals proposed new studies for the coming fiscal year, and requests input from scientists, stakeholders, partners and the general public about information needs and suggestions for new studies.

More than 70 individual study suggestions are received from external stakeholders and BOEM staff each year, including ideas identified from programmatic reviews and public comments. The ESP's structured decision-making approach to prioritizing study ideas for funding consideration consists of an evaluation by BOEM subject-matter experts to identify a short-list of high priority study profiles for further consideration. This evaluation is based on the following seven criteria (detailed in the ESP's *Studies Development Plan 2021-2022* (USDOI, BOEM, ESP 2020b)).

1. Need for the information in BOEM decision-making
2. Contribution to existing knowledge
3. Research concept, design, and methodology
4. Cost-effectiveness
5. Leveraging of funds
6. Partnerships and collaboration
7. Multi-regional and strategic utility

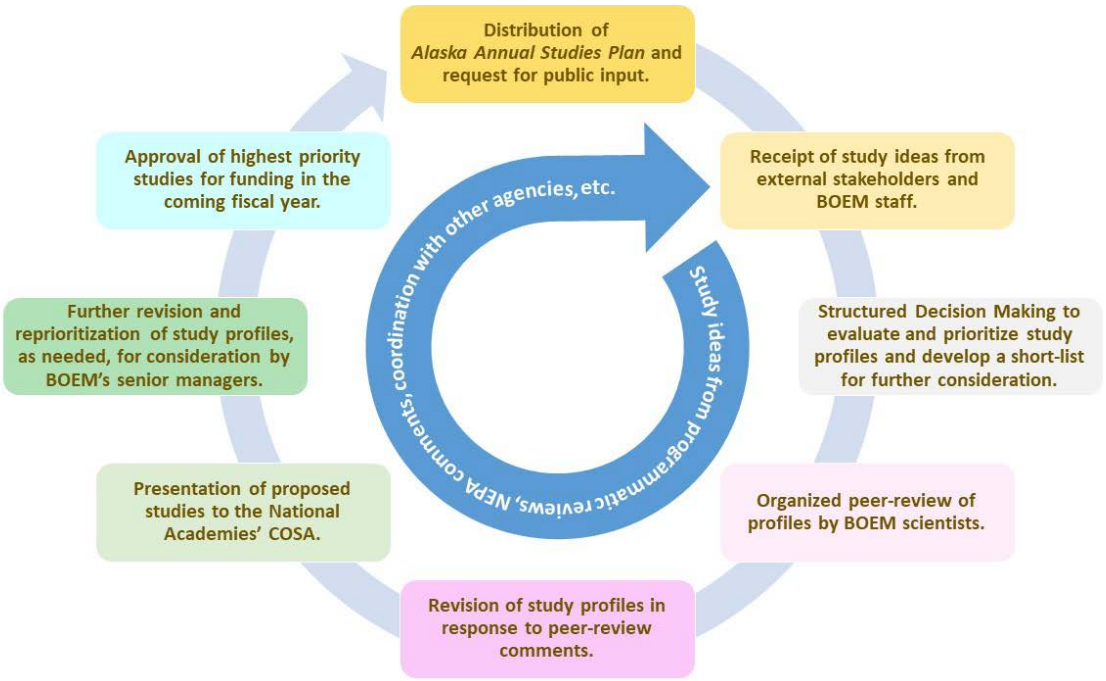

Figure 2. The Alaska Regional Office's Annual Studies Planning Cycle

Following this evaluation, the study profiles move through several additional steps before the circle is closed:

1. The proposed profiles undergo an organized process of peer-review by scientists throughout BOEM to evaluate the priority and quality of each proposed study, including providing feedback on technical aspects of proposed study methods.
2. The proposed studies are presented to the Committee on Offshore Science and Assessment (COSA) of the National Academies of Sciences, Engineering, and Medicine for additional input.
3. The profiles are again revised, reprioritized, and finalized during summer for consideration by senior managers at the regional and national levels to determine funding allocation in the new fiscal year.
4. The highest priority studies are approved for funding.
5. The ASP is published and circulated to the public in autumn, when the cycle begins again.

When conducting research projects, the ESP in Alaska coordinates routinely with numerous Federal entities, as well as active research and monitoring programs in Alaska supported by industry. In addition, the ESP works directly on specific projects with a wide range of Federal, State, and local agencies; tribal entities; non-governmental organizations; and academic institutions.

The University of Alaska Coastal Marine Institute (CMI), a cooperative arrangement created in 1993, allows the ESP to tap the scientific expertise of regional and local

experts to collect and disseminate environmental information about coastal topics associated with the development of energy resources in the Alaska OCS. Through the CMI, the ESP stimulates important studies with a budget of up to $1 million and a cost-saving dollar-for-dollar match arrangement. In its first 25 years, the CMI has funded approximately 110 studies and leveraged over $20 million of agency funds into $40 million of relevant marine-based research, with non-Federal matching funds from more than 50 different organizations. During that time, the CMI program has also provided more than 200 years of student training and nearly $2.5 million in student support. More information about the CMI can be found at http://www.cfos.uaf.edu/cmi.

The ESP also conducts cooperative research with universities through the Cooperative Ecosystem Studies Units (CESUs). The CESUs are working partnerships among leading academic institutions, Federal, State, and non-governmental organizations. A national network of seventeen CESUs has been established to facilitate collaboration through the working partnerships to provide high quality research, education and technical assistance for stewardship of cultural and natural resources. BOEM currently participates in seven CESUs that encompass all areas of the OCS.

Additional linkages have been established at an international level with other arctic nations' research and regulatory entities. The ESP in Alaska coordinates with Arctic Council activities, such as the Arctic Monitoring and Assessment Programme, Conservation of Arctic Flora and Fauna, Protection of the Arctic Marine Environment, and other working groups. The ESP provides information to these working groups through review of reports and plans, such as the Arctic Climate Impact Assessment, and helps to inform participants of available information sponsored by BOEM. Further, the ESP identifies and facilitates specific studies that can coordinate and integrate with working group activities.

BOEM also strives to incorporate local and traditional knowledge of Alaska Natives, Alaskan residents, and the permanent participants of the Arctic Council in its decision-making processes (Kendall et al. 2017; Brooks et al. 2019). The ESP considers and integrates local and traditional knowledge at all stages, beginning with the study development process through the preparation of study products and interpretation of results. In field-oriented studies sponsored by the ESP, researchers typically coordinate directly with local communities to discuss their plans, seek advice and ensure that interested individuals learn about the project and its results. The process of integrating local and traditional knowledge and community-based monitoring varies from project to project, but the outcome of better information for decision-making is a common goal.

SECTION 2.0 IDENTIFICATION OF INFORMATION NEEDS

BOEM has an ongoing need for updated information about the physical, biological, and human environment in Alaska to support NEPA analysis for future lease sales, EPs, or DPPs on the OCS. BOEM has placed primary emphasis on studying the Beaufort Sea, Chukchi Sea, and Cook Inlet Planning Areas. The ESP in Alaska is looking to broaden the geographic focus, however, due to the interconnectivity of the different regions and the potential for new areas to be included in a new National Program.

2.1 Specific Information Needs by Planning Area

2.1.1 OCS Activities in Alaska

Since 1976, a total of 2,365 leases have been issued in 26 OCS lease sales in Alaska, including 929 tracts leased in ten OCS lease sales in the Beaufort Sea Planning Area. Industry has drilled a total of 85 exploratory wells in seven planning areas, including 30 wells in the Beaufort Sea and six wells in the Chukchi Sea. As of October 2020, there are 19 active leases in the Beaufort Sea Federal offshore area (Figure 3) and 14 active leases in Cook Inlet (Figure 4). There are no active leases from previous lease sales in the Chukchi Sea, Bering Sea, or Gulf of Alaska subregions.

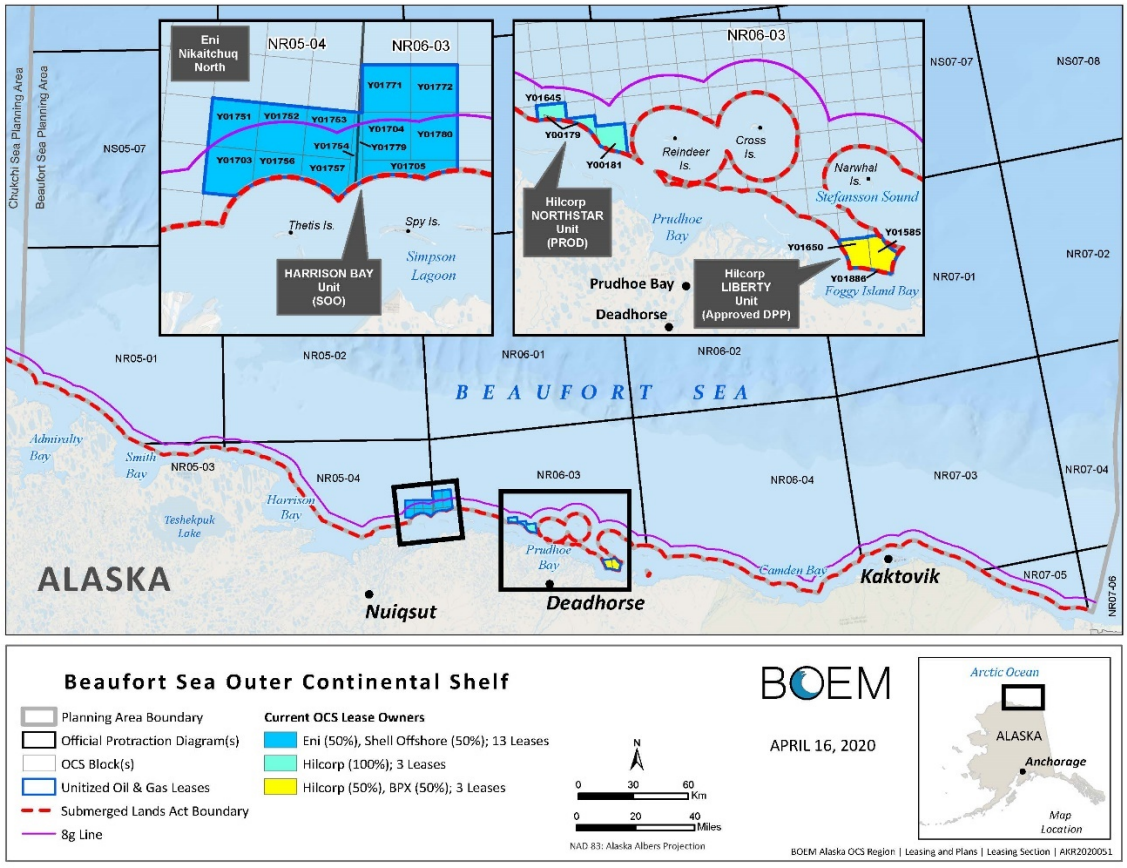

Figure 3. Beaufort Sea OCS Leases

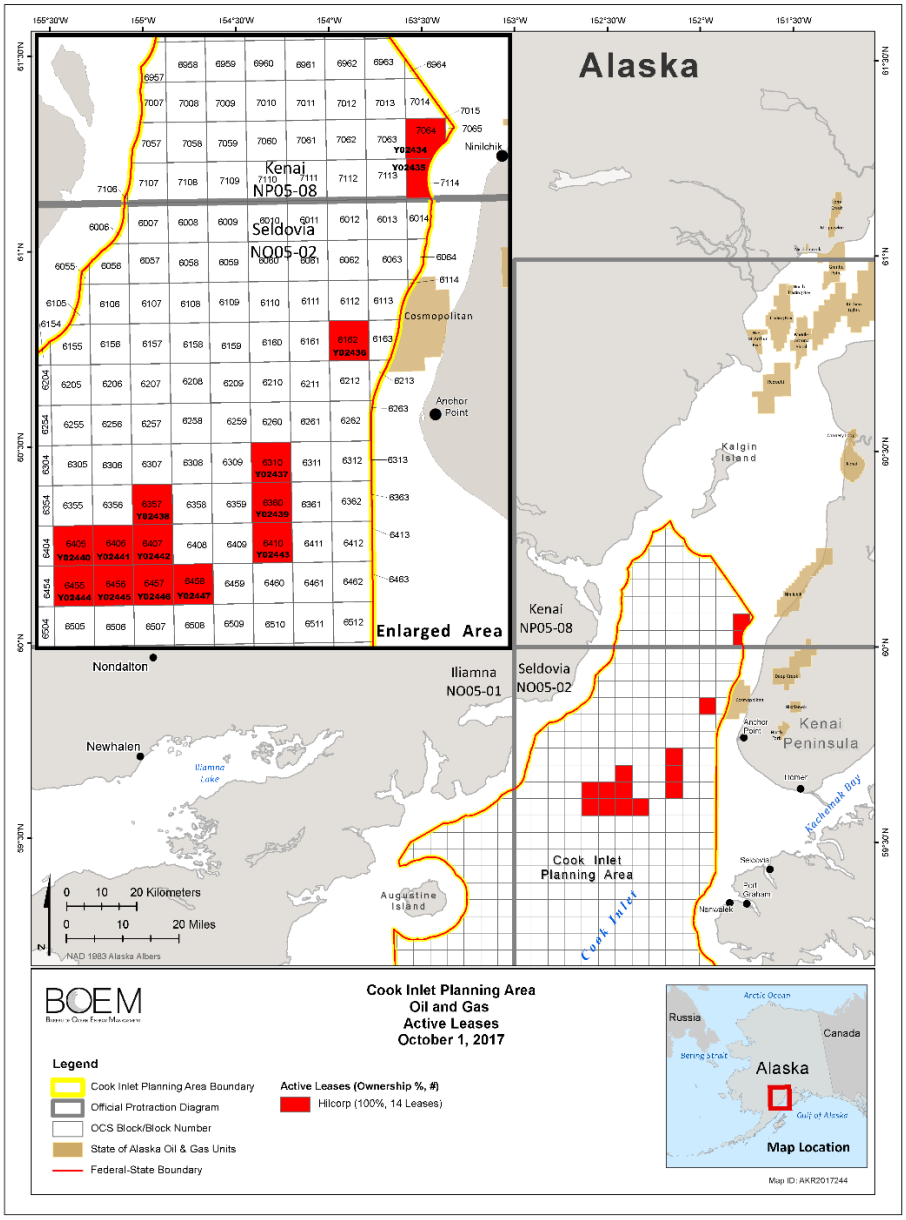

Figure 4. Cook Inlet OCS Leases

Production:

Northstar – Northstar is a joint Federal/State of Alaska unit located in state waters in the Beaufort Sea about 12 miles northwest of Prudhoe Bay (see Figure 5). The six producing Federal wells fall under Bureau of Safety and Environmental Enforcement (BSEE) regulatory authority, the State wells fall under the State's oversight. Production started in 2001 and peaked in 2004. Total production of crude oil through August 2020 is more than 183 million barrels, with the Federal portion comprising approximately 33 million barrels.

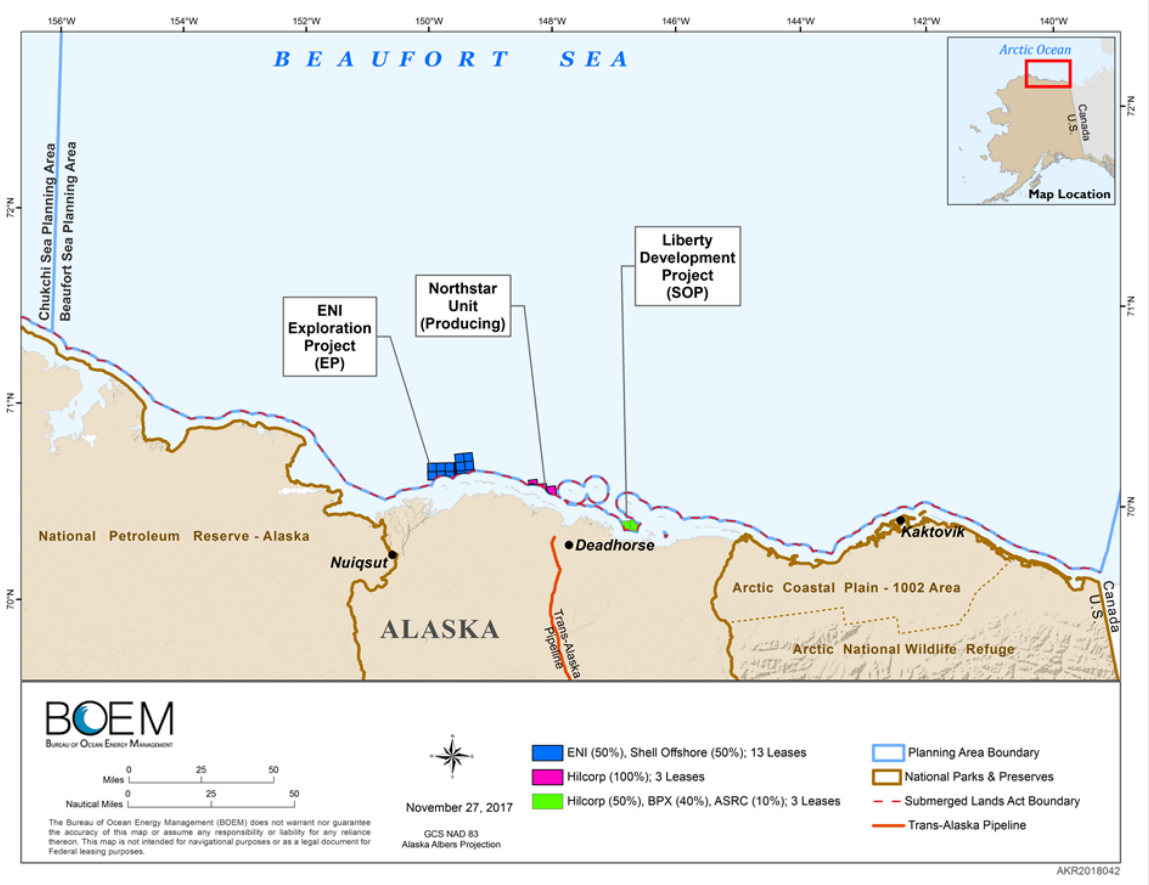

Figure 5. Location of Northstar, Liberty, and Eni project areas in the Beaufort Sea

Development:
Liberty – The Liberty prospect is located in the central Beaufort Sea, to the east of the existing Endicott Satellite Drilling Island (see Figure 5). In November 2014, primary ownership and operatorship of Liberty was acquired by Hilcorp Alaska LLC. Hilcorp submitted a DPP (Hilcorp 2015) for the Liberty Unit, which is estimated to contain up to 150 million barrels of recoverable crude oil. In their DPP, Hilcorp proposes construction of a Liberty Drilling and Production Island, which will be built of reinforced gravel in 19 feet of water about 5 miles offshore in Foggy Island Bay. Process facilities on the island will separate crude oil from produced water and gas, which will be injected into the reservoir to provide pressure support and increase recovery from the field. A single-phase subsea pipe-in-pipe pipeline will transport sales-quality crude to shore, where an above-ground pipeline will transport crude to the existing Badami pipeline and into the Trans-Alaska Pipeline System. BOEM conditionally approved the Liberty Project Development and Production Plan on October 24, 2018.

