

ALASKA ANNUAL STUDIES PLAN

FY 2014

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF OCEAN ENERGY MANAGEMENT
ALASKA OUTER CONTINENTAL SHELF REGION
ANCHORAGE, ALASKA

NOVEMBER 2013



Prepared by
U.S. Department of the Interior
Bureau of Ocean Energy Management
Alaska Outer Continental Shelf Region
3801 Centerpoint Drive, Room 500
Anchorage, Alaska 99503-5823

November 2013

This document may be accessed electronically at <http://www.boem.gov/akstudies/>. To request a hard copy, please contact Dr. Heather Crowley at (907) 334-5281 or by email at Heather.Crowley@boem.gov. To request further information about the Studies Program or our planning process, please contact Dr. Dee Williams, Alaska OCS Region Studies Chief, at (907) 334-5283 or by email at Dee.Williams@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. The scope of the studies is subject to change prior to initiation of any work.

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Cover Photos:

Coastal lagoon near Kaktovik:	Mandy Lindeberg, NOAA; ShoreZone on the North Slope, 2012
Bongo nets:	Deanna Wheeler, PolarTREC; Hanna Shoal Ecosystem Study, 2012
Searching for bearded seals:	John Jansen, NMML; Pinniped Movements and Foraging, 2011
Glider in the water:	Hank Statscewich, UAF; Circulation of the NE Chukchi Sea, 2012
Sharing traditional knowledge:	John Callahan, BOEM; Public Hearing in Point Hope, 2011
Meteorological buoy:	Mesoscale Meteorology Modeling Study project team, 2011
Aerial survey in the Beaufort:	Megan Ferguson, NMML, Distribution of Marine Mammals, 2011
Collecting ice samples:	Bob Selby, Champlain College; Hanna Shoal Ecosystem Study, 2013



United States Department of the Interior

BUREAU OF OCEAN ENERGY MANAGEMENT

Alaska OCS Region

3801 Centerpoint Drive, Suite 500

Anchorage, Alaska 99503-5823

November 6, 2013

Dear Stakeholder:

Thank you for your interest in the Environmental Studies Program (ESP) of the Bureau of Ocean Energy Management (BOEM). The agency assesses its information needs and develops new study profiles on an annual basis. We follow a well-established process that involves a role for both stakeholder input and scientific peer review (see a complete description of our process in Section 1.1.3). We are interested to know your perspectives and to receive any suggestions you may have for the BOEM *Alaska Annual Studies Plan, FY 2015*, which we are now beginning to formulate.

For your convenient reference, we are providing the *Alaska Annual Studies Plan FY 2014*, developed from submissions we received over the past year. For FY 2015 planning, we will continue to receive hardcopy submissions at our regional office. In addition, we have prepared a web docket at <http://www.regulations.gov> to facilitate public submission of new study ideas in digital format. Please enter "BOEM-2011-0096" in the search bar to open the latest docket folder.

To assist us in processing any suggestions for new studies, we ask that you follow the formatting guidance for a study profile as shown on the next page. Please keep in mind that studies proposed for our consideration must address specific BOEM mission and decision needs (see Section 1.3). Suggestions need to be received by us no later than December 20, 2013, to assure consideration for the 2014 fiscal year. Following revisions to the plan, we will issue a final *Alaska Annual Studies Plan FY 2015* in the autumn of 2014.

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, Studies Plan Coordinator, at (907) 334-5281.

Sincerely,

Dee Williams, Ph.D.

Chief, Environmental Sciences Management

**Bureau of Ocean Energy Management
Alaska Environmental Studies Program**
<http://www.boem.gov/akstudies/>

Proposed Study for FY 2015

Formatting Guidance: We recommend study profiles be less than 2 pages. Please do not try to make this a detailed scope of work. If the study is selected for further consideration, BOEM will prepare a more detailed scope of work. Please provide the following categories of information.

Region: Sample Region

Planning Area(s): All

Title: Sample Title and Profile to Show Formatting

BOEM Information Need(s) to be Addressed: Provide brief and conclusive reason(s) why BOEM needs the information. For example, identify how the study relates to analysis under the National Environmental Policy Act and/or specific BOEM decision(s), such as formulation of a mitigation measure. Please be as specific as possible.

Period of Performance: FY 2015-20XX

Description:

Background: Please provide 1 to 2 paragraphs on 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 objective(s) of the study. Explain what hypothesis will be tested or what questions will be answered by this study. We encourage the use of lists (1, 2, 3, etc.) for multiple, related objectives.

Methods: Provide brief detail on what information, techniques or methods are available that could be used. Explain how the objectives of the study will be accomplished.

Date information is required: Provide dates when products would be most useful and for what purpose, such as “Final report is needed by September 2016 to support NEPA analysis for planned lease sales in 2017.” If the study includes products additional to the scientific report (e.g. database, model, bibliography), explain in this section.

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ACRONYMS AND ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
ADF&G	Alaska Department of Fish and Game
AEWC	Alaska Eskimo Whaling Commission
AKMAP	Alaska Monitoring and Assessment Program
ANIMIDA	Arctic Nearshore Impact Monitoring in Development Area
Approx.	Approximate
ASP	Alaska Annual Studies Plan
AOOS	Alaska Ocean Observing System
AUV	Autonomous Underwater Vehicle
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOWFEST	Bowhead Whale Feeding Ecology Study
BPXA	BP Exploration Alaska
BSMP	Beaufort Sea Monitoring Program
BSEE	Bureau of Safety and Environmental Enforcement
BWASP	Bowhead Whale Aerial Survey Project
CAB	Chemistry and Benthos
cANIMIDA	Continuation of Arctic Nearshore Impact Monitoring in Development Area
CESU	Cooperative Ecosystem Studies Unit
CHAOZ	Chukchi Acoustics, Oceanography and Zooplankton study
CIAP	USDOJ Coastal Impact Assistance Program
CMI	Coastal Marine Institute
COMIDA	Chukchi Offshore Monitoring in Drilling Area
CTD	Conductivity, Temperature, Depth sensor
DFO	Department of Fisheries and Oceans Canada
DPP	Development and Production Plan
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)
FY	Fiscal Year
GIS	Geographic Information Systems
GPS	Global Positioning System
HF	High Frequency

IFO	Intermediate Fuel Oil
ITM	Information Transfer Meeting
IUM	Information Update Meeting
JIP	Joint Industry Program
LCC	Landscape Conservation Cooperative
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMML	National Marine Mammal Laboratory
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NOPP	National Oceanographic Partnership Program
NOS	National Ocean Service
NPRB	North Pacific Research Board
NSB	North Slope Borough
NSSI	North Slope Science Initiative
NSF	National Science Foundation
NSL	National Studies List
OCSEAP	Outer Continental Shelf Environmental Assessment Program
OCSLA	Outer Continental Shelf Lands Act
OSRA	Oil-Spill-Risk Analysis
OSU	Oregon State University
OWM	Oil Weathering Model
PMEL	Pacific Marine Environmental Laboratory
SDI	Satellite Drilling Island
SOAR	Synthesis of Arctic Research
TK	Traditional Knowledge
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
UAS	Unmanned Aircraft System
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UT	University of Texas
UW	University of Washington
WHOI	Woods Hole Oceanographic Institution

SECTION 1.0 PROGRAMMATIC OVERVIEW

1.1 Introduction to the Region

1.1.1 Background

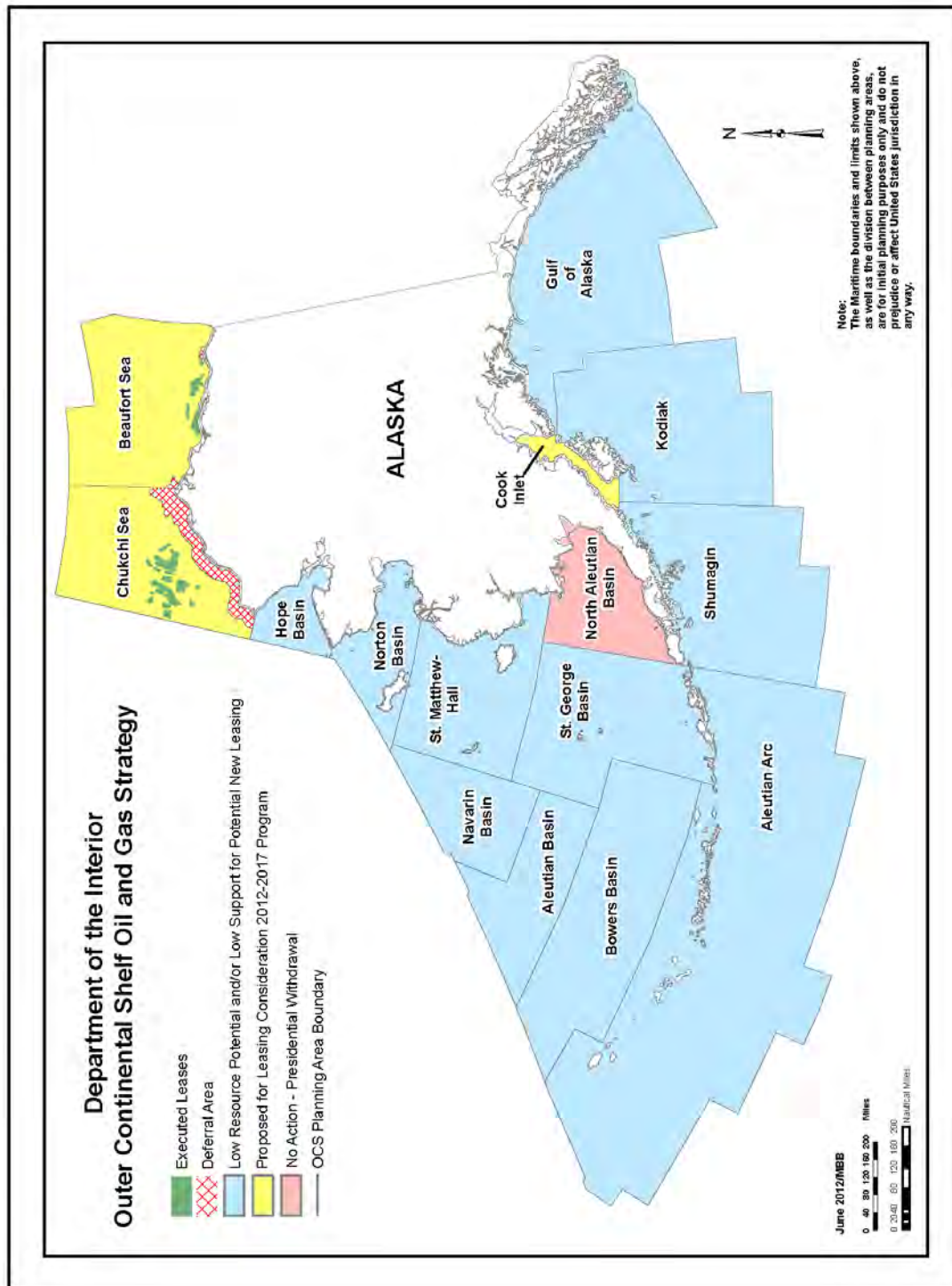
The Environmental Studies Program (ESP) of the Bureau of Ocean Energy Management was established and funded by the United States Congress to support the offshore oil and gas leasing program of the U.S. Department of the Interior (USDOI) in pursuit of national energy policies. The Environmental Studies Program was administered originally by the Bureau of Land Management (BLM) from 1973 until 1982, then by the Minerals Management Service (MMS), and presently by the Bureau of Ocean Energy Management (BOEM) since October 2011. The consistent mandate of the ESP since its inception has been to establish the scientific information needed for assessment and management of potential impacts from oil and gas development on the human, marine and coastal environments of the Outer Continental Shelf (OCS). The OCS refers to 1.7 billion acres of Federal jurisdiction lands submerged under the ocean seaward of State boundaries, generally beginning three statute miles off the coastline (for most states) and extending for 200 miles. The Alaska OCS Region alone contains approximately 1 billion acres.

The Outer Continental Shelf Lands Act (OCSLA) of 1953, as amended (43 U.S.C. 1331 et seq.), provides direction for implementing an OCS oil and gas exploration and development program based on the need to balance orderly energy resource development with protection of the human, marine, and coastal environments. Also, the National Environmental Policy Act (NEPA) of 1969 requires that all Federal Agencies use a systematic, interdisciplinary approach that will ensure the integrated use of the natural and social sciences in any planning and decision-making that may have effects on the environment. Federal laws impose additional requirements on the offshore leasing process, these include the Coastal Zone Management Act; Federal Water Pollution Control Act Amendments; Marine Mammal Protection Act (MMPA); Endangered Species Act (ESA); and Marine Protection, Research and Sanctuaries Act.

The ESP operates on a national scale to assist in predicting, projecting, assessing and managing potential effects on the human, marine and coastal environments of the OCS that may be affected by oil and gas development. Lease-management decisions are enhanced when current, pertinent and timely environmental information is available. Final reports from the ESP are most directly utilized by teams of NEPA analysts within the BOEM Environmental Analysis Sections when they prepare Environmental Impact Statements (EISs) and Environmental Assessments (EAs), and review Geological and Geophysical permit applications, Exploration Plans (EPs) and Development and Production Plans (DPPs). Of course, a wide range of scientists, stakeholders and decision-makers also make use of our study products.

Since the ESP began, the USDOI and BOEM have funded nationally more than \$1 billion for environmental studies through fiscal year (FY) 2013. More than \$425 million of that amount has funded studies in Alaska across 15 planning areas in the Arctic,

Figure 1. Alaska OCS Region Planning Areas



Bering Sea and Gulf of Alaska sub-regions (see Figure 1) to produce more than 500 different study reports, as well as more than 300 peer-reviewed publications since 1990. The ESP manages ongoing study projects in Alaska (currently about 50) in disciplines such as physical oceanography, air quality, fate and effects of pollutants, protected and endangered species, marine ecology, and the social sciences, including traditional knowledge. Completed study reports are posted on our website at http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp. An alternate location for browsing Alaska Region study reports by year is <http://www.boem.gov/BOEM-Newsroom/Library/Publications/Alaska-Scientific-and-Technical-Publications.aspx>.

Early in the development of the program, the focus was on obtaining baseline information on the vast biological resources and physical characteristics of the Alaskan environment for pre-lease decision-making. These studies included biological surveys of marine species, basic oceanography and meteorology, and geologic and sea ice phenomena. As a broader base of information was established, it became possible to focus on more topical studies in smaller areas to answer specific questions and fill identified information needs. In addition, generic studies were initiated to examine the potential effects of oil spills on biological resources and different oil development scenarios were modeled to determine the most likely routes of transport and dispersion of oil that might affect the marine environment. The use of computer modeling techniques has been implemented to aid in the assessment of potential oil spill and other pollutant risks to the environment, and to key species such as fur seals, sea otters and endangered whales. Modeling has also been used in ecosystem studies, especially where extrapolation to other areas provided valid analysis.

As studies information has been amassed, improved focus has required greater integration of various scientific disciplines. The ESP has initiated Synthesis Meetings, Information Transfer Meetings (ITMs) and Information Update Meetings (IUMs) to gather maximum expertise and assess the status of existing information, as well as to plan the best possible approach to a study within the constraints of time and resources. As BOEM and other Federal and State agencies collect more pertinent information, BOEM funds studies to search and evaluate existing literature and data prior to initiation of field efforts. This prevents duplication of effort and saves valuable resources by focusing study efforts on the areas of greatest information need and highest usefulness. Of course, additional research coordination with groups external to BOEM occurs continuously through a variety of institutional mechanisms, as discussed in the following section.

1.1.2 Scientific Studies are Conducted in Partnership

The ESP in Alaska, through its day-to-day operations and studies planning process, works to:

- Coordinate plans and studies with other ongoing programs and research projects, both internal and external to BOEM, to assure optimal studies management and efficient use of funding resources.

- Enhance utilization of existing information.
- Enhance interdisciplinary approaches to project planning, data collection and data interpretation.

Currently, a major portion of the ESP in Alaska is conducted on a collaborative basis with an extensive range of bilateral and multilateral partnerships. The ESP in Alaska coordinates routinely on major projects with numerous Federal entities, including: National Oceanographic Partnership Program (NOPP); National Oceanic and Atmospheric Administration (NOAA) and the National Marine Fisheries Service (NMFS) Alaska Fisheries Science Center; NOAA's National Marine Mammal Laboratory (NMML); U.S. Geological Survey (USGS)-Alaska Science Center; U.S. Fish and Wildlife Service (USFWS) and the Arctic Landscape Conservation Cooperative (LCC); USDOJ Coastal Impact Assistance Program (CIAP); the North Slope Science Initiative (NSSI); National Aeronautics and Space Administration (NASA); National Science Foundation (NSF); U.S. Arctic Research Commission; and the Polar Research Board.

In addition, the ESP works directly on specific projects with the Alaska Ocean Observing System (AOOS); the North Pacific Research Board (NPRB); Alaska Department of Fish and Game (ADF&G); the North Slope Borough (NSB) Department of Wildlife Management; the Alaska Eskimo Whaling Commission (AEWC); and academic institutions including the University of Alaska Anchorage (UAA), University of Alaska Fairbanks (UAF), Woods Hole Oceanographic Institution (WHOI), University of Washington (UW), Idaho State University, and University of Texas (UT). The ESP also coordinates closely with active industry research and monitoring programs in Alaska conducted by BP, Shell Offshore Inc., ConocoPhillips, and others.

In 1993, the University of Alaska Coastal Marine Institute (CMI) was created by a cooperative agreement between the University of Alaska and the ESP to study coastal topics associated with the development of natural gas, oil and minerals in Alaska's OCS. Under this arrangement, the ESP taps the scientific expertise of regional and local experts through the University of Alaska to collect and disseminate environmental information about resource issues of mutual interest. Through the CMI, the ESP stimulates important studies in a cost-saving one-to-one match structure. Since its inception, the CMI match has come from more than 50 different organizations and has leveraged over \$20 million of agency funds into \$40 million worth of relevant marine-based research. During that time, the CMI program has also provided roughly 137 years of student support and completed over 80 studies. The ESP has extended the cooperative agreement through 2017. For this agreement, the Alaska OCS Region has planned \$1,000,000 per year with a dollar-for-dollar match arrangement. More information about the CMI can be found at <http://www.sfos.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, with each unit focusing on a separate biogeographic region. The goal of the CESU network is 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 the State of Alaska, the Pacific Northwest, California, Hawaii and the Pacific Islands, the North Atlantic Coast, the South Atlantic Coast, and the Gulf of Mexico.

Additional linkages have been established at an international level with other arctic nations' research and regulatory entities. The U.S. and seven other arctic nations voluntarily agreed to cooperate on an Arctic Environmental Protection Strategy, which evolved into the formation of the Arctic Council in 1996. The ESP in Alaska has coordinated with Arctic Council activities, such as the Arctic Monitoring and Assessment Program, Conservation of Arctic Flora and Fauna, Arctic Climate Impact Assessment and others. The ESP provides information to these working groups through review of reports and plans, 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.

Since the people of Alaska's remote arctic and subarctic communities rely so heavily on subsistence resources of the marine environment, they are especially concerned about industrial activities that may directly or indirectly affect hunting success or the habitats of the species important to subsistence. The people of Cook Inlet also have concerns about potential effects of OCS activities on subsistence, commercial fishing, sport fishing and tourism. Many other related issues potentially could be affected by OCS activities, such as the well-being of marine mammals and threatened and endangered species. Coastal residents of Alaska have concerns about these resources, as do State and Federal agencies responsible for their management by law.

In ESP field oriented studies, 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 ESP strives to assimilate local and traditional knowledge of Alaskan residents directly in the preparation of its study products and interpretation of results. The process of melding local and traditional knowledge varies from project to project, but the outcome of better information for decision making is a common goal.

1.1.3 Alaska OCS Studies Planning Process

In the Alaska OCS Region of BOEM, research planning is a continual process that follows a longstanding annual cycle, beginning with the distribution of the Alaska Annual Studies Plan (ASP). The ASP is distributed in autumn to more than 200 stakeholder groups across Federal, State, Native, academic, and industry sectors spanning international, regional, and local interest groups. While the ASP describes ongoing research and reveals approved new studies for the coming fiscal year, it also serves to initiate the next planning cycle by circulating a letter that calls for suggestions about new information needs from all interested parties, including scientists, stakeholders, and the general public.

In Alaska, we typically receive more than 60 study profiles from external institutions and BOEM staff with suggestions for new research. Correspondence from agencies such

as NMFS, USFWS, and the State of Alaska are carefully considered; particularly those that are relevant to interagency consultations under the Endangered Species Act and other processes. Additional ideas for new research derive throughout the year from program reviews and public meetings, including science conferences, multilateral planning sessions, and public hearings. Study profiles also address recommendations from broad programmatic reviews or “data gap” analyses, such as those coming from the National Academy of Sciences, the Interagency Ocean Policy Task Force, the 2011 USGS Circular 1370, and the Arctic Council. Furthermore, we prepare and advertise a web docket every autumn to facilitate convenient public submission of study ideas for consideration. Of course, the majority of incoming proposals for new research still originate with BOEM staff and managers in the regular performance of their duties.

From these multiple sources of input, BOEM subject-matter experts assimilate the various study comments and recommendations and consolidate them into discrete study profiles. Often, this involves merging several related objectives from multiple sources into a single study effort. It also involves revising submissions to enhance mission-focus or to provide more conclusive results. Consistent with our mission, the Environmental Studies Program funds studies that have strong applicability to pending pre- and post-lease decisions under the OCS Five-Year Oil and Gas Leasing Program. The most important considerations for establishing priorities within the national context include: program relevance; timing in relation to assessment needs; feasibility and likelihood of conclusive findings; and availability of information from other sources.

After evaluation of incoming proposals for completeness and extensive internal discussions, we prepare a short-list of the high priority study profiles to be considered by regional and national senior managers. In late January, the short-list of proposed profiles, as defined by priority of information need and consideration of budgetary constraints, is shared and coordinated with other agencies through multilateral partnerships such as the North Slope Science Initiative and the Arctic Landscape Conservation Cooperative. The proposed new profiles are then formally reviewed each spring by our OCS Scientific Committee (an external peer-review advisory body) to evaluate the priority and quality of each proposed study, as well as the technical aspects of proposed study methods. The proposed profiles are again revised and reprioritized as needed, and finalized by August for funding allocation in the new fiscal year. The Annual Studies Plan is then finalized and circulated to the public in autumn, when the cycle starts all over again.

Once a research project achieves funding and gets underway, interim reports and project websites facilitate data sharing and report dissemination. When a project is complete, final study reports are posted to the BOEM website and a number of other scientific web portals to facilitate distribution. Project data are typically delivered to the National Oceanographic Data Center (NODC) and to customized project websites. The Environmental Studies Program is also developing new platforms for enhanced data sharing with all stakeholders. Thus, from start to finish, the entire planning, procurement, and dissemination process involves constant coordination with multiple organizations and scientific entities.

1.1.4 Issues To Be Addressed

The *Alaska Annual Studies Plan FY 2014* complements and reinforces the goals of the Environmental Studies Program. The ESP is guided by several broad themes, which include:

- Monitoring Marine Environments
- Conducting Oil-Spill Fate and Effects Research
- Minimizing Seismic and Acoustic Impacts
- Understanding Social and Economic Impacts
- Maintaining Efficient and Effective Information Management
- Integrating Scientific Results with Local and Traditional Ecological Knowledge

To be responsive to current and future offshore activities and changing technologies, the Alaska OCS Region continually proposes new studies and pursues information needs in conjunction with ESP goals. Due to the great differences that exist between Alaskan environments and other OCS areas, the ESP in Alaska must remain especially flexible in planning and implementing needed studies.

At each step of the offshore leasing, exploration and development process, a variety of potential issues or resource-use conflicts may be encountered. Two questions are fundamental:

- What is the expected change in the human, marine and coastal environment due to offshore activity?
- Can undesirable change be minimized through mitigation measures?

Environmental studies are the primary means to provide information on these questions for use by decision-makers. Currently the ESP in Alaska has primary focus on upcoming lease sales, as well as planned and proposed exploration activities in the Beaufort Sea and Chukchi Sea Planning Areas. Offshore oil and gas-related issues addressed by ongoing and proposed studies in the Beaufort and Chukchi Seas include, but are not limited to:

- What refinements can we make to our knowledge of major oceanographic and meteorological processes and how they influence the human, marine and coastal environment?
- What role will currents play in distribution of anthropogenic pollutants near exploration and development prospects?
- What long-term changes in heavy metal and hydrocarbon levels may occur near exploration and development prospects, or regionally along the Beaufort and Chukchi coasts?
- How do we improve our model predictions of the fate of potential oil spills?
- If oil is spilled in broken ice, what will its fate be?

- What effects might pipeline construction have on nearby marine communities or organisms?
- What changes might occur in sensitive benthic communities such as the Stefansson Sound “Boulder Patch,” and other Beaufort Sea kelp communities or fish habitats?
- What are the current spatial and temporal use patterns of these planning areas by potentially sensitive species such as bowhead whales, polar bears, other marine mammals, seabirds and other birds, or fish?
- What is the extent of endangered whale feeding in future proposed or potential lease sale areas?
- What changes might occur in habitat use, distribution, abundance, movement or health of potentially sensitive key species such as bowhead whales, polar bears, other marine mammals, seabirds and other birds, or fish?
- What interactions between human activities and the physical environment, including noise, have affected potentially sensitive species?
- What changes might occur in socioeconomics and subsistence lifestyles of coastal Alaska communities?
- What are current patterns of subsistence harvest, distribution and consumption and what changes might occur in key social indicators as a result of offshore exploration and development?
- How can we continue to integrate local and/or traditional knowledge into studies related to the ESP in Alaska?

Many of these same issues are also relevant to the Cook Inlet Planning Area. Some additional concerns in Cook Inlet include:

- What are the potential effects of oil exploration and development on key economic activities such as commercial fishing, sport fishing, and tourism?
- How do we improve our model predictions of the fate of potential oil spills in locations with extensive intertidal areas?
- What are the current spatial and temporal use patterns of this planning area by potentially sensitive species such as beluga whales, fin whales, Steller sea lions, sea otters, other marine mammals, seabirds and other birds, or fish?

1.2 Projected OCS Activities

This *Alaska Annual Studies Plan* reflects consideration of the many changes occurring in the Alaska OCS Region, as well as anticipated needs for the future. In a frontier region such as the Arctic, planning lead-time is necessary to conduct adequate environmental studies. Challenges include: large and remote planning areas, diverse and extreme environmental conditions, still-evolving hydrocarbon extraction technology, and potential environmental hazards associated with offshore activities.

1.2.1 Pre-lease Considerations

Preparation of an EIS based on the best available information is an essential part of the pre-lease process and ensures that decisions on whether to make areas of the OCS available for leasing are based on consideration of potential environmental impacts. This introduces an additional time-sensitivity to the information need. Although much relevant information exists for certain Alaska OCS lease areas, data are sparse in other areas and environmental and other conditions are changing over time. Updating past studies to address information needs and changing conditions can substantially improve the quality of the information upon which our environmental analyses are based and help facilitate informed leasing decisions.