Exploration:
Harrison Bay – On July 12, 2017, BOEM conditionally approved an Exploration Plan (EP) submitted by Eni US Operating Company, Inc. proposing to conduct drilling into leased OCS areas from an existing gravel island located in State waters (see Figure 5). BOEM approved a revision of Eni's EP on April 13, 2018.

Cook Inlet – On May 1, 2020, BOEM issued a permit to Hilcorp Alaska LLC to conduct a geohazard site clearance survey over several of its leases in Cook Inlet during the summer and autumn of 2020. This survey is used to identify seafloor obstructions, shallow drilling hazards, and archaeological resources and is required by BOEM prior to further exploration activities. Hilcorp also conducted an exploratory seismic survey over these leases in the autumn of 2019.

Data related to these oil and gas activities are sparse. However, BOEM's science needs and environmental analyses in Alaska are further informed by activities located in coastal areas and State waters of Cook Inlet and the Beaufort Sea.

2.1.2 Geographic Variations in Environmental Conditions

The wide range of environmental conditions from the Gulf of Alaska and Cook Inlet to the Bering Sea and the Arctic is, of course, an important consideration during the process of formulating new studies. Though vastly diverse, these areas share many of the same information needs, such as the need for assessment of variability and long-term trends in oceanographic conditions and biological communities. For example, a better understanding of trophic and community structure in nearshore habitats is needed to support evaluation of resiliency of fish and invertebrate populations under changing environmental conditions in each area.

Residents of Beaufort Sea coastal communities have expressed concerns about long-term effects of OCS activities, particularly changes to currents and sedimentation rates and potential effects on social systems, including subsistence whaling activities, in the vicinity of Northstar and Liberty. The need for information about factors contributing to observed changes in the fall migration of the bowhead whale across the Beaufort Sea is particularly acute, including altered wind and current patterns, resulting changes in zooplankton concentrations, and vessel traffic through the Chukchi and Beaufort seas in support of oil and gas exploration and development activities.

The fundamental issues in the Chukchi Sea are very similar to those in the Beaufort Sea, although many species that regularly appear within the Chukchi Sea are not typically found in the Beaufort Sea. Projects in these areas typically pursue multi-year data collection efforts on a regional scale, with careful attention to inter-annual variability and ecosystem processes. Most of the studies in the Arctic exhibit complex, multilateral collaborations, with explicit inter-disciplinary linkages between the physical and biological sciences, and many of them also provide a role for active participation by Alaska Native residents and input from sources of traditional knowledge.

In Cook Inlet, some particular interests for information include, but are not limited to: an improved understanding of distribution and geographic range of the endangered Cook Inlet beluga whale stock; abundance and distribution of the northern sea otter, including the southwestern stock that is listed as threatened under ESA; and obtaining further baseline information about contaminants and potential impacts from oil and gas-related activities to the economy and subsistence use of lower Cook Inlet.

2.2 Specific Information Needs by Discipline

Interdependent Physical, Biological and Social Processes

The Alaska Regional Office has a long history of supporting multidisciplinary research, beginning with the "Outer Continental Shelf Environmental Assessment Program" (OCSEAP) surveys conducted between the 1970s and early 1990s and the "Beaufort Sea Monitoring Program" (BSMP) in the 1980s. The "Arctic Nearshore Impact Monitoring in the Development Area" (ANIMIDA) program began in 1999 to provide baseline data and monitoring for trace metals and chemical contaminants, turbidity, and subsistence whaling in the vicinity of the Northstar and Liberty development sites. The monitoring was extended through two follow-on projects and expanded to include Camden Bay. Similarly, the multiple components of the "Chukchi Sea Oceanographic Monitoring in the Drilling Area" (COMIDA) program, which evolved from a planning workshop in November 2006, represent an ecosystem-based approach for providing baseline data and tracking environmental changes across the Chukchi Sea, with particular focus on the highly productive area around Hanna Shoal. Several ongoing studies also take an integrated approach to examining the interdependence of physical, biological and social processes and filling identified information needs across the various disciplines.

Ocean Circulation and Sea Ice

Accurate information on surface wind fields, ocean currents, and sea ice is important for assessing the fate of spilled oil and the potential impacts on biota in the area. It is particularly important to know locations and seasonal changes in polynyas, leads, and landfast ice, as well as the motion of the seasonal ice pack. Studies conducted by the Alaska Regional Office have demonstrated that water motion is very different under landfast ice than in adjoining open-water or pack-ice areas. Information about ice gouge characteristics and recurrence rates also supports assessments of risks associated with burial of oil production pipelines to support BOEM's fault tree modeling.

Air Quality

In December 2011, Congress transferred jurisdiction and authority for the regulation of oil and gas-related air emissions on the OCS adjacent to the North Slope Borough from the Environmental Protection Agency (EPA) to BOEM. Arctic oil and gas exploration and extraction activities proposed for the OCS require air quality operating approval, as well as environmental evaluations pursuant to NEPA, as well as to comply with the impact analysis under BOEM's implementation of the OCSLA.

Pollutants

The environmental effects of oil and gas development on biota, including effects from potential oil spills, is a concern for residents of coastal communities in Alaska. Up-to-date information on ocean currents and sea ice and how they affect the motion of spilled oil is necessary to fully address these concerns. North Slope residents are especially concerned about potential contamination of their food supply, which include such foods as bowhead whales, seals, waterfowl, and fish.

Marine Mammals and Other Wildlife

Information is needed across Alaska about the current spatial and temporal use patterns on the OCS of sensitive species including cetaceans, sea otters, pinnipeds, and seabirds. BOEM is currently collaborating with the National Oceanic and Atmospheric Administration (NOAA) to identify the winter range of the critically endangered Cook Inlet beluga whale population. In the Arctic, BOEM has an ongoing need for information about the populations of bowhead whales, polar bears, spectacled eiders, spotted and ringed seals, walruses and other arctic species. Potential effects from loss of sea ice are a concern, especially for those species listed as threatened or endangered. More comprehensive abundance estimates for these ice-associated marine mammals enhance the assessment of potential impacts under NEPA and assist NOAA and the U.S. Fish and Wildlife Service (USFWS) in ensuring compliance with Federal management and regulatory mandates for marine mammals under the MMPA.

A particular information need is the effect of noise on the well-being and the behavior of bowhead whales. The bowhead whale is central to Alaska Native cultural and spiritual life and the Iñupiat rely heavily on bowhead whales for subsistence. Whale hunters have reported that migrating bowhead whales deflect from their normal migratory route well upstream of active industry vessels and may divert a great distance from their migration route, making them potentially more difficult to hunt. It is also important to assess the factors that may be affecting the habitat use, health, population status and migration routes of bowhead whales and the potential cumulative impacts from multiple factors (e.g. noise from industry activities combined with environmental change) on the whales. Furthermore, North Slope residents are also concerned about potential disturbance of beluga whales, bearded seals, waterfowl and other subsistence-wildlife species by oil and gas activities such as helicopter overflights.

Fish and Lower Trophic Communities

Fishes fill an essential role in the ecosystem by consuming small prey and in turn providing a food resource for larger fishes, birds, marine mammals, and people. Assemblages and populations of fish and benthic organisms in marine ecosystems off Alaska have undergone observable regime-shifts in diversity and abundance over the last 20-30 years. It is important to assess the distribution and abundance of fishes in the waters off Alaska and to distinguish between changes due to anthropogenic and natural effects. In addition, BOEM engages in consultation with NOAA's National Marine Fisheries Service (NMFS) under the Magnuson-Stevens Fishery Conservation and Management Act regarding any action that may adversely designated Essential Fish Habitat (EFH) for adult and late juvenile life-stages of a number of species, including Arctic cod, Pacific salmon, and saffron cod.

Alaska Native Culture

The Iñupiat report in public testimony that their culture is vulnerable to short-term, long-term and cumulative effects from OCS activities. They are concerned that OCS activities might lead to:

- Social disruption and a change in cultural values through population shifts (immigration of large numbers of non-Iñupiat to the North Slope)
- Impacts to community health
- Cumulative effects of multiple industrial activities, alteration of subsistence-harvest patterns, and displacement of hunters and subsistence resources

There is an ongoing need to monitor key indicators of socioeconomic and cultural changes on the North Slope. The Iñupiat rely on a wide variety of marine resources as significant sources of food. In addition, the harvesting, sharing and consuming of subsistence resources form an important part of the traditional Iñupiaq culture and spiritual life. A temporary or permanent elimination of primary subsistence foods could cause large numbers of North Slope residents either to shift to less desired subsistence resources or to replace subsistence foods with expensive store-bought foods. The Iñupiat are concerned about mitigation of impacts and compensation for potential losses, though an anticipated decline in oil revenues to the North Slope Borough (NSB) is also an issue of concern. Another key interest is the use of local and traditional knowledge in analysis of potential environmental effects. We continue to seek and include firsthand knowledge of local subsistence hunters to enhance the scientific knowledge base.

Archaeological Resources

The archaeological significance of offshore areas has been increasingly recognized in recent years and marine archaeological studies have been showing the presence of prehistoric sites on the shelves beneath the modern ocean. Basic information and analysis is needed for assessments of archaeology potential in the Beaufort and Chukchi seas to support the National Historic Preservation Act and NEPA review.

2.3 Topical Areas for Future Research Consideration

Here, we present a general forecast of important topical issues and concerns for FY 2023 and beyond. In general, these topics conform with the research themes of the ESP. The great differences existing between Alaskan environments and other OCS areas and the uniqueness of issues in Alaska dictate the need to anticipate new topical areas for implementation. The discussion will focus on BOEM mission needs within the context of varying industry interest in OCS exploration, development and production, and altered baselines and potential trends in a changing environment.

A future *Outer Continental Shelf Oil and Gas Leasing Program* could lead to increased levels of oil and gas activities in the Beaufort Sea and Cook Inlet, as well as the addition of other Alaska OCS Planning Areas. This would expand BOEM's information needs across the Alaska OCS.

Environmental Change

In recent years, the extent, duration, and thickness of summer ice cover in the Arctic have decreased to record historical lows. The continuing loss of ice cover is causing changes to

both physical oceanography and ecosystem productivity and has substantial ramifications for marine mammals, birds and fish species that live on, below, or near the ice.

Oceanic current patterns in the Arctic, especially in nearshore regions, are strongly influenced by climatological factors such as winds, river runoff, and sea ice coverage. The rapid changes in each of these factors could lead to drastic alterations of the surface current fields. Oil-spill trajectory analyses performed by BOEM are based on surface current data derived from ocean circulation hindcast models. As climate change continues, oil-spill trajectory modeling may need to be updated on a more frequent basis.

Climate change is also associated with altered water chemistry, particularly a reduction in pH, which will likely produce substantial habitat stresses for calcifying marine organisms (Mathis and Cross 2014). In addition, the duration and extent of seasonal sea ice, seawater temperature, and water mass structure are critical controls on water column production, organic carbon cycling, and pelagic-benthic coupling. The recently observed changes in these factors have the potential to alter the current benthic-based food web to one more dominated by pelagic trophic transfers (Grebmeier and Cooper 2012). More research is needed to better understand the implications of such a shift, such as whether conditions may become less favorable for krill and arctic copepods, the preferred prey of bowhead whales.

Climate change also entrains many socioeconomic issues. Some immediate concerns include increased shoreline erosion and permafrost melt that threatens arctic villages and infrastructure; changes in distribution and availability of hunted subsistence species; and potential changes in commercial and subsistence fisheries as commercial species such as salmon move north. In consideration of such basic transition, scientists are challenged to project how climate change effects will interact with OCS activities in the Arctic over the next 25-50 years.

Air Quality

While implementing its authority for the regulation of oil and gas-related air emissions, BOEM will need air quality monitoring information to assess the cumulative air quality impact of OCS Arctic oil and gas activity and to support compliance with the OCSLA and environmental justice initiatives. In particular, more information is needed to evaluate how high levels of substances such as black carbon and methane might impact climate change, as well as human health, in the region.

Physical Oceanography

An ongoing challenge in Alaska is the need for better, finer scale circulation and oil-spill models and higher resolution data. This need is underscored by the rapidly changing conditions in the Arctic. The need exists for continued development and application of state-of the-art couple ice-ocean circulation models to support future OSRA-based EIS analyses. Increased resolution of ice models and ice data is needed to address the propagation of fine scale, non-random interactions across hundreds of miles of pack ice,

as evidenced by ice leads and extensive break-out events seen in satellite images in recent years.

BOEM needs a better understanding of the first order physics controlling regional circulation and ice conditions within the U.S. Beaufort and Chukchi Seas, as well as interactions with the Arctic basin and Canadian Beaufort, to inform and improve regional analyses for NEPA documents and review of oil-spill response planning documents. In particular, more information is needed to assess the impact of ice on the nature and amplitude of the upwelling/downwelling, to evaluate influences of Atlantic water and other water masses, and to gain a better understanding of the dynamics associated with river outflow plumes, especially under ice.

Fate and Effects

The Alaska Regional Office has been collecting baseline biological and chemical monitoring data in the Beaufort Sea since the 1980s, first under the BSMP and more recently through the suite of ANIMIDA studies. Similar monitoring work has been ongoing in the Chukchi Sea since 2008, through the component projects of the COMIDA program. The need for additional monitoring will continue to be re-evaluated as oil and gas exploration and development on the Alaska OCS evolves.

Available information about input of hydrocarbon to the environment through natural oil seeps across the OCS off Alaska is limited. The ESP is conducting a study to collate and synthesize currently available data regarding seeps offshore of Alaska, and to develop recommendations for future field research. Gathering information on the chemical composition and weathering characteristics of the oils from these seeps would provide insight for analysis of potential effects from oil spills. Furthermore, the presence of natural oil seeps is indicative of organisms adapted to metabolize the hydrocarbons and additional information is needed about hydrocarbon-consuming organisms resident in the Arctic.

Marine Mammals and Protected Species

Potential impacts to marine mammals from oil and gas-related activities will continue to be a concern. Species protected under the ESA, MMPA and the Migratory Bird Treaty Act are of particular concern. Possible risks include oil spills and other discharges, noise from various industrial and support activities, and increased human interaction with arctic offshore species. Future studies are expected to continue to explore use of satellite tagging for information on movements and residence times in development areas. Advancement of UAS technologies also will lead to expanded research opportunities for bowhead whales and other species.

As benthic feeders with a preference for bivalves, walruses are especially vulnerable to climate change or ecosystem shifts (Berchok et al. 2015). Walruses characteristically will haul out onto sea ice to rest, with the advantage that the ice can carry them to new feeding grounds. The summer distribution of walruses has been changing as a result of the loss of summer pack ice, however, with large numbers of walruses observed to haul out on land along the Chukchi coast. Information is needed to more fully understand

how this shift to land-based haulouts affects walrus foraging behavior, diet, and energetic needs.

Other key subsistence species for which behavioral or monitoring studies may be needed include polar bears, beluga whales, ringed seals, ribbon seals and bearded seals. High priority information needs include the impacts of sea ice loss and other environmental change on both ice seals and polar bears. The status of the critically endangered North Pacific right whale and potential effects from future oil and gas activity is also of ongoing concern. Furthermore, BOEM will continue to develop specific information on the hearing capabilities of baleen whales and other marine mammals with the goal of better understanding their behavior in response to industrial noise.

Marine Fish Migrations, Recruitment, and Essential Fish Habitat

BOEM needs information to assess and manage the potential environmental effects of OCS development on marine fish. More detailed information about the biology and ecology of many marine fish species inhabiting areas of potential oil and gas activity would be especially useful. The highest priority BOEM information needs include species presence, distribution, abundance and potential effects of oil spills, particularly during periods when ice is present. Also, more information is needed to evaluate EFH and to clarify environmental assessment and mitigation needs.

Alaska Natives are concerned that OCS activities will affect subsistence fish populations and reduce availability for subsistence harvest. Consequently, additional research on arctic fisheries and recruitment to nearshore feeding populations are an important consideration. In addition, more information is needed regarding the effects of seismic exploration on the health, behavior, distribution, and migration of the numerous important fish species of the Beaufort and Chukchi seas.