On June 28, 2012, BOEM released the *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program 2012-2017* (USDOI, BOEM, 2012). This Proposed Final Program schedules three potential lease sales in the Alaska OCS. These potential lease sales are deliberately scheduled late in the program to allow for further development of scientific information regarding the sensitive habitats, unique conditions and important other uses, including subsistence hunting and fishing, as well as the oil and gas resource potential in these areas. The first potential sale is scheduled for 2016 in the Chukchi Sea Planning Area (see Figure 2). The *Proposed Final Program* includes a pre-existing 25-mile nearshore buffer and an additional deferral area to the north of Barrow that will not be considered for leasing due to its documented importance for subsistence use. Another sale is proposed for 2017 in the Beaufort Sea Planning Area (see Figure 3). Two subsistence whaling areas near Barrow and Kaktovik will be excluded from this lease sale. Also, the *Proposed Final Program* includes a sale in the Cook Inlet Planning Area (see Figure 4) in 2016. BOEM has determined that the scope of potential industry interest is sufficient to warrant completion of a full environmental impact statement prior to making a final determination about the lease sale. Historically, industry interest in this area was limited and environmental analysis must be updated for the proposed sale.

1.2.2 Post-lease Considerations

Prior to FY 1982, most studies offshore of Alaska were planned, conducted, and concluded before a lease sale was held in order to provide information for decision making and EIS production. However, not all needed information can be obtained prior to a lease sale. In accordance with mandates of Section 20 of the OCS Lands Act, the need for studies continues into the post-lease period to address environmental concerns and monitoring related to specific areas of industry activity. The ESP acquires additional information for environmental analyses related to exploration, development and production in the post-lease phase. Thus, an increasing number of studies have become more closely related to proposed exploration and development schedules and related monitoring in addition to those broader studies related to the pre-lease stage. As with the pre-lease stage, the wide range of environmental conditions from Cook Inlet to the Arctic is considered during the process of formulating new studies. Post-lease activities that require environmental data and assessment include:

Figure 2. Chukchi Sea Oil and Gas Leases

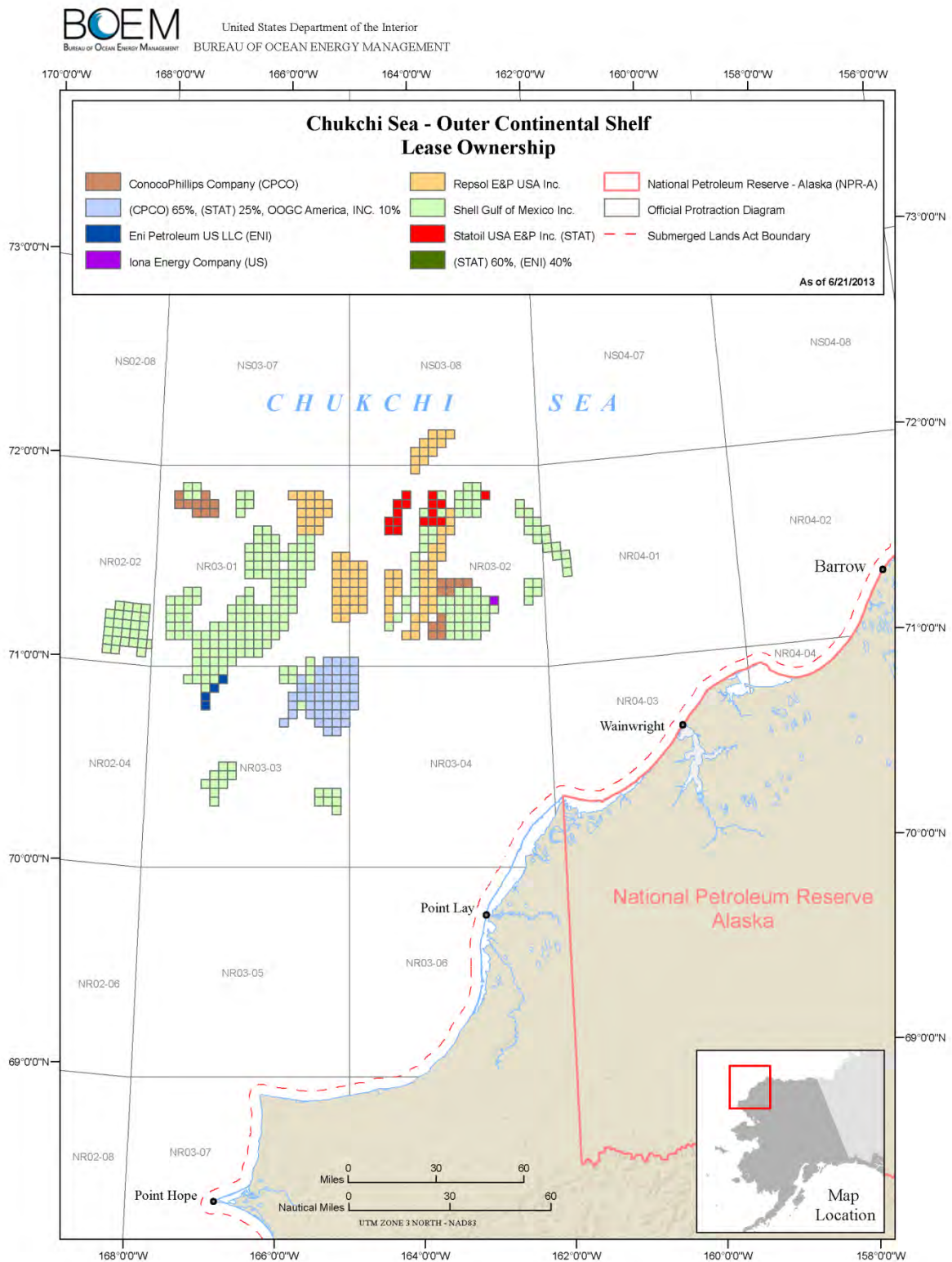


Figure 3. Beaufort Sea Oil and Gas Leases

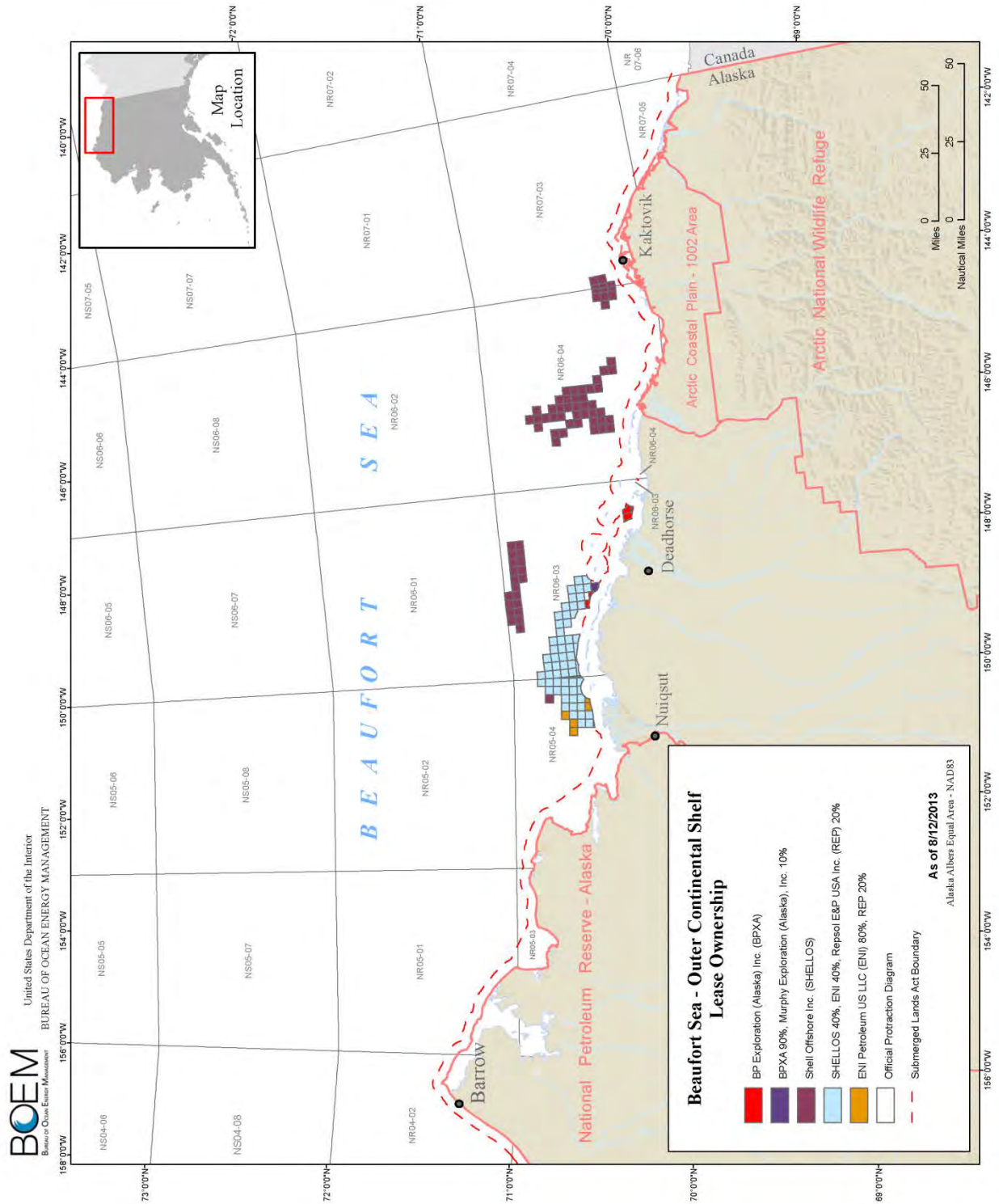
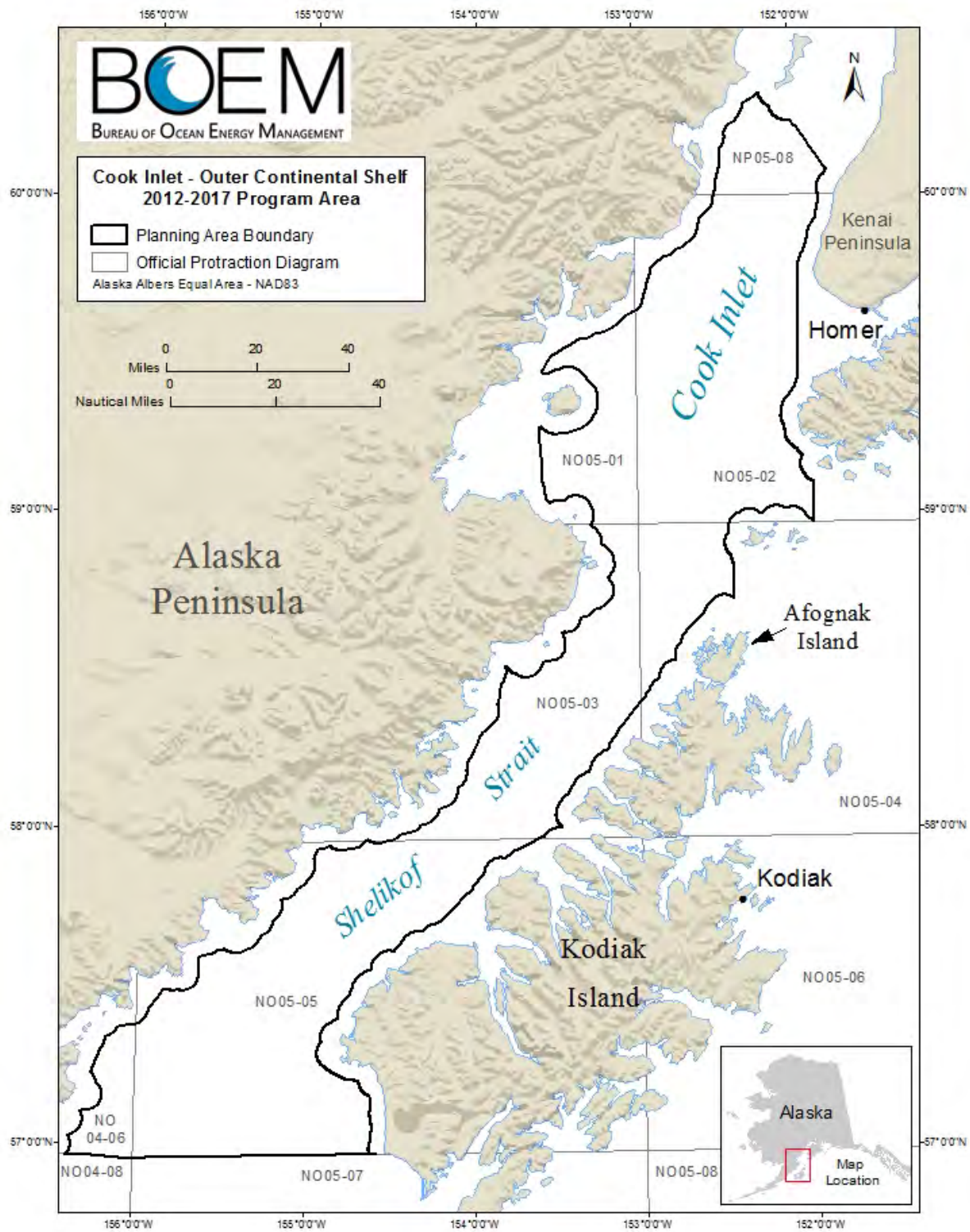


Figure 4. Cook Inlet Planning Area



- Geophysical surveys
- Review of Exploration Plans (EPs)
- Monitoring of exploration drilling Review of Development and Production Plans (DPPs)
- Monitoring of development, construction and production activities
- Oil and gas transportation
- Platform decommissioning
- Oil spill detection, containment, clean-up and damage assessment

In the Beaufort Sea Planning Area, there have been 929 tracts leased in ten OCS lease sales. Industry has drilled 30 exploratory wells and determined 11 to be producible. Lease Sale 193 in February 2008 resulted in 487 leases being issued in the Chukchi Sea Planning Area. As of September, 2013, there are 151 active leases in the Beaufort Federal offshore area and 460 active leases in the Chukchi Sea. There are no active leases from previous lease sales in the Chukchi Sea or Hope Basin portions of the Arctic Subregion or in the Bering Sea, Cook Inlet or Gulf of Alaska Subregions.

Production:

Northstar – Northstar (see Figure 5) is a joint Federal/State of Alaska unit located in state waters in the Beaufort Sea about 6 miles northwest of Prudhoe Bay. BP Exploration Alaska, Inc. (BPXA) is the lessee and operator of Northstar. 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 2013 is more than 158 million barrels, with the Federal portion comprising about 28.2 million barrels.

Development:

Liberty – The Liberty prospect is located in the central Beaufort Sea about 6 miles east of the existing Endicott Satellite Drilling Island (SDI). BP Exploration Alaska (BPXA) is considering development options, including potential construction of a gravel island. BPXA estimates that the reserves for the Liberty project total 150 million barrels of oil.

Exploration:

Conditionally Approved Exploration Plan for Camden Bay (Beaufort Sea) – Shell plans to drill up to four exploration wells in the Beaufort Sea over multiple years. The wells will be located about 20 miles offshore, in waters approximately 120 feet deep. BOEM approved the Beaufort Sea EP subject to 11 conditions on August 4, 2011. The conditions included requirements for Shell to receive specific permits and authorizations from the EPA, NMFS and USFWS. The conditions also included requirements that Shell submit documentation for approval on the procedures for deployment, installation and operation of the subsea well-capping and containment system, as well as relief well plans. Under the conditions of the plan, Shell must employ an approved, site-specific bowhead whale monitoring program, beginning on August 1. Shell must also suspend any drilling operations in the Beaufort Sea from August 25 until nearby Alaska Native villages have completed their subsistence hunts and Shell has received approval from BOEM to resume

Figure 5. Northstar Island, August 2000



activity. During 2012, Shell completed the top hole section of one well at its Sivulliq Prospect in the Beaufort Sea. Due to problems encountered with towing their drill rig out of Alaska in December 2012, Shell did not return in 2013, but they have expressed interest in continuing their exploration in the Beaufort Sea.

Conditionally Approved Exploration Plan for the Chukchi Sea – Shell proposes drilling up to six exploration wells in the Chukchi Sea over multiple years. The wells will be located about 85 miles northwest of the coastal village of Wainwright, in waters approximately 140 feet deep. On December 16, 2011, BOEM approved the Chukchi Sea EP subject to 15 conditions. Among the conditions of approval is a measure designed to mitigate the risk of an end-of-season oil spill by requiring Shell to leave sufficient time for response and cleanup. Consistent with the Department's cautious approach to offshore oil and gas exploration in the Arctic, Shell was directed cease drilling into hydrocarbon zones in the Chukchi Sea 38 days before the earliest anticipated date of ice encroachment. Approval is also conditioned on a series of other measures to increase safety and confirm the availability of response equipment, including a well capping and containment system, and to ensure that Shell takes important steps to avoid conflicts with subsistence activities. Approval to operate is also conditioned upon receipt of necessary approvals from other agencies, including BSEE. During 2012, Shell completed the top hole section of one well at its Burger Prospect in the Chukchi Sea. Due to problems encountered with towing their drill rig out of Alaska in December 2012, Shell did not return in 2013, but they have expressed interest in continuing their exploration in the Chukchi Sea.

Air Quality: The Consolidated Appropriations Act of 2012 transferred jurisdiction to regulate air emissions associated with oil and gas activities on portions of the Alaska OCS from EPA to BOEM. Companies seeking to operate facilities on the Chukchi Sea OCS and Beaufort Sea OCS no longer require an air quality permit from the EPA. Rather, their proposed facilities' emissions will be verified by BOEM as a prerequisite to approval of the operator's exploration plan or development and production plan. BOEM's existing regulations are designed to ensure that air quality in coastal areas complies with national ambient air quality standards as promulgated by EPA. These regulations have protected air quality in coastal states along the Gulf of Mexico for decades and were also used to regulate oil and gas exploration activities in the Arctic during the 1980s.

Legal Challenges: Litigation remains a factor for Alaska OCS activities. Currently, there are two active cases.

Native Village of Point Hope v. Salazar, No. 1:08-cv-00004-RRB (D. Alaska) (Sale 193). In January 2008, a coalition of environmental groups, a local government, a Federally recognized tribe, and an Alaska Native organization challenged the government's decision to hold Lease Sale 193, which offered tracts in the Chukchi Sea. The plaintiffs alleged inadequacies in the environmental reviews supporting the leasing decision. On July 21, 2010, the U.S. District Court for the District of Alaska issued an order that enjoined all activity under Lease Sale 193 and remanded the action back to the government for additional NEPA review. Specifically, the Court instructed the government to: (1) analyze the environmental impact of natural gas development; (2)

determine whether missing information identified in the Sale 193 Final EIS was essential or relevant under 40 CFR 1502.22; and (3) determine whether the cost of obtaining the missing information was exorbitant, or the means of doing so unknown. BOEMRE (now BOEM) prepared a Final Supplemental EIS to satisfy these three concerns, and on October 3, 2011, the Secretary of the Interior signed a Record of Decision that affirmed Sale 193 as held.

On February 13, 2012, finding that BOEM had satisfied its remand, the District Court entered an order dismissing the matter in its entirety. On April 12, 2012, Plaintiffs filed a Notice of Appeal. The Ninth Circuit Court of Appeals heard oral arguments on March 5, 2013. A final ruling is still pending.

Center for Sustainable Economy v. Salazar. In October 2012, a non-profit organization filed a petition in the U.S. Court of Appeals for the District of Columbia Circuit challenging the *Proposed Final Program for 2012-2017*. Based on its subsequent filings, the petitioner is expected to assert violations of the Outer Continental Shelf Lands Act, the National Environmental Policy Act, and the Administrative Procedures Act. Arguments will likely focus on BOEM's economic and environmental analysis.

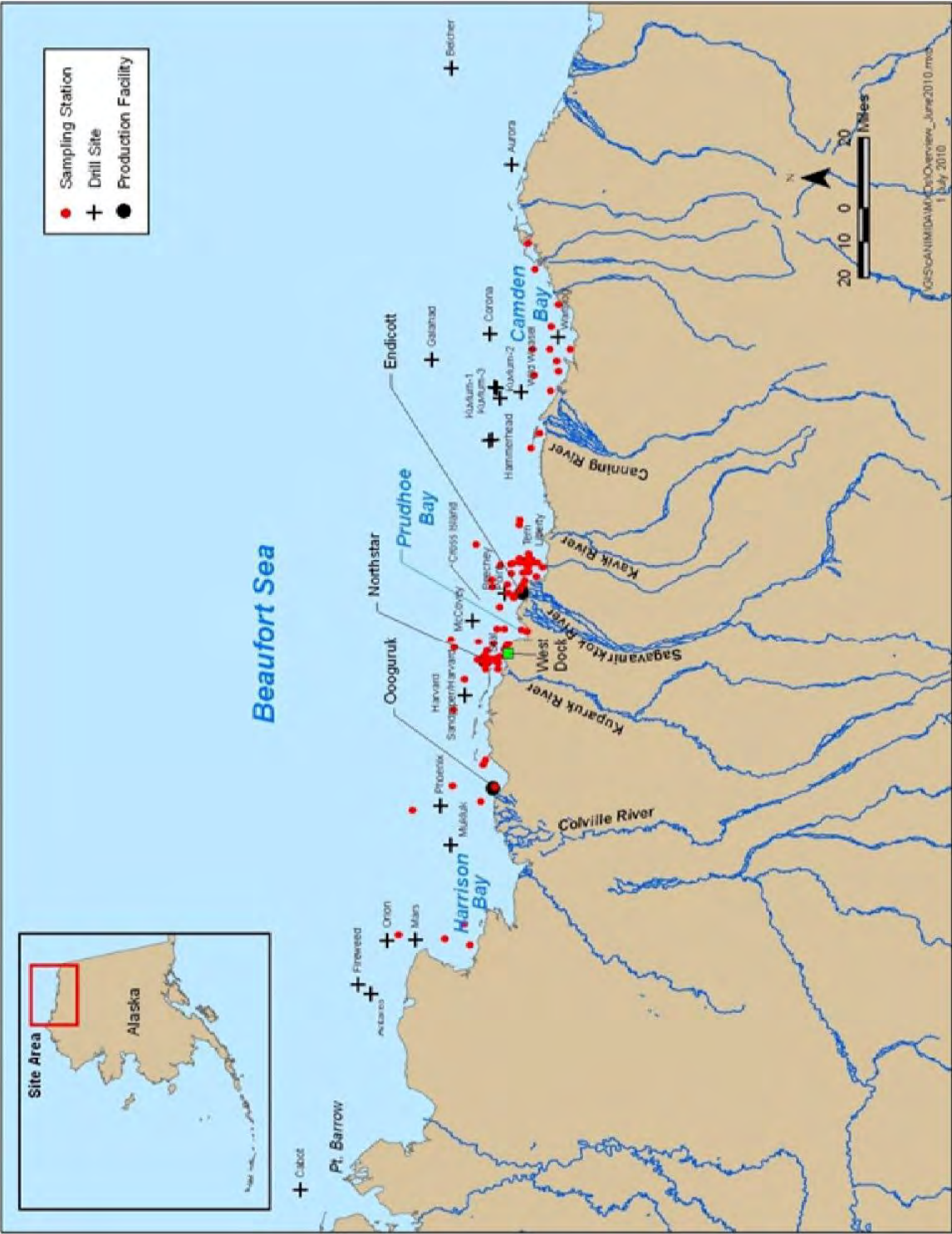
1.3 Identification of Information Needs

1.3.1 Beaufort Sea General Information Needs

Both offshore and onshore oil and gas development and production activities are continuing across Alaska's North Slope. Residents of Nuiqsut, Kaktovik and Barrow are particularly concerned about long-term effects of offshore developments at Northstar and other possible developments, as well as long-term and cumulative effects of any exploration from OCS Beaufort Sea lease sales. Key constituents have identified the need to monitor under-ice currents, sedimentation and potential effects on social systems in the vicinity of Northstar and Liberty, as well as other potential offshore activities. Related questions that need to be addressed include the characteristics of major oceanographic and meteorological processes and how they influence the human, marine and coastal environment.

Interdependent Physical, Biological and Social Processes: The Alaska OCS Region 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 Development Area" (ANIMIDA) program and its continuation (cANIMIDA) started in 1999 to provide baseline data and monitoring results for chemical contamination, turbidity, and subsistence whaling in the vicinity of Northstar and Liberty development sites (see Figure 6). This work continues today with the studies "ANIMIDA III: Boulder Patch and Other Kelp Communities in the Development Area," begun in 2012, and the recently awarded "ANIMIDA III: Contaminants, Sources, and Bioaccumulation," which has been expanded to include Camden Bay.

Figure 6. Locations of sampling stations for the cANIMIDA Program. (Neff, 2010)



In addition to the ongoing need for integrated research programs, there is also a need for synthesis of results from multiple studies to facilitate interpretation of data across disciplines. The ongoing “Synthesis of Arctic Research” (SOAR) study brings together a multidisciplinary group of Arctic scientists and Alaskan coastal community representatives to explore and integrate information from completed and ongoing marine research in the northern Bering, Chukchi and Beaufort seas. A number of 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. Highlights of these and other important research projects are provided in Section 1.3.5.