More information is needed on the forage fish resources and their relation to apex predators on the OCS. A better understanding of the seasonal distribution, abundance, and habitat use of forage fish, including the effects of changing temperatures and prey availability, will inform evaluation of the potential environmental impacts associated with OCS development. Understanding of key spawning and migration events that quickly transfer large amounts of energy to upper trophic levels is also important.

Subsistence and Socioeconomics

Residents of the North Slope coastal communities frequently express concern about cumulative impacts of offshore and onshore developments, as well as climate change, on their subsistence way of life. Some of the concerns of the Iñupiat include diminished access to hunting and fishing areas around oil industry infrastructure, reduced harvests, increased hunter efforts, increased hunter cost and general food security. How, and to what degree, subsistence activities have been affected by industry infrastructure and industry activity, or may be in the future, are concerns that will continue to be further addressed by additional research. Consideration of cumulative impacts is an important issue for BOEM in preparing NEPA documents.

Aggregate effects research also encompasses a broader set of issues concerning how the Iñupiat society has been potentially affected. Relevant issues include a wide range of topics, such as the changing relationship between the cash economy and household subsistence activities, changing sources of anxiety and stress at multiple levels of organization, potential changes in sharing of subsistence resources and in the recruitment of youth into subsistence activities. Ongoing evaluation of social indicators is needed to serve as a basis for estimating long-term aggregate impacts.

Furthermore, additional information is needed regarding contaminant levels in the marine mammals and fish species of Cook Inlet and other OCS areas off Alaska. The potential impact of contamination or perception of tainting in relation to subsistence, commercial, and recreational fishing activities is a particular concern.

SECTION 3.0 CURRENT EFFORTS OF THE ESP IN ALASKA

This section, which describes ongoing and planned activities of the ESP in Alaska, provides additional context about our current and future information needs.

3.1 Notable Program Highlights

IARPC support: As an active participant of the Inter-agency Arctic Research Policy Committee (IARPC), the BOEM Environmental Studies Program has played a lead role in implementing national research priorities in the Arctic. Appendix 1 provides a table that displays the substantial progress that BOEM has made in recent years toward fulfilling itemized IARPC research priorities while meeting its own regulatory mission.

Collaboration with the North Pacific Research Board (NPRB): Since 2015, BOEM has collaborated with NPRB as a co-sponsor of the "Arctic Integrated Ecosystem Research Program," which is investing more than $16 million in studying marine processes in the U.S. Arctic through 2021. The study "Arctic Integrated Ecosystem Survey, Phase II" is a key component of this program. In addition, BOEM regularly co-sponsors with NPRB the annual Alaska Marine Science Symposium to allow our Principal Investigators to brief the scientific community about results from ongoing research.

Renewable Energy Research: In partnership with UAF, BOEM is assisting the State of Alaska in its effort to assess the feasibility and potential environmental effects of a wave energy converter project off Yakutat in the Gulf of Alaska. The "Alaska Wave Energy Converter Impact Assessment" study is collecting data to improve scientific understanding of seabed dynamics, ambient underwater noise, and fish and marine mammal presence and habitat requirements in the project area. A key goal of the project is to evaluate implications of findings from the Yakutat Wave Energy Project to inform feasibility studies in other coastal regions of Alaska, including extensions onto the OCS.

3.2 Planned New Studies

Table 1. BOEM Alaska Regional Office Studies Planned for FY 2021*

Page Number	Discipline	Study Title	Planning Area(s)
19	MM	Winter Ringed Seal Density within Beaufort Sea Oil and Gas Project Areas	Beaufort
21	FE	Synthesis of Contaminants Data for Cook Inlet: Evaluation of Existing Data as "Baseline Conditions" and Recommendations for Further Monitoring	Cook Inlet
24	MM	Resource Areas to Support Oil Spill Risk Analysis (OSRA) and National Environmental Policy Act (NEPA) Needs in the Cook Inlet Region	Cook Inlet
27	MM	Bowhead Whale Migration Patterns along the Alaskan Beaufort Shelf in During a Period of Rapid Environmental Change	Beaufort, Chukchi
30	SE	Coastal and Submerged Historic Properties and Precontact Sites on the Alaska Outer Continental Shelf	All Alaska Planning Areas
33	BIO	GPS Tagging of Seabirds to Obtain Areas of Foraging Aggregations and Forage Fish Schools in Lower Cook Inlet	Cook Inlet
Discipline Codes			
BIO = Biology FE = Fates & Effects ID = Interdisciplinary & Information Management		MM = Marine Mammals & Protected Species SE = Social Science & Economics BIO = Biology	

* Initiation and conduct of any of these planned studies is subject to availability of funds.

Title	Winter Ringed Seal Density within Beaufort Sea Oil and Gas Project Areas
Administered by	Alaska Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2021–2023
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	An estimate of the number of ringed seals that occur and could be disturbed within oil and gas project areas is needed to assess potential impacts to them for Endangered Species Act (ESA) Section 7 consultations and NEPA documents. Ringed seals stay under the ice and snow in winter and are not visible for counting during ice road and island building or winter seismic and drilling operations.
Intervention	This study will enhance ring seal assessments by establishing viable ways to locate ringed seals and their under-snow structures using satellite-telemetry tags that sense and record whether a seal is inside a lair, and a sensor web to monitor under-snow structures for ringed seal activity.
Comparison	This study will consider various approaches to develop capabilities for sensing ringed seal lairs and monitor their use and provide suggested mitigation measures to reduce impacts to ringed seals.
Outcome	This study will produce new technological and logistical solutions for quantifying impacts of oil and gas activities on ringed seals and refining guidance for future permitting and mitigation decisions for BOEM. The new technology will also expand capabilities for population assessment of ringed seals, facilitate research on their habitat requirements, and improve understanding about their vulnerability in a warming Arctic.
Context	Beaufort Sea nearshore areas

BOEM Information Need(s): Ringed seals are the most numerous marine mammals present during winter in the coastal OCS of the Alaskan Arctic and they are listed as threatened under the ESA. BOEM needs more detailed information on ringed seals that may be affected by actions that could cause disturbance or injury (known as “take” under ESA), during the winter and early spring, when their breathing holes and under-snow lairs are inconspicuous to human observers and are susceptible to ice road, gravel island, and seismic and drilling operations. This

information will support ESA Section 7 consultations and NEPA analyses to inform permitting decisions related to these activities.

Background: Recent advances in technology have created the potential for key improvements in understanding ringed seal use of under-snow lairs and how sensitive that use is to various human activities. Bio-loggers have been proposed as a viable approach for integrating new sensors into tags that would indicate ringed seal presence inside lairs. These tags could be useful for studying responses of seals near oil and gas activities during infrastructure development. A redundant wireless network would autonomously indicate the presence/absence of seals in the lair structures and track structure integrity through the onset of melt and eventual collapse. Such monitoring of ringed seals' responses to human activities would support development of satellite remote sensing techniques. These new technologies would more easily and economically characterize important ringed seal breeding habitat.

Objectives: This study will enhance capacity for assessment of impacts on ringed seals by establishing a viable solution for maintaining the capability to find ringed seals and their under-snow structures and developing associated mitigation measures to reduce impacts.

Methods: Researchers will construct prototype bio-logger devices and test them in artificial snow structures. Testing will be conducted at various stages of snow transformation (full winter conditions, melt season, and collapse) over two winter seasons to evaluate performance. The final tag design will be available for the research community to deploy.

Researchers will coordinate discussions among stakeholders, including BOEM, NOAA, industry representatives, Alaska Native organizations, and university researchers, to identify requirements and design a 'sensor web' to monitor under-snow structures for ringed seal activity. The web will monitor under-snow lair use and conditions throughout the snow-covered period and relay the data autonomously to an internet node to ensure continuous availability of ringed-seal detection for mapping structures around oil and gas activities and for supporting research to improve understanding of ringed seal behavior and habitat needs. Final products will include recommendations for application of the sensor web to best mitigate potential impacts to ringed seals from oil and gas exploration, development, and production activities.

Specific Research Question(s): How can new technology expand capabilities, facilitate research on the habitat of ringed seals, and improve understanding about potential impacts from oil and gas activities?

Title	Synthesis of Contaminants Data for Cook Inlet: Evaluation of Existing Data as "Baseline Conditions" and Recommendations for Further Monitoring
Administered by	Alaska Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2021–2023
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	Contaminant background levels in Cook Inlet Planning Area water and sediment are necessary for supporting National Environmental Policy Act (NEPA) analyses of potential impacts from Federal outer continental shelf (OCS) oil and gas related activities.
Intervention	This study will compile existing information about a suite of contaminants to provide the foundation upon which to better evaluate any potential impacts to water and sediment quality from Federal OCS oil and gas related activities in Cook Inlet.
Comparison	This study will produce a contaminant baseline that can be compared against promulgated Federal and State water quality criteria.
Outcome	The resulting data synthesis would facilitate a thorough analysis of potential oil and gas impacts on water and sediment quality. The results of the report would identify information needs and recommend a sampling and monitoring program.
Context	Cook Inlet Planning Area

BOEM Information Need(s): Synthesized, updated, and readily accessible contaminants information would support environmental analyses for future Cook Inlet Planning Area lease sales, Exploration Plans, and Development and Production Plans. Baseline data compared against promulgated water and sediment quality criteria is necessary to assess potential impacts of future OCS activities. This information would also be used to develop a sampling and monitoring program to inform contaminant data collection for the Cook Inlet Planning Area.

Background: Since oil industry operations began in Cook Inlet in the late 1960s, there have been various contaminant assessments, usually focusing on hydrocarbons and heavy metals in the water column, sediments, or tissues of resident organisms. Most of these efforts were

targeted on specific areas of the Inlet, such as produced water discharge locations, or were otherwise limited in scope. Although several projects have assessed anthropogenic contaminant sources, few were designed as monitoring programs or used a statistical approach that allows for interpretation of background levels and natural sources. The more comprehensive studies include "Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet" (OCS Study MMS 2000-024) by the former Minerals Management Service (MMS) and the Integrated Environmental Monitoring and Assessment Program (ICIEMAP) led by the Cook Inlet Regional Citizens Advisory Council (CIRCAC).

Objectives:

- Identify and compile existing organic and inorganic contaminants data, as well as a comprehensive list of any known or potential contaminant sources for the Cook Inlet Planning Area.
- Conduct a meta-analysis of existing data sets to evaluate the comparability of prior statistical designs and analytic methods and, when combined, as representative of baseline conditions in the Cook Inlet Planning Area.
- Compare data against Federal and State regulatory threshold levels.
- Recommend a study approach that would assess baseline conditions in Cook Inlet and monitor sediment contaminants (e.g., hydrocarbons and priority metals) in areas potentially impacted by Federal OCS oil and gas related activities.

Methods: This study will compile existing inorganic and organic contaminants data and metadata for the water column, sediment, and benthic infaunal tissue in the Cook Inlet Planning Area. Efforts will focus on hydrocarbons, metals, technologically enhanced naturally occurring radioactive materials (TENORMs), and the Environmental Protection Agency's (EPA's) 126 priority pollutants. Researchers will collect associated data, such as total suspended sediments (TSS), salinity, total organic carbon (TOC), sediment grain size, and other concomitant data. They will assemble data into an integrated dataset and develop visualization tools to facilitate data exploration, summaries, sharing, and interactive comparisons. The researchers will conduct a meta-analysis, including comparisons against current threshold levels published by EPA, State of Alaska, and the National Oceanic & Atmospheric Administration (NOAA) (e.g., ambient water quality criteria, human health criteria, Alaska Water Quality Standards, 18 Alaska Administrative Code [AAC] 70, and NOAA sediment criteria).

A team of experts (contaminants specialists and statisticians) will evaluate the dataset for comparability of results and its "representativeness" of conditions in Cook Inlet and identify recommendations for further study.

Specific Research Question(s):

1. Does the meta-analysis provide for a contemporary comparable baseline of contaminant data in the Cook Inlet Planning Area?

2. Do background contaminant levels exceed current EPA, State of Alaska, and NOAA promulgated threshold levels?
3. What areas in the Cook Inlet Planning Area, if any, could benefit from further contaminant sampling and monitoring to fill information needs?

References:

Boehm, P.D. 2001. Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet. OCS Study MMS 2000-024. Cambridge, MA: Prepared by Arthur D. Little, Inc. for USDOI, MMS, Alaska OCS Region. 345 pp.

Title	Resource Areas to Support Oil Spill Risk Analysis (OSRA) and National Environmental Policy Act (NEPA) Needs in the Cook Inlet Region
Administered by	Alaska Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2021–2024
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	Tools and methods are needed to identify Environmental Resource Areas (ERAs) for marine mammals, cetaceans, terrestrial mammals and other biological resources to support the assessment of potential impacts from Outer Continental Shelf (OCS) oil and gas related activities in Cook Inlet.
Intervention	This study will synthesize available information for biological resources to facilitate the development of methods to identify the spatial and temporal resource distributions or habitat areas of importance.
Comparison	This study will provide improved efficiency over existing approaches that are individualized for various resources in developing and refining ERAs. This approach will allow for increased continuity to update information following staff changes.
Outcome	A consistent approach that can be applied to multiple resources and planning areas to assist BOEM in defining ERAs to support OSRA and NEPA assessments. This project will complement existing BOEM efforts.
Context	Cook Inlet Planning Area and adjacent areas

BOEM Information Need(s): This study will collate and refine information on the density and spatial and temporal distribution of biological resources and associated habitat areas in the region of Cook Inlet to provide tools to model and map resource areas to help refine ERAs used in BOEM's OSRA and NEPA analyses. These products will assist with NEPA analyses for future lease sales and other OCS activities, ESA Section 7 consultations, and decision making related to potential impacts to resources from activities in the Cook Inlet Planning Area of Alaska. The approach developed through this effort may be applied to other OCS planning areas.

Background: BOEM and others have amassed extensive datasets documenting spatial and temporal presence and other information for a wide range of species and habitats in the Cook Inlet region. The distributions of many species are temporally and spatially structured, showing

seasonal or interannual changes in response to various mechanisms. These factors affect the vulnerability of a species to contact from a potential oil spill, which BOEM considers as part of its OSRA through identification of ERAs. ERAs are areas of concern relating to social, environmental, or economic resources, including critical habitat or use areas for different species of concern. Each ERA has a spatial and temporal attribute and its vulnerability may vary according to the time of year. This study will complement the current study "Environmental Resource Areas: Developing Products to Support Oil-Spill Risk Analysis (OSRA) and National Environmental Policy Act (NEPA)" (AK-18-01), which is focused on seabirds and forage fish.

Objectives: The overall goal of this study is to establish a consistent foundation for developing and refining ERAs used for OSRA. It will build on current efforts focused on seabirds and forage fish by synthesizing existing data for other biological resources and habitat areas in Alaska's Cook Inlet region. Specifically, this project will:

- Use spatial techniques to provide density information or other datasets that are appropriate for identifying ERAs for the species or populations evaluated to support OSRA in the Cook Inlet region.
- Provide a synthesis report, as a description of the biological affected environment, that can inform NEPA assessments for the Cook Inlet region.
- Assess the biological inventories and resource areas to help determine future data collection priorities to best support OSRA and NEPA.

Methods: This study will collate and refine biological inventories for Alaska's Cook Inlet region by compiling data from state, federal, private sector, and academia sources. Researchers will engage with representatives from communities in the Cook Inlet region and other entities (Cook Inlet Regional Citizens Advisory Council, NOAA, USFWS, Gulf Watch Alaska, National Park Service, etc.) who may be conducting marine biological monitoring activities. Researchers will consider various advanced modeling techniques (e.g., Quakenbush and Citta 2013, Citta et al. 2015, Roberts et al. 2016) to identify the most appropriate methods for providing BOEM with data products to evaluate the distribution, habitat use, density/abundance and temporal timing of biological resources. As appropriate, statisticians, data management specialists, oceanographers, or specialists in passive acoustics or aerial surveys will be consulted for additional input regarding advanced data analyses.

The synthesis report will describe the biological affected environment and address additional information needs, approaches for incorporating Local and Traditional Knowledge, and areas where synergy is needed to provide better information for decision makers. Data products will include maps and data layers suitable for plotting in Geographic Information Systems (GIS) to facilitate additional analyses. BOEM analysts will coordinate with the researchers to tailor data products to best suit BOEM's needs.

Specific Research Question(s):

1. What biological inventories are available for the Cook Inlet region?

2. Are inventories available and adequate for each biological resource to define important resource areas?
3. What resources and data collection focuses should be prioritized for future studies planning?
4. What are the best approaches for cooperation and synergy to achieve future research goals in the most cost effective and efficient manner?

References:

Citta, J. J., Quakenbush, L. T., Okkonen, S. R., Druckenmiller, M. L., Maslowski, W. Clement-Kinney, J., George, J. C., Brower, H., Small, R. J., Ashjian, C. J., Harwood, L. A., Heide-Jørgensen, M. P., 2015. Ecological characteristics of core-use areas used by Bering–Chukchi–Beaufort (BCB) bowhead whales, 2006–2012. Progress in Oceanography, 136:201-222. http://dx.doi.org/10.1016/j.pocean.2014.08.012.

Quakenbush, L.T., and Citta, J.J., 2013. Kernel densities from satellite-tracked bowhead whales, 2006-2012, for use in determining environmental resource areas for oil spill response analysis. Special Technical Report, submitted to BOEM, August 2013. 11pp + GIS shapefiles.