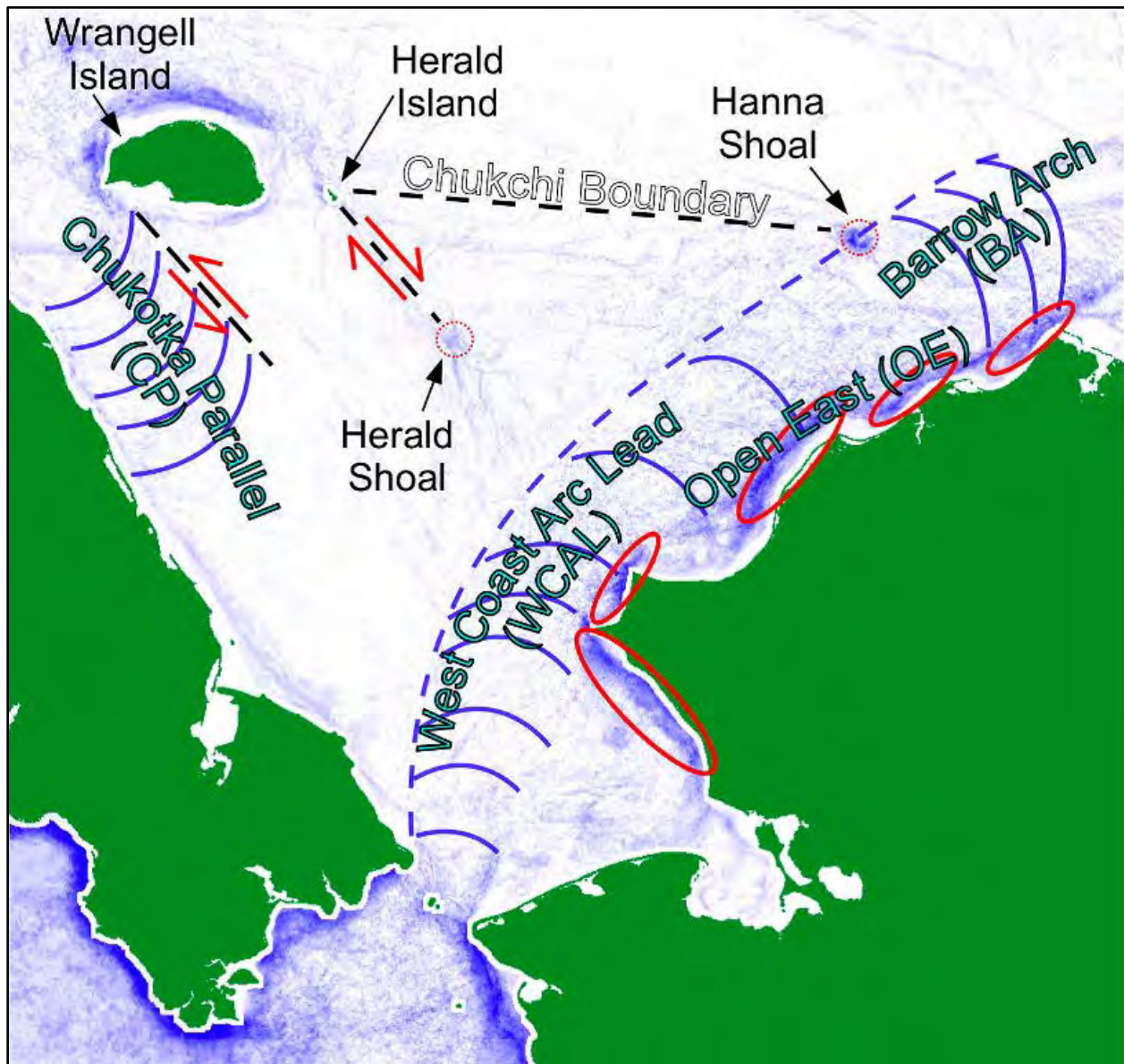
Ocean Circulation and Sea Ice: Accurate information on surface wind fields, ocean currents, and sea ice is important for determining the fate of spilled oil in this region and the impacts on biota associated with these systems. Studies conducted by the Alaska OCS Region have demonstrated that water motion is very different under landfast ice than in adjoining open or pack-ice areas. It becomes very important to know locations and seasonal changes in the distribution of polynyas, leads, and landfast ice. Figure 7 shows a schematic of key sea ice lead patterns sketched onto a map of recurrence probability estimates in the Chukchi Sea computed for the month of April between 1993 and 2010. Information about ice gouge characteristics and recurrence rates is also needed to assess risks associated with burial of oil production pipelines to support BOEM’s fault tree modeling.

Air Quality: The transfer of authority to BOEM to regulate industrial emissions in OCS areas of the Beaufort and Chukchi seas necessitates increased focus on Arctic OCS air quality considerations. Arctic oil and gas exploration and extraction activities proposed for the OCS require environmental evaluations pursuant to the National Environmental Policy Act and air quality operating approval to comply with the impact analysis required under NEPA and the Clean Air Act. Information will be used to assess the cumulative air quality impact of off-shore Arctic oil and gas activity, including oil spill response equipment and associated support equipment not already accounted for through State and Federal air quality permit requirements. The recently awarded study “Arctic Air Quality Impact Assessment Modeling” will compile a dataset of emission sources that will be used to drive EPA-approved air quality models.

Pollutants: North Slope residents are concerned about potential contamination of their food supply. In the Beaufort Sea such foods include bowhead whales, seals, waterfowl and fish. Of particular concern are environmental effects of development on these biota, including those from potential oil spills. Up-to-date information on ocean currents and sea ice is necessary to fully address these concerns. Contaminant monitoring in biota and sediments is ongoing in both the Beaufort and Chukchi seas.

Concern has also been raised over increasing spillage from corroded pipelines on the North Slope. The ongoing study “Oil Spill Occurrence Estimators for Onshore Alaska North Slope Crude and Refined Oil Spills” will update spill data for the Alaska North Slope and estimate occurrence rates for onshore oil spills. Information on the fate (weathering) of oil spills has recently been examined as part of a joint industry consortium (Oil in Ice JIP [Joint Industry Program]) doing field experiments on

Figure 7. Schematic of sea ice lead patterns sketched onto a map of recurrence probability in the Chukchi Sea for the month of April. (Mahoney et al. 2012)



cleanup, behavior, and weathering of oil in broken ice. The study “Physical and Chemical Analysis of Crude and Refined Oils: Lab and Mesoscale Oil Weathering,” proposed for FY 2014, will conduct laboratory and mesoscale oil weathering tests on a number of Alaskan crude or condensate oils, as well as refined oils.

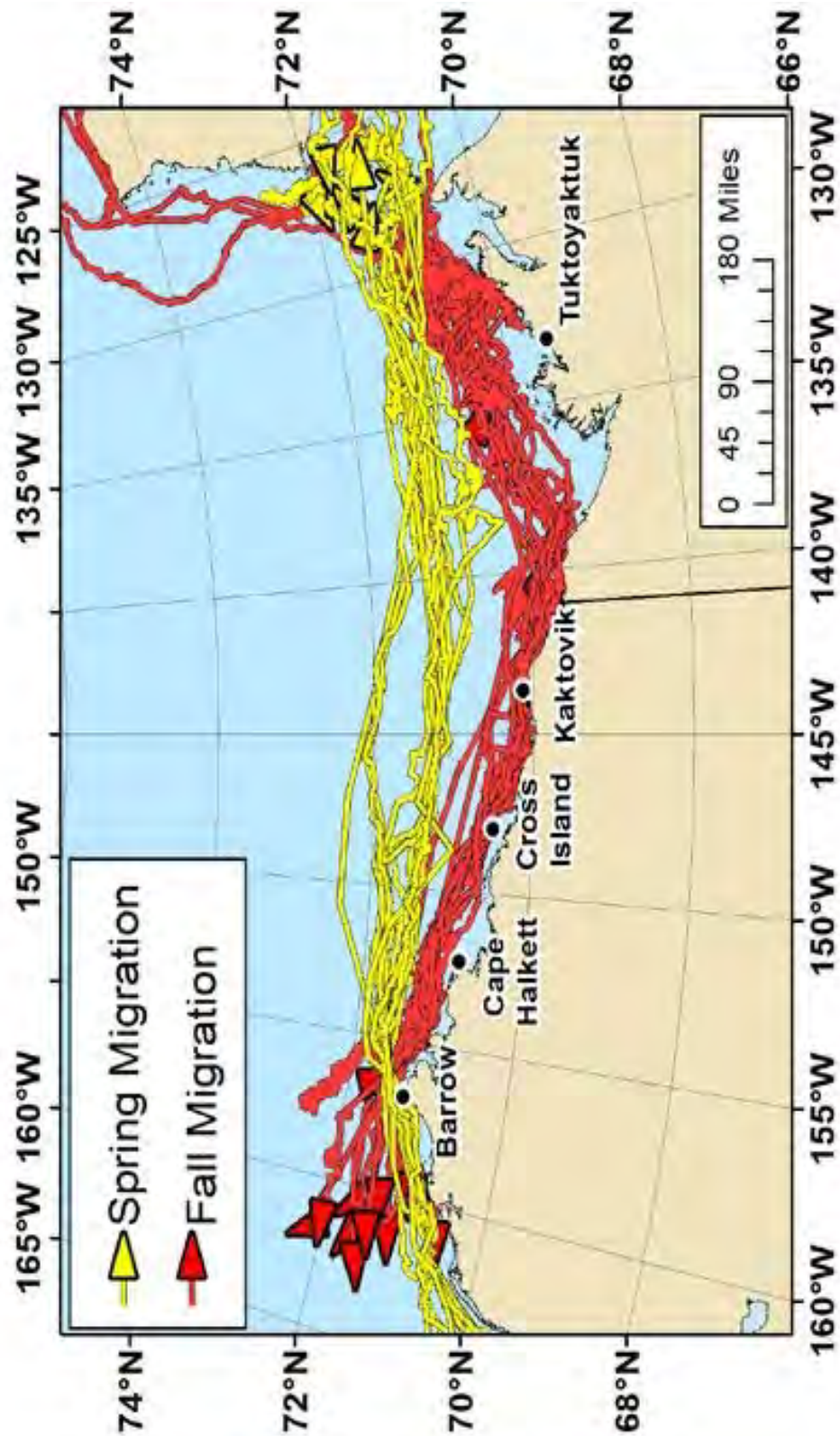
Information on Bowhead Whales and Other Wildlife: The Iñupiat rely heavily on bowhead whales for subsistence. The bowhead whale is central to village cultural and spiritual life. Whale hunters have reported that migrating bowhead whales deflect from their normal migratory route well upstream of active industry vessels and may divert a great distance from their migration route. A concern is that deflection around oil and gas activity (including seismic surveys, drilling activity and associated icebreaker support) makes whales skittish and more difficult to hunt. Figure 8 depicts a synthesis of tracks from satellite-tagged bowhead whales during the spring and fall migrations showing that spring migration occurs farther from shore than in fall. A total of 57 bowheads were tagged between 2006 and 2010. Information about bowhead feeding and habitat use is needed, and it is important to assess the factors that may be affecting the habitat use, health, population status and migration routes of bowhead whales. Noise from industrial activity is a central concern. Additionally, Iñupiat whale hunters and the scientific community have raised concerns about potential cumulative impacts on bowhead whales.

The populations of bowhead whales, polar bears, spectacled eiders, spotted and ringed seals, and other threatened and endangered species, as well as candidate species such as walrus and some ice seals, are an ongoing concern. Potential effects from loss of sea ice are a particular concern. More comprehensive abundance estimates for these ice-associated marine mammals enhance the assessment of potential impacts under NEPA and to ensure compliance with Federal management and regulatory mandates for marine mammals under the MMPA. North Slope villages are also concerned about potential disturbance of beluga whales, ringed seals, waterfowl and other subsistence-wildlife species by oil and gas activities such as helicopter overflights.

Fish and Lower Trophic Communities: Fishes in the Beaufort and Chukchi seas fill an essential role in the Arctic ecosystem by consuming small prey and in turn providing a food resource for larger fishes, birds, marine mammals, and people. It is important to assess the distribution and abundance of fishes in these areas and to distinguish between changes due to anthropogenic and natural effects. In addition, fish assemblages and populations in marine ecosystems off Alaska have undergone observable regime-shifts in diversity and abundance over the last 20-30 years.

The Magnuson-Stevens Fishery Conservation and Management Act is the Federal law that governs U.S. marine fisheries management for all outer continental shelf waters. Under the Magnuson-Stevens Act, each fishery management plan must describe and identify Essential Fish Habitat (EFH) for the fishery, minimize to the extent practicable the adverse effects of fishing on EFH, and identify other actions to encourage the conservation and enhancement of EFH. BOEM and other Federal agencies must consult with NMFS regarding any action that may adversely affect EFH. BOEM engages in consultation with NMFS officials and EFH assessment related to a number of species, including Arctic cod (adult and late juvenile), Pacific salmon (adult and late juvenile), and saffron cod (adult and late juvenile).

Figure 8. Tracks from satellite-tagged bowhead whales during the spring and fall migrations (Quakenbush et al. 2012)



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)
- Employment changes (potential effects on subsistence way of life by a cash economy)
- 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. People are concerned that a temporary or permanent elimination of primary subsistence foods would cause North Slope residents either to shift to less desired subsistence resources or to replace subsistence foods with expensive Western foods. Figure 9 provides an example of a synthesis map depicting bowhead whale subsistence hunting areas near Barrow over time. The Iñupiat are concerned about mitigation of impacts and compensation for potential losses. An anticipated decline in oil revenues to the NSB is also an issue of concern. Another concern 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 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. Data are very limited in the Chukchi Sea, and the last baseline study in the Beaufort Sea is decades old.

1.3.2 Chukchi Sea General Information Needs

The fundamental issues in the Chukchi Sea are very similar to those in the Beaufort Sea (see Section 1.3.1), although many species that regularly appear within the Chukchi Sea are not typically found within the Beaufort Sea. One major difference is that USDOI placed less emphasis on studying the Chukchi Sea than the Beaufort Sea beginning in the mid-1990s in recognition of leasing priorities at the time. Since 2007, however, the Alaska OCS Region has developed a new suite of studies in the Chukchi Sea, leveraging more than \$65 million (through FY 2013) to conduct interim baseline research and monitoring in all the following fields of interest: meteorology, ice dynamics and basic oceanography, benthic fauna and sedimentation, marine mammals (including whales, walrus, seals, and polar bear), fish, birds, and social systems. Most of the projects

Figure 9. A synthesis map depicting bowhead whale subsistence hunting use areas for the community of Barrow over time. (Stephen R. Braund & Associates, 2009)

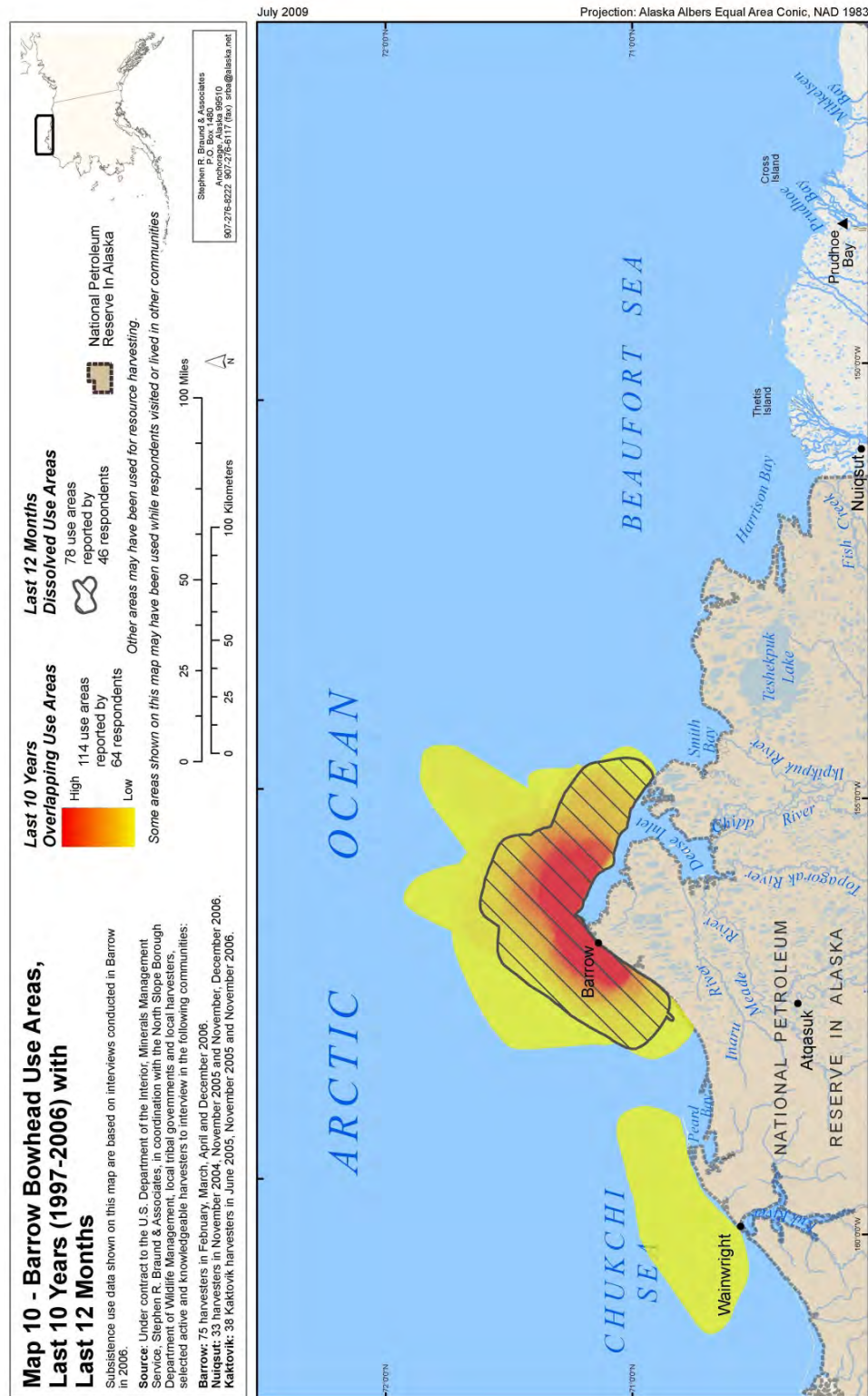


exhibit complex, multilateral collaborations, with explicit inter-disciplinary linkages between the physical and biological sciences, and many of them also provide a role for active participation by Alaska Native residents and input from sources of traditional knowledge. Most of them pursue multi-year data collection efforts on a regional scale, with careful attention to inter-annual variability and ecosystem processes.

1.3.3 Cook Inlet General Information Needs

The Alaska OCS Region has not undertaken a thorough environmental analysis of the Cook Inlet Planning Area since 2003. Updated information about the physical and biological environment in Cook Inlet and Shelikof Strait is needed to support NEPA analysis for potential future lease sales in this area. Specific information needs in Cook Inlet include, but are not limited to:

- An improved understanding of circulation and water mass movement in lower Cook Inlet
- Assessment of variability and long-term trends in oceanographic conditions and biological communities
- Use of the area by sensitive species including cetaceans, sea otters, pinnipeds, and seabirds

1.3.4 Renewable Energy General Information Needs

Section 388 of the Energy Policy Act of 2005 amended the OCSLA to give discretionary authority to BOEM to issue leases, easements or rights-of-way on the OCS for alternative energy projects, such as wind, wave, or ocean current facilities. Under this authority, the areas that BOEM makes available for alternative energy leasing are likely to be determined through a process that assesses different types of alternative energy resources, anticipated and potential environmental impacts, and other relevant information on a national, regional, or local basis. No lease sales for renewable energy are currently planned for the Alaska OCS.

1.3.5 Current Keystone Studies

Integrated Multidisciplinary Studies:

Hanna Shoal Ecosystem Study: This study continues the ecological monitoring of the Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemistry and Benthos (CAB) study and extends it to the region of Hanna Shoal. The study also will document the circulation and density fields, as well as ice conditions, at Hanna Shoal and examine important chemical, physical and biological interactions with the unique ecological regime in this highly productive area.

U.S.-Canada Transboundary Fish and Lower Trophic Communities: In collaboration with the Department of Fisheries and Oceans Canada, this partnership with UAF will document baseline fish and invertebrate species presence, abundance, distribution and biomass in the U.S. and Canadian Beaufort Sea. The hydrographic structure of the eastern Beaufort shelf also will be documented to provide enhanced understanding of

the effects of habitat variables such as temperature and salinity on species distributions under different climate conditions.

COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic: This study documents the general presence of bowhead, right, fin, gray, and other baleen whales in areas of potential seismic, drilling, construction, and production activities. Data will be useful for estimating temporal limits and formulating designs of mitigation for such activities. The study funds the fabrication and deployment of arrays of long-term acoustic recorders that are capable of continuous year-round recording. The recently awarded three-year study “Chukchi Acoustics, Oceanography and Zooplankton (CHAOZ): Hanna Shoal” will extend this monitoring to the area of Hanna Shoal.

Synthesis of Arctic Research: Between the years 2005 and 2015 BOEM will have invested more than \$50 million in marine mammal and related oceanographic studies in the western Arctic. These data serve to increase our ecosystem knowledge about the region considerably, but interpretation will be complicated by concurrent environmental changes. This study will conduct 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.

Use of the Chukchi Sea by Endangered Whales: In collaboration with NMFS and the Pacific Marine Environmental Laboratory (PMEL), this study assesses patterns of spatial and temporal use of the Chukchi Sea by endangered bowhead, fin and humpback whales, and beluga and gray whales, and evaluate ecological relationships that affect critical habitat for these species. This effort combines targeted oceanographic sampling with biological sampling and satellite tagging of individual humpback, fin and gray whales to expand scientific understanding of whale behavior and to improve predictions about where and when aggregations of feeding whales are likely to occur. This study extends the research of the “Bowhead Whale Feeding Ecology Study” (also known as BOWFEST) into the Chukchi Sea and expands the scope to include other cetacean species.

Air Quality and Meteorology:

Arctic Air Quality Modeling: This study will conduct air quality modeling using existing dispersion models to reasonably predict the potential cumulative air quality effects associated with onshore and offshore emission sources. The study will evaluate existing methods for establishing emissions exemption thresholds and, if necessary, suggest improved methods.

Physical Oceanography:

Characterization of Circulation in the Northeast Chukchi and Western Beaufort Sea: In collaboration with UAF, ocean current circulation fields are being mapped and analyzed along the coast of the northeastern Chukchi and western Beaufort seas through the deployment of coastal High Frequency radar systems, offshore bottom mounted Acoustic Doppler Current Profilers (ADCPs), gliders and surface drifters. Such direct circulation measurements improve understanding of the ocean currents that drive oceanographic processes and influence the transport and fate of spilled oil.

Marine Mammals:

Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea: In partnership with NMML, this study merges the Bowhead Whale Aerial Survey Project (BWASP) and the Chukchi Sea aerial surveys of marine mammals. This combined effort collects aerial survey data on seasonal distribution, relative abundance, and habitat use of marine mammals in the Beaufort and Chukchi seas. Observations are focused on bowhead whales, but also help to monitor gray whales, beluga whales, Pacific walrus, polar bears, bearded seals, and several other species of ice seals. All of these species are subject to changes in environmental variables such as oceanographic currents, sea temperature, sea ice cover, prey availability, and anthropogenic impacts. MMS/BOEM has conducted aerial surveys of the fall migration of bowhead whales each year since 1987. Methods are comparable from year to year and based on similar monitoring dating to 1979.

Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring: In collaboration with the Alaska Department of Fish and Game, this study will track the movements and document the behavior and habitat utilization of bowhead whales using satellite telemetry. Tags equipped with environmental sensors will be deployed to monitor, collect, and transmit ambient oceanographic conditions during bowhead whale migrations. Acoustic tags will document vocalization rates and ambient noise levels to develop analysis of call rates relative to behavior and disturbance. Data will be used to examine interannual variation in bowhead feeding concentrations and vocalizations. Other large cetacean species (Gray whale, Humpback whale and Fin whale) may be opportunistically tagged and tracked as a pilot study for future research.

Demography and Behavior of Polar Bears: In partnership with the USGS Alaska Science Center and USFWS Marine Mammals Management, this study collects data to estimate the demographic composition and inter-annual patterns of use of coastal areas by the sub-population of polar bears summering on land in Alaska. The project will also evaluate the implications of extended summer use of land on polar bear health and nutrition, behavior, and population status.

Abundance Estimates of Ice-Associated Seals in the Chukchi Sea: In collaboration with scientists at NOAA's National Marine Mammal Laboratory (NMML) and the Russian Institution Giprorybflot, this study will conduct surveys of ice-associated seals using high-resolution digital photographic and thermal imaging sensors and calculate abundance estimates for bearded, spotted and ribbon seals in the Bering and Chukchi seas. Abundance estimates will be computed using hierarchical models for seal abundance developed at NMML.

Habitat and Ecology:

Distribution of Fish, Crab and Lower Trophic Communities in the Chukchi Sea Lease Area: This partnership with NOAA and UAF documents and characterizes the distribution of pelagic and demersal fish and invertebrate communities in the Chukchi Sea lease area. The study includes 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. This project is a component of the "Arctic Ecosystem Integrated Survey," a

collaborative effort involving scientists from UAF, NOAA's Alaska Fisheries Science Center, USFWS and ADF&G.

Biogeochemical Assessment of the OCS Arctic Waters: In collaboration with the Coastal Marine Institute at UAF, the objective of this cooperative study is to assess the effect of ocean acidification on the marine environment of the Bering Sea and Chukchi Sea. Dissolved organic and inorganic nutrients and carbon, total alkalinity, particulate organic matter, and pCO₂ measurements are used to calculate net ecosystem production and acidification.

Distribution and Habitat Use of Fish in the Nearshore Ecosystem of the Beaufort and Chukchi Seas: In partnership with NOAA, this study will inventory the distribution and diversity of nearshore fish, their habitat and prey along high priority sites in the Beaufort and Chukchi Seas. The age and diet of the fish, as well as ambient oceanographic conditions, will be assessed to improve understanding about the effect of habitat variables like temperature and salinity on fish species distributions.

Social Systems:

Social Indicators in Coastal Alaska: Arctic Communities: This study will update key socio-cultural and economic baseline data for analysis of potential local and regional impacts from offshore exploration and development activities. It will evaluate the pace, direction and magnitude of regional socio-economic changes experienced by residents in select Arctic coastal communities including: Point Lay, Wainwright, Barrow, Nuiqsut and Kaktovik.

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SECTION 2.0 STUDY PROFILES

2.1 Profiles of Ongoing Studies

Information about ongoing studies can be found at:

<http://www.boem.gov/akstudies>

This website is updated two times each year and includes:

1. An updated status of each study.
2. Report due dates.
3. Related publications.
4. Affiliated websites.

For all completed ESP Studies, go to:

http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp.

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Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Arctic Air Quality Impact Assessment Modeling
(AK-13-01)

BOEM Information Need(s) to be Addressed: BOEM requires information to assess the cumulative air quality impact of off-shore Arctic oil and gas activity, including oil spill response equipment and associated support equipment not already accounted for through State and Federal air permit requirements. This information would be used by BOEM and various Federal and State agencies to support compliance with the Clean Air Act and environmental justice initiatives. In addition, the information would provide public agencies, permit applicants, and the public with a holistic view of the air pollution impact on the people and environment in Northern Alaska. In light of the change in jurisdiction for control of oil and gas emission sources on the Arctic OCS, BOEM requires information defining emission thresholds to insure exempt OCS facilities will not produce significant onshore ambient air concentrations.

Total Cost: \$1,751,036

Period of Performance: FY 2013-2016

Conducting Organization: Eastern Research Group, Inc.

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

Description:

Background: Arctic oil and gas exploration and extraction activities proposed for the OCS require environmental evaluations pursuant to NEPA, and air quality operating approval to comply with the impact analysis required under NEPA and the Clean Air Act. An air quality model suitable air impact analysis requires various input datasets, including emission sources, meteorology, and pre-existing pollutant concentrations. This project would develop these major input datasets, which would be applied to an air quality model such as the Community Multipurpose Air Quality model (CMAQ) or the Comprehensive Air Quality Model, with extensions (CAMx), to assess the cumulative air quality impact of proposed offshore OCS projects and North Slope support activities.

Various estimates exist for pollutant emissions from proposed and existing North Slope and OCS activities, but there is no overall analysis to show the increased pollutant concentration from all aspects of the proposed activities, including increased emissions in towns along the coast, emissions from support vehicles far from the drilling operation, and aircraft and helicopter emissions. This project would pull together all existing emissions information available from the Alaska Department of Environmental Conservation, which would be combined with estimates of additional emissions from proposed OCS activity. From this comprehensive database, an emission inventory could be calculated and translated to three-dimensional emissions for a time period of interest (i.e., output from the Sparse Matrix Operator Kernel Emissions [SMOKE] processor).

This project would leverage data from the recently completed BOEM project, “Chukchi/Beaufort Seas Mesoscale Meteorology Modeling Study” (MMM to produce a five-year meteorological modeling dataset (years 2007-2011) that could be evaluated and optimized for performance with air quality dispersion models. The meteorological and emissions datasets would be applied to a regional air quality model such as CMAQ or CAMx. The results would assist in defining the cumulative impacts of all pollution sources induced by OCS activity, including the formation of secondary fine particulate matter (PM_{2.5}) and ozone chemistry that may be occurring in this environment. This study will be coordinated with work in the Gulf of Mexico OCS Region to avoid duplication of efforts and ensure consistency with similar approaches.

Objectives:

- Test the hypothesis that the cumulative impacts from OCS-related activities, exclusive of permitted sources, would not be statistically significant.
- Test the hypothesis that secondary PM_{2.5} and ozone are not significant for cumulative impact analyses.
- Evaluate modeling results to assess the cumulative impact of emissions on the OCS and on the North Slope.
- Apply the results to demonstrate compliance under the NEPA and the Clean Air Act for analyses prepared by BOEM and to develop valid exemption thresholds.

Methods:

1. Build upon meteorological datasets developed by the BOEM “Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study” and by industry that reflect climatological conditions of the North Slope, Beaufort Sea, and Chukchi Sea.
2. Format the compiled dataset for use in dispersion models approved for the Arctic OCS.
3. Build an input database of emission sources typically associated with oil and gas activities on the OCS. Build in scenarios of potential OCS development.
4. Prepare an emission inventory using EPA-approved calculation methods and prepare emissions data sufficient as input to a regional air quality model.
5. Conduct air quality modeling by applying the input datasets to an EPA-approved model such as CMAQ or CAMx.
6. Analyze importance of atmospheric chemistry with tools such as a literature survey, box chemistry models, plume models with chemistry, and regional air quality models.
7. Assess the results to identify the background impact and the cumulative impact of proposed OCS activities to meet the project objectives.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b)

BOEM Information Need(s) to be Addressed: The BOEM is studying marine mammal distribution, benthic biota, and anthropogenic chemicals to monitor for environmental effects of oil and gas exploration in the Chukchi OCS. Interannual and seasonal variability in the Chukchi is very high and there is a need to distinguish oil and gas effects from those related to variability in the physical environment or from local effects of global warming. This task would provide that context to other monitoring tasks and also greatly improve our understanding of first order physics in the NE Chukchi Sea. In addition, this study will provide information useful for ground-truthing and tuning of numerical ocean models.

Total Cost: \$2,068,928 plus joint funding **Period of Performance:** FY 2010-2015

Conducting Organization: NOAA-Pacific Marine Environmental Laboratory

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

Description:

Background: The western Arctic physical climate is rapidly changing. The summer minimum sea ice extent in 2007 and 2008 covered an area which was 37% less than the areal coverage of two decades ago and 20% less than the previous minimum coverage in 2005. This reduction in sea ice area opens up vast new regions of the Arctic Ocean to increased absorption of sunlight and storage of heat. This heat is returned to the atmosphere in the following autumn resulting in increased Arctic temperatures of more than 5° C, extending the sea ice free season into November, and causing changes in wind patterns. Such Arctic changes appear to be irreversible. As the sea ice that has lasted for several years melts away and extra heat is stored in the ocean during autumn, potential future periods of colder than normal air temperatures may not be sufficient to rebuild the summer sea ice cover.

One of the methods to be applied to the Chukchi Sea includes measuring the changing ecosystem through long term biophysical moorings coupled with shipboard observations. These will provide information on the ecosystem, including physical drivers of primary production and higher trophic levels, and support the development of hypotheses for mechanisms controlling ecosystem organization. Moorings permit observations during ice covered periods and the critical spring and early summer when spring phytoplankton blooms occur. Such measurements are impossible to obtain from ships, because of the relatively short duration they spend in the area.

Objectives:

- Obtain two full years of biophysical measurements on the shallow Chukchi shelf utilizing moorings at three sites, and collect hydrographic and lower trophic level data during deployment/recovery of the moorings.
- Collaborate with the protected-species study: “COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic” in order to evaluate the extent to which variability in environmental conditions such as sea ice, oceanic currents, water temperature and salinity, and prey abundance influence whale distribution and relative abundance.
- Rerun the National Center for Atmospheric Research (NCAR) climate model (Community Climate System Model: CCSM) for future projections using the sea ice extents from 2007/2008 as initial conditions.
- Analyze multiple ensemble members from the NCAR model and other International Panel on Climate Change (IPCC) models to assess the future variability of sea ice cover and extended sea ice free seasons during fall for the Chukchi Sea.
- Provide long-term estimates of habitat use for large whale species and compare this with predictions about annual ice coverage in order to establish predictive variables to describe large whale occurrence.

Methods: Moorings will be deployed at three different sites of tight-acoustic arrays on the Chukchi Sea shelf (See protected-species study: “COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic.”) Each mooring site has two moorings; one is a bottom mounted upward-looking ADCP with instruments that measure fluorescence, temperature, and oxygen; the second mooring will contain instruments to measure ice thickness, nitrate, temperature and salinity. At one site there will also be an upward looking TAPS-8 (on the P mooring), which acoustically measures zooplankton biovolume as a function of size. During each deployment/ recovery cruise, hydrographic data (temperature, conductivity, nutrients, chlorophyll, oxygen) and zooplankton will be collected at each mooring site, along the transect between moorings and at other selected sites in northern part of the Bering Sea and in the Chukchi. Samples for mesozooplankton and micronekton will be collected using double-oblique tows of paired bongo frames or when appropriate, (e.g. for groundtruth of the acoustic data) using a Tucker Sled which allows us to collect samples right next to the bottom.

The climate modeling task will adapt the NCAR CCSM to examine the influence of natural variability on sea ice loss and compare results with a new set of IPCC model results. The latest IPCC model results will be evaluated for application to Chukchi Sea climate projections. Recent satellite sea ice analyses, including high resolution AMSR-E microwave analyses from Europe, multiyear sea ice fraction from QuikSCAT, and ICESat thickness data together with data from the moorings will be used for model verification.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Characterization of the Circulation on the Continental Shelf Areas of the Northeast Chukchi and Western Beaufort Seas (AK-12-03a)

BOEM Information Need(s) to be Addressed: The BOEM needs information on several aspects of the temporal and spatial structure of ocean currents in the northeastern Chukchi and western Beaufort seas. This characterization encompasses a description of the mean circulation under different wind and sea ice coverage conditions. This knowledge will be valuable for (a) improving the quality of information used in the Oil-Spill-Risk Analysis conducted by BOEM, (b) inferring the transport of zooplankton, contaminants and other quantities in key areas, (c) providing insight into the flow-related feeding aggregations of bowhead whales near Barrow, (d) providing important information for the preparation of NEPA documents, (e) providing information for ocean modeling efforts (including validation and skill assessment), and (f) complementing ongoing social research on offshore subsistence hunting.

Total Cost: \$5,056,252 plus joint funding **Period of Performance:** FY 2012-2016

Conducting Organization: University of Alaska Fairbanks

BOEM Contact: [Warren Horowitz](#)

Description:

Background: The circulation in the region of the junction between the Chukchi and Beaufort continental shelves is likely complex given the abrupt change in the orientation of the isobaths, change in shelf width, and the convergence of the mean westward wind-driven flow over the Alaskan Beaufort Sea with the mean northeastward flow along the eastern flank of Barrow Canyon. The nature of this junction varies with the winds and ice environment. The regional circulation is such that contaminants introduced on either the Chukchi or Beaufort shelf will likely have a variety of fates. These include being advected from one shelf to the other, being flushed offshore into the Arctic basin, or perhaps accumulating within the vicinity of the western Beaufort Sea due to flow convergence from currents on both shelves. The conditions under which these various scenarios occur are not well known.

This proposed study is a continuation and expansion of the existing surface circulation study within the northeast Chukchi Sea. Prior to 2009, surface current observations on the Chukchi shelf were extremely limited. Through a joint Industry/BOEM supported study, the University of Alaska Fairbanks (UAF), Coastal Marine Institute began measuring surface currents during the open water period on the Chukchi shelf beginning in September 2009 with the deployment of long range (180 km), High Frequency (HF) radar systems located at the villages of Barrow and Wainwright. In

2010, coverage was expanded to the southwest to include additional offshore lease areas. The surface current data was supplemented by water column profile data collected by Slocum Gliders. Acoustic Doppler current profilers (ADCPs) were also deployed across the Alaska Coastal Current at the head of Barrow Canyon to assess the annual flow regime, the connectivity between surface and subsurface currents during the open water season, and the changes in subsurface currents beneath the mobile pack ice and lead system during the winter months. This new study will expand our present efforts to improve understanding of the flow regime and shelf dynamics between the inner and outer Chukchi shelf, the exchange of waters between the Chukchi Sea and western Beaufort shelf through Barrow Canyon, and the upwelling of Atlantic Waters.

Objectives:

- Extend the present Chukchi Sea HF radar, mooring and glider study to include the western Beaufort shelf slope and Barrow Canyon to investigate the spatial and temporal structure of ocean currents within the western Beaufort and northeast Chukchi shelves and the exchange of waters between these areas.
- Characterize 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.
- Describe the oceanic response, at different levels in the vertical, using all available wind observations, as well as those generated by atmospheric and/or coupled models.

Methods: The above objectives will be pursued using a suite of instrumentation including: ADCPs, CTDs, Ice Profiling Sonar (IPS5), gliders, surface drifters and HF radars. Long Range HF radar systems presently deployed along the Chukchi coast at Point Lay, Wainwright and Pt. Barrow will be modified to increase the maximum observable range to approximately 250 km to capture the summer surface current flow over a larger area of the Chukchi shelf and around Hanna Shoal. A planned HF radar deployment at Cape Simpson (CIAP funds) will capture surface current flow along the western Beaufort shelf and slope and within Barrow Canyon. Gliders, surface drifters, moored ADCPs and towed CTDs will collect data on depth and time dependent current, temperature and salinity structure. Ice Profiling Sonar and moored ADCPs will be used to calculate ice drift and velocity. Sea ice extent will be obtained from satellite information, while drifting buoys will be crucial for computing flow trajectories and diffusivities. Data from the ADCPs, CTDs, glider deployments, HF radars, planned drifter measurements and available industry data will be synthesized to acquire a comprehensive characterization of the circulation in the study area. This project will coordinate and collaborate with other research projects in the area (BOEM, WHOI, industry, etc.) to synthesize and integrate all available data.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Applications for Mapping Spilled Oil in Arctic Waters
(AK-12-03b)

BOEM Information Need(s) to be Addressed: The results from this study could inform BOEM Oil-Spill-Risk Analysis (OSRA) and oil spill fate modeling efforts, and may improve detection and cleanup operations in the event of a large oil spill. Outputs could be used to verify oil spill contingency plans. Results will support decisions associated with environmental assessments and exploration plans. The BOEM analysts and decision makers may use the results to improve NEPA analysis and documentation for any future Alaska OCS lease sales.

Total Cost: \$1,249,977

Period of Performance: FY 2013-2016

Conducting Organization: University of Alaska, Fairbanks

BOEM Contact: [Warren Horowitz](#)

Description:

Background: There is a need in the Arctic OCS to test, develop, and implement the observational platforms, mapping software, and oil spill models that could track and assess the fate of spilled hydrocarbons. Such systems are presently being tested in the Gulf of Mexico and preliminary tests have been successful. This study would build and test similar equipment to be used on AUVs for the Arctic. This study will jointly fund and field test environmental response and mapping software in cooperation with Federal, State, and industry parties who would be willing to share costs and incorporate real-time observational data into this tracking and mapping software system. We will develop and test the instrumentation for AUV gliders that can map, sample and analyze potential subsurface hydrocarbon-enriched plumes in order to understand their distributions, transport, aging, and ecosystem consequences, especially with regard to the potential use of dispersants. The BOEM will jointly work with other interested parties to field test the capability of the environmental response and mapping software to track a planned release of fluorescein dye within the Chukchi Sea. Real time data streams from aerial surveys, ship tracks, gliders, drifters, meteorological buoys, HF radar generated surface currents and possibly satellite tagged marine mammals and birds will be tracked. Protocols will be developed and tested over multiple field experiments to assess applications for tracking a potential spill in the offshore during the open water season.

Objectives:

- Develop a better understanding of small scale transport processes important to fate and effects modeling used in oil impact analysis.

- Assess the effectiveness of HF Radar surface current mapping system and drogue drifters for providing near-surface current input data to oil spill models.
- Develop, test, and deploy instrumentation for Autonomous Underwater Vehicles (AUV) that can be customized for use in the Arctic to detect the spatial and temporal locations of subsurface hydrocarbon plumes. (Field tests to be conducted with non-toxic fluorescein dyes.)
- Conduct at least two field tests of the dispersal and tracking of non-toxic fluorescein dye off the Chukchi coast.
- Track the dispersed dye plume by incorporating input from the AUVs and other real time data collection sensors in the Chukchi Sea (e.g., surface currents from HF Radar, drifters, real time WRF high resolution wind fields, data from meteorological buoys and other offshore instruments) to assess the fate and transport of the dye plume.
- Develop algorithms quantifying small scale transport processes based on measurable oceanographic and meteorological data (i.e., advection, Langmuir circulation, wind drift, vertical and horizontal dispersion coefficients, etc.)

Methods: The first part of this effort will develop the instrumentation necessary for gliders to map the subsurface movement of a hydrocarbon plume. The second part will develop the field protocols to track the movement of dispersed fluorescein dyes (simulated spill) on the surface and within the water column utilizing shipboard and aerial surveys and real time observation systems within the Chukchi Sea. The researchers will obtain permits to release non-toxic dyes that can be tracked within the Chukchi Sea through the use of shipboard CTDs and fluorometers, aerial surveys or very high resolution satellite imagery, existing coastal radars, drifters and underwater gliders. Researchers will conduct two years of field tests to perfect equipment and produce protocols, work to improve existing or develop new mapping systems for the Chukchi Sea that could be used to incorporate real time data feeds from the deployed AUVs along with other real time surface observations and conduct analysis of the dispersed dyes to achieve a better understanding of the associated transport processes.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Enhanced Verification and Interpretation of Arctic Ice Break-up and Freeze-up for the Beaufort and Chukchi Seas, Alaska OCS (AK-13-04)

BOEM Information Need(s) to be Addressed: This study will provide improved analytic interpretation and decision-making tools about inter-annual ice characteristics for offshore lease areas in the Beaufort and Chukchi Seas during break-up and freeze-up conditions. The study will improve resolution and interpretation of available data about ice formation, including new ice as well as pack ice incursion timing, growth, distribution, density, and velocity. Improve our understanding of the processes that control ice melt and growth and apply that information to a jointly developed coupled ice-ocean-atmospheric model. The resultant hindcast and forecast products will provide BOEM and BSEE with more accurate information on environmental conditions at proposed and active drill site locations. The BOEM's NEPA analysts will need the detailed spatial and temporal information about break-up and freeze-up conditions over specific locations within the OCS. Study products will be used for NEPA analysis, including region specific environmental assessments, and during regulatory review of applications for permit to drill (30 CFR§250.417).

Total Cost: TBD

Period of Performance: FY 2014-2019

Conducting Organization: TBD

BOEM Contact: [Warren Horowitz](#)

Description:

Background: BOEM has proposed a restriction on late season (freeze-up) drilling operations that would assure a greater opportunity for spill response and cleanup. As a consequence of this proposed mitigation measure, BOEM requires information on the timing of freeze-up conditions over the proposed drilling locations. BOEM utilizes spatial data from the BOEM Sea Ice Database to provide Environmental Assessment Analysts with the information needed to determine the timing of freeze-up conditions, and when drilling activities must cease at the proposed drill site. The BOEM Sea Ice Database contains daily and biweekly National Ice Center (NIC) interpreted spatial and temporal sea ice polygons in ESRI GIS format.

This new study will enhance the resolution of regional scale ice data through analysis improvements in ice data interpretation through ground-truthing. The new data analysis will provide a more refined product describing the type and extent of new ice formation beyond the landfast ice boundary and improve interpretation of the timing, characteristics, and speed of the main pack ice incursion into the active OCS lease area.

Adaptive management requires additional forecast information typically included within a coupled ice-ocean-atmospheric model and real time observations of the ocean, atmosphere and sea ice conditions. This type of information is not available to BOEM staff; consequently the NWS will provide BOEM with the ice and weather forecast information with their existing models. We will conduct field work to better comprehend the processes that control the evolution of the ice-ocean-atmosphere-wave systems and their connections, with the purpose to develop and improve coupled ice-ocean-atmosphere-wave model capabilities to better forecast drilling conditions under BOEM's adaptive management plan.

Objectives:

- Establish a team of discipline experts to guide and oversee database development, model hindcast and forecast development, field work, data collection, and information enhancements to better assess ocean, sea ice, waves, and atmospheric conditions that may impact safety, transportation, drilling, spill response and clean-up operations.
- Improve the BOEM Sea Ice Database product through upgraded sea ice analyses and environmental observations of break-up and freeze-up
- Collect and analyze new field data that best explains the dynamic environmental processes that govern the seasonal melting and freezing of sea ice on the Chukchi Sea OCS and Beaufort Sea OCS.
- Develop/improve coupled ice-ocean-wave-atmosphere models that provide hindcasts and forecasts of ocean, ice, wave, and atmospheric conditions. Determine the effectiveness of these models to forecast ice, ocean, and atmospheric conditions during the open-water drilling season at “weather” and “seasonal” (monthly) scales.

Methods: This new study will enhance the resolution of regional scale ice data 1) through analysis of bi-weekly satellite data (high resolution Synthetic Aperture Radar) and other imagery; and 2) as a result of improvements in ice data interpretation through ground-truthing from available meteorological and oceanographic measurements of offshore conditions. High resolution Synthetic Aperture Radar (SAR), thermal, MODIS sea surface temperature, and other satellite imagery will be processed and analyzed to map late season new ice formation from shore out to the active lease areas and pack ice incursion into the active lease areas from the north. Available atmospheric model data, local meteorological data, and oceanographic measurements will be collected to document the seasonal growth of new ice from shore. Atmospheric model data will be used to estimate the daily, weekly, and late season movement of pack ice into the active lease areas.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Cook Inlet

Title: Cook Inlet Circulation Model Calculations (AK-13-x10)

BOEM Information Need(s) to be Addressed: Oil-Spill-Risk Analysis (OSRA) is a cornerstone foundation for evaluating alternatives in OCS oil and gas leasing NEPA analyses and oil spill response plans. The results of this study will be used by BOEM to create the Oil-Spill Risk Analysis (OSRA) estimates of oil spill trajectories. The ocean models have been shown to have skill in estimating the near surface currents. This study will result in a time series of simulated current and wind fields that will be compared to field projects that have been conducted in the Cook Inlet and will be used in the OSRA calculations.

Total Cost: TBD

Period of Performance: FY 2014-2015

Conducting Organization: TBD

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

Description:

Background: Ocean currents in Cook Inlet are forced by winds and river runoff, as well as having very large tidal amplitude and extreme tidal currents. The Alaska Coastal Current that flows into Lower Cook Inlet and continues out through Shelikof Strait is an important element of the nearshore circulation of the northern Gulf of Alaska. Sea ice forms in Cook Inlet, but its effect on the overall circulation pattern has not been studied in detail.

The circulation of Cook Inlet has been studied through previous model simulations, with funding by NOAA, BOEM, USACE, and others. The models were subjected to many sensitivity calculations and skill was assessed by teams of oceanographers and the models were shown to have significant skill in simulating the ocean surface currents. Many field programs that may provide observational data for assimilation and validation have also been conducted in this area.

Objectives: The objective of this study is to obtain simulations of the surface circulation in Cook Inlet for use in OSRA. The simulations must have significant skill in reproducing the near-surface currents, compared to drifting buoy data, fixed current meters, ADCPs, and other data sets. The results of the model will provide environmental variability input into the OSRA calculations.

Methods: This study will adapt an existing community ocean model to produce a high-resolution hindcast of the current fields in Cook Inlet, using data assimilation methods whenever practical. The hindcast period will be determined by data availability, but shall be no less than 5 years. The tidal current must be accurately reproduced. The wind forcing will be derived from the products of an atmospheric model. Skill

assessment comparisons against historical field observations, i.e. current meters and drifting buoy velocities, will be performed.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Satellite-Tracked Drifter Measurements in the Northeast Chukchi Sea (AK-08-12-08)

BOEM Information Need(s) to be Addressed: This study will provide information on surface currents in the vicinity of the Chukchi Sea Lease Area during the open water season. Results from his study will provide model validation data for BOEM modeling efforts, and provide new information regarding current shear in the upper ocean and its relation to changes in stratification and winds.

Total Cost: \$459,892 plus joint funding **Period of Performance:** FY 2011-2014

Conducting Organization: CMI, UAF

BOEM Contact: [Warren Horowitz](#)

Description:

Background: The oil and gas industry plans to drill exploratory wells within the Chukchi Sea during the open water season within the coming years to assess the extent of potential hydrocarbon resource within the subsurface formations. The BOEM and the oil and gas industry are presently sponsoring a physical oceanographic study in the Chukchi Sea to measure ocean current circulation fields from High Frequency (HF) radar sites located along the northwestern coast of Alaska at Barrow, Wainwright and Point Lay. The data from this study are providing us with significant new information on Chukchi Sea surface current circulation within the boundary of the radar coverage. The drifter measurements as proposed within this CMI study will provide information on near surface current movements, augmenting the HF radar effort by extending the surface current measurements beyond the range of HF radar coverage. In addition, the drifter measurements will answer critical questions on not only how currents flow at the surface, as HF radars define, but how currents flow below the surface, where pollutants could also get transported.

Objectives:

- Map the surface current drift within the upper water column at one meter and ten meter water depths.
- Document the differences in the surface and subsurface flow fields as related to the bathymetry, seasonally-varying winds, stratification, and/or ice-edge fronts.
- Display the daily results of the drifter trajectories on a project website open to the public.

Methods: A ship will deploy CODE-type drifters to measure the upper meter surface current flow and WOCE-drifter drogues to measure current speed and direction at a

depth of 10 meters. Each drifter will contain a surface thermistor to measure surface water temperatures. The drifters will be deployed from a ship from two different oil and lease block locations, on a weekly basis, beginning in early August and ending by mid-September. The drifter positions will be determined by satellite GPS fixes twice every hour during its time of operation. Repeated drifter deployments will allow statistical analysis of the spatial and temporal distribution of upper ocean flow, its vertical shear, and surface water motion. Comparison of drifter movements will also be made against available subsurface current measurements from current meters and ADCPs and surface measurements collected from HF radars. The impacts on drifter motion from the seasonal changes in ocean stratification will also be examined. Synthetic Aperture Radar (SAR) satellite imagery will be analyzed to document whether drifter motion is impacted by ice edge fronts. These drifter deployments will encompass a near full range of sea ice concentrations, meteorological, and oceanographic conditions that would be expected during the July/August through September/October open water season in the northeast Chukchi Sea. Their individual trajectories will be updated daily to a map on the publically available, University of Alaska Fairbanks project web site. A second field season has been added to this program.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Development of an Accurate Model of the Beaufort and Chukchi Ice Drift and Dispersion for Forecasting Spill Trajectories and Providing Decision Support for Spill Response (AK-13-03-03)

BOEM Information Need(s) to be Addressed: In the event of an oil spill, sea ice complicates the tracking of ice/oil trajectories and can hinder clean-up operations. There is a need for a sea ice model that can accurately simulate ice pack deformation and failure to improve ability to track ice/oil trajectories and support oil response operations. BOEM analysts and decision makers will use this information in NEPA analysis and documentation for Lease Sales, EPs and DPPs.

Total Cost: \$359,078 plus joint funding **Period of Performance:** FY 2013-2016

Conducting Organization: CMI, UAF

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

Description:

Background: Offshore oil and gas exploration and production activities in the Beaufort and Chukchi Seas can be significantly and adversely affected by sea ice. For example, in the event of an oil spill, the presence of sea ice vastly complicates the issues of tracking ice/oil trajectories and conducting clean-up operations. It becomes important to forecast the trajectory and dispersion of contaminated ice and to simulate the location of pressured ice, which can hinder transportation. Of particular interest is simulating realistic lead distributions (opening and closing rates), ice deformation, ice velocity, ice stress, ice flow trajectory, and the location of ice divergence and convergence zones.

The current state-of-the-art for coupled ocean-ice-atmosphere modeling makes use of a continuum model of sea ice kinematics originally developed by Hibler. Ice-ocean modeling of the Beaufort and Chukchi Sea areas is under development for BOEM using ROMS, which includes an ice model with elastic viscous-plastic (EVP) ice dynamics. This type of coupled ice-ocean models has difficulty in reproducing observed sea ice strain-rates. The representation of sea ice in the regional, pan-Arctic and global models currently used for simulating the coupled ice-ocean system or for ice forecasting does not represent the brittle failure behavior of the ice pack on the spatial scales these models attempt to resolve. The difficulty is that the continuum EVP models used to describe ice constitutive properties do not represent observed internal ice stresses and strain rates (opening and shearing), and they do not reproduce realistic patterns of localized shear zones. Hence these models cannot simulate the dispersion of sea ice well, which limits their utility in forecasting or hindcasting the trajectories of contaminated ice.

A discrete element method (DEM) sea ice model can simulate fracture patterns with intersection angles and spacing characteristics similar to those observed in Arctic pack ice. Although, to date, no regional model of sea ice has reproduced realistic deformation patterns, the DEM approach has been successful in simulating the density of fractures expected in the Beaufort Sea. The DEM approach directly accounts for discontinuities in the ice pack at which failure can occur and stresses concentrate to form cracks, unlike continuum approaches that use an isotropic rheology (such as CICE which uses the EVP model) and require artificial seeding of stress discontinuities in order to simulate cracks. As the DEM approach specifies the failure stress of weaknesses (defined as joints or contacts between grains or unit cell floes), control of fracture characteristics is more physically based in a DEM model.

Objectives: This project will build upon previous work funded by MMS/BOEM (OCS Study MMS 2005-068, OCS Study MMS 2008-020, OCS Study BOEM 2012-067) and NSF to:

- Develop a DEM model that accurately simulates ice velocity, kinematics and dispersion in the Beaufort and Chukchi Seas.
- Optimize the model to simulate realistic lead distributions (opening rate) and the location of pressured ice that hinders transportation.
- Build validation metrics appropriate for confining parameters in pack ice constitutive relations.
- Produce an open-source well-documented DEM sea ice model usable by the general sea ice community and readily incorporated into coupled sea ice/wind/ocean models

Methods: This study will build a model of sea ice interaction, simulating drift and deformation of the ice pack, with the DEM. The researchers will work to improve model parameters over previous DEM models by tuning the model to field data and investigate the effects on model simulations of varying the failure process from a gradual weakening ice strength during failure to a sudden rupture upon reaching failure criteria. In developing the model, they will identify appropriate representation of tensile, compressive and shear failure of pack ice.