Roberts, J. J.; Best, B. Mannocci, D., Fujioka, L., E., E.; Halpin, P. N., Palka, D. L., Garrison, L. P., Mullin, K. D., Cole, T. V. N., Khan, C. B., McLellan, W. M., Pabst, D. A., Lockhart, G. G., 2016. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. Scientific Reports 6: 22615. doi: 10.1038/srep22615.

Title	Bowhead Whale Migration Patterns along the Alaskan Beaufort Shelf During a Period of Rapid Environmental Change
Administered by	Alaska Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2021–2024
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	Evolving environmental conditions on the Beaufort Shelf appear to be changing the utilization of the shelf by bowhead whales and the bowhead whale migration path may be shifting farther offshore. Very few bowheads were seen on the Beaufort Shelf during the 2019 fall migration and only one whale was landed during the 2019 fall bowhead hunt at Utqiaġvik, Alaska. However, the lack of contemporary measurements of hydrographic and whale prey conditions create challenges for diagnosing the changes near Pt. Barrow and across the Beaufort Shelf that may have influenced the bowhead whale migration.
Intervention	This study would renew and geographically expand annual hydrographic and plankton sampling conducted under the "BOWFEST" study (Shelden and Mocklin 2013).
Comparison	Collected data will be examined in the context of an 11-year (2005-2015) record of late August-early September biophysical (hydrography, currents, zooplankton) conditions in the NE Chukchi and western Beaufort seas.
Outcome	This project will provide new basic information on hydrography, circulation, and zooplankton prey fields encountered by migrating bowhead whales to improve understanding of the recent behavioral changes of the whales. Results from this effort also will provide context for assessing ongoing changes to the ecosystem and establish a baseline for the "new normal" that is currently being observed.
Context	Northeast Chukchi Sea and Beaufort Sea shelf

BOEM Information Need(s): This project will provide information on how biological and physical characteristics in the Beaufort and Chukchi seas may be transforming in response to ongoing environmental change and how they may influence bowhead whale utilization

patterns, such as migration pathways and feeding locations, on the Beaufort Shelf. Results from the project will support ESA Section 7 consultations and NEPA analyses for potential future lease sales and DPPs. The information obtained from these surveys may assist in development of mitigation measures and strategies to reduce potential impacts on bowhead whales.

Background: The rate of change of summer-fall conditions in the Arctic has accelerated in recent years. The fall of 2016 saw almost no upwelling winds along the Beaufort Shelf and the bowhead whale migration path lay offshore of the shelf, almost out of range of the Utqiaġvik hunters. The summer of 2019 was extremely warm along the entire Alaskan coast, with numerous die-offs of seabirds attributed to starvation because of a paucity of the large crustacean prey (copepods, krill). Fall 2019 saw the unprecedented failure of the fall bowhead hunt at Utqiaġvik, with migrating bowhead whales not being seen within the safe operating zone for the hunters. The first and only fall whale was landed 16 November. Moreover, few or no bowhead whales were observed on the western Beaufort Shelf through Oct. 30, 2019 by survey flights of the Aerial Surveys of Arctic Marine Mammals (ASAMM) program. The absence of the bowhead whales has been hypothesized to be caused by warm ocean temperatures or a lack of bowhead prey in the region that resulted in a delayed fall migration of the whales or in the whale's fall migration path lying much further offshore. In order to diagnose underlying causes contributing to recent dramatic changes in bowhead migration, contemporaneous measurements of the hydrographic and whale prey conditions are needed.

Objectives: This study will examine recent ecosystem changes in the Beaufort Sea and how they may be influencing bowhead whale migration patterns. Specific objectives include:

- Quantify the biological and physical environments in the western and central portions of the Beaufort shelf, including upwelling induced introduction of krill through shelf-edge depressions
- Assess the linkages between environmental conditions and physical drivers at local and regional scales
- Examine longer-term trends and evaluate whether recent conditions on the Beaufort Shelf will occur more frequently

Methods: Researchers will conduct vessel-based *in situ* sampling to monitor hydrography and zooplankton conditions in late summer along transects in Barrow Canyon, the western Beaufort shelf, and the shelf near Prudhoe. Seasonal and year-round moorings will monitor circulation and acoustic backscatter (zooplankton proxy) in Barrow Canyon and on the Beaufort shelf. Researchers will use a combination of historical data, including long-term monitoring programs, and model output to examine longer-term trends in Beaufort Shelf conditions and provide context to the mechanisms identified from the fieldwork.

Specific Research Question(s):

1. Are unusual/extreme conditions in the Chukchi and Beaufort seas becoming more common?

2. What factors contribute to interannual variability of zooplankton available to bowhead whales during their fall migration?
3. Are there environmental cues that influence timing of fall bowhead migration?
4. What is the relationship between availability of zooplankton on the Beaufort Shelf and local and regional physical forcing mechanisms?

References:

Shelden, K.E.W., and J.A. Mocklin, Editors. 2013. Bowhead Whale Feeding Ecology Study (BOWFEST) in the western Beaufort Sea. Final Report, OCS Study BOEM 2013-0114. National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115-6349.

Title	Coastal and Submerged Historic Properties and Precontact Sites on the Alaska Outer Continental Shelf
Administered by	Alaska Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2021–2023
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	Energy development activities on the sea floor and coast could affect submerged and terrestrial historic properties and precontact sites. Spatial data about these resources should be updated to ensure accurate consultations with the State Historic Preservation Office and other parties. The lack of data could delay approval of exploration and development plans.
Intervention	The study will develop information on Alaska's submerged and coastal historic properties and precontact sites, including their known, reported, or potential locations.
Comparison	BOEM will compare results with existing geo-referenced databases in the state and other regions.
Outcome	BOEM will use these data to describe the affected environment, develop alternatives to proposed actions, analyze potential effects, develop mitigation measures, and conduct consultations. The study will add the Alaska OCS to the national database.
Context	This study is relevant to all Alaska OCS planning areas.

BOEM Information Need(s): An inventory and analysis of submerged and coastal historic properties and precontact sites is needed to inform environmental impact assessments and mitigation of potential impacts to these resources. Specific mission-critical assessments, including visual impacts, affected environment, cumulative effects, and site-specific disturbances to the seafloor, are required under the National Environmental Policy Act, Section 106 of the National Historic Preservation Act, and Executive Order 11593. Results from this study would assist BOEM in meeting requirements to apply the National Register Criteria to properties that may be affected by its undertakings and consult with the Alaska State Historic Preservation Office (SHPO) and other parties. The information also would help BOEM analysts

interpret and evaluate specific archaeological surveys conducted by operators to comply with Federal regulations at 30 CFR 550.194.

Background: For the Alaska OCS, BOEM has assembled a list of shipwrecks discovered prior to 2011 (www.boem.gov/Alaska-Coast-Shipwrecks). BOEM needs to update data in the current shipwrecks list. Updates could include new shipwreck discoveries, shipwreck names, vessel types, site locations, site descriptions, and geology. Updating shipwreck information would enhance BOEM's assessments of potential effects to the resources.

The Alaska OCS holds potential for submerged and coastal precontact sites related to human migration into and settlement of the Americas. Existing information has not been adequately compiled and analyzed to thoroughly address precontact sites. This study will provide a framework to better predict locations of paleo landforms and potential precontact sites.

Project proponents and operators conduct site-specific surveys on a project-by-project basis. Information from this study will inform these site-specific surveys. BOEM has systematically collected this information for all planning areas except in Alaska. This study will add the Alaska OCS to the national database.

Objectives:

- Develop a geo-referenced inventory of known, reported, and potential historic shipwreck and aircraft wreck sites for the Alaska OCS.
- Assess potential precontact sites, developing a GIS-based model to help indicate where intact submerged paleo landforms might be expected to occur.
- Develop a geo-referenced database of coastal precontact sites that could be impacted by onshore infrastructure tied to future development in the Alaska OCS.
- Develop a geo-referenced database of coastal historic properties that could be impacted by alteration of the adjacent seascape.

Methods: This study will compile existing data from the State of Alaska, published research, and archival documents (e.g., maps, charts, ethnographies, maritime surveys). Researchers will provide a literature review and synthesis to help support required consultations with the SHPO and other consulting parties. Researchers will develop a GIS-based inventory of known, reported, and potential historic properties, precontact sites, and other cultural and historic resources important to Alaska Native tribes and corporations. The database will be compatible with ArcGIS. Researchers will discuss results in relation to current and evolving theories of precontact settlement patterns, paleo-shorelines, sea level rise, and regional geology. Researchers will include properties nominated to or eligible for listing in the National Register of Historic Places. They will provide a final report and databases similar to deliverables developed for the Pacific, Gulf of Mexico, and Atlantic OCS regions (e.g., ICF International et al., 2013; NOAA Maritime Heritage Program, 2017; Pearson et al., 2003; Van Tilburg et al., 2017; Watson et al., 2017).

Specific Research Question(s):

1. What are the types and potential locations of submerged historic properties and precontact sites in the Exclusive Economic Zone of the Alaska OCS?
2. What are the types and potential locations of terrestrial historic properties and precontact sites in Alaska's coastal areas?
3. What types of cultural and historic resources could be affected by OCS development?

References:

ICF International, Davis Geo-archaeological Research, and Southeastern Archaeological Research. 2013. Inventory and Analysis of Coastal and Submerged Archaeological Site Occurrence on the Pacific Outer Continental Shelf. OCS Study BOEM 2013-0115. Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, 280 pp.

NOAA Maritime Heritage Program. 2017. The Unseen Landscape: Inventory and Assessment of Submerged Cultural Resources in Hawai`i. OCS Study BOEM 2017-021. Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, 240 pp.

Pearson, C.E., S.R. James, Jr., M.C. Krivor, S.D. El Darragi, and L. Cunningham. 2003. Refining and Revising the Gulf of Mexico Outer Continental Shelf Region High-Probability Model for Historic Shipwrecks: Final report. OCS Study MMS 2003-060 Volume I: Executive Summary. New Orleans, LA: U.S. Department of the Interior, Minerals Management Service, 13 pp.

Van Tilburg H, T.K. Watson, K. Faria, K. Hoomanawanui, I. Ho-Lastiama, W. Ritte, K. Maly, M. Nahoopii, K. Horcajo, K. Kaupiko, D. Ball D. 2017. A Guidance Document for Characterizing Native Hawaiian Cultural Landscapes. OCS Study BOEM 2017-023. Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, 208 pp.

Watson TK, K. Hoomanawanui, R. Thurman, B. Thao, K. Boyne. 2017. Na 'Ikena I Kai (Seaward Viewsheds): Inventory of Terrestrial Properties for Assessment of Marine Viewsheds on the Eight Main Hawaiian Islands. OCS Study BOEM 2017-022. Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, 137 pp.

Title	GPS Tagging of Seabirds to Obtain Areas of Foraging Aggregations and Forage Fish Schools in Lower Cook Inlet
Administered by	Alaska Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2021–2023
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	Research suggests that recent seabird population declines and breeding failures in the Cook Inlet Planning Area are the result of a warming environment and changes in the marine ecosystem. Given these changing environmental conditions, a better understanding of baseline distribution and foraging habitat requirements is needed to provide environmental managers with tools to assess the potential cumulative effects of oil and gas-related activities on seabird populations in the Cook Inlet Planning Area.
Intervention	This study will focus on capturing adult kittiwakes and murres at colonies and fitting them with GPS units to document their foraging movements in Cook Inlet.
Comparison	Results will be evaluated in the context of extensive historical data to help document changes in seabird populations and foraging areas in Cook Inlet.
Outcome	This study will link seabird foraging success to foraging locations and species of forage fish at these locations and will help identify important foraging hotspots within the Cook Inlet Planning Area.
Context	Cook Inlet Planning Area

BOEM Information Need(s): Given the population decline of seabirds in the Cook Inlet Planning Area, BOEM needs more detailed information on the temporal and spatial distribution of seabird foraging activities, forage fish aggregations and type of forage at these aggregations. This study will support BOEM NEPA analyses for potential future Cook Inlet lease sales, exploration plans and development and production plans providing information to: 1) better assess the potential cumulative impacts of oil and gas related activities on Cook Inlet seabirds, 2) better define sensitive resource areas for Oil Spill Risk Analyses (OSRA), and 3) help develop

mitigation measures and strategies to reduce potential disturbance to seabird populations due to OCS oil and gas related activities.

Background: The USGS led seabird and forage fish studies in lower Cook Inlet during 1995-1999 to assess the recovery of seabird populations following the 1989 *Exxon Valdez* oil spill. The original project was designed to measure the foraging and population response of seabirds to fluctuating forage fish densities around seabird colonies in lower Cook Inlet. Major ecosystem changes have occurred since those surveys were conducted, including a persistent (2014-2016) marine heat wave (MHW) in the North Pacific (aka "the Blob"), an associated murre die-off of unprecedented scale, and acute failures at murre breeding colonies (Piatt et al. 2020). The USGS OCS program supported research in 2016-2019 (AK-16-09) that repeated historical studies of 1995-2001, and a follow-on study (AK-20-10) will continue surveys to quantify the impact of the MHW on seabirds and their prey in Lower Cook Inlet (LCI), and to characterize recovery over time.

Objectives:

- Track seabird movements and diving behavior with GPS and activity loggers to identify hotspot foraging areas, and link breeding biology and body condition to foraging success and the density/quality of prey concentrations.
- Provide the location of foraging areas to help further assess the spatial distribution of forage fish aggregations and seabird foraging aggregations, in lower Cook Inlet.

Methods: This study will complement ongoing BOEM-supported efforts assessing seabird and forage fish status, trends, and ecology in LCI (AK-16-09, AK-20-10). Researchers will capture adult kittiwakes and murres at LCI colonies, fit them with GPS units to the tail feathers (kittiwakes) or lower back (murres) as described by Elliott et al. (2013, 2014), and collect blood samples. For both species, GPS points will be recorded every 1 minute while the bird is not diving. The units also will record dive duration for murres (kittiwakes do not dive). The strong relationship between dive duration and dive depth will allow researchers to infer dive depth and thereby obtain three-dimensional information on bird movement. After 5 days of data collection, capture sites will be revisited, all tagged birds recaptured, and devices redeployed on new birds, to maximize sample size. Because the units download to a base station, data will be collected even if recapture is problematic. During the recapture and tag removal, a second blood sample will be taken, and body mass will be measured to examine change in body mass and metabolites and identify successful foraging periods.

Important foraging sites will be identified based on factors such as the frequency and persistence of foraging visits to a site and whether visits to a site resulted in a successful foraging period. Foraging sites will be visited through efforts of a separate study (AK-20-10) to determine the characteristics of the forage fish aggregations (e.g., density, species, energetic value) and seabird aggregations at each site.

Specific Research Question(s):

1. Where are the most important and persistent feeding aggregation sites in lower Cook Inlet?
2. Are these foraging hotspots defined by particular prey species concentrations or other environmental characteristics?

References:

Elliott KH, Ricklefs RE, Gaston AJ, Hatch SA, Speakman JR, Davoren GK (2013) High flight costs, but low dive costs, in auks support the biomechanical hypothesis for flightlessness in penguins. Proc Natl Acad Sci 110:9380-9384

Elliott KH, Chivers LS, Bessey L, Gaston AJ, Hatch SA, Kato A, Osborne O, Ropert-Coudert Y, Speakman JR, Hare JF (2014) Windscapes shape seabird instantaneous energy costs but adult behavior buffers impact on offspring. Movement Ecol 2:17

Piatt, J.F., Parrish, J.K., Renner, H.M., Schoen, S.K., Jones, T.T., Arimitsu, M.L., Kuletz, K.J., Bodenstein, B., García-Reyes, M., Duerr, R.S. and Corcoran, R.M., 2020. Extreme mortality and reproductive failure of common murres resulting from the northeast Pacific marine heatwave of 2014-2016. PloS one, 15(1), p.e0226087.

Table 2. BOEM Alaska Regional Office Studies to be Considered for FY 2022

Page Number	Discipline	Study Title	Planning Area(s)
37	ID	Collaboration with the Gulf Watch Alaska Monitoring Program in Cook Inlet	Cook Inlet
39	MM	Arctic Marine Assessment Program for Protected Species (ArMAPPS)	Beaufort, Chukchi, Bering
41	BIO	Measuring and Modeling Oil Impacts on Early Life Stages of Arctic Cod	Beaufort, Chukchi
Discipline Codes			
BIO = Biology ID = Interdisciplinary & Information Management MM = Marine Mammals & Protected Species			

Title	Collaboration with the Gulf Watch Alaska Monitoring Program in Cook Inlet
Administered by	Alaska OCS Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2022–2025
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	This study will build upon ongoing monitoring efforts to examine areas where collaborative studies can facilitate environmental monitoring efforts and inform decision-making on the sustainable use of resources in marine environment.
Intervention	BOEM will enhance existing working relationships with Gulf Watch Alaska and the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC), NOAA, AOOS, industry and others by establishing financial cooperation, data sharing agreements, and logistical support agreements.
Comparison	BOEM and Gulf Watch Alaska will partner on collaborative research, leveraging expertise across several partners in Cook Inlet.
Outcome	This project will support mutually identified information needs on the physical and biological processes in the marine environment.
Context	Cook Inlet and the northern Gulf of Alaska

BOEM Information Need(s): BOEM needs updated information regarding the physical and biological environment, including variability in oceanographic conditions and plankton communities, as well as data related to sensitive species. BOEM strives to leverage funding for updated environmental data collection as significant opportunities arise and is seeking to partner with Gulf Watch Alaska on new collaborative research in the Cook Inlet and the northern Gulf of Alaska as that program develops its next five-year plan.

Research from this collaboration will support mutually identified information needs related to environmental drivers, nearshore and pelagic ecosystems, and science synthesis. Data and results from this partnership will support NEPA analysis and documentation for lease sales, Explorations Plans (EPs), and Development and Production Plans (DPPs). Collected oceanographic, benthic and seabird data will support validation and sensitivity testing of ocean circulation models used for BOEM's Oil-Spill Risk Analysis efforts.

Background: Gulf Watch Alaska (https://gulfwatchalaska.org/) is the long-term ecosystem-monitoring program of the EVOSTC for the marine ecosystem affected by the 1989 oil spill. The Trustee Council began funding the program in 2012; however, many of the studies have a much longer time series. A plan is currently being developed for the third 5-year increment of the program, which is anticipated to span a period totaling 20-years. Gulf Watch Alaska conducts collaborative research in the Cook Inlet and the northern Gulf of Alaska, leveraging expertise across several partners, including NOAA, Alaska Ocean Observing System (AOOS), USGS, USFWS, National Park Service, Prince William Sound Science Center, University of Alaska Fairbanks and others. BOEM recently collaborated with NOAA, USFWS, and National Park Service through Gulf Watch Alaska on the project "Ecological Processes in Lower Cook Inlet and Kachemak Bay: A Partnership in Monitoring." Ongoing efforts from Gulf Watch Alaska include:

- Examining seasonal and inter-annual variability in oceanographic conditions and plankton communities and provide information to assess long-term trends.
- Enhanced monitoring of sensitive species (seabirds, sea otters) and habitats in conjunction with monitoring of environmental conditions.
- Synthesizing data both across the Gulf Watch Alaska geographic sampling region and across time to understand what is affecting differing population responses to environmental variability.

Objectives: BOEM seeks to build upon existing working relationships with EVOSTC and Gulf Watch Alaska, NOAA, USGS, AOOS, and others by collaborating with scientists conducting long-term monitoring and synthesis through the Gulf Watch Alaska program.

Methods: BOEM will collaborate with the Gulf Watch Alaska team to continue the long-term monitoring and synthesis efforts and advance collaborative studies that could help enhance informed decision-making on the sustainable use of resources.

Specific Research Question(s): What is the range of environmental effects in Cook Inlet and the northern Gulf of Alaska from environmental change occurring in the marine environment?

Title	Arctic Marine Assessment Program for Protected Species (ArMAPPS)
Administered by	Alaska OCS Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2022–2026
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	Marine ecosystems in the U.S. Arctic support a high diversity of cetacean species, several of which are listed as endangered under the Endangered Species Act (ESA). BOEM must assess potential impacts to these species from future OCS activities. However, collecting high quality data over such large spatial scales is both logistically challenging and costly.
Intervention	In this study, BOEM will partner with NOAA, the Navy, and other entities to conduct rotational, large-scale, visual and acoustic ship-board or aerial surveys in the Bering, Chukchi, and Beaufort seas to obtain data on the presence, distribution, and abundance of cetaceans, with particular focus on subsistence-harvested species such as bowhead and beluga whales. Habitat-based density models will be developed to generate fine-scale predictions of cetacean seasonal density or occurrence.
Comparison	These surveys will provide baseline information and facilitate future comparisons to examine the potential effects of natural and anthropogenic disturbances. The resulting habitat density models will be compared to areas of potential oil and gas activity, as well as areas identified by BOEM's oil spill trajectory modeling.
Outcome	ArMAPPS will provide periodic data on the abundance and distribution of cetaceans in the Alaskan Arctic and facilitate the development of habitat-based density models to better understand how natural and anthropogenic disturbances could affect cetacean species.
Context	Bering, Chukchi, and Beaufort seas

BOEM Information Need(s): BOEM needs periodically updated information on cetacean abundance and distribution to assess overlap between species' habitat and potential oil and gas activities in the U.S. Arctic. This project will provide cetacean information required for consultations and assessments under the ESA, Marine Mammal Protection Act (MMPA), and

National Environmental Policy Act (NEPA) analyses for future lease sales, Exploration Plans, and Development and Production Plans.

Background: Federal agencies are responsible for assessing populations and managing potential impacts to protected species within the waters of the U.S. Exclusive Economic Zone (EEZ). This mandate led to the development of three very successful large-scale, multi-agency, cetacean assessment programs jointly established and funded by BOEM, NOAA, and the U.S. Navy: 1) Atlantic Marine Assessment Program for Protected Species (AMAPPS), 2) Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS; https://www.boem.gov/environment/environmental-studies/gommapps), and 3) Pacific Marine Assessment Partnership for Protected Species (PacMAPPS). The ArMAPPS program would expand these efforts to the Arctic and provide opportunities for collecting high quality data to meet the needs of several federal agencies.

Objectives:

- Use visual and acoustic survey techniques to collect abundance and distribution data for cetaceans in the Bering, Chukchi, and Beaufort seas.
- Conduct satellite telemetry studies to determine foraging behavior and seasonal movements of target cetacean species.
- Collect data on life-history, residence time, and stock structure when possible.
- Develop habitat-based density models for generating fine-scale predictions of cetacean seasonal density or occurrence and for understanding how these are changing with the environment.

Methods: Visual and acoustic shipboard and aerial surveys will be conducted on a rotational basis in the Bering, Chukchi, and Beaufort seas to collect abundance and distribution data of cetaceans. A refined survey schedule will be developed collaboratively through discussion among BOEM partners including but not limited to the Navy and NOAA. Survey efforts will be designed with a 5-6-year rotation among subregions such as the Beaufort Sea, Chukchi Sea, northern Bering Sea, and southeastern Bering Sea. The survey design will consist of predetermined track lines within survey strata, defined for each geographic subregion given current information on cetacean distribution. A higher proportion of survey effort will be allocated within areas where cetacean abundance for some species is expected to be higher. Researchers will analyze acoustic and line-transect survey data independently to calculate abundance estimates for as many cetacean species as possible. Additionally, visual and acoustic detections will be combined to examine spatial variation in the probability of occurrence for cetacean species following emerging analytical techniques; while distribution data will be linked to habitat characteristics to create fine-scale spatially-explicit density estimates that can be used to meet regulatory requirements of BOEM.

Specific Research Question(s): What is the abundance, seasonal distribution, and habitat use of cetaceans in the Bering, Chukchi, and Beaufort seas?

Title	Measuring and Modeling Oil Impacts on early life stages of Arctic Cod
Administered by	Alaska OCS Regional Office
BOEM Contact(s)	Alaska.Studies@boem.gov
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2022–2024
Final Report Due	TBD
Date Revised	October 30, 2020
PICOC Summary	
Problem	An oil spill in the Alaskan Arctic OCS Region could have ecosystem-wide impacts by way of injury to early life stages of Arctic cod, a keystone species. Drastic changes in the distribution and abundance of Arctic cod would lead to widespread food web changes, particularly in ice-obligate species. Additionally, these effects may be exacerbated by thermal stress associated with atmospheric warming.
Intervention	This study will expose Arctic cod eggs and larvae to environmentally relevant concentrations of fresh and weathered oil to obtain a better understanding of the effects of low-level oil exposure on this vulnerable species.
Comparison	All experimental treatments and sampling of oil-exposed embryos will occur alongside unexposed, replicated control treatments. Data will be incorporated in Arctic cod Individual Based Models (IBMs) under varying oil spill scenarios explored by the GNOME oil spill/fate model.
Outcome	This project will 1) characterize latent effects of early life stage oil exposures on Arctic cod that impact survival, growth, and reproduction, and 2) develop a modeling framework that can incorporate oil injury to assess the impact of various oil spill scenarios on Arctic cod early life stages, under current and future climate scenarios.
Context	Beaufort and Chukchi seas

BOEM Information Need(s): BOEM needs a better understanding of the acute and latent effects of low-level exposures to fresh and weathered oil on early life stages of Arctic cod under current and future climate scenarios. This data would inform National Environmental Policy Act (NEPA) documents for OCS Leasing and Exploration Plans and lend to Oil Spill Risk Analysis (OSRA) and other assessments for oil exploration and development activities.

Background: Arctic cod (*Boreogadus saida*) is a keystone species in the Alaskan Arctic and one of few species that link the lower and higher trophic levels. Arctic cod, especially early life stages, are especially sensitive to injury from oil exposure, and the buoyancy and long development time of Arctic cod embryos makes them particularly susceptible to injury (Laurel et al. 2019). For the past four years, NOAA has been working with its counterpart in Norway, the Institute of Marine Research (IMR), to investigate low-level toxic impacts of oil to high latitude fish species in both the North Pacific and North Atlantic, including circumpolar Arctic species. In 2017, a new oil-dosing lab was established by the Alaska Fisheries Science Center (AFSC), putting NOAA and its partners in a unique position to study the effects of oil exposure on sensitive early life stages of Arctic cod and other key species under variable climatic conditions. In 2018 and 2019, a biophysical Individual Based Model (IBM) for Arctic cod, developed under the North Pacific Research Board (NPRB) Project #1508 (Arctic Gadids in a Changing Climate), also became available to 'scale-up' oil impacts by incorporating oil injury data (e.g., growth impacts) alongside the established oil spill and fate model (GNOME, General NOAA Operational Modeling Environment). Incorporating new oil injury data into modeling frameworks that account for biophysical transport of the species (IBMs) alongside oil spill scenarios (e.g., GNOME) are about 3 years into development in the Norwegian Arctic (Barents Sea) but have yet to be developed in the Alaskan Arctic OCS Region.

Objectives: The goal of this project is to supply information needed to spatially and temporally quantify the acute and chronic effects of exposure to hydrocarbons on this key marine forage fish. Specific objectives include:

- Determine the delayed effects of low oil dose embryonic exposure on the biochemistry, physiology, growth and behavior of feeding larval/juvenile stages.
- Modeling the spatio-temporal dispersal and fate of hydrocarbons from several oil spill scenarios over the Alaskan Arctic OCS
- Integrating the oil exposure of individual embryos using IBMs to evaluate the multi-stressor effects on growth and survival in a dynamic oceanographic environment

Methods: Husbandry and larviculture are now routine procedures in the NOAA-AFSC laboratory in Newport, Oregon, following 6 years of broodstock development of Arctic cod. In this study, Arctic cod embryos will be exposed to environmentally relevant concentrations of fresh and weathered oil for short periods (~3 days) using an extremely reliable, continuously generated oil dispersion laboratory established in the Newport lab. Exposures will be fully characterized by (1) measuring PAHs in water and in embryos at key points before, during and after exposure, and (2) quantifying CYP1A mRNA expression levels as a marker of PAH exposure. In addition, endpoint measures will be applied at relevant ontogenetic stages. These include measures of growth, survival, condition (lipid), gene expression, morphometric defects, cardiac performance, respiration, and swim activity.

Results from exposed eggs and larvae will be simulated by communicating with the oil dispersal and fate model, which will enable quantification of acute or sub-lethal effects. Particles will be initiated at hypothesized spawning grounds and drift along individual drift trajectories will be

determined by their time-dependent ambient currents, while simulated growth and development of each particle in the model will be based on ambient temperature. Individual exposure of eggs and larvae will be tracked by communicating with the oil dispersal and fate model, which will enable quantification of acute or sub-lethal effects. Data will be incorporated in Arctic cod Individual Based Models (IBMs) under varying oil spill scenarios explored by the GNOME oil spill/fate model.

Specific Research Question(s):

1. What are the impacts of oil exposure on the early life stages of Arctic cod?

2. How are the effects of oil exposure on the early life stages of Arctic cod predicted to vary under current and future climate change scenarios?

References:

Laurel BJ, Copeman LA, Iseri P, Spencer ML, Hutchinson G, Nordtug T, Donald CE, Meier S, Allan SE, Boyd DT, Ylitalo GM, Cameron JR, French BL, Linbo TL, Scholz NL, Incardona JP (2019). Embryonic crude oil exposure impairs growth and lipid allocation in a keystone Arctic forage fish. iScience. https://doi.org/10.1016/j.isci.2019.08.051

3.3 Ongoing Studies

Study profiles for each of the studies identified in Table 3 can be found at the Ongoing Studies Table link at http://www.boem.gov/AKstudies

This information, which is updated three times each year, includes:

- An updated status of each study.
- Report due dates.
- Related publications.
- Affiliated websites.

Table 3. BOEM Alaska Regional Office Ongoing Studies

NSL #	Study Title	Planning Area(s)	Start FY	Partners
PLANNED NEW STARTS *				
AK-20-05	Improvements to the Oil Spill Risk Analysis (OSRA) Input Quality Assurance/Quality Control (QA/QC) and Validation	All Alaska Planning Areas		
AK-20-06	Subsistence Harvest and Iñupiaq Knowledge of Beluga Whales for Kaktovik, Alaska	Beaufort		
AK-20-x09	Kenai Peninsula Borough Socioeconomic Profile, 2008 to 2020	Cook Inlet		
***Note: The procurement of any study is contingent upon availability of funding**				
ONGOING STUDIES				
Biology				
AK-15-01	Initiating an Arctic Marine Biodiversity Observing Network (AMBON) for Ecosystem Monitoring	Chukchi	2015	NOPP; NOAA;
AK-16-07†	Arctic Integrated Ecosystem Survey, Phase II	Beaufort, Chukchi	2017	NOAA; UAF;
AK-16-09	Updating Status and Trends of Seabirds and Forage Fish in Lower Cook Inlet	Cook Inlet	2016	USGS
AK-17-02†	Wave Energy Converter Impact Assessment	All Alaska Planning Areas	2017	CESU-UAF
AK-17-03	Marine Bird Distribution and Abundance in Offshore Waters	Beaufort, Chukchi, Cook Inlet	2017	USFWS
AK-17-x11	Nearshore fish surveys in the Beaufort Sea	Beaufort	2017	USGS
AK-18-01	Environmental Resource Areas: Developing Products to Support Oil-Spill Risk Analysis (OSRA) and National Environmental Policy Act (NEPA)	All Alaska Planning Areas	2018	USGS

AK-19-01	Impacts of Sedimentation and Drivers of Variability in the Boulder Patch Community, Beaufort Sea	Beaufort	2019	UT-Austin
AK-19-02-02	Kelp Restoration in the Boulder Patch	Beaufort	2019	CMI
AK-19-02-03†	Utilization of the Under-ice Habitat by Arctic Cod in the Western Arctic Ocean: A Multidisciplinary Collaborative Study	Beaufort, Chukchi	2019	CMI
AK-19-07	Model-based essential fish habitat (EFH) descriptions for Arctic cod, saffron cod and snow crab in the Alaskan Arctic	Beaufort, Chukchi	2019	UAF
AK-20-07	Early Detection Plan for Marine Non-native Species on the Arctic Outer Continental Shelf (OCS)	Beaufort, Chukchi	2020	SI
AK-20-10	Monitoring the Recovery of Seabirds and Forage Fish Following a Major Ecosystem Disruption in Lower Cook Inlet (LCI)	Cook Inlet	2020	USGS
AK-20-11	The Impact of Marine Fish Communities on Red-throated Loon Productivity in the Beaufort Sea	Beaufort	2020	USGS
NT-13-05†	Marine Arctic Ecosystems Study (MARES): A Multi-Agency NOPP Partnership	Beaufort	2014	NOPP
NT-20-10†	A sustainable, integrated AMBON in the US Arctic	Beaufort, Chukchi	2020	NOPP
Fates and Effects				
AK-16-04	Oil-Spill Occurrence Estimators for the Alaska Outer Continental Shelf	Beaufort, Chukchi	2017	
AK-18-x11	Hydrocarbon Seeps in the Lower Cook Inlet, Gulf of Alaska, Chukchi Sea and Beaufort Sea OCS Planning Areas	All Alaska Planning Areas	2018	UAF
AK-18-x12	Oil Spill Occurrence Estimators for Onshore and Offshore Crude and Refined Oil Spills on the Alaska North Slope and Cook Inlet, Alaska	Beaufort, Chukchi, Cook Inlet	2018	
AK-19-08†	Oil Spill Impact Literature Synthesis: Crude and Refined Spills 1,000–20,000 bbls	All Alaska Planning Areas	2019	
Information Management				
AK-16-02†	Collaboration with North Pacific Research Board (NPRB) Arctic Marine Research Program	Beaufort, Chukchi	2016	NPRB
AK-19-02†	Alaska Coastal Marine Institute	All Alaska Planning Areas	2019	CMI
AK-20-02†	Support for Alaska Marine Science Symposium	All Alaska Planning Areas	2020	NPRB
Marine Mammals and Protected Species				
AK-16-01	Aerial Surveys of Arctic Marine Mammals (ASAMM) – Personnel and Aircraft Needs	Beaufort, Chukchi	2016	MML
AK-19-02-05	Evaluating Novel Assessment Approaches for Coastal Ice Seal Haulout Areas and Behavior in the Alaskan Beaufort Sea	Beaufort	2019	CMI

AK-20-01	Cook Inlet Beluga Acoustic Monitoring in Lower Cook Inlet (LCI) Rivers	Cook Inlet	2020	NOAA
AK-20-04	Quantifying Sea Otter Abundance, Distribution, and Foraging Intake in Cook Inlet Alaska	Cook Inlet	2020	USGS
AK-20-08	Comprehensive Synthesis of Impacts to Marine Mammals from Oil and Gas Activities in the Alaska Outer Continental Shelf (OCS), 2000–2020	Beaufort, Chukchi, Cook Inlet	2020	
AK-Ofc-01	NOAA-BOEM Partnership: Range-Wide Distribution of Cook Inlet Beluga Whales (*Delphinapterus leucas*) in the Winter	Cook Inlet	2019	NOAA
Physical Oceanography				
AK-13-03-17	Measuring Wave Forces along Alaska's Coastal Sea Ice	Chukchi	2016	CMI
AK-13-03-23	High-frequency Characterization of the Physicochemical Parameters of Cook Inlet, Alaska	Cook Inlet	2017	CMI
AK-17-01	Wave and Hydrodynamic Modeling in the Nearshore Beaufort Sea	Beaufort	2017	CESU-UAF;
AK-19-02-04	Western Beaufort and Chukchi Sea Surface Current Analysis	Beaufort, Chukchi	2019	CMI
AK-19-03	Landfast Ice Climatology in the Beaufort and Chukchi Seas	Beaufort, Chukchi	2019	CESU-UAF
AK-20-03	Update of River Overflood on Sea Ice and Strudel Scour Database	Beaufort	2020	
Social Science and Economics				
AK-15-05†	Traditional Knowledge Implementation: Accessing Arctic Community Panels of Subject Matter Experts	Beaufort, Chukchi	2016	NSB
AK-16-05	Community Based Monitoring: LEO Network	Beaufort, Chukchi, Cook Inlet	2016	ANTHC
AK-19-05	Monitoring of the Cross Island Subsistence Whale Hunt for Effects from Liberty DPP	Beaufort	2019	

Partner Codes

ANTHC = Alaska Native Tribal Health Consortium
CESU = Cooperative Ecosystem Studies Unit
CMI = University of Alaska Coastal Marine Institute
MML = Marine Mammal Laboratory (NOAA)
NOAA = National Oceanic and Atmospheric Administration
NOPP = National Oceanographic Partnership Program
NPRB = North Pacific Research Board
NSB = North Slope Borough
SI = Smithsonian Institution
UAF = University of Alaska Fairbanks
USFWS = U. S. Fish and Wildlife Service
USGS = U. S. Geological Survey
UT = University of Texas

† Integrated, Multi-disciplinary Studies

3.4 Recent Reports and Publications

The ESP in Alaska has published approximately 70 OCS Study reports in the past five years (Appendix 2). These reports address a broad range of topics, including:

- Arctic Ecosystem Integrated Survey on Distribution of Fish, Crab, and Lower Trophic Communities in the Northeastern Bering Sea and Chukchi Sea
- Satellite-tracked Drifter Measurements in the Chukchi and Beaufort Seas
- Coastal Community Vulnerability Index and Visualizations of Change in Cook Inlet, Alaska
- Migration Trends for King and Common Eiders and Yellow-billed Loons past Point Barrow in a Rapidly Changing Environment
- Arctic Air Quality Impact Assessment Modeling Study
- Physical and Chemical Analyses of Crude and Refined Oils: Laboratory and Mesoscale Oil Weathering

Reports from completed ESP Studies can be found on the ESP Information System at http://www.boem.gov/ESPIS/. Alaska study reports can also be found at http://www.boem.gov/AKpubs.