The model domain will encompass the Beaufort and Chukchi Seas with zero velocity and stress gradients across the open ocean boundaries. This will ensure no artificial shear is imparted at the open boundaries that would manifest as unrealistic kinematic features. External forcing will be developed from available products. The validation metrics developed in the study will provide insight into the mechanical properties of pack ice. Sensitivity experiments will be conducted to tune the model.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Updates to the Fault Tree for Oil-Spill Occurrence
Estimators Needed Under the Forthcoming BOEM 2012-
2017, 5-Year Program (AK-11-01)

BOEM Information Need(s) to be Addressed: The Oil-Spill Risk Analysis (OSRA) is a cornerstone to regional EISs, EAs, and oil-spill response planning. Oil-spill issues constitute a significant portion of public comments submitted on lease sale or development EISs and exploration EAs in the Alaska OCS Region. This study is necessary to incorporate fault-tree spill occurrence estimators into NEPA analyses for Arctic OCS oil and gas lease sales or Arctic development in the BOEM 2012-2017, 5-Year Plan.

Total Cost: \$229,840

Period of Performance: FY 2011-2016

Conducting Organization: Bercha International

BOEM Contact: [Caryn Smith](#)

Description:

Background: The OCS spill occurrence rates used in non-Arctic BOEM NEPA analyses are based on historical Gulf of Mexico and Pacific OCS platform, pipeline or worldwide tanker crude oil-spill rates. Since 2002, the Alaska OCS Region has incorporated a fault-tree approach which considers 1) differences in oil-spill occurrence factors between the Arctic and Gulf of Mexico OCS and 2) Arctic-specific factors. Recent examples of such analyses include:

- Bercha, F. G. 2006. Alternative Oil Spill Occurrence Estimators and Their Variability for the Chukchi Sea - Fault Tree Method. OCS Study MMS 2006-033. Prepared by Bercha Group, Calgary, Alberta, for MMS Alaska OCS Region, Anchorage, AK.
- Bercha, F. G. 2008. Alternative Oil Spill Occurrence Estimators and Their Variability for the Alaskan OCS - Fault Tree Method: Update of GOM OCS Statistics to 2006. OCS Study MMS 2008-025. Prepared by Bercha Group, Calgary, Alberta, for MMS Alaska OCS Region, Anchorage, AK.
- Bercha, F. G. 2008. Alternative Oil Spill Occurrence Estimators and Their Variability for the Beaufort Sea - Fault Tree Method. OCS Study MMS 2008-035. Prepared by Bercha Group, Calgary, Alberta, for MMS Alaska OCS Region, Anchorage, AK.
- Bercha, F. G. 2008. Alternative Oil Spill Occurrence Estimators and Their Variability for the Chukchi Sea - Fault Tree Method. OCS Study MMS 2008-036. Prepared by Bercha Group, Calgary, Alberta, for MMS Alaska OCS Region, Anchorage, AK.

Objectives: Provide an update to fault tree spill occurrence rates and confidence intervals for NEPA analyses for any Arctic OCS Lease Sales or for OCS offshore oil and gas developments during the contract period of performance.

Methods: This study will: 1) review and assimilate oil-spill occurrence reports, data and geohazard data from alternative sources and locations as needed; 2) use updated Gulf of Mexico OCS historical data together with its measures of spill size and frequency variance to run the Monte Carlo fault tree model with these measures of variance; 3) provide updated fault tree analyses for Arctic oil and gas lease sales based on BOEM-supplied exploration and development scenarios, generating life-of-field oil spill occurrence rates and indicators; 4) provide up to two additional fault-tree analyses for Beaufort and/or Chukchi Seas for site-specific oil and gas development taking into account site-specific geohazards and generating life-of-field occurrence indicators; 5) provide a formal report documenting each analytical or fault-tree update, and 6) provide professional support to BOEM in regard to statistical issues of occurrence rates and estimator(s) related to this study and its results.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Loss of Well Control Occurrence and Size Estimators for the Alaska OCS (AK-11-12)

BOEM Information Need(s) to be Addressed: The Oil-Spill-Risk Analysis (OSRA) is a cornerstone to regional EISs, environmental assessments, and oil-spill-contingency planning. A fault-tree approach is used to extrapolate the historical non-Arctic spillage to Arctic conditions for Arctic NEPA analyses. The OSRA spill rate calculations, because of oil-spill issues, constitutes a significant portion of public comments submitted on lease sale or development EISs and exploration EAs in the Alaska OCS Region even prior to 2010 Deepwater Horizon spill in the Gulf of Mexico OCS. Well control incident data from Gulf of Mexico, the North Sea, and offshore Australia exploration and development well activities will be reviewed, statistically analyzed and formatted for use for future fault tree and NEPA analyses.

Total Cost: \$298,540

Period of Performance: FY 2012-2014

Conducting Organization: Bercha International

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

Description:

Background: The BOEM uses the historical blowout record on the Outer Continental Shelf (OCS) and the North Sea as an input to the fault tree model to develop oil spill occurrence rates for oil-and-gas-lease sales and any development projects in the Chukchi and Beaufort Sea OCS Planning Areas proposed under BOEM and industry planning. In recent years, the Alaska OCS Region has frequently been tasked to provide frequency estimates and analysis of loss of well control occurrence during lease sale, exploration and development in NEPA assessments. The largest spill from a single well control incident in the history of offshore oil industry, the *Deepwater Horizon* blowout in the Gulf of Mexico OCS, has further focused interest in consideration of very large spills from well control incidents in NEPA analyses.

Under the Bureau of Safety and Environmental Enforcement Regulations 30 CFR § 250.188 (3) industry must report all losses of well control. “Loss of well control” means: (i) Uncontrolled flow of formation or other fluids. The flow may be to an exposed formation (an underground blowout) or at the surface (a surface blowout); (ii) Flow through a diverter; or (iii) Uncontrolled flow resulting from a failure of surface equipment or procedures. *Offshore Blowouts: Causes and Control* (Holand, 1997) has the most comprehensive analysis of worldwide blowout data, but those data are in need of updating. The primary world database for this information has been compiled by and is held by SINTEF, with SINTEF and a few others with access providing statistical analyses based on the database.

Objectives:

- Update offshore loss of well control frequency information through 2011 for the Gulf of Mexico and Pacific OCS, the North Sea, Australian offshore regions and other areas with a comparable regulatory regime.
- Apply statistical procedures to develop loss of well control occurrence rates for different operational phases and product spilled (e.g., gas, crude and condensate, drilling mud).
- Estimate confidence intervals for occurrence rates.
- Provide statistical measures such as mean and median spill sizes including appropriate methods for statistical outliers such as the *Deepwater Horizon* blowout.

Methods: The investigators will collate and analyze available data on offshore well control incidents in the Gulf of Mexico and Pacific OCS, the North Sea, Australian offshore regions and other areas with a comparable regulatory regime. Existing very large oil spill examples (probability, size, and basis) from regional (Alaska) oil spill contingency plans and environmental assessments will also be reviewed. The investigators will calculate well control incident frequencies and perform appropriate statistical analyses, including trend analysis.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea

Title: ANIMIDA III: Boulder Patch and Other Kelp
Communities in the Development Area (AK-11-14a)

BOEM Information Need(s) to be Addressed: The Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) and continuation of ANIMIDA (cANIMIDA) have monitored the Boulder Patch Area of Special Biological Concern in the Beaufort Sea OCS, with last Boulder Patch survey in 2007. There is a continuing, ongoing need for this monitoring in the development area within the Beaufort Sea during the performance period of the study, which will coincide with continued production from Northstar, development and production from Liberty, and Camden Bay delineation and potential development. The information will be used for NEPA analysis and documentation for Beaufort Sea Lease Sales and DPPs.

Total Cost: \$606,000

Period of Performance: FY 2012-2018

Conducting Organization: University of Texas at Austin

BOEM Contact: [Catherine Coon](#)

Description:

Background: The ANIMIDA project started monitoring of the Boulder Patch in 2000. This and multiple other research projects on the Boulder Patch by BOEM, the National Science Foundation, and industry have allowed one of very few long-term monitoring records in the Arctic to be cobbled together, stretching from the late 1970's through the current decade.

The Liberty prospect adjoins the Boulder Patch. In 2008, the MMS approved a development plan for the nearby Liberty prospect. Shell has also submitted an exploration plan to delineate existing oil discoveries in the Sivulliq and Torpedo prospects in Camden Bay, an area with known but poorly mapped kelp beds. Ongoing industry activities necessitate ongoing monitoring projects.

Objectives:

- Evaluate the potential impact from additional activities at the Liberty prospect on the Boulder Patch kelp community.
- Monitor the impact to the Boulder Patch community from increased summer turbidity and other oceanographic changes occurring with climate change.
- Estimate the importance of and extent of Camden Bay kelp patches.

Methods: The Boulder Patch kelp bed surveys and monitoring will be conducted using small vessel support in the open water season. Kelp production will be measured using

established or comparable techniques. Oceanographic measurements shall include ambient light intensity and total suspended solids using established or comparable techniques. Data will be combined with the existing long-term dataset. The extent of kelp in Camden Bay will be surveyed and GIS maps constructed of kelp and implied (boulder and or hard bottom) kelp beds in the study area.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea

Title: ANIMIDA III: Contaminants, Sources, and Bioaccumulation (AK-11-14b)

BOEM Information Need(s) to be Addressed: This project has monitored the development area in the Beaufort Sea OCS, with last sampling of contaminants, sources, and bioaccumulation in 2006. There is a continuing, ongoing need for this monitoring in the development area within the Beaufort Sea during the performance period of the study, which will coincide with continued production from Northstar, development and production from Liberty, and Camden Bay delineation and potential development. The information will be used for NEPA analysis and documentation for Beaufort Sea Lease Sales and DPPs.

Total Cost: \$2,700,000

Period of Performance: FY 2013-2017

Conducting Organization: Olgoonik/Fairweather, LLC

BOEM Contact: [Dr. Dan Holiday](#)

Description:

Background: The Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) and continuation of ANIMIDA (cANIMIDA) started in 1999 and, has provided baseline data and monitoring results for chemical contamination, turbidity, Boulder Patch productivity, and subsistence whaling in the vicinity of oil industry development in the Beaufort Sea OCS. Northstar and Liberty prospects were monitored prior to development and Northstar into development and production. A second continuation of the subsistence whaling task is already under way and a continuation of the Boulder Patch monitoring is proposed for FY 2012.

In 2008, the MMS approved a development plan for the Liberty prospect that would use directional drilling from an enlarged Satellite Drilling Island (SDI) at the east end of the Endicott Causeway. Shell has also submitted an exploration plan to MMS that would delineate existing oil discoveries in the Sivulliq and Torpedo prospects in Camden Bay. Ongoing industry activities necessitate ongoing monitoring projects. The last contaminant sampling under cANIMIDA occurred in 2006 and did not include the deeper Camden Bay area of interest.

Objectives:

- Continue the ANIMIDA/cANIMIDA sediment chemistry monitoring emphasizing hydrocarbon and priority metal concentrations.
- Improve the cANIMIDA conceptual model of suspended sediment interactions, loading, and export from the ANIMIDA area, continue to delineate and quantify

the offshore dispersion of river runoff and suspended sediments during the spring melt, trace the dispersion of suspended sediments into deeper, outer shelf water, continue to refine sourcing techniques for suspended sediments particularly in the expanded eastern ANIMIDA area, expand the chemical analyses of suspended sediments to include hydrocarbon composition, estimate the contribution of shoreline erosion, Mackenzie River, and offshore waters to suspended sediment load and composition.

- Continue development of a conceptual model of bioaccumulation and trophic interaction in ANIMIDA biota, monitor bioaccumulation of contaminants in selected species, and continue ANIMIDA/cANIMIDA contaminant monitoring program for amphipod and bivalve samples.
- Develop and initiate a contaminant monitoring program for deeper water benthic biota found in this expanded ANIMIDA study area. Include mid-Beaufort Distributed Biological Observatory stations as part of the monitoring program

Methods: Field logistics will include small vessel support in the open water season. Larger vessel support will be needed in offshore Camden Bay for the biological/contaminant effort. Primary biological/contaminant field surveys should occur in the open-water period, with some effort during breakup with high river flow, and at least once during the ice-covered season.

Sediment and biota sampling will be scheduled such that stations sampled in eastern, central, and western Beaufort in ANIMIDA/cANIMIDA will be resampled at least once and that new deeper eastern Beaufort Region stations around Sivulliq and Torpedo would be sampled at least twice (to form a baseline). Focus will be on oil and gas development potential contaminants in sediments and benthic biota, and distribution and abundance of benthic biota.

Chemical fingerprinting and cANIMIDA/ANIMIDA ratio techniques will be used to characterize sources of suspended sediments. Profiles for turbidity, salinity, temperature and current would be obtained from numerous sites around the pertinent project area at the time of sampling. The choice of elemental and isotope parameters to be analyzed for suspended sediment will be designed to maximize the potential for discriminating among different sources of particles. A variety of dispersion models and predictive tools should be considered.

The study uses cANIMIDA conceptual food web model to help guide development of specific objectives for this task, increase statistical viability of the results with the goal of longer-term strategy for biological contaminant monitoring, and will make improvements to this conceptual model based on study findings.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Evaluating Chukchi Sea Trace Metals and Hydrocarbons
Sourced from Nearby Coastal Rivers (AK-08-12-12)

BOEM Information Need(s) to be Addressed: Quantifying trace metals and polycyclic aromatic hydrocarbons (PAH) contributions from these terrestrial sources will provide needed information about chemistry and seasonal variability in outputs of contaminants and pollutants from land to the offshore Chukchi lease areas and thus provide a major constraint on background source variability of these chemicals. BOEM analysts and decision makers will use this information in NEPA analysis and documentation for Lease Sales, EPs and DPPs.

Total Cost: \$232,760 plus Joint Funding **Period of Performance:** FY 2012-2014

Conducting Organization: CMI, UAF

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

Description:

Background: The Yukon, Kobuk, and Noatak Rivers comprise 88% of the land-derived area draining into the Chukchi Sea (via strong northward directed currents through the Bering Strait). These rivers deliver relatively unknown quantities of particulate and dissolved phases (including metals and hydrocarbons) to the Bering and Chukchi seas. There are ambient levels of metals and hydrocarbons present in marine sediments and seawater in the Arctic, much of which are thought to be originally derived from terrestrial sources. Metals and hydrocarbons from offshore drilling operations can alter the natural biogeochemical state of marine ecosystems. Previous studies have added to our knowledge about concentrations of metals and hydrocarbon pollutants proximate to the OCS lease areas (e.g., ANIMIDA, cANIMIDA, COMIDA CAB). This study will complement previous work by quantifying terrestrial particulate inputs to the Chukchi Sea from “upstream” sources such as the Yukon River.

Objectives:

- Develop an inventory of trace metals and PAHs to the Chukchi Sea of river sediments from the Yukon River.
- Evaluate the completeness of the historic record found in cores taken from high-sedimentation areas.
- Examine the relationship between trace metal abundance in riverine sediment sources and sediment grain-size.

Methods: Researchers will collect active river channel bedload and suspended load sediments for trace metal and PAH analyses from the Yukon River during two summer

field seasons. Bedload samples will be collected from river banks whereas suspended sediment load samples will be collected from water pumped at a 1 m depth below the surface. Samples will then be filtered using a continuous flow centrifuge. Sediment cores will also be extracted from the three locations using a vibracorer. Local residents will be trained to collect additional suspended load and bedload samples during the fall, winter and spring seasons.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Distribution and Abundance of Select Trace Metals in Chukchi and Beaufort Sea Ice (AK-13-03-04)

BOEM Information Need(s) to be Addressed: Anthropogenic contaminants from local, regional, or global sources can contribute to the abundance and distribution of trace metals in sea ice and therefore could significantly affect the distribution of dissolved trace metals in surface waters. Offshore exploration and development products (e.g. drilling muds, produced water or oil) are potential local and regional sources, while atmospheric emissions from industrialized regions captured in winter snow are potential regional and global sources. Results from this project will improve understanding of trace metal distribution and abundance in the Arctic sea ice environment, and on its role as a source of trace metals in the water column. BOEM analysts and decision makers will use this information in NEPA analysis and documentation for Lease Sales, EPs and DPPs.

Total Cost: \$262,073 (plus joint funding) **Period of Performance:** FY 2013-2016

Conducting Organization: CMI, UAF

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

Description:

Background: Increased oil and gas activities in the offshore Alaskan Arctic can potentially lead to changes in the natural environment. Offshore exploration and extraction of mineral resources in the Alaskan Arctic under a changing sea ice environment emphasizes the need to better understand the role of natural environmental processes in the retention, transport, and subsequent release of trace metals in sea ice. Concentrations of trace elements in seawater and sediments in the nearshore Beaufort Sea development area have been well constrained by numerous studies during the last 20 years, including the ANIMIDA and cANIMIDA projects. In contrast, there are no data for dissolved trace metals in Alaskan Arctic sea ice and a very limited number of unpublished data points for particulate metals. Sea ice samples were collected during the cANIMIDA projects, but contamination issues stemming from the type of corer used precluded the measurement of dissolved trace elements.

The concentrations of certain trace metals are significantly elevated in sea ice relative to seawater, as indicated by results of previous studies in Antarctica and the Bering Sea. Consequently, sea ice melt has been shown to increase concentrations of some elements in surface waters, but the processes controlling the retention and subsequent release of trace metals in sea ice are not well understood. Possible mechanisms include: 1) trace metals mobilized into the dissolved phase from suspended sediments that were trapped during sea ice formation; 2) trace metals mobilized from aerosols deposited onto the sea

ice as snow begins to melt; 3) trace metals that vary only as a function of salinity and have limited particle reactivity (i.e. Ba and Al); or 4) trace metals concentrated within brine channels during ice formation, and as the base of the sea ice interacts with the upper water column during the growing season. Understanding the relative importance of these mechanisms will provide the basis for understanding how trace metals (naturally occurring and anthropogenic) are retained, transported, and released by sea ice.

Objectives:

- Manufacture and test a trace metal clean ice corer.
- Conduct laboratory-based experiments on sea ice retention and release of trace metals. Collect aerosols and surface seawater samples in the Chukchi Sea and near ice floes.
- Quantify dissolved and particulate trace metals in laboratory grown sea ice and the resulting brine/seawater mixture.
- Quantify dissolved and particulate trace element concentrations in offshore surface seawater samples.
- Quantify particulate trace element concentrations and ratios in offshore atmospheric deposition (aerosol/snow) samples.
- Quantify dissolved and particulate trace metal concentrations and ratios in ice cores collected in Camden Bay.
- Quantify dissolved and particulate trace metal concentrations and ratios in snow samples collected in Camden Bay.
- Share project results with local communities.

Methods: The researchers will build a new corer using commercially pure titanium battery powered drill head to minimize potential contamination. Laboratory experiments to investigate the cycling of trace elements in sea ice will focus on 1) the effect of sediment inclusion and brine rejection during ice formation and growth and 2) the effects of sea ice degradation on the characteristics of material exported from sea ice. These experiments will be conducted under temperature-controlled conditions in plastic tanks, and the resultant concentration of the trace metals in the sea ice and underlying waters will be monitored. Changes in the dissolved and particulate fractions will be monitored as ice grows in both the ice and remaining seawater. The ice will be allowed to grow slowly and a time series of trace metal concentrations in both seawater and ice obtained.

Offshore surface seawater and aerosols samples will be collected on board the R/V Mirai in collaboration with the Japanese Agency for Marine-Earth Science and Technology (JAMSTEC). Snow will be collected onboard the ship opportunistically during snow events using wide mouth plastic bottles mounted on a polyethylene polepositioned as high and forward as possible on the ship. A total of ~80-100 cores samples will be collected from 10 stations during the sea ice sampling effort in Camden Bay. Specially designed sampling techniques will be employed to minimize contamination.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Arctic Fish Ecology Catalogue (AK-07-05)

BOEM Information Need(s) to be Addressed: The BOEM needs organized fish ecology and behavioral information for NEPA analysis of fisheries resources, including Essential Fish Habitat and rare species. Study products will be used in post-sale NEPA analysis, review of EPs, DPPs and other reviews for post-sale and post-exploration BOEM decision making and mitigation. Also, study results will be used in similar pre-lease analyses and documentation for potential future Chukchi Sea Lease Sales.

Total Cost: \$275,000 plus Joint Funding **Period of Performance:** FY 2009-2013

Conducting Organization: USGS

BOEM Contact: [Kate Wedemeyer](#)

Description:

Background: A comprehensive synthesis of ecological and behavioral information concerning arctic fishes of Alaska is important to BOEM fisheries scientists investigating arctic fish resources. The MMS co-funded the most recent reference on Alaskan fishes. However, the latter is primarily a taxonomic key to Alaska fish species with summary distribution maps. A companion volume describing the ecology and behavior of important fish species has yet to be funded. Limited sub-arctic commercial and forage fish data are available in gray literature, e.g., the NMFS groundfish assessment documents for Gulf of Alaska, the Bering Sea and Aleutian Islands. Arctic fish ecological and behavioral information has not been synthesized; it is only available piecemeal from a wide range of peer-reviewed and gray literature.

Objectives:

- Synthesize ecological and behavioral information into species by species accounts Arctic Alaska fish, including future information needs, for use by BOEM NEPA analysts
- Synthesize reviews of present knowledge of general arctic fish ecology topics.

Methods: This study will 1) Develop review of the knowledge of each fish species that may occur or expand into Arctic Alaska waters; 2) include freshwater, diadromous, and marine fish species occurring in the Beaufort and Chukchi seas and possibly adjacent Arctic waters (eastern Russia and western Canada); 3) synthesize ecological and behavioral information into a desk reference catalogue for use by BOEM NEPA analysts.

The first portion of the catalogue will include species-specific accounts 1-3 pages in length per species. Pertinent information for each species will include: species

binomen; synonymy; common names; illustration; field marks; diagnostic features; geographical distribution (including GIS maps of documented occurrences and habitat areas by life history stage); biology (e.g. reproductive biology); behavior, ecology, and habitat (e.g. life history strategy, habitat types and areas, migration); size; interest to fisheries; literature; and remarks. Data deficiencies and areas for future research for each species will be identified.

The second portion of the catalogue will include articles synthesizing ecological and behavioral information by topic. Broad topics will include, but are not limited to: environmental and organism constraints, foraging and feeding ecology, bioenergetics, use of time and space, growth, reproduction, predation and parasitism, competition and mutualism, dynamics of population abundance and production, life history strategies, fish assemblages, information needs and areas for future research.

The study will publish as a desk reference available to fisheries scientists and the greater public to use in research and education.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Beaufort Sea Marine Fish Monitoring Survey in the Central Beaufort Sea (AK-10-06)

BOEM Information Need(s) to be Addressed: Fish resources are important to upper trophic levels in the Beaufort Sea ecosystem and to the coastal communities. NEPA analysts need additional species presence and abundance information for assessing potential impacts of offshore development activities. Study information will be used in NEPA analyses and documentation for Beaufort Sea Lease Sales, EPs, and DPPs in 2011 and beyond.

Total Cost: \$1,764,252 plus joint funding **Period of Performance:** FY 2010-2014

Conducting Organization: University of Alaska

BOEM Contact: [Kate Wedemeyer](#)

Description:

Background: Enhanced marine fish information is needed for Beaufort Sea NEPA analyses. Data at the most basic level—e.g., fish species presence/absence and distribution data—are not only spotty, but also outdated. Fish assemblages and populations in other marine ecosystems off Alaska have undergone observable regime-shifts in diversity and abundance over the last 20-30 years. While the same is likely true of the Beaufort Sea, it is unconfirmed because the scant distribution and abundance data available are pre-regime-shift. Furthermore, important marine mating, spawning, rearing, feeding, and migration habitats (pre or post regime-shift) is yet to be delineated. A baseline of fish species, distribution, relative abundance, and the locations of critical or sensitive life history stage habitats in this central lease area remains a very high-priority information need for NEPA analyses. The original central Beaufort target area remains the region of most intense industry interest and thus the region of greatest BOEM information need.

An under-ice pilot survey is included because the Beaufort Sea lease area is under ice for half to three-fourths of the year. Thus, it is important that BOEM obtain a more complete data set that encompasses the under-ice season. The addition of the under-ice pilot survey study will provide a more complete methodology and a baseline data set that encompasses all seasons in the Beaufort Sea, including ice-covered seasons. Such a data set will allow BOEM to support environmentally sound offshore oil and gas exploration and development decisions.

The addition of bird and marine mammal observers and zooplankton sampling will provide transect data in offshore areas where data for those species is as sparse as for

fish species. The contemporaneous collection will also enable first-time correlations between fish, zooplankton, birds and marine mammal species in this area.

Objectives:

- Identify the fish species that occupy the central OCS Beaufort Sea lease area.
- Develop and recommend a methodology adapted to arctic conditions and specific BOEM information needs in the Beaufort Sea for use in future surveys.
- Identify the fish species that occupy the central lease area during the ice-covered season.
- Correlate observation of seabirds and marine mammals to fish and zooplankton for increased understanding of this arctic ecological system.

Methods: The survey will sample fish and zooplankton in the central Beaufort between 147° and 152° west longitude, where BOEM information needs are greatest. Due to logistical conflicts encountered in 2008, it will incorporate new strategies for timing surveys to avoid interference from industry seismic exploration. It will include methods adapted to sampling small sized and rare fish thought to inhabit the Beaufort Sea and also assess additional options to effectively sample bottom habitats. Addition of bird and marine mammal observers will provide transect data to those specialties and allow correlations between fish, zooplankton, birds, and marine mammals.

A pilot under-ice marine survey will implement a design outlined in the 2007 MMS “Under-Ice Sampling Workshop.” The survey will occur in three stages: 1) assemble local and traditional knowledge with Inupiat residents; 2) under-ice sampling by local residents and time lapse under-ice cameras, 3) test survey of three different and difficult-to-sample Arctic cod habitats at the ice-water interface with DIDSON sonar (dual frequency identification sonar), remotely operated vehicles (ROVs), and shallow-water scuba transects. The pilot study will provide statistical hypothesis testing between the open water, ROV and dive surveys, which will provide a baseline for subsequent surveys and provide sampling statistics, including variance estimators, for future time-series analyses.

The final products will include Geographic Information Systems (GIS) and report formats. Intermediate results will be provided for NEPA analyses.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Joint Funding Opportunities in Existing Marine Fish Studies (AK-10-09)

BOEM Information Need(s) to be Addressed: Data on the distribution, abundance and feeding ecology of fish in the offshore environment is valuable for understanding key ecological transfer events that cascade to higher trophic level predators. This information is valuable for assessing oil-spill risks. Data on fish will be useful in Essential Fish Habitat and NEPA analysis in terms of fish themselves and as prey items for marine birds and mammals. Information resulting from fish surveys will be useful for developing mitigation measures to reduce potential impacts to upper trophic level birds, fish, and marine mammals from proposed oil and gas exploration and development activities.