During the same five-year period, studies in Alaska generated over 200 peer review journal publications (Appendix 3). The peer review publications in recent years include five special journal issues derived from four projects:

Synthesis of Arctic Research (SOAR): This study conducted a synthesis of multidisciplinary marine science information in the northern Bering, Chukchi and Beaufort Seas from recent and ongoing research conducted by BOEM, as well as other Federal and State agencies and industry. In addition to two OCS Study reports (BOEM 2012-031 and BOEM 2018-017), the SOAR project produced two special journal issues:

Moore, S. E. and P. J. Stabeno (editors). 2015. *Synthesis of Arctic Research (SOAR)*. Progress in Oceanography. 136:1-274.

Moore, S. E., P. J. Stabeno, and T. I. Van Pelt (editors). 2018. *Synthesis of Arctic Research SOAR Phase II*. Deep Sea Research Part II: Topical Studies in Oceanography. 152:1-214.

Arctic Ecosystem Integrated Survey: This partnership with NOAA and UAF documented and characterized the distribution of pelagic and demersal fish and invertebrate communities in the Chukchi Sea. The study included field surveys to obtain baseline data on the structure and function of the Chukchi ecosystem and the ecology of important fish species in the region. Products from this study include an OCS Study report (BOEM 2017-077) and an issue of Deep Sea Research Part II:

Mueter, F. J., J. Weems, E. V. Farley, M. F. Sigler (editors). 2017. *Arctic Ecosystem Integrated Survey (Arctic Eis): Marine ecosystem dynamics in the rapidly changing Pacific Arctic Gateway*. Deep Sea Research Part II: Topical Studies in Oceanography. 135:1-190.

Hanna Shoal Ecosystem Study: This study built on the ecological monitoring of the COMIDA-Chemistry and Benthos study with a specific focus on the area of Hanna Shoal. The study documented the circulation and density fields, as well as ice conditions, at Hanna Shoal and examined important chemical, physical and biological interactions with the unique ecological regime in this highly productive area. Products include an OCS Study report (BOEM 2016-047) and an issue of Deep Sea Research Part II:

Dunton, K., J. Grebmeier, and J. Trefry (editors). 2017. *The Hanna Shoal Ecosystem Study of the Northeastern Chukchi Sea*. Deep Sea Research Part II: Topical Studies in Oceanography. 144:1-190.

The precursor to the *Hanna Shoal Ecosystem Study*, called *Chukchi Sea Offshore Monitoring in Drilling Area: Chemistry and Benthos* (OCS Study BOEM 2012-012), also produced an issue of Deep Sea Research Part II:

Dunton, K. H., J. M. Grebmeier, and J. H. Trefry (editors). 2014. *The Northern Chukchi Sea Benthic Ecosystem: Characterization, Biogeochemistry, and Trophic Linkages*. Deep Sea Research Part II: Topical Studies in Oceanography. 102:1-164.

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APPENDIX 1: U.S. ARCTIC RESEARCH PLAN: Intersection with BOEM Environmental Studies

This table is organized to display recent BOEM-directed research as it supports relevant Research Goals and Objectives outlined in IARPC's *Arctic Research Plan: 2017-2021* released in December 2016.

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
Research Goal 1: Enhance Understanding of Health Determinants and Improve the Well-being of Arctic Residents				
Research Objective 1.1: Support integrative approaches to human health that recognize the connections among people, wildlife, the environment, and climate.				
Performance Element 1.1.2: In collaboration with the ANTHC, support community-based monitoring and Indigenous Knowledge and Local Knowledge by maintaining and strengthening the Local Environmental Observer (LEO) Network to help describe connections between climate change, environmental impacts, and health effects.				
AK-16-05 Community Based Monitoring: LEO Network	ANTHC	$400,000	2016-2021	Supports continued maintenance and expansion of the LEO network to improve reporting from the North Slope and Cook Inlet and enhance the quality, rigor, and consistency of data collection.
Performance Element 1.1.4: Increase understanding of how both natural climate change and the effects of human activities are affecting the ecosystem by documenting observations of changing sea ice conditions, with implications for development and subsistence.				
AK-13-03-16 Northern Alaska Sea Ice Project Jukebox OCS Study BOEM 2018-027	UAF-CMI	$60,663	2016-2018	Documented personal observations and traditional knowledge about ice near Barrow and Kotzebue to assess what has changed and how the Iñupiat are adapting to the changes.
AK-19-03 Landfast Ice in the Beaufort and Chukchi Seas	UAF	$1.70M	2019-2023	Developing protocols to analyze satellite data and create and maintain a landfast ice climatology database for the Beaufort and Chukchi seas.
AK-21-xx Bowhead Whale Migration Patterns along the Alaskan Beaufort Shelf in During a Period of Rapid Environmental Change			2021-2024	This planned project will provide new basic information on hydrography, circulation, and zooplankton prey fields encountered by migrating bowhead whales to improve understanding of the recently observed behavioral changes of the whales.
Research Goal 3: Enhance Understanding and Improve Predictions of the Changing Arctic Sea Ice Cover				
Research Objective 3.1: Conduct coordinated/integrated atmosphere-ice-ocean observations and research to understand the processes that determine the spatial and temporal variation of the thickness, extent, and volume of sea ice and their effects on atmosphere-ice-ocean interactions and feedbacks over multiple time scales (hourly, daily, weekly, seasonal, inter-annual, decadal).				
Performance Element 3.1.1: Support investigator-driven observations and process studies of the pack ice (e.g., ice thickness distribution, topography/surface roughness and strength; ice motion and deformation; snow depth distribution and melt pond characteristics; surface albedo and energy balance) and landfast ice (e.g., extent, stability, and break-up).				

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
AK-13-03-07 Development and Testing of a Low-Cost Satellite-Tracked Ice Drifter for Arctic Waters OCS Study BOEM 2017-079	UAF-CMI	$243,286	2014-2018	Deployed drifters on landfast and mobile pack ice to develop new information on the fate of landfast ice in the Chukchi and Beaufort seas.
AK-13-03-17 Measuring Wave Forces along Alaska's Coastal Sea Ice	UAF-CMI	$311,392	2016-2020	Improve understanding of wave energy propagation into sea ice and determine its effect on landfast ice stability along the Chukchi coast.
AK-19-03 Landfast Ice in the Beaufort and Chukchi Seas	UAF	$1.70M	2019-2023	Developing protocols to analyze satellite data and create and maintain a landfast ice climatology database for the Beaufort and Chukchi seas.
AK-20-03 Update of River Overflood on Sea Ice and Strudel Scour Database		$347,055	2020-2022	This study will document maximum river overflood boundaries and collate industry acquired strudel scour data from Smith Bay to Camden Bay between 2008 and 2019
Performance Element 3.1.5: Use multiple remote sensing data sets to: (1) investigate sea ice properties and processes and atmosphere-ice-ocean interactions; and (2) develop algorithms for automated ice edge detection and delineation of the marginal ice zone, landfast ice extent, ice classification (e.g., age/type of ice, melt ponds, floe size), and ice motion and deformation.				
AK-19-03 Landfast Ice in the Beaufort and Chukchi Seas	UAF	$1.70M	2019-2023	Developing protocols to analyze satellite data and create and maintain a landfast ice climatology database for the Beaufort and Chukchi seas.
AK-20-03 Update of River Overflood on Sea Ice and Strudel Scour Database		$347,055	2020-2022	This study will document maximum river overflood boundaries and collate industry acquired strudel scour data from Smith Bay to Camden Bay between 2008 and 2019
Performance Element 3.1.6: Develop and deploy new technologies that enable persistent data collection on a variety of environmental variables using mobile platforms and sensors operating above, on, in, and under the Arctic sea ice cover to support a framework of observations that will improve forecasting and prediction of sea ice.				
AK-13-03-17 Measuring Wave Forces along Alaska's Coastal Sea Ice	UAF-CMI	$311,392	2016-2020	Improve understanding of wave energy propagation into sea ice and determine its effect on landfast ice stability along the Chukchi coast.
AK-19-03 Landfast Ice in the Beaufort and Chukchi Seas	UAF	$1.70M	2019-2023	Developing protocols to analyze satellite data and create and maintain a landfast ice climatology database for the Beaufort and Chukchi seas.
AK-20-03 Update of River Overflood on Sea Ice and Strudel Scour Database		$347,055	2020-2022	This study will document maximum river overflood boundaries and collate industry acquired strudel scour data from Smith Bay to Camden Bay between 2008 and 2019
Performance Element 3.1.7: Investigate Arctic Ocean processes, interactions and feedbacks that affect the dynamics and thermodynamics of the sea ice cover, including ocean circulation and stratification, turbulence and mixing, horizontal and vertical heat transport, and freshwater transport and storage.				
NT-13-05 Marine Arctic Ecosystems Study (MARES): A Multi-Agency NOPP Partnership OCS Study BOEM 2017-017; OCS Study BOEM 2018-024; OCS Study BOEM 2019-009: OCS Study BOEM 2020-029	NOPP	$5.42M	2015-2020	Describing ocean currents at different depths along the Beaufort Sea continental shelf, including the biogeochemical-physical interactions and feedback processes in ice free and ice-covered areas.

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
AK-12-03a Characterization of the Circulation on the Continental Shelf Areas of the Northeast Chukchi and Western Beaufort Seas OCS Study BOEM 2017-065	CESU-UAF	$5.06M	2012-2018	Characterized the flow regimes and surface water exchange among areas of the inner and outer Chukchi shelf and the western Beaufort shelf under varying conditions of wind forcing and sea ice coverage.
AK-17-01 Wave and Hydrodynamic Modeling in the Nearshore Beaufort Sea	CESU-UAF; USGS	$2.12M	2017-2022	Using observations and a coupled ocean-wave model to obtain a better understanding of the physical processes related to wave conditions and their effects within Stefansson Sound in the Beaufort Sea.
AK-19-02-04 Western Beaufort and Chukchi Sea Surface Current Analysis	UAF-CMI	$77,640	2019-2022	Assessing the relationships between the wind and the surface flow field structure and evolution.
AK-19-03 Landfast Ice in the Beaufort and Chukchi Seas	UAF	$1.70M	2019-2023	Evaluating how changes in landfast ice relate to local and regional changes in temperature, pressure, and major storms.
AK-20-03 Update of River Overflood on Sea Ice and Strudel Scour Database		$347,055	2020-2022	This study will document maximum river overflood boundaries and collate industry acquired strudel scour data from Smith Bay to Camden Bay between 2008 and 2019
Research Objective 3.2: Improve models for understanding sea ice processes and for enhanced forecasting and prediction of sea ice behavior at a range of spatial and temporal scales.				
Performance Element 3.2.1: Support investigator-driven modeling studies designed to understand and parameterize key sea ice properties and processes, including ice thickness distribution, topography, and strength; ice motion, deformation and mechanics; snow depth distribution and melt pond characteristics; surface albedo and energy balance; and biogeochemistry.				
AK-15-02 Development of a Very High-resolution Regional Circulation Model of Beaufort Sea Nearshore Areas OCS Study BOEM 2018-018; OCS Study BOEM 2018-007	CESU-Rutgers University; UAF	$489,735	2015-2018	Developed an updated coupled ice-ocean circulation model of the Arctic Ocean, including nested domains for high-resolution computations on the Beaufort Sea shelf.
AK-19-03 Landfast Ice in the Beaufort and Chukchi Seas	UAF	$1.70M	2019-2023	Producing data that will support verification and validation of sea ice models.
AK-17-01 Wave and Hydrodynamic Modeling in the Nearshore Beaufort Sea	CESU-UAF; USGS	$2.12M	2017-2022	Using observations and a coupled ocean-wave model to obtain a better understanding of the physical processes related to wave conditions and their effects within Stefansson Sound in the Beaufort Sea.
Performance Element 3.2.2: Enhance operational sea ice forecasting and research-oriented prediction capabilities through improvements to model physics (explicit and parameterized); initialization techniques; assimilation of observations, including newly available and future data sources such as VIIRS, AMSR2, CryoSat-2, SMOS, and ICESat-2; model evaluation and verification; evaluation of model skill, post-processing techniques and forecast guidance tools used in operational forecasts and decision support.				
AK-15-02 Development of a Very High-resolution Regional Circulation Model of Beaufort Sea Nearshore Areas OCS Study BOEM 2018-018; OCS Study BOEM 2018-007	CESU-Rutgers University; UAF	$489,735	2015-2018	Contributed to advancement of predictive capabilities for sea ice in ocean circulation models.

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
Research Goal 4: Increase Understanding of the Structure and Function of Arctic Marine Ecosystems and Their Role in the Climate System and Advance Predictive Capabilities				
Research Objective 4.1: Increase knowledge on the distribution and abundance of Arctic marine species across all trophic levels and scales, including an improved understanding of the formation and maintenance of biological hotspots and proximate causes of shifts in range.				
Performance Element 4.1.1: Continue distribution and abundance surveys of Arctic marine species, for example, concurrent monitoring of polar bears and their ice seal prey.				
AK-11-05 Synthesis of Arctic Research (SOAR): Physics to Marine Mammals in the Pacific Arctic OCS Study BOEM 2018-017	NOAA-PMEL	$1.79M	2011-2018	Used a synthesis approach to increase scientific understanding of the relationships of oceanographic conditions, lower trophic prey species and marine mammal distribution and behavior in the Pacific Arctic. The project included development of the Arctic Marine Pulses (AMP) model was developed that depicts seasonal biophysical 'pulses' across a latitudinal gradient by linking processes across contiguous ecological domains.
AK-12-04 U.S.-Canada Transboundary Fish and Lower Trophic Communities OCS Study BOEM 2017-034	UAF; DFO Canada	$5.19M	2012-2018	Documented baseline fish and invertebrate species presence, abundance, distribution and biomass.
AK-12-07 Arctic Whale Ecology Study (ARCWEST): Use of the Chukchi Sea by Endangered Baleen and Other Whales OCS Study BOEM 2018-022; OCS Study BOEM 2019-024	MML	$4.60M	2012-2017	Assessed spatial and temporal patterns of use of the Chukchi Sea by endangered bowhead, fin and humpback whales, and beluga and gray whales and evaluated ecological relationships for the species.
AK-13-02 Chukchi Acoustic, Oceanography and Zooplankton Study: Hanna Shoal (Extension of CHAOZ) OCS Study BOEM 2018-008; OCS Study BOEM 2019-024	MML	$3.93M	2013-2019	Assessed the spatial and temporal distribution of marine mammals near Hanna Shoal and the extent that environmental conditions such as sea ice, oceanic currents, water temperature and salinity, and prey abundance influence whale distribution and relative abundance.
AK-13-06 Walrus Seasonal Distribution and Habitat Use in the Eastern Chukchi Sea	USGS	$1.69M	2013-2018	Evaluating seasonal abundance, distribution, and habitat use of walruses in the Chukchi Sea.
AK-16-07 Arctic Integrated Ecosystem Survey, Phase II	NOAA; UAF; USFWS	$2.50M	2017-2022	Quantifying the distribution, abundance, and condition of fishes, shellfishes, and seabirds throughout the U.S. shelf waters of the Chukchi Sea and Western Beaufort Sea.
AK-17-03 Marine Bird Distribution and Abundance in Offshore Waters	USFWS	$500,000	2017-2021	Using long-term surveys to determine seabird spatial distribution, species composition, and seasonal changes in species abundance in the Arctic.
AK-16-01 Aerial Surveys of Arctic Marine Mammals (ASAMM) OCS Study BOEM 2018-023	MML	$11.44M	2016-2019	Long-term surveys to document the distributions and relative densities of marine mammals in the Chukchi Sea and Beaufort Sea Planning Areas.
AK-16-06 Estimation of Abundance and Demographic Rates of Pacific Walruses Using a Genetics-based Mark-Recapture Approach OCS Study BOEM 2019-059	USFWS	$250,000	2016-2019	Estimating annual abundance of walruses for evaluation of population status and trends by applying mark-recapture analytical techniques to biopsy samples.

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
AK-19-02-03 Utilization of the Under-ice Habitat by Arctic Cod in the Western Arctic Ocean: A Multidisciplinary Collaborative Study	UAF-CMI	$258,539	2019-2022	Conducting under-ice surveys of Arctic cod to obtain better understanding of the under-ice associations of Arctic cod life history and key under-ice habitat locations.
AK-19-02-05 Evaluating Novel Assessment Approaches for Coastal Ice Seal Haulout Areas and Behavior in the Alaskan Beaufort Sea	UAF-CMI	$204,990	2019-2021	Evaluating the potential of time-lapse cameras to assess the seasonal presence, behavior, and numbers of spotted and bearded seals at known summer-fall coastal haulouts.
Performance Element 4.1.2: Continue studies to document Arctic marine species biodiversity (e.g. Arctic Marine Biodiversity Observation Network—AMBON—and programs that monitor loss of sea ice) and habitat use in the Arctic.				
AK-15-01 Initiating an Arctic Marine Biodiversity Observing Network (AMBON) for Ecosystem Monitoring	NOPP; NOAA; UAF	$1.75M	2015-2020	Examining the phenology, distribution, and life history of upper trophic predators in response to availability of lower trophic prey resources; and improving knowledge about rates of consumption, growth, and reproduction of benthic and pelagic organisms.
AK-16-02 Collaboration with North Pacific Research Board (NPRB) Arctic Marine Research Program	NPRB	$1.00M	2016-2021	Provides support for NPRB's Arctic Integrated Ecosystem Research Program, including coordination among the ASGARD and Arctic IES (AK-16-07) components.
AK-16-07 Arctic Integrated Ecosystem Survey, Phase II	NOAA; UAF; USFWS	$2.50M	2017-2022	Quantifying the distribution, abundance, and condition of fishes, shellfishes, and seabirds throughout the U.S. shelf waters of the Chukchi Sea and Western Beaufort Sea.
AK-19-01 Impacts of Sedimentation and Drivers of Variability in the Boulder Patch Community, Beaufort Sea	UT-Austin; UAF	$750,000	2019-2024	Conducting a monitoring program to examine long-term drivers of community variability during Liberty development activities.
AK-19-02-02 Kelp Restoration in the Boulder Patch	UAF-CMI	$138,884	2020-2023	Evaluating the value of artificial reefs as a mitigation tool for potential disturbances to foundation kelp in the Boulder Patch.
AK-19-07 Model-based Essential Fish Habitat (EFH) Descriptions for Arctic Cod, Saffron Cod and Snow Crab in the Alaskan Arctic	UAF	$125,000	2019-2021	Identifying habitat characteristics most important to distributions and habitat suitability of larval (if data is available), juvenile and adult Arctic cod, saffron cod and snow crab.
AK-20-07 Early Detection Plan for Marine Non-native Species on the Arctic Outer Continental Shelf	Smithsonian Istitution	$650,000	2020-2025	Establishing a monitoring scheme for detection of marine non-native species in the Arctic.
AK-20-11 The Impact of Marine Fish Communities on Red-throated Loon Productivity in the Beaufort Sea	USGS	$1.0M	2020-2023	This study will evaluate the offshore marine use areas of red-throated loons in the context of differences in nearshore fish communities that vary in space and time.
AK-21-xx Bowhead Whale Migration Patterns along the Alaskan Beaufort Shelf in During a Period of Rapid Environmental Change			2021-2024	This planned project will provide basic information on hydrography, circulation, and zooplankton prey fields encountered by migrating bowhead whales to improve understanding of the recently observed behavioral changes of the whales.

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
Performance Element 4.1.3: Assess winter distributions of key Arctic species, via passive acoustic sampling and satellite tagging for marine mammals to include further development of autonomous, unmanned surface and underwater vehicles equipped with sensors capable of recording marine mammal vocalizations.				
AK-12-02 Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring	ADF&G	$2.70M	2012-2019	Deployed satellite transmitters with environmental and passive acoustic monitoring capabilities to track the movements and document the behavior of bowhead whales.
AK-12-07 Arctic Whale Ecology Study (ARCWEST): Use of the Chukchi Sea by Endangered Baleen and Other Whales OCS Study BOEM 2018-022 ; OCS Study BOEM 2019-024	MML	$4.60M	2012-2017	Used passive acoustic monitoring to assess spatial and temporal patterns of use of the Chukchi Sea by endangered bowhead, fin and humpback whales, and beluga and gray whales.
AK-13-02 Chukchi Acoustic, Oceanography and Zooplankton Study: Hanna Shoal (Extension of CHAOZ) OCS Study BOEM 2018-008 ; OCS Study BOEM 2019-024	MML	$3.93M	2013-2019	Used passive acoustic monitoring to assess spatial and temporal distribution of marine mammals near Hanna Shoal.
Research Objective 4.3: Advance the understanding of how climate-related changes, biophysical interactions, and feedbacks at different scales in the marine ecosystems impact Arctic marine resources and human communities that depend on them.				
Performance Element 4.3.1: Continue Distributed Biological Observatory (DBO) sampling in regions 1-5 and make data publicly available through upload of metadata to the Earth Observing Laboratory/DBO data portal.				
AK-16-07 Arctic Integrated Ecosystem Survey, Phase II	NOAA; UAF; USFWS	$2.50M	2017-2022	Sampling plan includes DBO regions.
AK-15-01 Initiating an Arctic Marine Biodiversity Observing Network (AMBON) for Ecosystem Monitoring	NOPP; NOAA; UAF	$1.75M	2015-2020	Sampling plan includes DBO regions.
NT-20-10 A sustainable, integrated AMBON in the US Arctic	NOPP	$450,000	2020-2025	Sampling plan includes DBO regions.
Performance Element 4.3.4: Continue research and make simultaneous observations of biological, chemical, and physical variables to examine linkages among marine species, oceanographic and sea ice conditions, and climate change to understand the mechanisms that affect performance and distribution. Quantify feedbacks and interactions of bottom-up and top-down processes that regulate production.				
AK-11-03 Hanna Shoal Ecosystem Study OCS Study BOEM 2016-047	CESU-UT	$5.69M	2011-2018	Examined important chemical, physical and biological interactions with the unique ecological regime in the highly productive area of Hanna Shoal.
AK-13-02 Chukchi Acoustic, Oceanography and Zooplankton Study: Hanna Shoal (Extension of CHAOZ) OCS Study BOEM 2018-008 ; OCS Study BOEM 2019-024	MML	$3.93M	2013-2019	Assessed the spatial and temporal distribution of marine mammals near Hanna Shoal and the extent that environmental conditions such as sea ice, oceanic currents, water temperature and salinity, and prey abundance influence whale distribution and relative abundance.
AK-16-02 Collaboration with North Pacific Research Board (NPRB) Arctic Marine Research Program	NPRB	$1.00M	2016-2021	Provides support for NPRB's Arctic Integrated Ecosystem Research Program, including coordination among the ASGARD and Arctic IES (AK-16-07) components.

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
AK-16-07 Arctic Integrated Ecosystem Survey, Phase II	NOAA; UAF; USFWS	$2.50M	2017-2022	Quantifying the distribution, abundance, and condition of fishes, shellfishes, and seabirds throughout the U.S. shelf waters of the Chukchi Sea and Western Beaufort Sea.
AK-19-01 Impacts of Sedimentation and Drivers of Variability in the Boulder Patch Community, Beaufort Sea			2019-2022	Conducting a monitoring program to examine long-term drivers of community variability during activities at the Liberty Development.
AK-19-02-02 Kelp Restoration in the Boulder Patch	UAF-CMI	$138,884	2020-2023	Evaluating the value of artificial reefs as a mitigation tool for potential disturbances to foundation kelp in the Boulder Patch.
AK-21-xx Bowhead Whale Migration Patterns along the Alaskan Beaufort Shelf in During a Period of Rapid Environmental Change			2021-2024	This planned project will provide new basic information on hydrography, circulation, and zooplankton prey fields encountered by migrating bowhead whales to improve understanding of the recently observed behavioral changes of the whales.
NT-13-x11 WALRUS – Walrus Adaptability and Long-term Responses; Using multi-proxy data to project Sustainability	NSF	$200,000	2013-2019	Tracking changes in walrus trophic position, foraging location, and genetic structure and diversity over the past 2500 years using multi-proxy datasets.
Performance Element 4.3.7: Continue development, testing, and runs of prognostic models that use Intergovernmental Panel on Climate Change (IPCC) scenarios in a regional context to explore current understanding of biophysical interactions and feedbacks, such as perturbations across several modeled food webs from the subarctic to the Arctic to estimate relative ecosystem sensitivities and rates of change.				
AK-11-05 Synthesis of Arctic Research (SOAR): Physics to Marine Mammals in the Pacific Arctic OCS Study BOEM 2018-017	NOAA-PMEL	$1.80M	2011-2018	This synthesis project included a component that examined sea-ice cover timing in the Pacific Arctic based on IPCC scenarios.
Research Goal 8: Strengthen Coastal Community Resilience and Advance Stewardship of Coastal Natural and Cultural Resources by Engaging in Research Related to the Interconnections of People, Natural, and Built Environments				
Research Objective 8.1: Engage coastal communities in research to advance knowledge on cultural, safety, and infrastructure issues for coastal communities.				
Performance Element 8.1.1: Engage coastal community members in research by seeking cooperative opportunities between community members, IK holders, and/or LK holders, and researchers in knowledge co-production research processes. Employ IK and/or LK to jointly conceive of and plan research activities and to report research results back to communities.				
AK-15-05 Traditional Knowledge Implementation: Accessing Arctic Community Panels of Subject Matter Experts	NSB-DWM	$359,470	2016-2020	Develops panels of subject matter experts to systematically incorporate Traditional (Indigenous) Knowledge from community members through co-production of knowledge and sharing with western scientists.
AK-20-07 Early Detection Plan for Marine Non-native Species on the Arctic Outer Continental Shelf	Smithsonian Institution	$650,000	2020-2025	Capturing LK related to marine invertebrates and introductions of non-native species. Local citizens will be involved with field surveys and plans to establish a long-term monitoring scheme.
Performance Element 8.1.2: Engage coastal community members in research by supporting community-based monitoring focused on measuring physical and biotic information by strengthening initiatives led by groups such as the Arctic-focused LCCs, BOEM, NOAA, and FWS.				

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
AK-19-05 Monitoring of the Cross Island Subsistence Whale Hunt for Effects from Liberty DPP		$481,852	2019-2025	Engaging with Alaska Native hunters to monitor the annual bowhead whale hunt at Cross Island and document the hunters' IK/LK.
AK-17-01 Wave and Hydrodynamic Modeling in the Nearshore Beaufort Sea	CESU-UAF; USGS	$2.12M	2017-2022	Involving local community members in collecting ocean observations.
AK-20-06 Subsistence Harvest and Iñupiaq Knowledge of Beluga Whales for Kaktovik, Alaska			2020-2023	Documenting how the people of Kaktovik hunt belugas and how beluga is processed and examining the cultural importance of belugas and beluga harvest for Kaktovik.
Performance Element 8.1.4: Investigate and protect cultural resources through research to identify and document archaeological sites in high-risk, rapidly eroding Arctic coastal areas.				
AK-21-xx Coastal and Submerged Historic Properties and Precontact Sites on the Alaska Outer Continental Shelf			2021-2023	The planned study will develop information on Alaska's submerged and coastal historic properties and precontact sites, including their known, reported, or potential locations.
Research Objective 8.2: Advance knowledge of ecosystems and environmental health in coastal areas by monitoring trends and modeling biological processes.				
Performance Element 8.2.1: Monitor and conduct studies to understand trends, processes, and biotic-abiotic feedback loops affecting the distribution, abundance, and ecology of coastal species in relation to food security, biodiversity, and ecosystems through projects such as the Arctic Council Conservation of Arctic Flora and Fauna working group Coastal Biodiversity Monitoring Programme.				
AK-15-01 Initiating an Arctic Marine Biodiversity Observing Network (AMBON) for Ecosystem Monitoring	NOPP; NOAA; UAF	$1.75M	2015-2020	Examining influences of sea ice dynamics on the phenology, distribution, and life history of upper trophic predators in response to availability of lower trophic prey resources; and improving knowledge about rates of consumption, growth, and reproduction of benthic and pelagic organisms.
AK-19-02-01 Coastal Marine Institute (CMI) Program Administration 2019-2024	UAF-CMI	$375,212	2019-2022	This award is supporting synthesis efforts for preparation of the State of the Arctic Marine Biodiversity Report (SAMBR).
AK-19-02-03 Utilization of the Under-ice Habitat by Arctic Cod in the Western Arctic Ocean: A Multidisciplinary Collaborative Study	UAF-CMI	$258,539	2019-2022	Conducting under-ice surveys of Arctic cod to obtain better understanding of the under-ice associations of Arctic cod life history and key under-ice habitat locations.
AK-19-07 Model-based Essential Fish Habitat (EFH) Descriptions for Arctic Cod, Saffron Cod and Snow Crab in the Alaskan Arctic	UAF	$125,000	2019-2021	Identifying habitat characteristics most important to distributions and habitat suitability of larval (if data is available), juvenile and adult Arctic cod, saffron cod and snow crab.
NT-20-10 A sustainable, integrated AMBON in the US Arctic	NOPP	$450,000	2020-2025	This project continues the efforts of AMBON (AK-15-01).
Performance Element 8.2.4: Understand and monitor processes to manage and mitigate potential and realized threats from coastal invasive species, biotoxicoses, and wildlife diseases by leveraging research under initiatives and programs such as One Health, the DBO network, AMBON, and Aerial Surveys of Arctic Marine Mammals (ASAMM) work.				
AK-20-07 Early Detection Plan for Marine Non-native Species on the Arctic Outer Continental Shelf	Smithsonian Institution	$650,000	2020-2025	Establishing a monitoring scheme for detection of marine non-native species in the Arctic.

BOEM Study	BOEM Partner(s)	BOEM Funding	Study Duration	Relationship to IARPC Performance Element
Research Objective 8.3: Advance knowledge of the physical coastal processes impacting natural and built environments.				
Performance Element 8.3.1: Improve understanding of coastal erosion and deposition, including related geomorphic changes due to permafrost degradation, reduced sea ice extent, storm surge, increased wave action, and sea level rise. This Element includes work by the USGS Coastal and Marine Geology Program, USGS Alaska Science Center, U.S. Army Corps of Engineers (USACE), and others.				
AK-17-01 Wave and Hydrodynamic Modeling in the Nearshore Beaufort Sea	CESU-UAF; USGS	$2.12M	2017-2022	Involving local community members in collecting ocean observations.
Research Goal 9: Enhance Frameworks for Environmental Intelligence Gathering, Interpretation, and Application toward Decision Support				
Research Objective 9.3: Enhance climate prediction capabilities for the Arctic System from subseasonal to decadal timescales and climate projection capabilities up to centennial timescales by focusing on improving earth system models and their interactions, and assessing the strengths and weaknesses of the various coupled regional Arctic and earth system models by conducting intercomparison and model evaluations.				
Performance Element 9.3.4: Support model development of Regional Arctic System Models focusing on improved resolution, better coupling, inclusion of new process models, and better assimilation techniques for improved seasonal predictions.				
AK-15-02 Development of a Very High-resolution Regional Circulation Model of Beaufort Sea Nearshore Areas OCS Study BOEM 2018-018; OCS Study BOEM 2018-007	CESU-Rutgers University; UAF	$489,735	2015-2018	Contributed to advancement of predictive capabilities for sea ice in ocean circulation models.
Research Objective 9.4: Enhance availability, discoverability, understanding, and interoperability of Arctic data and tools across Federal data centers.				
Performance Element 9.4.4: Advance agile situational awareness and decision support for Arctic operators through efforts like ADAC's Arctic Information Fusion Capability28, ERMA, and NASA ACE project.				
AK-12-03b Arctic Tracer Release Experiment (ARCTREX): Applications for Mapping Spilled Oil in Arctic Waters OCS Study BOEM 2017-062	BSEE; UAF	$1.25M	2013-2018	Tested the ability of available observational technology to sample a simulated oil spill in the Chukchi Sea and to transmit data to NOAA's Arctic Environmental Response Management Application (ERMA).

APPENDIX 2: RECENT OCS STUDY REPORTS: 2016—2020

These and all Alaska study reports can be found at http://www.boem.gov/AKpubs and http://www.boem.gov/ESPIS/.