Total Cost: \$225,981

Period of Performance: FY 2010-2014

Conducting Organization: Various

BOEM Contact: [Kate Wedemeyer](#)

Description:

Background: More information about fishes in the Chukchi and Beaufort seas is needed because marine fish fill an essential role in the Arctic ecosystem by consuming small prey and themselves providing a food resource for larger fishes, birds, marine mammals, and people. The Chukchi and Beaufort seas are outside the range of the NOAA Alaska Fishery Science Center regular fish trawl surveys, subsistence and commercial fisheries are presently limited to very near shore (within 3 nmi), and the logistical effort and cost of offshore fishery investigations can be prohibitive. Often there are existing research venues that collect important fish data and specimens. To address this information need for arctic fishes, this project will build off other recently established (and ongoing) at-sea survey programs that will collect distribution data on key fish species (demersal and pelagic) via partnership and collaboration among the NOAA-Fisheries, the Alaska Monitoring and Assessment Program (AKMAP) from the Alaska Department of Environmental Conservation (ADEC), U.S. Coast Guard (USCG), the Russian-American Long-term Census of the Arctic (RUSALCA), and other vessel-based programs both inshore and offshore of lease areas.

Additional baseline data for fish species in the Chukchi and Beaufort seas will help explain effects of climate change. Such information will help to distinguish between anthropogenic and natural effects of change without a basis of comparison. Thus it is important to assess the distribution and abundance of fishes in the Chukchi Sea prior to oil exploration, and oil extraction in the Beaufort. Current research focuses on current and historic distribution and ecology of demersal fishes in the Chukchi Sea Lease Area

for small bottom fishes. Those collections enhance the NOAA-funded joint US-Russian RUSALCA program that collects fishes further north, south, and west. However, sampling of fishes in Lease Sale 193, especially in the vicinity of the leases, is lacking. Additionally opportunistic sampling within the Beaufort Sea areas is also needed. There remains a paucity of data for demersal fishes in these areas and information for pelagic fishes is lacking entirely. Filling these needs will be valuable for addressing impacts from oil and gas exploration.

Objectives:

- Estimate the spatial distribution, species composition and feeding ecology for fish species in designated and potential planning areas.
- Process the data (GIS based maps and attribute tables) for entry into BOEM Fish database for future accessibility and to facilitate new information for Oil-Spill-Risk Analysis and Essential Fish Habitat designations
- Preserve specimens for further study and for Alaska Museum voucher specimens.
- Identify high priority locations for mitigation or deferral areas under consideration in environmental assessments.

Methods: Fish samples, as well as abundance and distribution data, will be collected on ships of opportunity, primarily via partnership and collaboration among the NOAA-Fisheries, AKMAP, USCG, RUSALCA, and other vessel-based programs both inshore and offshore of lease areas. If permitted, scientific personnel may be deployed to assist in sample collection.

Implement quantitative ecological analyses of existing 2008 Western Beaufort Sea Marine Fish and Invertebrate Survey data with emphasis on ecological relationships among fish species, prey, habitats and communities.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Seabird Distribution and Abundance in the Offshore Environment (AK-10-10)

BOEM Information Need(s) to be Addressed: More information on the distribution and timing of use by marine birds, including listed and candidate species under the ESA (Spectacled Eider, Steller's Eider, Short-Tailed Albatross, Kittlitz's Murrelet) is necessary to assess potential impacts of oil and gas exploration and development in the Chukchi Sea Planning Area. Data on the distribution of marine birds is needed for ESA Section 7 consultations and NEPA analyses, DPPs and other documentation. The information obtained from these surveys may assist in development of mitigation measures and strategies to reduce potential impacts.

Total Cost: \$138,000

Period of Performance: FY 2010-2015

Conducting Organization: USFWS

BOEM Contact: [Catherine Coon](#)

Description:

Background: Basic information on timing and duration of use within designated (Chukchi Sea) and potential Beaufort Planning Areas is necessary to better define the impacts of perturbations and ultimately population effects. Breeding seabirds are generally monitored at colonies, yet they spend most of the year dispersed offshore. Additionally, one half or more of all seabirds do not breed in a given year, thus management of marine birds requires knowledge of spatial and temporal patterns of seabird distribution at sea. The North Pacific Pelagic Seabird Database (NPPSD) is used to consolidate marine bird survey data, but most of these data were collected in the 1970s-80s. Since then, many seabird species have declined and changes have occurred in ocean ecosystems. These changes may have affected the foraging patterns of seabirds. Further changes due to predicted Arctic climate change are anticipated. To address these needs, this project will build off of a recently established at-sea survey program, to collect distribution data on seabirds via partnership and collaboration among the USFWS, NOAA-Fisheries and other vessel-based programs.

Species composition of marine birds varies tremendously by season. For example, in the Bering Sea, shearwaters (*Puffinus* spp.) are the dominant species in summer and fall, accounting for 40-60 % of total marine bird density (birds/km²). When shearwaters return to their southern breeding grounds in winter and spring, seaducks (*Anatidae* spp.) and Murres (*Uria* spp.) dominate. These species groups have very different dispersal patterns and foraging behaviors, thus seasonal changes should be integrated into management schemes. Furthermore, there is little information on seabird

distribution during the migration and winter phases, and filling these information needs will be valuable for mitigating impacts from oil and gas exploration.

The results of this study will complement recent and on-going surveys of marine birds which are partially funded by the North Pacific Research Board (NPRB) and the USFWS. In 2006-2007, NPRB project placed 637 seabird observers on NOAA and NSF-funded vessel-based projects. During those two years, USFWS seabird observers joined 27 cruises and surveyed in excess of 42,000 km. Data on more than 547,000 birds were added to the NPPSD. However, only two of those cruises covered waters in the Chukchi or NAB areas. The at-sea survey program recently received additional funding from NPRB for 2008-2011, as part of the Bering Sea Ecosystem Integrated Research Program. Again, the funded surveys do not adequately provide coverage of the Chukchi or Beaufort areas. With minimal additional funding, the USFWS at-sea survey program could expand to other research cruises that will provide coverage of the lease sale areas. In combination, these surveys will provide a more complete and current data set on marine bird use of the region.

Objectives:

- Estimate the spatial distribution, species composition and seasonal changes in species and abundance for marine birds in designated and potential planning areas.
- Process the data for entry into the North Pacific Pelagic Seabird Database for future accessibility and facilitate management decisions for marine bird use of planning areas.

Methods: Seabird observers will be placed on ships of opportunity, primarily NOAA, BOEM, and NSF-funded research vessels. Based on on-going BOEM, NOAA and NSF programs, we anticipate availability of at least five additional cruises per year in the Chukchi and Beaufort planning areas or within the Bering Sea. Observers use standardized protocols for marine bird surveys and data is entered directly into a laptop computer with a GPS interface. The presence of marine mammals is also recorded, although the seabird protocol differs from those used exclusively for marine mammal surveys. Data will be processed for entry into the NPPSD, providing access to multiple users.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

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

BOEM Information Need(s) to be Addressed: This study will constitute a key component of Chukchi Sea environmental studies pertinent to Chukchi Sea oil and gas activity. The highest oil industry interest is in the Burger prospect bordering Hanna Shoal to the south. The BOEM analysts and decision makers will use the information in NEPA analysis and documentation for Lease Sales, EPs and DPPs, and in post-sale and post-exploration decision making in the Chukchi Sea.

Total Cost: \$5,665,144

Period of Performance: FY 2011-2016

Conducting Organization: University of Texas at Austin

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

Description:

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

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

Biological “hot spots” in the Chukchi Sea are thought to be related to coupled pelagic and benthic productivity. A high abundance of bottom fauna is correlated with high pelagic primary production, possibly associated with the ice edge that reached the seabed mostly ungrazed. However, the mechanisms that must explain the productivity at Hanna Shoal are relatively poorly understood. With the retreat of the summer ice-edge to deeper, more northern waters in recent years, this pelagic/benthic coupling may be weakening at Hanna Shoal. The ongoing productivity of this region depends on the timing and position of the ice edge. Other BOEM projects in the Chukchi are showing

sustained benthic productivity in the area of Hanna Shoal accompanied by high concentrations of water birds, walrus, and whales. Ongoing BOEM studies looking at ocean heat transport across the central U.S. Chukchi Sea, to the south and at circulation to the east, toward Barrow Canyon will provide context to this study.

Objectives:

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

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

Formal integration with other BOEM projects will be made through the planned “Marine Mammal/Physical Oceanography Synthesis” to provide upper trophic components to the study. Coordination will occur with other international, NSF, NOAA, ADEC, and industry research in the Chukchi Sea.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Distribution of Fish, Crab and Lower Trophic Communities in the Chukchi Sea Lease Area (AK-11-o8a; AK-11-o8b)

BOEM Information Need(s) to be Addressed: This project continues collection of marine fish baseline in the Chukchi Sea, and will provide information on the abundance and distribution of fish, crab, and lower trophic communities in the Chukchi Sea lease area. The study will provide the basis for a better understanding of distribution and relative importance of fish communities. The Alaska OCS Region identified a need for continued fish and invertebrate baseline monitoring during the 2007 MMS-sponsored “Chukchi Sea Information Status and Research Planning Meeting” to provide useful information to upcoming NEPA reviews and post-sale needs.

Total Cost: \$2,600,000

Period of Performance: FY 2012-2016

Conducting Organization: University of Alaska Fairbanks; NOAA

BOEM Contact: [Catherine Coon](#)

Description:

Background: This study proposes to develop a broader understanding of abundance and distribution of demersal and pelagic fish, crab, and lower trophic communities needed to evaluate and mitigate the effects of offshore oil and gas development. Interim results from a current BOEM funded Coastal Marine Institute (CMI) project, “Current and Historic Distribution and Ecology of Demersal Fish in the Chukchi Sea Planning Area,” have identified temporal, seasonal, and spatial gaps in data on fish in the Chukchi Sea in particular to sampling on or near the lease areas. This proposal was designed specifically to fill these information needs. It will build upon recent information on invertebrate communities in the Chukchi offshore lease area obtained by the recent COMIDA CAB study. This will also complement the component of COMIDA CAB that undertook midwater and benthic fishery samples at 20 sites in 2010 within the COMIDA CAB sample design. This study would utilize these data and create a similar survey design such that data sets were compatible, comparable, and extend the time series.

In the well-studied Bering Sea, it is apparent that the distribution and community composition of fish has changed in recent decades and many species are shifting their distributions northward. The MMS-funded 2008 Beaufort Sea fish survey indicated presence of common Bering Sea species, such as walleye pollock and dense aggregations of snow crab in the western Beaufort Sea. These species are also likely to be present in the adjacent Chukchi Sea. This study will increase the extent of fisheries information within the lease area and extend a baseline for further studies linking species distributions between the Bering and Beaufort Seas.

The demersal fish and invertebrate community of the Chukchi Sea is thought to be less dense and diverse than in the Bering Sea and does not support major commercial fisheries at this time. The Chukchi Sea, however, is critical to the existence of many protected species of marine mammals and birds. Alaskans living in coastal Chukchi villages depend on the sea for many of the subsistence foods critical to their way of life. Although the Chukchi has historically been considered a benthic dominated system, available data indicate that there is a large biomass of pelagic fish in the area that has not been adequately sampled. This pelagic fish community seems to be dominated by forage fish, including Arctic cod, sand lance and capelin. These species serve as an important mechanism of energy transfer to top predators such as birds, seals, and cetaceans.

Objectives:

- Document, characterize and understand the distribution of pelagic and demersal fish and invertebrate communities in the Chukchi Sea lease area for the open water season.
- Estimate the geographic range of fish, invertebrates, and lower trophic biomass in the lease area by comparing recent and historic fishery databases.
- Provide a comparison of these communities with that of prior studies, as well as adjacent regions (Beaufort and Bering Seas) and relate the data to oceanographic fronts.
- Assess utilizing icebreakers to undertake sampling during the winter for the iced-covered season.
- Provide GIS based maps and attribute tables of marine fish and lower trophics for OSRA and NEPA analysis.

Methods: This study will conduct a two year field study with fisheries and lower trophic survey in the Chukchi Sea region to obtain baseline data on the structure and function of these ecosystems and on the ecology of important fish species. Samples locations will be determined to compliment and extend recent work in the COMIDA CAB project. The abundance of pelagic fish, jellyfish, and large zooplankton (e.g., euphausiids) will be estimated with a multi-frequency echo-sounder and ground-truthed using pelagic gear. The results will be directly comparable to historic surveys conducted by COMIDA CAB, RUSALCA, Conoco/Shell, and Beaufort surveys, which will allow them to be placed into a broader latitudinal context. A series of coordinated bottom trawls would use the same survey methodology used by in the 1990/1991 Chukchi Sea Survey, and the RUSALCA surveys in 2004-2008. The results will extend the time series (2004-2008) and build upon the earlier surveys (1990, 1991) of demersal fish and invertebrate communities. To interpret the distribution of fishes and their importance as prey, water column properties (temperature, salinity, light level, chlorophyll fluorescence) will be measured at all trawl stations. This study will coordinate with other ongoing BOEM or other agency or university studies in oceanography and biology to maximize data needs and study design. This study has several collaborators which reference the study as Arctic Ecosystem integrated survey (Arctic Eis).

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Shorebirds and Infaunal Abundance and Distribution on Delta Mudflats along the Beaufort Sea (AK-11-10a)

BOEM Information Need(s) to be Addressed: More information is needed about the species composition, abundance, or distribution of the microfauna and meiofauna invertebrates that shorebirds depend upon for pre-migratory fattening along the Beaufort Sea coast. This study will assess the lower trophic levels forming the base of complex food webs and the biochemistry that influences these relationships. The infaunal abundance contributions to shore bird foraging, migration, and reproductive biology as well as bioremediation of oil spills has been shown to be important factors in the recovery and cleanup of past oil spill events in Alaska and other regions. The information obtained from this jointly-funded research will contribute to development of mitigation measures and strategies to reduce potential impacts from post-lease exploration and development.

Total Cost: \$237,169

Period of Performance: FY 2011-2016

Conducting Organization: USGS

BOEM Contact: [Catherine Coon](#)

Description:

Background: The Beaufort Sea coast includes a variety of biologically productive habitats in lagoons, barrier islands, river deltas, and adjacent tundra areas. These habitats support diverse biota and could be affected by oils spills or disturbance resulting from offshore oil exploration in the Beaufort Sea. Oil spills could impact shorebirds through direct oiling or by potentially impacting their prey and the benthic invertebrate community. The impacts of oil on aquatic invertebrates can be significant. These ecosystems are particularly vulnerable to predicted climate-change effects, such as inundation and increased erosion caused by rising sea levels and longer periods of open water. More information is needed about the species composition, abundance, or distribution of the aquatic invertebrates that shorebirds depend upon for pre-migratory fattening along the Beaufort Sea coast. This information need extends to the lower trophic levels forming the base of these complex food webs and the biochemistry that influences these relationships. Their contributions to shore bird foraging, migration, and reproductive biology as well as bioremediation of oil spills has been shown to be important factors in the recovery and cleanup of past oil spill events in Alaska and other regions. Microfauna (e.g. bacterial, fungal, or protozoan populations), and meiofauna (nematodes, gastrotriches, and other eukaryotic organisms) living within the interstitial spaces of these zones become important considerations in mitigation of long and short-term damage due to oil spill contamination in these microhabitats and surrounding

environments. Additionally understanding the chemical factors that determine the distribution of these microfauna and meiofauna is necessary.

In addition to quantifying invertebrate resources, the study will assess whether the resources available to shorebirds are sufficient to prepare the birds for their fall migration. A functional response model will be used for this assessment based on the capture rate and handling time modeled against invertebrate abundance.

Objectives: The specific objectives of this study are to:

- Quantify the spatial and temporal distribution of macrofauna assemblages at coastal lagoons and river deltas along the Beaufort Sea coast within the USFWS Arctic Refuge- at 3 sites associated with the coastal lagoons at the Jago, Hulahula/Okpilak, and Canning Rivers.
- Assess whether patterns of invertebrate abundance and distribution correspond to foraging shorebird abundance and distribution.
- Develop a model describing the connection between wind patterns and water levels on the mudflat and sediment dispersion that can be used to assess available foraging habitat for shorebirds.
- Assess whether shorebirds respond physiologically to a greater abundance in food resources by measuring body condition and triglyceride levels.
- Assess whether available invertebrate resources in the coastal lagoons and river deltas along the Beaufort Sea are sufficient for pre-migratory fattening of shorebirds or provide information for bioremediation.

Methods: This study builds on an existing study with the U.S. Fish and Wildlife Service (USFWS) and tiers off a previous MMS/CMI shorebird study by Abby Powell across the Beaufort and Chukchi Sea coasts. This study focuses intensively on a few sites along the coast of the USFWS Arctic Refuge and two years data collection has been funded by USFWS. This project is also in collaboration with the Arctic Landscape Conservation Cooperative (LCC). The USGS/BOEM partnership would collect data on a few sites intensively within the USFWS Arctic Refuge at 3 sites associated with the coastal lagoons at the Jago, Okpilak, and Canning Rivers for two additional field seasons. This project will provide additional sampling locations and core analysis to analyze population structures, chemical footprint, numbers of individuals, and diversity of populations from the interstitial spaces within the littoral zone. The project will continue to map the distribution of common functional groups of invertebrates using spatial analysis kriging techniques. Results will produce data reflecting measures of abundance of benthic invertebrates using mudflat core samples to determine availability of food resources for shorebirds.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Wading Shorebird Habitats, Food Resources, Associated Infauna, Sediment Characteristics and Bioremediation Potential of Resident Microbiota of Deltaic Mudflats (AK-11-10b)

BOEM Information Need(s) to be Addressed: More information is needed about species composition, abundance, or distribution of the microfauna and meiofauna living within the interstitial spaces of the littoral zones along the Beaufort Sea coast. Shorebirds depend on meiofauna for food for pre-migratory fattening. Additionally, these organisms make important contributions to bioremediation of oil spills as well as the chemical factors that determine their distribution. The information obtained from this research will contribute to development of mitigation measures and strategies to reduce potential impacts from post-lease exploration and development.

Total Cost: \$365,236

Period of Performance: FY 2011-2015

Conducting Organization: University of Alaska Fairbanks

BOEM Contact: [Catherine Coon](#)

Description:

Background: Nearshore shelf areas of the Beaufort Sea are defined by specific biological and physical gradients that have influence on the Arctic ecosystem including trophic structure, productivity, and the species that inhabit there. Massive freshwater discharges from the Mackenzie River along with numerous smaller rivers produce an environment that is estuarine in characteristic. The features of these estuarine ecosystems vary in trophic structure and productivity. The role of terrestrial carbon in these estuarine food webs is especially important in view of current warming trends in the Arctic and from post-lease exploration and development. Shorebirds depend on invertebrates for food for pre-migratory fattening along the delta mudflats that are at the river face. Smaller organisms that supply food sources for these organisms may also make important contributions to bioremediation of oil spills as well as the chemical factors that determine their distribution. More information is needed about species composition, abundance, or distribution of the microfauna and meiofauna living within the interstitial spaces of the littoral zones along the Beaufort Sea coast. Combined with the distribution of these microfauna and meiofauna a link can be generated with a collection of the chemical stimulation of this biota by describing sediment size and the amount and source of organic carbon.

The Beaufort Sea coast includes a variety of biologically productive habitats in lagoons, barrier islands, river deltas, and adjacent tundra areas. These habitats support diverse biota and could be affected by oils spills or disturbance resulting from offshore oil

exploration in the Beaufort Sea. These ecosystems are particularly vulnerable to predicted climate-change effects, such as inundation and increased erosion caused by rising sea levels, glacial melt, and longer periods of open water. More information is needed about the species composition, abundance, or distribution of the aquatic invertebrates along the Beaufort Sea coast. This information need extends to the lower trophic levels forming the base of these complex food webs and the biochemistry that influences these relationships. Their contributions to shore bird foraging, migration, and reproductive biology as well as bioremediation of oil spills has been shown to be important factors in the recovery and cleanup of past oil spill events in Alaska and other regions.

Objectives: The specific objectives of this study are to:

- Quantify the spatial and temporal distribution of bacterial assemblages, meiofauna, and macrofauna at coastal lagoons and river deltas along the Beaufort Sea coast within the USFWS Arctic Refuge at three sites associated with the coastal lagoons and deltas of Jago, Hulahula/Okpilak, and Canning Rivers.
- Characterize the sediment pore water chemistry for salinity, ammonium, organic carbon, chlorophyll a, stable carbon isotopic signature, and sediment grain size at sample locations representative of each site.

Methods: This study builds on an existing study with USGS to assess shorebird abundance and macrofauna assemblages and tiers off a previous MMS/CMI previous shorebird study by Abby Powell across the Beaufort and Chukchi Sea coasts. This study focuses intensively on a few sites along the coast of the USFWS Arctic Refuge. The USGS/ UAF/ BOEM partnership would collect data on a few sites intensively within the USFWS Arctic Refuge at 3 sites associated with the coastal lagoons at the Jago, Okpilak, and Canning Rivers. This project will provide additional sampling locations and core analysis to analyze population structures, chemical footprint, numbers of individuals, and diversity of populations from the interstitial spaces within the littoral zone. The project will continue to map the distribution of common functional groups of invertebrates using spatial analysis kriging techniques. Results will produce data reflecting measures of abundance of benthic invertebrates using mudflat core samples to determine availability of food resources for shorebirds.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea

Title: U.S.-Canada Transboundary Fish and Lower Trophic Communities (AK-12-04)

BOEM Information Need(s) to be Addressed: Arctic OCS development interests have recently intensified in the eastern Beaufort Sea, accelerating the need to collect ecological baseline data for fish and lower trophic organisms in transboundary marine waters. Information needs include documentation of fish species presence, abundance and distribution in the lease area as well as their ecological interactions with habitat and other trophic levels (prey species and plankton). This project extends recent marine fish and lower trophic surveys in the Beaufort Sea to assess potential effects of offshore development on lower trophic food webs and essential fish habitat (EFH). Study information will be used for NEPA and other environmental analyses for future lease sales, exploration plans, and potential development and production plans in both the U.S. and Canada.

Total Cost: \$5,191,125 plus joint funding **Period of Performance:** FY 2012-2016

Conducting Organization: UAF; Department of Fisheries and Oceans, Canada

BOEM Contact: [Kate Wedemeyer](#)

Description:

Background: Information needs in the eastern Beaufort Sea are growing, especially in light of new emphasis on marine spatial planning, EFH consultation, food web modeling and Arctic climate change issues. Currently, NEPA analysts must rely on limited historical data and extrapolation to analyze potential development impacts on eastern Beaufort Sea marine fish and lower trophic communities. A 2008 MMS fish survey in the western Beaufort documented unexpected diversity, including several commercial fish species (cod, pollock, crab) previously unknown in the region. We need better information in the eastern Beaufort about what fish species inhabit the lease area, as well as baseline information about abundance, distribution, habitat, and seasonal and inter-annual variability of fish and invertebrates in the understudied lower foodweb. An under-ice fish and invertebrate baseline, while challenging to obtain, is needed because Beaufort species live under ice three-fourths of the year. Additional oceanographic information about currents, upwelling, and hydrographic structure through fine-scale CTD resolution is needed to document biological habitats. Data will be used in NEPA documents to meet new NOAA requirements for Essential Fish Habitat (EFH) ecological analyses of fish, their prey and their habitat established for three additional Beaufort fish species (Arctic cod, saffron cod, and snow crab).

This trans-boundary survey effort, jointly-funded with the Canadian Department of Fisheries and Oceans (DFO), Central and Arctic Region, will share a research vessel, as well as expertise and methods. Costs will be shared in proportion to area surveyed. The

collaboration will advance our knowledge of the Beaufort Sea shelf ecosystem, trans-boundary fish stocks, essential fish habitat, life stage history, and oceanographic variability. Inclusion of invertebrate and primary production sampling will address lower trophic food webs and ecological relationships to bird and marine mammal populations. This work will also contribute to other studies including long-term monitoring efforts near Camden Bay and future international Arctic cod studies.

Objectives:

- Document baseline fish and invertebrate species presence, abundance, distribution and biomass.
- Analyze dietary habits, age and growth patterns of the most abundant species to support Canadian development of a Beaufort shelf fish and marine mammal food web model.
- Test under-ice methods and provide baseline information for the ice-covered season.
- Estimate seasonal variability of fish and habitats.
- Document the hydrographic structure of the eastern Beaufort shelf.
- Enhance understanding of how habitat variables (such as temperature and salinity) affect distributions under different climate conditions.

Methods: The survey will sample fish, invertebrates, and related biological and oceanographic habitat characteristics between longitudes 141° and 147° in the U.S. and into Canadian waters to ~138° (across the Canadian border to Herschel Island and the Mackenzie canyon). Field surveys will be performed every other year in order to reduce autocorrelation of climate conditions and to refine sampling strategy based on analysis of first year data. Field sampling will occur in years 1 and 3. Additional funds will be sought for a third survey in year 4 to better evaluate inter-annual variability.

This survey will expand the scope and reach of a Beaufort Sea Pilot Fish Survey conducted in 2008. Methodologies will follow those from the 2008 survey and the ongoing BOEM Central Beaufort Sea Fish Survey, modified in consideration of lessons learned from the earlier work. Sampling will deploy gear types such as beam trawl (10m wide), otter trawl, Isaacs-Kidd, and bongo nets. This study will include additional field surveys in both the under-ice and open water seasons to provide a better understanding of variability and collect additional habitat characteristics; collect invertebrates in both the water column and benthos; collect CTD data to document hydrographic structure; and collect and analyze ecological (e.g. energetics, isotope, genetic and otolith) samples for a foodweb model. This contemporaneous collection of integrated data over the lower food chain and physical environment supports an ecosystem management approach.

Products will include annual progress reports, final synthesis, databases, and GIS based maps and attribute tables of marine fish and lower trophic communities for inclusion in the in-house fisheries database and use in NEPA analyses.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Distribution and Habitat Use of Fish in the Nearshore Ecosystem of the Beaufort and Chukchi Seas (AK-12-06)

BOEM Information Need(s) to be Addressed: Information is needed on nearshore habitats and fish abundance in the Beaufort and Chukchi Seas to refine the legal definitions of Essential Fish Habitat (EFH) as presented in the Arctic FMP, adopted by NOAA in 2009. Fish in the ecologically fragile nearshore environments are particularly vulnerable to oil spills. The information from this study would be used to better identify and describe EFH in NEPA analyses and in Oil-Spill-Risk Analysis. A better understanding of how fish species respond to habitat variables to improve predictions on distributions under different climate conditions. This project will operate concurrently with other fish sampling efforts (AK-10-06 and AK-11-08) to provide a seamless baseline of forage fish data from the beach to the offshore environment.

Total Cost: \$164,000 plus joint funding **Period of Performance:** FY 2012-2014

Conducting Organization: NOAA

BOEM Contact: [Catherine Coon](#)

Description:

Background: The Arctic is one of the most rapidly changing ecosystems in the world, yet a large void exists in information on EFH and what species and life stages use these habitats. Information is nonexistent or sparse for fishes in the Arctic, especially in shallow, nearshore waters (shoreline out to 8 m depth). Nearshore habitats are some of the most productive habitats in Alaska and the most at risk to development and oil spills. Many species included in the Arctic Fisheries Management Plan for the Arctic, such as capelin and rainbow smelt, use nearshore habitats at some time in their life but estimates of their abundance and habitat use are poorly documented. Nearshore habitats differ from offshore (>30 m depth) habitats, as do fish assemblages in each area. Recent nearshore research in the Arctic has been limited to the Barrow area, which represents only a small fraction of the nearly 1,700 km of the U.S. Arctic coastline. Prior to major development or transportation activities in the Arctic, more information is needed on fish distribution and habitat use, life history characteristics, food webs, and species at risk to make informed management decisions regarding potential effects from global climate change and human disturbance. In addition, warming conditions in the Arctic will likely result in a reorganization of community structure; new fish species are expected to migrate to the Arctic with unknown consequences to existing stocks and food webs.

Many Arctic fish species are important in the diet of higher-level predators and in Inupiat subsistence fisheries. For example, in the Bering, Beaufort, and Chukchi seas, Arctic cod and saffron cod occur in the diets of 13 marine mammal species and 20 seabird species. Availability of prey is critical to some Arctic marine mammals such as ice seals, which themselves are important in the diet of polar bears. Larger predators are already under stress by reduced ice cover. The distribution, diversity, and habitat use of nearshore fishes is largely unknown in other areas of the Arctic, especially in the Chukchi Sea. The proposed study would expand fish distribution and habitat use information to the eastern Beaufort Sea and western Chukchi Sea.

Objectives:

- Inventory the distribution and diversity of nearshore fish, their habitat and prey along high priority sites in the Beaufort and Chukchi Seas
- Assess age and diet of fish important as prey species
- Describe oceanographic features of areas with nearshore fish
- Understand how habitat variables like temperature and salinity affect fish species distributions

Methods: Beach and small otter trawl sampling will occur in areas of high importance, defined as locations near oil and gas production, or close to foraging areas for birds or marine mammals, followed by areas with opportunities for research platforms for three sampling seasons. In the summer and fall 2013/2014 two primary areas will be at sites between Barrow and Peard Bay to establish a baseline of fish and habitat use and as reference sites to the Chukchi Lease area.

A random sample of key fish species (e.g., Arctic cod, saffron cod, and capelin) will be collected for age and diet analyses. A sample of select fish species will also be collected, frozen, and archived for later fatty acid and genetic analyses. Habitat will be measured at each sampling site. At seine sites each beach will be profiled according to ShoreZone protocols. Intertidal invertebrates and macroalgae will also be recorded. Additionally, a drop camera will be deployed, depending on water visibility, to search for and identify unusual habitat types and other fish species that may not be captured by seine or trawl.

Models will be generated to predict habitat use by fishes according to habitat variables. Maps will be generated to describe species distribution relative to multiple habitat variables. Information that may lead to NOAA's EFH general distribution will be shared. Relational databases will be built that contain data on species presence and abundance that will expand the current BOEM fish database, be suitable for use in GIS, and complement ShoreZone mapping efforts.

This project collaborates with staff and funding with the Alaska Coastal Ecosystem Survey (ACES) with joint funding from NPRB.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea, Bering Sea

Title: Biogeochemical Assessment of the OCS Arctic Waters:
Current Status and Vulnerability to Climate Change
(AK-08-12-03)

BOEM Information Need(s) to be Addressed: This study would provide an assessment of the current status of the ecosystem and its vulnerability to acidification or other aspects of climate change to use in evaluation of potential local and regional impacts from offshore exploration and development activities that may occur in Federal waters. The study was initiated for NEPA analysis and documentation for the North Aleutian Basin, but has shifted emphasis north into the Chukchi and Beaufort seas.

Total Cost: \$756,704 plus joint funding **Period of Performance:** FY 2008-2014

Conducting Organization: CMI, UAF

BOEM Contact: [Nancy Deschu](#)

Description:

Background: This study initially emphasized the North Aleutian Basin in the southeastern Bering Sea, one of the most productive marine ecosystems in the world. The scope of the study has expanded to include measurements first in the northern Bering Sea and now in the Chukchi and Beaufort seas. Over the last decade, the character of the ecosystem productivity in the southeastern Bering Sea has undergone dramatic changes due to variability in hydrographic and climate forcing. In recent years, the system has changed from one dominated by cold-water, Arctic species to organisms more indicative of temperate zones with the historically rich fishing areas shifting northward. Available data suggest decreased coupling of benthic and pelagic production. The National Science Foundation's multi-component Bering Sea Ecosystem Study (BEST) is examining these changes. This BOEM-sponsored Alaska Coastal Marine Institute (CMI) Task Order is being conducted in conjunction with BEST and also with the Bering Sea Integrated Ecosystem Research Program (BSIERP). This CMI study was extended to December 2013, to allow time for inclusion of additional samples and analyses from the Chukchi and Beaufort seas.

Objectives:

- Quantify upper ocean net ecosystem production (NEP) and its fate in North Aleutian Basin.
- Assess the effect of ocean acidification on the marine environment of the Bering Sea, Chukchi and Beaufort seas.

Methods: The CMI Task participates in multiple cruises in the Bering, Chukchi and Beaufort seas, including samples during the COMIDA CAB study. Dissolved organic and inorganic nutrients and carbon, total alkalinity, particulate organic matter, and pCO₂ measurements are used to calculate net ecosystem production and acidification. The seasonal changes in stocks of inorganic C and N are a measure of NEP. The fraction of NEP accumulating in the dissolved organic matter, suspended particulate matter, and sinking particulate matter pools will be estimated.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Trophic Links: Forage Fish, Their Prey, and Ice Seals in the Northeast Chukchi Sea (AK-08-12-05)

BOEM Information Need(s) to be Addressed: This study will provide BOEM NEPA analysts with needed basic diet information for both fish and seals in the Chukchi Sea. Because of the close association of the three trophic levels, it will greatly increase understanding of the ecological connections between invertebrates, fish, and seals and also provide measures of natural variability across a series of years that include both warm and cold ocean temperatures. This information will be used to meet Essential Fish Habitat and Marine Mammal Protection Act and NEPA requirements in the EISs for Chukchi Lease Sales.

Total Cost: \$532,173 plus joint funding **Period of Performance:** FY 2009-2014

Conducting Organization: CMI, UAF

BOEM Contact: [Kate Wedemeyer](#)

Description:

Background: In preparation for oil and gas exploration and the impending Lease Sale 193, MMS Alaska OCS Region conducted a Chukchi Offshore Monitoring in Drilling Area (COMIDA) workshop in November 2006. That workshop identified a clear need for knowledge about distribution and abundance of forage fish prey resources for marine mammals in the Chukchi Sea. Not only is there a pressing need for knowledge about fishes in the Chukchi Sea, but it is also essential to evaluate those fishes as prey resources for marine mammals. An additional factor that is making the requirement for information in the Chukchi Sea imperative is the potential listing of three species of ice seals under the Endangered Species Act. The decision to list is still pending for ringed seals (*Phoca hispida*), bearded seals (*Erignathus barbatus*), and spotted seals (*Phoca largha*). The petition for listing prepared by the Center for Biological Diversity states that global warming is threatening ice seals with extinction due to loss of sea ice habitat as argued for the recently-listed polar bears. An additional ice seal species, the ribbon seal (*Phoca fasciata*), was also proposed for listing, but NOAA decided not to list the ribbon seal at this time.

Oil exploration is likely to take place in the northeast Chukchi Sea simultaneously with ever-increasing rates of global warming. It will not be possible to discern the cause or extent of effects on this Arctic ecosystem without first determining its current status. There is a paucity of data and limited ecological understanding for pelagic and demersal fishes in Lease Sale areas. The rapidly receding sea ice in the Arctic has received much attention recently and record minima were recorded in both 2007 and 2008. The loss of habitat for ice seals has resulted in three species being considered for listing under the

Endanger Species Act. Dietary differences among forage fishes in the Lease Sale area may propagate into higher trophic levels such as ice seals. Thus, it is essential to evaluate fishes as prey resources, or “forage,” for marine mammals. The study design aligns fish, prey and seals sampled in the Chukchi Sea, not only across both diet and isotopic signals, but also matched over three recent and consecutive years to provide an essential measure of interannual variability. The proposed study will produce a more comprehensive picture of forage fishes in the Chukchi Sea and then trophically relate fishes and their prey to ice seals and their diets in the Chukchi Sea to provide an essential new understanding of the ecosystem. The resulting increase in basic knowledge of the Chukchi Sea ecosystem will facilitate good stewardship by the oil and gas industry.

Objectives:

- Assess the diet composition of forage fishes;
- Establish trophic level of forage fish species and of their prey;
- Analyze interannual differences in diet of fishes and in the trophic level of fishes and their prey;
- Document the trophic level of ice seals;
- Document ice seal trophic history;
- Develop isotopic mixing models;
- Compare trophic levels of forage fishes to those of ice seals;
- Provide diet and trophic level data to BOEM in electronic format;
- Complete data archiving with NODC and make available to BOEM in a GIS compatible format.

Methods: This study will: 1) conduct interannual diet and trophic analyses using fishes caught during 2007, 2008 and 2009; 2) analyze fish muscle for the effect of lipid-removal on stable carbon and nitrogen ratios; 3) assess the relative importance of functional groups of prey taxa in the diet of each fish species; 4) perform stable isotope analysis to assess the trophic level of the fish species that are consumed by ice seals.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Population Assessment of Snow Crab, *Chionoecetes opilio*, in the Chukchi and Beaufort Seas Including Oil and Gas Lease Areas (AK-08-12-09)

BOEM Information Need(s) to be Addressed: This study will provide information on historic and current data on abundance, biomass, stock structure, diet, and trophic position of snow crab (*Chionoecetes opilio*) in the Chukchi and Beaufort Seas including lease sale areas and relate patterns to environmental variables. This information will be used to evaluate and mitigate the potential environmental effects on marine invertebrates of offshore development. The BOEM analysts and decision makers will use the information from this study in NEPA analysis for potential lease sales, EPs and DPPs, mitigation, and monitoring in the Beaufort and Chukchi Seas.

Total Cost: \$181,019 plus joint funding **Period of Performance:** FY 2011-2014

Conducting Organization: CMI, UAF

BOEM Contact: [Catherine Coon](#)

Description:

Background: Changing climate in the Arctic is manifesting as warming temperatures and changing sea ice conditions, which appear to be causing changes in marine communities and northward range contractions of Arctic species. For commercially important or subsistence species in particular, we must understand the ecological and environmental parameters that influence population structure and species distributions if we are to predict how climate change or human activities such as oil and gas exploration will affect both new and established populations in sensitive areas. Snow crab (*Chionoecetes opilio*) concentrations have recently contracted northward in the Bering Sea. It is a current predominant commercial fishery in this region and is thought to be a very common species throughout the Chukchi and parts of the Alaskan Beaufort Seas, including oil and gas lease sale areas. However, existing knowledge for adequate management planning and risk assessment is sparse and more background information on stock size and structure and reproductive condition is needed.

To conduct a current assessment of Arctic snow crab, this proposal will cost-effectively use recently collected snow crabs from the Chukchi and Beaufort Seas, in addition to new collections to be made during the 2011 central Beaufort Sea fish survey and a NOAA-funded 2012 Chukchi Sea survey. The proposed work will address a BOEM research need by providing information to better understand potential resources and marine environments potentially affected by offshore oil and gas exploration and extraction. This information will also aid in defining the general distribution for crab species Essential Fish Habitats (EFH).

Sensitivity of fauna to potential oil and gas-related pollution is related to trophic level (the position of a taxon in a food web), because bioaccumulation and biomagnification potential of persistent pollutants, including a suite of chemicals contained in petroleum products, are dependent on the trophic position of an organism. Snow crab prey includes polychaete worms, crustaceans, bivalves and brittle stars with some regional and age-specific variability in dominant prey items. Recent research indicates that Snow crabs in the southern Chukchi Sea occupy a trophic level among the highest levels of dominant invertebrates and fishes in the region. Organisms feeding at high trophic levels have a high potential for biomagnification, the accumulation of chemicals in organism tissues through dietary accumulation. Combining stable isotope analysis to determine trophic level and stomach content analysis to determine prey taxa will allow us to interpret the food web connections of snow crab and their bioaccumulation and biomagnification potential in light of food availability and distribution within and outside oil and gas exploration areas.

Objectives:

- To estimate abundance and biomass and assess distribution of snow crab in the Chukchi Sea and Beaufort Sea lease sale areas and adjacent regions in relation to water depth, bottom water temperature and salinity, water mass and sediment type using existing and new data.
- To determine stock structure including: sex ratio, size-frequency distribution, size at maturity, fecundity of female snow crab, and sperm reserves in spermathecae.
- To identify diet and trophic position of snow crab in different geographic areas.
- To compare our findings between years at re-sampled Chukchi Sea stations, compare to existing recent data from the northern Bering Sea and to the few available earlier quantitative studies in the Chukchi.

Methods: Adult specimens of *C. opilio* collected throughout the Bering, Chukchi and Beaufort seas will be examined for degrees of genetic variation in adult populations using a microsatellite approach. Additionally, a limited number of mitochondrial gene sequences will be generated for inclusion in phylogenetic studies and for DNA bar coding purposes. Polymorphic DNA microsatellite loci from adult specimens will be isolated and compared with the genotypes of adult crab between regions using isolation by distance models. This will indicate spatial scales of genetic exchange. This project will provide genetic data from a public database. The data generated can be used meet BOEM planning needs.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Dispersal Patterns and Summer Ocean Distribution of Adult Dolly Varden from the Wulik River, Alaska, Evaluated Using Satellite Telemetry (AK-08-12-11)

BOEM Information Need(s) to be Addressed: This study addresses an important subsistence fish that is a key resource for residents of northwestern Alaska. It will provide important information about the distribution of Dolly Varden in the Chukchi Sea. BOEM analysts and decision makers will use this information in NEPA analysis and documentation for Lease Sales, EPs and DPPs.

Total Cost: \$272,250 plus joint funding **Period of Performance:** FY 2012-2014

Conducting Organization: CMI, UAF

BOEM Contact: [Kate Wedemeyer](#)

Description:

Background: In northwest Alaska, Dolly Varden (*Salvelinus malma*) are highly valued as a subsistence fish and local residents harvest thousands of these fish each year. Dolly Varden are classified as anadromous fishes, meaning they spawn and rear as juveniles in freshwater and feed in saltwater later in life. Young Dolly Varden rear in freshwater for 2–5 years and after this freshwater residence period, they undertake annual migrations in the spring into marine waters to feed during the summer, sometimes traveling large distances. In northwestern Alaska, Dolly Varden usually undertake three to five ocean migrations before reaching maturity, and once becoming sexually mature, they generally only spawn every two years.

In the fall, these fish return to rivers to overwinter. The lower Wulik, Kivalina, and Noatak rivers, where sufficient groundwater provides suitable habitat throughout the winter, are important overwintering areas. Immature and mature-nonspawning Dolly Varden do not demonstrate site fidelity to overwintering areas, therefore during this phase in their life they may become distributed over a wide geographic area resulting in mixed populations in overwintering areas. However, Dolly Varden appear to return home to natal streams for spawning.

Objectives: This study will describe baseline ecological information about Dolly Varden tagged in the Wulik River, Alaska, including: timing of outmigration from the Wulik River; summer dispersal; temporal and spatial distribution; and depth and temperature occupancy.

Methods: This study will tag 20 large Dolly Varden in the Wulik River using satellite pop-up tags. The tags will be programmed so that four tags will pop-up every two weeks

and transmit their data via satellite. The tags will measure and record temperature, depth and ambient light data for daily geolocation estimates at 10-minute intervals. Information on depth and temperature occupancy may provide important insights into Dolly Varden behavior, such as feeding migrating and spawning.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Sensitivity to Hydrocarbons and Baselines of Exposure in Marine Birds on the Chukchi and Beaufort Seas (AK-13-03-02)

BOEM Information Need(s) to be Addressed: Baselines of exposure levels on avian species in the U.S. arctic would provide invaluable reference information for monitoring population status and restoration efforts. Identification of sensitive species and populations will assist in planning risk assessments of new development activities, and development of long term monitoring strategies. BOEM analysts and decision makers will use this information in NEPA analysis and documentation for Lease Sales, EPs and DPPs.

Total Cost: \$194,676 plus joint funding **Period of Performance:** FY 2013-2016

Conducting Organization: CMI, UAF

BOEM Contact: [Rick Raymond](#)

Description:

Background: With prospects of increasing development of oil and gas resources in the Chukchi and Beaufort Seas, establishment of baselines and assessment of sensitivity of arctic biota to hydrocarbon exposure would provide vital information needs for management and conservation of natural resources potentially impacted by development. Evaluating baselines of hydrocarbon exposure in selected avian species of subsistence importance [king eider (*Somateria spectabilis*), common eider (*Somateria mollissima*), and greater white-fronted goose (*Anser albifrons*)] in the Chukchi and Beaufort Seas will provide measurements of liver cytochrome P450 (CYP1A) enzyme activity. Study results will provide a first assessment of baselines for hydrocarbon exposure by forming a basis for further development of field programs for monitoring of exposure levels in marine birds in the Chukchi and Beaufort Sea region. In addition, results will provide information for assessment of current and future safety of subsistence caught food.

Bird sensitivity to hydrocarbons will be evaluated in a broader suite of marine bird species using species-specific cell culture methods. This longer list of species includes spectacled eider, Steller's eider (*Polysticta stelleri*), king eider, common eider, long-tailed duck (*Clangula hyemali*), greater white-fronted goose, black brant (*Branta bernicla*), and three species of alcids. These species represent a broader spectrum of candidate bioindicators of exposure and additional species of conservation and subsistence importance. Results from this study will provide guidance on further selection of suitable bioindicator species, based on their responses and sensitivity to

hydrocarbon exposure will provide information for assessment of relative risks of hydrocarbon exposure to the arctic biota.

Objectives:

- Measure baselines of hydrocarbon exposure in selected species of marine bird indicator species (species of subsistence importance) liver cytochrome (p450) activity.
- Assess and measure comparative sensitivity to hydrocarbon exposure in selected marine bird indicator species (larger suite of marine birds).
- Coordinate and collaborate field work with the North Slope Borough, Department of Wildlife.
- Coordinate with North Slope subsistence hunters to gather cell samples (spring, summer and fall).
- Conduct cell culture assays in laboratory.
- Share study findings to local communities through public outreach programs, produce poster and flyer and present at scientific conferences.

Methods: This study will utilize multiple criteria to select and identify suitable avian species as candidates for ecological monitoring programs. Measurement of liver 7-ethoxyresorufin-O-deethylase (EROD) activity in liver cultures allows for species specific assessment of magnitude and duration of cytochrome P450 (CYP1A) induction. EROD is widely used as an indicator of CYP1A induction and EROD results can be combined with other measurements to determine cellular or genetic effects, allowing evaluation of potential cellular or genetic pathology associated with hydrocarbon exposure. Liver samples to measure hydrocarbon-inducible CYP1A activity will be collected in collaboration with the North Slope Borough, Department of Wildlife Management and local hunters. Ultimately, this study will help in the development of guidelines and field sampling protocols by refining techniques for sample collection.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Oceanography and Feeding (AK-06-01; AK-10-02)

BOEM Information Need(s) to be Addressed: With additional information on the importance of the study area to feeding bowhead whales, and a better understanding of potentially predictable factors that correlate with variations in whale behavior, alternative mitigation options for future Beaufort Sea lease sales may be feasible. Also, this study addresses a conservation recommendation in NMFS' 2001 *Arctic Region Biological Opinion* to study "the use of the Beaufort Sea by feeding bowheads and assess the importance of this feeding to the health and well-being of these animals." Information from this study will be used for permit approvals for all Beaufort Sea Lease Sales and NEPA analysis and documentation for Beaufort Sea Lease Sales, EPs and DPPs.

Total Cost: \$8,095,000 plus joint funding **Period of Performance:** FY 2006-2013

Conducting Organization: NMFS NMML, WHOI, UAF, URI, NSB, OSU, UW

BOEM Contact: [Jeff Denton](#)

Description:

Background: A previous MMS study estimated the extent to which the bowhead whale population utilizes OCS areas in the eastern Alaskan Beaufort Sea for feeding, as well as that area's importance to individual whales. Additional research on this subject has been requested particularly at locations other than those included in the previous study. In a 2001 Arctic Region Biological Opinion NMFS made a Conservation Recommendation that MMS (now BOEM) continue to study "the use of the Beaufort Sea by feeding bowheads and assess the importance of this feeding to the health and wellbeing of these animals." Other stakeholders have recommended that MMS/BOEM expand the scope of the research to include the entire Alaskan Beaufort Sea.

In this study, emphasis will be placed on achieving an understanding of the factors enhancing or limiting the expression of feeding behavior in various locations in the western Alaskan Beaufort Sea. Implicit to the proposed study is the assumption that feeding by bowhead whales occurs with some degree of regularity during August-October the western Beaufort Sea study area. It is further assumed that variation in feeding behavior potentially results from any, or all, of a variety of environmental and behavioral variables including, but not limited to: sea ice coverage, oceanographic conditions, prey concentrations, and movements by whales, potentially from summering areas in both the Beaufort Sea and Chukchi Sea. By understanding how such factors are related to bowhead feeding in western Beaufort Sea locations near offshore oil and gas

leases, BOEM would be in a better position to mitigate potential effects of such actions on bowheads and their populations.

Objectives: To better understand the relationship between feeding and environmental and behavioral variables on the timing and spatial extent of bowhead feeding in the western Alaska Beaufort Sea; specifically to:

- Document the movements of whales of various ages, sexes, and reproductive status from the Beaufort Sea and Chukchi Sea within the study area.
- Document feeding behavior and prey utilization by bowheads at locations in the western Alaska Beaufort Sea with emphasis on timing and dynamics/variability.
- Document variability in locations and densities of potential prey of bowhead whales.
- Estimate variability of physical oceanographic conditions associated with concentrations of bowheads and their prey.
- Integrate results from this study with previous results from other sources to develop a dynamic model of bowhead feeding behavior in the western Alaska Beaufort Sea.
- Synthesize existing results and conclusions in a scientifically reviewed monograph to be published in an appropriate journal or other similar outlet.

Methods: This study will be conducted over geographic and temporal scales sufficient to include normal variability associated with environmental phenomena including local currents and upwellings, variation in ice conditions, and el Nino. The study area will be encompassed by the polygon bounded by the shoreline, 100 m isobath, 152° W and 155° W meridians.

Collaborations will be developed among whaling captains, AEWC, NSB, ADF&G, NMFS, BOEM and other interested parties to clarify roles in research permitting, co-sponsorship and implementation. Based on preliminary observations of locations of bowhead feeding having high potential for more comprehensive study and analysis, project planning and research would be initiated using logistics and field methods including, but not limited to, those similar to those used to accomplish the previous eastern Alaskan Beaufort Sea bowhead feeding study. These could include placement of permanent moorings for passive acoustic and sea-water current, temperature and salinity monitoring, fieldwork such as analyses of stomach contents at Barrow and Cross Island, behavioral observations by aircraft, bowhead tagging from Native operated boats, plankton tows by small vessel, stable isotope ratios in baleen layers, fatty acid comparisons, recording of traditional knowledge, and computer modeling of feeding information. Real-time distribution of whales in the Beaufort Sea, as well as historic information on bowhead whale feeding activity in the study area, would also be provided by the ongoing BOEM *Bowhead Whale Aerial Survey Project*. The study would be carefully coordinated with the AEWC and Whaling Captains Associations in Barrow, Nuiqsut and Kaktovik to avoid interference with fall subsistence hunts and, where feasible, to involve whaling communities in the conduct of the study.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Pinniped Movements and Foraging: Walrus Habitat Use in the Potential Drilling Area (AK-09-01)

BOEM Information Need(s) to be Addressed: Large numbers of pinnipeds migrate through and potentially occupy areas of high oil and gas potential in the Chukchi Sea, including habitat near the Burger Prospect. Pinnipeds may be affected in a variety of ways during all stages of oil and gas exploration, development, and production. Study findings will be used for NEPA analysis of lease sales scheduled for 2010 and 2012, review of EPs, DPPs and other reviews for post-sale and post-exploration BOEM decision-making and mitigation.

Total Cost: \$1,529,137

Period of Performance: FY 2009-2014

Conducting Organization: ADF&G

BOEM Contact: [Catherine Coon](#)

Description:

Background: The majority of the reproductive component of the Pacific walrus population (i.e., females, calves, and juveniles) migrate through the Chukchi Sea twice annually between winter and summer areas. Each summer, as winter pack ice receded, walruses, bearded seals, and other pinnipeds have followed the ice edge from wintering areas to its northern margin. For example, large numbers of walruses migrated past the Lisburne Peninsula northward over rich potential feeding habitat such as Hanna Shoal and adjacent areas of high oil and gas potential. During this northward migration, many walruses moved along coastal leads between Point Hope and Point Barrow and were hunted by Natives.

Over the past few years, summer distribution of walruses may be changing as a result of changes in summer pack ice. Concern has been expressed by Native hunters that in recent summers, sea ice (which females use as a platform for rest between feeding bouts) has been receding faster and further to the north, making walrus less available to the communities that depend on them. Walruses are less likely to follow the ice edge beyond the shelf break and have been using land haul-outs instead. For example, in summer 2007, large numbers of walruses were hauled out on land between the villages of Point Lay and Wainwright. Many additional tens of thousands hauled out along the Chukchi coastline in Russia. In the future, less sea ice will likely make land haul-outs more important and feeding areas near those haul-outs of great importance. Updated information is needed on how walruses move through this region, where they haul out, and where they forage.

The Burger Prospect has potentially strong renewed interest for oil and gas exploration and development and is located just south of Hanna Shoal. It is thus situated between winter habitat and potentially important summer feeding habitat on, and around, Hanna Shoal. Plans for geophysical exploration, field delineation, and development of production facilities and pipelines in that region are being developed and such activities may have consequences for pinniped movements and habitat utilization, which in turn could further alter the availability of walruses and ice seals for subsistence by Natives in villages along the Northwestern Alaskan coastline. Identification of migration routes and high-use habitat areas is critical to assessment of potential impacts from oil- and gas-related industrial activities on pinniped populations and subsistence use by Alaskan Natives. A planning phase is currently being accomplished under a cooperative agreement with the University of Alaska-Fairbanks by the Alaska Department of Fish and Game.

Objectives:

- Develop a phased cooperative project to study the movements and habitat use of selected pinnipeds in the Chukchi Sea Planning area.
- Develop considerations for enhanced monitoring of changes in habitat use and movements.