OCS Study #	Title
BOEM 2020-051	Oil Spill Occurrence Rates for Cook Inlet, Alaska Oil and Gas Exploration, Development, and Production
BOEM 2020-050	Oil Spill Occurrence Rates from Alaska North Slope Oil and Gas Exploration, Development and Production
BOEM 2020-033	Microbial Biodegradation of Alaska North Slope Crude Oil and Corexit 9500 in the Arctic Marine Environment
BOEM 2020-029	Marine Arctic Ecosystem Study (MARES): Moorings on the Beaufort Sea Shelf (2016–2018) and Program Synthesis
BOEM 2020-027	Distribution and Relative Abundance of Marine Mammals in the Eastern Chukchi Sea, Eastern and Western Beaufort Sea, and Amundsen Gulf, 2019 Annual Report
BOEM 2019-079	Ice Seal Movements and Foraging: Village-Based Satellite Tracking and Collection of Traditional Ecological Knowledge Regarding Ringed and Bearded Seals
BOEM 2019-078	Nearshore Food Web Structure on the OCS in Cook Inlet
BOEM 2019-076	Satellite Tracking of Bowhead Whales Habitat Use, Passive Acoustics and Environmental Monitoring
BOEM 2019-075	Assessment of nearshore communities and habitats: Lower Cook Inlet Nearshore Ecosystem 2015-2018
BOEM 2019-067	CMI Graduate Student Projects Volume 3: The Influence of Water Flow, Water Conditions, and Seasonality on Fish Communities in Estuarine Nearshore Habitats in Kachemak Bay, Alaska; Identifying Hatch Dates and Potential Hatch Location of Arctic Cod (*Boreogadus saida*) through Otolith Analysis
BOEM 2019-059	Estimation of abundance and demographic rates of Pacific walruses using a genetics-based mark-recapture approach
BOEM 2019-053	ANIMIDA III Boulder Patch and Other Kelp Communities in Development Area
BOEM 2019-032	Arctic Aerial Calibration Experiments (Arctic ACEs): Comparing Manned Aerial Surveys to Unmanned Aerial Surveys for Cetacean Monitoring in the Arctic

BOEM 2019-031	Coastal Community Vulnerability Index and Visualizations of Change in Cook Inlet, Alaska
BOEM 2019-030	Identifying sources of organic matter to benthic organisms in the Beaufort and Chukchi outer continental shelves
BOEM 2019-024	Chukchi Sea Acoustics, Oceanography, and Zooplankton Study: Hanna Shoal Extension (CHAOZ-X) and Arctic Whale Ecology Study (ARCWEST) Supplemental Report
BOEM 2019-021	Distribution and Relative Abundance of Marine Mammals in the Eastern Chukchi and Western Beaufort Seas, 2018 Annual Report
BOEM 2019-009	Marine ARctic Ecosystem Study (MARES): Moorings on the Beaufort Sea shelf, 2016-2017
BOEM 2019-005	Coastal Marine Institute (CMI) Annual Report 25: Calendar Year 2018
BOEM 2018-064	University of Alaska Coastal Marine Institute, Program Administration 2013-2017
BOEM 2018-059	Migration Trends for King and Common Eiders and Yellow-billed Loons past Point Barrow in a Rapidly Changing Environment
BOEM 2018-058	CMI Graduate Student Projects: Volume 2: Functional Diversity of Epibenthic Communities on the Chukchi and Beaufort Sea Shelves; Using Trace Elements in Pacific Walrus Teeth to Track the Impacts of Petroleum Production in the Alaskan Arctic
BOEM 2018-048	Oil-Spill Occurrence Estimators: Fault Tree Analysis for One or More Potential Future Beaufort Sea OCS Lease Sales
BOEM 2018-037	ShoreZone Imaging and Mapping along the Alaska Peninsula
BOEM 2018-036	Fate and Persistence of Oil Spill Response Chemicals in Arctic Seawater
BOEM 2018-032	US Outer Continental Shelf Oil Spill Causal Factors Report (2018)
BOEM 2018-027	Northern Alaska Sea Ice Project Jukebox: Phase III
BOEM 2018-024	Marine Arctic Ecosystem Study—Biophysical and Chemical Observations from Glider and Benthic Surveys in 2016
BOEM 2018-023	Distribution and Relative Abundance of Marine Mammals in the Eastern Chukchi and Western Beaufort Seas, 2017 Annual Report
BOEM 2018-022	Arctic Whale Ecology Study (ARCWEST): Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of the BOWFEST)

BOEM 2018-021	CMI Graduate Student Projects: Characterizing Bacterial Communities in Beaufort Sea Sediments in a Changing Arctic; Chukchi-Beaufort Seas Storms and Their Influence on Surface Climate; Using Genotyping-by-Sequencing (GBS) Population Genetics Approaches to Determine the Population Structure of Tanner Crab (*Chionoecetes bairdi*) in Alaska
BOEM 2018-020	Arctic Air Quality Impact Assessment Modeling Study: Final Project Report
BOEM 2018-018	Development of a Very High-Resolution Regional Circulation Model of Beaufort Sea Nearshore Areas
BOEM 2018-017	Synthesis of Arctic Research (SOAR): Physics to Marine Mammals in the Pacific Arctic
BOEM 2018-016	Development of an Autonomous Carbon Glider to Monitor Sea-Air CO2 Fluxes in the Chukchi Sea
BOEM 2018-008	Chukchi Sea Acoustics, Oceanography, and Zooplankton Study: Hanna Shoal Extension (CHAOZ-X)
BOEM 2018-007	Technical Manual for a Coupled Sea-Ice/Ocean Circulation Model (Version 5)
BOEM 2018-006	US Outer Continental Shelf Oil Spill Statistics
BOEM 2017-087	Crude Oil Infiltration and Movements in First-Year Sea Ice; Impacts on Ice-Associated Biota and Physical Constraints
BOEM 2017-080	U.S.-Canada Northern Oil and Gas Research Forum Final Report
BOEM 2017-078	Distribution and Relative Abundance of Marine Mammals in the Eastern Chukchi and Western Beaufort Seas, 2016 Annual Report
BOEM 2017-077	Arctic Ecosystem Integrated Survey Final Report on Distribution of Fish, Crab, and Lower Trophic Communities in the Northeastern Bering Sea and Chukchi Sea
BOEM 2017-076	IceTrackers: Low-Cost Tracking of Sea Ice in Remote Environments
BOEM 2017-072	Alaska Monitoring and Assessment Program (AKMAP) Survey of Estuaries within the National Petroleum Reserve - Alaska
BOEM 2017-066	Genomics of Arctic Cod
BOEM 2017-065	Characterization of the Circulation on the Continental Shelf Areas of the Northeastern Chukchi and Western Beaufort Seas
BOEM 2017-062	Arctic Tracer Release Experiment (ARCTREX), Applications for Mapping Spilled Oil in Arctic Waters
BOEM 2017-055	Demographic Composition and Behavior of Polar Bears Summering on Shore in Alaska

BOEM 2017-043	Siku Sea Ice Discrete Element Method Model
BOEM 2017-040	Arctic Air Quality Impact Assessment Modeling - Evaluation of the Exemption Thresholds
BOEM 2017-035	Social Indicators in Coastal Alaska: Arctic Communities
BOEM 2017-034	US-Canada Transboundary Fish and Lower Trophic Communities
BOEM 2017-033	Central Beaufort Sea Marine Fish Monitoring
BOEM 2017-032	Arctic Nearshore Impact Monitoring in Development Area III (ANIMIDA): Contaminants, Sources and Bioaccumulation
BOEM 2017-029	Arctic Air Quality Modeling Study - Final Near-Field Dispersion Modeling Report
BOEM 2017-020	Demography and Behavior of Polar Bears Summering on Shore in Alaska (USFWS)
BOEM 2017-019	Distribution and Relative Abundance of Marine Mammals in the Eastern Chukchi and Western Beaufort Seas, 2015 Annual Report
BOEM 2017-017	Marine Arctic Ecosystem Study - Pilot Program: Marine Mammals Tagging and Tracking
BOEM 2017-011	Seasonality of Seabird Distribution in Lower Cook Inlet
BOEM 2017-004	Seabird Distribution and Abundance in the Offshore Environmental Final Report
BOEM 2016-079	Distribution and Abundance of Select Trace Metals in Chukchi and Beaufort Sea Ice
BOEM 2016-078	Evaluating Chukchi Sea Trace Metals and Hydrocarbons in the Yukon River Delta, Alaska
BOEM 2016-077	Abundance Estimates of Ice-Associated Seals: Bering Sea Populations that Inhabit the Chukchi Sea During the Open-Water Period
BOEM 2016-076	Arctic Air Quality Modeling Study - Final Photochemical Modeling Report
BOEM 2016-075	Sea Level Measurements Along the Alaskan Chukchi and Beaufort Coasts
BOEM 2016-066	Distribution and Habitat Use of Fish in the Nearshore Ecosystem in the Beaufort and Chukchi Seas
BOEM 2016-064	Sensitivity to Hydrocarbons and Baselines of Exposure in Marine Birds on the Chukchi and Beaufort Seas
BOEM 2016-062	Physical and Chemical Analyses of Crude and Refined Oils: Laboratory and Mesoscale Oil Weathering

BOEM 2016-053	Pinniped Movements and Foraging: Village Based Walrus Habitat Use Studies in the Chukchi Sea
BOEM 2016-052	Final Report: Updates to Fault Tree Methodology and Technology for Risk Analysis -- Liberty Project
BOEM 2016-051	Testing the Use of Unmanned Aircraft Systems for Intertidal Surveys
BOEM 2016-048	Alaska Arctic Marine Fish Ecology Catalog
BOEM 2016-047	Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Hanna Shoal Ecosystem Study
BOEM 2016-037	Technical Manual for a Coupled Sea-Ice/Ocean Circulation Model (Version 4)

APPENDIX 3: RECENT PUBLICATIONS FROM ALASKA STUDIES: 2016—2020

2020

Ashjian, C. J., R. G. Campbell, and S. R. Okkonen. 2020. Biological Environment. In The Bowhead Whale., eds. J. C. Craig, J. G. M. Thewissen, p. 403-416. Elsevier.

Barton, M.B., J.J. Vollenweider, R.A. Heintz, B.L. Norcross, and K.M. Boswell. 2020. Spatiotemporal Variation of Environmental Conditions and Prey Availability that Drive Arctic Nearshore Fish Community Structure in the Point Barrow, Alaska, Region. *Canadian Journal of Fisheries and Aquatic Sciences* (999): 1-13. First published online 31 August 2020.

Beatty, W.S., P.R. Lemons, S.A. Sethi, J.P. Everett, C.J. Lewis, R.J. Lynn, G.M. Cook, J.L. Garlich-Miller, and J.K. Wenburg. 2020. Panmixia in a Sea Ice-Associated Marine Mammal: Evaluating Genetic Structure of the Pacific Walrus (*Odobenus Rosmarus Divergens*) At Multiple Spatial Scales. *Journal of Mammalogy*. 101(3): 755-765.

Boucher, N.P., A.E. Derocher, and E.S. Richardson. 2020. Spatial and Temporal Variability in Ringed Seal (*Pusa Hispida*) Stable Isotopes in the Beaufort Sea. *Ecology and Evolution*.10(10): 4178-4192.

Clark, C.T., L. Horstmann, and N. Misarti. 2020. Zinc Concentrations in Teeth of Female Walruses Reflect the Onset of Reproductive Maturity. *Conservation Physiology*. 8(1). doi:10.1093/conphys/coaa029.

Citta, J. J., L. Quakenbush, and J. C. George. Distribution and Behavior of Bering-Chukchi-Beaufort Bowhead Whales as Inferred by Telemetry. In *The Bowhead Whale*., eds. J.C. George, J.G.M. Thewissen, p. 31-56. Elsevier.

Copeman, L., M. Spencer, R. Heintz, J. Vollenweider, A. Sremba, T.s Helser, L. Logerwell, et al. 2020. Ontogenetic Patterns in Lipid and Fatty Acid Biomarkers of Juvenile Polar Cod (*Boreogadus Saida*) and Saffron Cod (*Eleginus Gracilis*) from Across the Alaska Arctic. *Polar Biology* 43(8): 1121-1140

Danielson, S.L., D. F. Hill, K.S. Hedstrom, J. Beaner, and E. Curchister. 2020. Demonstrating a High-Resolution Gulf of Alaska Ocean Circulation Model Forced Across the Coastal Interface by High-Resolution Terrestrial Hydrological Models. *Journal of Geophysical Research: Oceans*. 125(8): e2019JC015724.

Danielson, S.L., T.D. Hennon, K.S. Hedstrom, A.V. Pnyushkov, I.V. Polyakov, E. Carmack, K. Filchuk, et al. 2020. Oceanic Routing of Wind-Sourced Energy along the Arctic Continental Shelves. *Frontiers in Marine Science* 7. First Published Online 10 July 2020.

Fang, Y.-C., T.J. Weingartner, E.L. Dobbins, P. Winsor, H. Statscewich, R.A. Potter, T.D. Mudge, C.A. Stoudt, and K. Borg. 2020. Circulation and Thermohaline Variability of the Hanna Shoal Region on the Northeastern Chukchi Sea Shelf. *Journal of Geophysical Research*: Oceans: 125(7): e2019JC015639.

Ferguson, M. C., J. T. Clarke, A. A. Brower, A. L. Willoughby, and S. R. Okkonen. 2020. Ecological Variation in the Western Beaufort Sea. In *The Bowhead Whale.*, eds. J. C. Craig, J. G. M. Thewissen, p. 365-379. Elsevier.

Forster, C.E., B.L. Norcross, F.J. Mueter, E.A. Logerwell, and A.C. Seitz. 2020. Spatial Patterns, Environmental Correlates, And Potential Seasonal Migration Triangle of Polar Cod (*Boreogadus Saida*) Distribution in the Chukchi and Beaufort Seas. *Polar Biology*. 43(8): 1073-94.

Forster, C.E., B.L. Norcross, and I. Spies. 2020. Documenting Growth Parameters and Age in Arctic Fish Species in the Chukchi and Beaufort Seas. *Deep Sea Research Part II: Topical Studies in Oceanography*. 104779. First published online 27 March 2020.

Gofstein, T.R., M. Perkins, J. Field, and M.B Leigh. 2020. The Interactive Effects of Crude Oil and Corexit 9500 on Their Biodegradation in Arctic Seawater. *Applied and Environmental Microbiology*. First published online 23 August 2020.

Gradinger, R. and B.A. Bluhm. 2020. First Analysis of an Arctic Sea Ice Meiofauna Food Web Based on Abundance, Biomass and Stable Isotope Ratios. *Marine Ecology Progress Series*. 634: 29-43.

Huntington, H.P., S.L. Danielson, F.K. Wiese, M. Baker, P. Boveng, J.J. Citta, A. De Robertis, D.M. Dickson, E. Farley, and J.C. George. 2020. Evidence Suggests Potential Transformation of the Pacific Arctic Ecosystem is Underway. *Nature Climate Change*. 10(4): 342-348.

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Marsh, J.M. and F.J. Mueter. 2020. Influences of Temperature, Predators, and Competitors on Polar Cod (*Boreogadus Saida*) at the Southern Margin of their Distribution. *Polar Biology*. 43(8): 995-1014.

Marsh, J.M., F.J. Mueter, and T.J. Quinn. 2020. Environmental and Biological Influences on the Distribution and Population Dynamics of Polar Cod (*Boreogadus Saida*) in the US Chukchi Sea. *Polar Biology*. 43(8): 1055-1072.

Mikan, M.P., H.R. Harvey, E. Timmins-Schiffman, M. Riffle, D.H. May, I. Salter, W.S. Noble, and B.L. Nunn. 2020. Metaproteomics Reveal that Rapid Perturbations in Organic Matter Prioritize Functional Restructuring Over Taxonomy in Western Arctic Ocean Microbiomes. *The ISME Journal*. 14(1): 39-52.

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Sutton, L., K. Iken, B.A. Bluhm, and F.J. Mueter. 2020. Comparison of Functional Diversity of Two Alaskan Arctic Shelf Epibenthic Communities. *Marine Ecology. Progress Series* 651(1): 1-21.

Taylor, N., C.T. Clark, N. Misarti, and L. Horstmann. 2020. Determining Sex of Adult Pacific Walruses from Mandible Measurements. *Journal of Mammalogy*. First Published Online 20 June 2020.

Weingartner, T. J., S. R. Okkonen, S. L. Danielson. 2020. Physical Oceanography. In The Bowhead Whale., eds. J. C. Craig, J. G. M. Thewissen. Elsevier.

Whitehouse, G.A., and K.Y. Aydin. 2020. Assessing the Sensitivity of Three Alaska Marine Food Webs to Perturbations: an Example of Ecosim Simulations Using Rpath. *Ecological Modelling* 429: 109074.

Willoughby, A.L., M.C Ferguson,.R. Stimmelmayr, J.T. Clarke, and A.A. Brower. 2020. Bowhead Whale (*Balaena Mysticetus*) and Killer Whale (*Orcinus Orca*) Co-Occurrence in the U.S. Pacific Arctic, 2009−2018: Evidence from Bowhead Whale Carcasses. *Polar Biology*. First Published Online 10 September 2020

Wilson, R.E., S.A. Sonsthagen, N. Smé, A. J. Gharrett, A. R. Majewski, K. Wedemeyer, R. J. Nelson, and S.L. Talbot. 2020. Mitochondrial Genome Diversity and Population Mitogenomics of Polar Cod (*Boreogadus Saida*) And Arctic Dwelling Gadoids. *Polar Biology*. 43(8): 979−994.

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Barton, M.B., S.Y. Litvin, J.J. Vollenweider, R.A. Heintz, B.L. Norcross, and K.M. Boswell. 2019. Implications of Trophic Discrimination Factor Selection for Stable Isotope Food Web Models of Low Trophic Levels in the Arctic Nearshore. *Marine Ecology Progress Series*. 613: 211-216.

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