Methods: This study is modeled on a cooperative study of bowhead whale distribution and movements that is currently supported by BOEM. Review literature and existing data to develop hypotheses about habitat use and seasonal movements between winter and summer habitat. Work with Natives in coastal villages to compile and analyze traditional ecological knowledge concerning pinniped movements and habitat use. Train Native hunters or other coastal village residents to deploy satellite transmitters on walruses in the vicinity of respective villages. Deploy transmitters to test hypotheses developed. Since tags will have a relatively short lifespan, sampling is to be spread among villages and to the extent possible divided among northward and southward migrating walruses. Involve local Natives in shore-based monitoring of walruses hauling out along the Chukchi Sea coastline with emphasis on relationships between tagged-walrus behaviors and general haul-out use patterns. Analyze data to test hypotheses and develop considerations for enhanced monitoring of changes in habitat use and migration. Maintain data in a Geographical Information System (GIS) database and provide summaries of individual movements regularly on a public website. Share results with residents of communities near the study area. Encourage participation of local Natives, especially young people, in analysis and interpretation of findings and conclusions to the extent possible.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a)

BOEM Information Need(s) to be Addressed: Information from this study will document the general presence of bowhead, right, fin, gray, and other baleen whales in areas of potential seismic, drilling, construction, and production activities. Study results may be useful for estimating temporal limits and formulating designs of mitigation for such activities. Findings may be used for evaluating potential deferral areas and other potential limitations on offshore leasing and development. This study will provide useful information needed to support NEPA analysis and documentation for Beaufort and Chukchi Sea Lease Sales, DPPs, and monitoring. Results will support ESA consultations, MMPA permitting, and preparation of Biological Evaluations and Biological Opinions.

Total Cost: \$4,304,300 plus joint funding **Period of Performance:** FY 2010-2015

Conducting Organization: NOAA-NMML

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

Description:

Background: The observed northward retreat of the minimum extent of summer sea ice has the potential to expand oil and gas-related exploration and development into previously closed seasons and localities in the Alaskan Arctic. This change, coupled with steadily increasing abundance and related seasonal range expansion by the bowhead, gray, humpbacked, fin, and possibly other whales, indicates that more complete information on the year-round presence of large whales is needed in the western Beaufort Sea and Chukchi Sea planning areas. Aerial surveys can provide some of the needed coverage, but are not cost-effective for extended use on a year-around basis. Nor will planned aerial surveys provide the geographic extent of coverage potentially available from passive acoustic monitoring.

Passive acoustic detection and tracking is a proven tool for assessment of large whales in Alaskan seas. Specifically, acoustic detection has proven a key addition to the census of bowhead whales (*Balaena mysticetus*) during their spring migration past Barrow, and in relation to oil and gas development activities offshore Prudhoe Bay. More recently, gray whale calls have been detected year-round near Barrow on long-term recorders deployed in collaboration with the NSF/Shelf-Basin Interaction Study. Other data have been obtained on North Pacific right, humpback, and fin whales in the southern Bering Sea.

The proposed study will fund the fabrication and deployment of arrays of long-term acoustic recorders in the Beaufort and Chukchi seas that are capable of continuous recording, year-round. Acoustically recording the Beaufort and Chukchi seas year-round for several years will provide previously unattainable assessment of the seasonal occurrence of large whales in these regions and their response to environmental changes (including climate and anthropogenic use of the area).

Objectives:

- Assess the year-round seasonal occurrence of bowhead, gray, and other baleen whale calls in the Beaufort and Chukchi Seas.
- Track individuals through a hydrophone array to estimate relative abundance.
- Evaluate whether changes in seasonal sea ice extent is enabling a northward shift of Bering Sea cetacean species such as fin, humpback and North Pacific right whales.
- Provide long-term estimates of habitat use for large whale species and compare this with annual ice coverage in order to establish predictive variables to describe large whale occurrence.
- Collaborate with the study entitled: “COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling” in order to evaluate the extent to which variability in environmental conditions such as sea ice, oceanic currents, water temperature and salinity, and prey abundance influence whale distribution and relative abundance.

Methods: Build autonomous hydrophones based on a proven design, modified for cold, shallow water deployment for 365 days per deployment. Deploy instruments in tight arrays having a minimum of 3 instruments to facilitate evaluating the movements of individual animals. Refurbish and redeploy instruments annually. Analyze annual data for whale calls to estimate: seasonal occurrence by species, inter-annual differences in occurrence by species, variation in occurrence due to changes in ice extent, types and strengths of anthropogenic noise in the study area.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Migration and Habitat Use by Threatened Spectacled Eiders in the Eastern Chukchi Near and Offshore Environment (AK-09-03)

BOEM Information Need(s) to be Addressed: Research focusing on the distribution and timing of habitat use by the threatened (ESA) Spectacled Eiders was identified as an information need at the COMIDA workshop held on Nov. 1-3, 2006. Lease sales are planned for the Chukchi Sea Planning Area in 2010 and 2012. This information will be used for ESA Section 7 consultations, NEPA analyses, Exploration Plans, DPPs and other documentation. The information obtained from this jointly-funded research will contribute in development of mitigation measures/strategies to reduce potential impacts.

Total Cost: \$1,200,000

Period of Performance: FY 2009-2014

Conducting Organization: USGS

BOEM Contact: [Catherine Coon](#)

Description:

Background: Basic information on timing and duration of habitat use by Spectacled Eiders within the Chukchi Sea Planning Area (CSPA) and the Beaufort Sea Planning Area (BSPA) is necessary to better define parameters used to model the impacts of perturbations and ultimately population effects. Recent improvements in satellite telemetry have yielded some information on the distribution and movements of Long-tailed Ducks and King and Common Eiders, many of which stage, migrate or molt in the Eastern Chukchi Sea. Changing patterns of sea ice could shift some use to the BSPA. In 1996 the spectacled eider was listed by USFWS as threatened species. When the petition to list was submitted, studies began in 1993 to map and document the distribution, timing of migration, and wintering areas of the three populations. At that time, the molting, staging, and wintering areas of Spectacled Eiders in the Arctic and North Pacific Oceans were unknown. Subsequently, Ledyard Bay, Point Lay, and Peard Bay were identified as areas used by migrating, molting, and staging eiders that bred on the Indigirka River Delta, Russia; Yukon-Kuskokwim Delta, western Alaska; and the Prudhoe Bay region. Information on the timing and use of areas by Spectacled Eiders during fall migration, staging, and molting is now dated and limited because of small sample sizes. There is little information available about the timing of spring migration or locations of spring staging areas.

Objectives:

- Estimate the spatial distribution, demographic composition, timing of use, and residence times of male and female spectacled eiders in the Chukchi Sea Planning Area and the Beaufort Sea Planning Area.
- Evaluate the fidelity of individual Spectacled Eiders to areas within the eastern Chukchi Sea and western Beaufort Sea.

Methods: This study will use implantable satellite transmitters to document spatial distribution and timing of use by adult and juvenile Spectacled Eiders. Each tagged individual will supply two years of data from which assessments of individual and population affinity and variation will be made. Also using satellite telemetry, scientists will document both local and long-distance movements of individual Spectacled Eiders during migration; they will identify spring and autumn staging areas, and molting sites. After examining measures of bathymetry, weather, ice, and bird status, the project will develop models to represent factors influencing timing of movements and distribution of individual Spectacled Eiders during spring, summer (molt), and autumn.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Demography and Behavior of Polar Bears Summering on Shore in Alaska (AK-09-05a; AK-09-05b)

BOEM Information Need(s) to be Addressed: A jointly-funded study could address information needs identified in a 2005 MMS funded workshop hosted by the USFWS, “Beaufort Sea Polar Bear Monitoring Workshop.” It would provide useful information on the sub-population of polar bears summering in areas of increasing oil and gas activities along the Alaskan Arctic coastline. New information will support NEPA analysis and documentation for Beaufort and Chukchi Sea Lease Sales, Draft Production Plans, ESA consultations, MMPA permitting, and development of related mitigation.

Total Cost: \$1,480,767 plus joint funding **Period of Performance:** FY 2009-2014

Conducting Organization: USGS Alaska Science Center, USFWS Marine Mammals Management

BOEM Contact: [Mary Cody](#)

Description:

Background: Polar bear use of terrestrial habitat along the Beaufort and Chukchi Sea coastlines of Alaska has increased in recent years, with up to 10% of the polar bears inhabiting the southern Beaufort Sea remaining on land during the open water period. The remaining bears continue to summer on the pack ice, but now find themselves far north of the productive waters over the continental shelf. Neither situation seems favorable for polar bear foraging, and recent observations of starvation, cannibalism, drowning, and poor survival of young, suggest that polar bears in this region are increasingly subject to nutritional stresses. Although future survival of polar bears will depend on the strategies adopted in the diminishing ice environment; relative advantages and consequences of summering on land or Arctic sea ice over deep waters are unknown. Simultaneously, long-term expansion of oil and gas development is being contemplated in the southern Beaufort Sea and northern Chukchi Sea. Polar bear-human interactions may increase because areas of importance to polar bears for resting, feeding, and traveling are becoming coincident with areas of high interest for oil- and gas-related development.

Results from aerial surveys as well as a recent study monitoring polar bears feeding on bowhead whale carcasses at Barter and Cross islands indicates that all age/sex classes of polar bears are present along shore during the fall open water period and that approximately 50 percent of the bears are represented by family groups. Large numbers of bears have been observed near Barter Island, Cross Island, and Barrow. Industrial

operators in the Prudhoe Bay area report an increasing trend in the numbers, frequency, and duration of polar bear use during the open water period.

Objectives:

- Estimate the demographic composition and inter-annual patterns of use of coastal areas by the sub-population of polar bears summering on land in Alaska.
- Evaluate the implications of extended use of land during the open water period to polar bear health, behavior, and population status.
- Estimate the potential for the health and behavior of polar bears summering along the Beaufort Sea and Chukchi Sea coastlines to be influenced by oil- and gas-related activities and development.
- Develop draft conservation recommendations to reduce the possibility that industrial activity and changing environmental conditions will interact to the detriment of the polar bear population.

Methods: The investigator will conduct a thorough literature review and develop hypotheses about implications 1) to the management and stability of the polar bear population, and 2) to the health and behavior of individual bears in specific demographic groups of increasing numbers of polar bears remaining on land for extended periods during the open water period. Behavioral observations supported by application of appropriate technology (e.g. satellite tags, radio-frequency tags, and similar tags) will be used to monitor representative polar bears in Alaska that show a tendency to remain on land during the open water period. Movements, site fidelity, and limited life history data will be used to test specific hypotheses. Physical exams will be used to evaluate the health and physical condition of representative bears to test specific hypotheses. Predictions and observations will be reconciled and a plan developed to reduce the possibility of negative interactions between polar bears and oil- and gas-related development in a changing physical environment.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea – Personnel Needs (AK-10-05)

BOEM Information Need(s) to be Addressed: This study will generate information pertaining to possible impacts to marine mammals from exploratory offshore seismic surveying for oil and gas and subsequent leasing in the Chukchi and Beaufort Seas. The information will assist BOEM in NEPA analyses, ESA Section 7 consultations, MMPA documentation for Lease Sales, EPs and DPPs, and post-sale and post-exploration decision-making in the Beaufort and Chukchi Seas.

Total Cost: \$4,786,585

Period of Performance: FY 2011-2016

Conducting Organization: NOAA-NMML

BOEM Contact: [Jeff Denton](#)

Description:

Background: Bowhead whales (*Balaena mysticetus*), gray whales (*Eschrichtius robustus*), beluga whales (*Delphinapterus leucas*), Pacific walrus (*Odobenus rosmarus divergens*), polar bears (*Ursus maritimus*), bearded seals (*Phoca fasciata*), and several other species of ice seals are known to occupy the Chukchi Sea, at least during some seasons. All of these species are subject to changes in environmental variables such as oceanographic currents, sea temperature, sea ice cover, prey availability, and anthropogenic impacts. Moreover all of these species are used for subsistence both in Russia and the US and form an important part of the diet and cultural base for most people in villages along the Chukchi coast. Having a good understanding of the seasonal distribution, relative abundance, and habitat use of marine mammals in the Chukchi Sea is fundamentally important to evaluating the potential environmental impacts associated with oil and gas exploration and development and other anthropogenic activities. Reliable, up-to-date information of this type is needed for marine mammal populations in the Chukchi Sea. Aerial surveys of marine mammals are an efficient tool because they offer quick coverage of large marine areas. Past surveys are available for comparison with new data to assess whether changes in distribution or abundance have occurred since the earlier surveys were completed.

Aerial surveys of the fall migration of the bowheads have been conducted each year since 1979. This is one of the longest-maintained monitoring of a biological phenomenon and has produced an invaluable baseline of the distribution and habitat use of the bowheads. The baseline can be used to observe changes in distribution and habitat use that may occur due to changing atmospheric and oceanic climates and to

offshore oil and gas development activities. This investigation will continue the aerial observations of the fall migration for evidence of these changes

Since the beluga whales and other marine mammals seasonally or otherwise resident in the Beaufort and Chukchi are often sighted during the bowhead whale aerial surveys, their occurrence will also be part of the acquired data. This will provide coincidental sightings, but it will be of scientific value nonetheless.

Objectives:

- Document the distributions and relative densities of marine mammals in the Chukchi Sea Planning Area.
- To the extent possible, delineate the areas that are most important to marine mammals during critical seasons of their annual life history cycles such as molting, calving/pupping, and feeding.
- Define the annual fall migration of bowhead whales, significant inter-year differences, and long-term trends in the distances from shore and water depths at which whales migrate.
- Monitor temporal and spatial trends in the distribution, relative abundance, habitat, and behaviors (especially feeding) of endangered whales in arctic waters.
- Provide real-time data to BOEM and NMFS on the general progress of the fall migration of bowhead whales across the Alaskan Beaufort Sea.
- Provide an objective wide-area context for management understanding of the overall fall migration of bowhead whales and site-specific study results.
- Record and map beluga whale distribution and incidental sightings of other marine mammals.

Methods: Aerial line-transect surveys will be flown in the Chukchi Sea Program Area during two time periods: late-July to early-August and October to early-November. Aerial line-transect surveys will be flown in the Beaufort Sea to observe the fall migration of the bowhead whales, continuing the decades-long set of observations. For surveys in both seas, the observational and data recording methodology shall follow protocols used by BOEM in the past surveys of the bowhead fall migration.

The observations, data recording, and subsequent data analysis will be performed by scientists and support personnel at the National Marine Mammal Laboratory. Additionally, the scientists will be responsible for the management of this project, all necessary training of support personnel, providing all needed field equipment, conducting all logistical tasks, and insuring the safety of all people involved.

Aircraft support is funded under the companion study titled “Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea – Aircraft Needs.”

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea – Aircraft Needs (AK-11-06)

BOEM Information Need(s) to be Addressed: This study will generate information pertaining to possible impacts to marine mammals from exploratory offshore seismic surveying for oil and gas and subsequent leasing in the Chukchi and Beaufort Seas. The information will assist BOEM in NEPA analyses, ESA Section 7 consultations, MMPA documentation for Lease Sales, EPs and DPPs, and post-sale and post-exploration decision-making in the Beaufort and Chukchi Seas.

Total Cost: \$9,800,000

Period of Performance: FY 2011-2016

Conducting Organization: USDOJ National Business Center

BOEM Contact: [Jeff Denton](#)

Description:

Background: Bowhead whales (*Balaena mysticetus*), gray whales (*Eschrichtius robustus*), beluga whales (*Delphinapterus leucas*), Pacific walrus (*Odobenus rosmarus divergens*), polar bears (*Ursus maritimus*), bearded seals (*Phoca fasciata*), and several other species of ice seals are known to occupy the Chukchi Sea, at least during some seasons. All of these species are subject to changes in environmental variables such as oceanographic currents, sea temperature, sea ice cover, prey availability, and anthropogenic impacts. Moreover all of these species are used for subsistence both in Russia and the US and form an important part of the diet and cultural base for most people in villages along the Chukchi coast. Having a good understanding of the seasonal distribution, relative abundance, and habitat use of marine mammals in the Chukchi Sea is fundamentally important to evaluating the potential environmental impacts associated with oil and gas exploration and development and other anthropogenic activities. Reliable, up-to-date information of this type is needed for marine mammal populations in the Chukchi Sea. Aerial surveys of marine mammals are an efficient tool because they offer quick coverage of large marine areas. Past surveys are available for comparison with new data to assess whether changes in distribution or abundance have occurred since the earlier surveys were completed.

A recent, BOEM-funded investigation of the seasonal migration of the bowhead whales using satellite-tracked animal tags revealed that they are resident in the Bering Sea during the winter and return to the Beaufort Sea in the summer when opening spring leads allow for passage along the Alaskan and Canadian coasts. The bowheads leave the Beaufort in the fall and cross the Chukchi Sea before moving back into the Bering Sea for the winter.

Since 1979, aerial surveying of the fall migration of the bowheads has been conducted, initially by the Bureau of Land Management and subsequently by MMS, now BOEM. This is one of the longest-maintained monitoring of a biological phenomenon and has produced an invaluable baseline of the distribution and habitat use of the bowheads. The baseline can be used to observe changes in distribution and habitat use that may occur due to changing atmospheric and oceanic climates and to offshore oil and gas development activities. This investigation will continue the aerial observations of the fall migration for evidence of these changes

Since the beluga whales and other marine mammals seasonally or otherwise resident in the Beaufort and Chukchi are often sighted during the bowhead whale aerial surveys, their occurrence will also be part of the acquired data. This will be coincidental sightings, but of scientific value nonetheless.

Objectives: Obtain the necessary aircraft services (planes, fuel, maintenance, pilots, etc.) via Interagency Agreement between NBC-AMD and BOEM required by the study titled “Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea –Personnel Needs.”

Methods: The USDOJ National Business Center’s Acquisition Services Directorate will issue contracts to private companies to obtain the needed aircraft services.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Synthesis of Arctic Research (SOAR) Physics to Marine Mammals in the Pacific Arctic (AK-11-05)

BOEM Information Need(s) to be Addressed: The changing physical environment of the U.S. Arctic OCS is hypothesized to drive a rapid tempo of change in the distribution and behavior of a number of protected marine mammals that inhabit those waters. The same species may be affected by oil and gas activities within BOEM Planning Areas, with strong potential for deleterious interactions between natural and human induced phenomena. Under NEPA and the ESA, BOEM is required to evaluate whether and how federal actions associated with oil and gas development may affect these protected populations. Information on ocean circulation and hydrography is useful for those evaluations as well as for input into various models used to predict the outcome of oil spills and other physical phenomena. Given recent high investment in interdisciplinary biological and oceanographic research by the Governments in the region, a synthesis of results of completed and ongoing studies would be useful to inform management decision-makers and may be useful in determining needs of future research activities.

Total Cost: \$1,798,459 plus joint funding **Period of Performance:** FY 2011-2016

Conducting Organization: NOAA- Pacific Marine Environmental Laboratory

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

Description:

Background: The physical climate of the western Arctic appears to be rapidly changing. The summer minimum sea ice extent in 2007 and 2008 covered an area which was 37% less than the areal coverage of two decades ago and 20% less than the previous minimum coverage in 2005. High water temperatures and dense concentrations of zooplankton have been observed near Barrow. The rapidity of these changes was unexpected.

During the same period, several marine mammals have exhibited unusual movements or behaviors that may be related to these environmental changes. The range of humpback whales has moved northward to include the northern Chukchi and western Beaufort Seas. Fin whales have expanded their range northward to include waters north of Icy Cape in the Chukchi. In 2009, bowhead whales fed extensively in the northern Chukchi Sea, a phenomenon not observed since the end of commercial whaling one hundred years ago. In recent years, gray whales have fed in increasing numbers along the coastline between Wainwright and Barrow. In 2007 and 2009, walrus formed large aggregations on shore between Norton Sound and Barrow. This behavior appears to be related to the summer retreat of sea ice well northward of traditional walrus feeding areas on the shelf break.

Between the years 2005 and 2015 BOEM will have invested more than \$60 million in marine mammal and related oceanographic studies in the western Arctic. These data will increase our body of knowledge about the region considerably, but interpretation will be complicated by concurrent environmental changes. This study proposes a synthesis of research from the ongoing studies in the Region. These studies include, but are not limited to:

- Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales & Oceanography and Feeding
- Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic
- Ecosystem Observations in the Chukchi Sea: Biophysical Mooring and Climate Modeling
- Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea
- Walrus Habitat Use in the Potential Drilling Area
- Pinniped Movements and Foraging: Bearded Seals
- Studies conducted by the State of Alaska and the North Slope Borough under the USDOJ Coastal Impact Assistance Program (CIAP)

Objectives:

- Increase scientific understanding of the inter- and intra-relationships of oceanographic conditions, lower trophic prey species, and marine mammal distribution and behavior in the Chukchi Sea lease area and adjacent waters.
- Enhance capability to predict future changes in oceanographic features such as currents, upwellings, and ice leads and associated changes in the behavior of marine mammals and their prey.

Methods: Using a synthesis approach, PIs will analyze data available from BOEM supported and related studies in the Beaufort and Chukchi seas, using available statistical and other models to identify and test hypotheses that cross scientific disciplines. This study will be guided by an oversight committee formed of senior scientists and accomplished through annual, or more frequent, meetings. In the first meeting participants will inventory available data and deem its sufficiency for use to address specific hypotheses and questions identified by the participants in facilitated sessions. Recommendations for further analyses and publication development will be provided in a report to BOEM summarizing that meeting. After BOEM review and approval, subgroups of interdisciplinary scientists will work together to prepare data for integration and conduct appropriate statistical analyses or modeling to identify interdisciplinary relationships and/or test hypotheses previously identified. Sub-groups will then prepare multi-authored manuscripts for publication in appropriate peer-review literature. Topics for synthesis include, but are not limited to, inter- and intra-relationships of oceanographic circulation, sea ice, hydrography, lower-trophic abundance and distribution, and marine mammal distributions and behavior. Deliverables from this study will include multiple workshop proceedings and summary recommendation reports, as well as multiple peer-review journal publications.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (AK-12-02)

BOEM Information Need(s) to be Addressed: This project will extend ongoing research to provide more information on the locations and use of bowhead whale feeding areas, the variability of those locations from year to year, and the environmental factors that can be used to predict where bowhead whales will concentrate. This information is used for developing mitigation options for Beaufort and Chukchi Lease sales and exploration and development activities. Information on the vocal behavior of bowhead whales under various environmental conditions is needed to interpret the habitat use and call behavior being collected on many passive acoustic recorders currently in use. Information from this study will be used for ESA Section 7 consultations and NEPA documentation.

Total Cost: \$2,699,856

Period of Performance: FY 2012-2016

Conducting Organization: ADF&G

BOEM Contact: [Jeff Denton](#)

Description:

Background: A previous BOEM study using satellite telemetry has greatly added to the knowledge of bowhead whale movements, concentration areas, and the timing of both. Multiple years of tracking during this study has begun to provide information regarding the inter-annual variability in movements and concentration areas. Continued tracking will provide a better understanding of this variability and will allow us to predict the timing and location of bowhead concentration areas making mitigation measures more directly applicable and useful.

Satellite-linked transmitters are a valuable tool for tracking bowhead whales and they have been effective at documenting movements of large and small whales of both sexes, and the timing and locations of concentration areas. Another tool, of increasing use, is the passive acoustic recorder deployed near areas of interest to record marine mammal vocalizations. Recorded bowhead vocalizations indicate that a bowhead was present at the time of vocalization, but an absence of calls could mean bowheads are present but not vocalizing. Bowhead whale vocalization rates related to various behaviors (e.g., feeding and travelling) or potential disturbances (e.g., boat traffic, seismic operations, and drilling) are needed to interpret the information being collected by passive acoustic recorders. Sensors for monitoring environmental conditions such as temperature and salinity have been developed and are in use on large whales, including bowheads in Greenland.

Objectives: To better understand interannual variation in bowhead whale feeding concentrations and to interpret call counts and calling rates collected by passive acoustic recorders.

Methods: This study will track the movements and document the behavior of bowhead whales using satellite telemetry to compare among years emphasizing new tagging locations such as St. Lawrence, Island, Pt. Hope and Canada. Bowhead whale vocalization rates and ambient noise levels will be documented using an acoustic tag to develop analysis of call rates relative to behavior and disturbance. Tags equipped with environmental sensors will be deployed to monitor, summarize, and transmit ambient oceanographic conditions as bowheads migrate. Limited numbers of individuals of other species of large whales (Gray, Humpback, Fin) may be tagged and tracked as opportunities arise as a pilot study for future work.

This study also will continue collaborations between whaling captains, AEWC, NSB, ADF&G, NMFS, BOEM, DFO-Canada, and Natural Resources Greenland and develop additional collaborations with oil companies and consultants collecting acoustic data to accomplish this project. Satellite transmitters with environmental and passive acoustic monitoring capabilities will be deployed on bowhead whales near Native villages in the Beaufort, Chukchi, and Bering seas. Plots of whale tracks will be made available weekly and location data compared among years to determine inter-annual variability of movements and concentrations. Acoustic data will be analyzed to determine individual whale calling rates relative to whale behavior and disturbance factors. This study will be coordinated with AEWC and local whaling captains' associations to prevent any interference with subsistence whaling and hunting. All necessary research and access permits will be obtained by the PI.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea, Northern Bering Sea

Title: Ice Seal Movements and Foraging: Village-based Satellite Tracking and Acoustic Monitoring of Ringed and Bearded Seals (AK-12-05)

BOEM Information Need(s) to be Addressed: More information is needed on seal movements and feeding areas relative to areas of interest for oil and gas leasing, exploration and development. Additional information would be particularly useful to evaluate potential interaction between industrial development and anticipated effects of diminished summer sea ice in much of their habitat. Data can be used to help design monitoring and mitigation measures and will provide more information to be used in NEPA environmental analyses. Since ice seals have been petitioned for listing under the ESA, information from this study may be useful for future ESA Section 7 consultations.

Total Cost: \$1,174,994

Period of Performance: FY 2013-2017

Conducting Organization: ADF&G

BOEM Contact: [Dr. Dan Holiday](#)

Description:

Background: Considerable effort has been expended since the 1980s to document the distribution, abundance and behavior of ice seals in the Beaufort and Chukchi Seas. However most of that effort involved aircraft surveys and analysis of prey from stomachs collected by biologists or in subsistence harvests. Some satellite telemetry studies of ringed, bearded, and spotted seals movements have been conducted (funded by MMS and others) showing large scale movements by all species and age classes. One highly successful project was conducted from 2004-2010 near Kotzebue in which local hunters were trained for capture and tagging. Seals tagged near Kotzebue ranged farther north than Barrow and south to Bristol Bay. Overall, because of the proximity to the tagging location most of the locations are in the southern Chukchi Sea near Kotzebue. Additional tagging locations are needed to better understand the range of movements and use patterns. Other village-based tagging projects could be developed to expand the tagging locations and increase the knowledge of seal movements. Tagging near Pt. Lay, Wainwright, and Barrow may show a greater use of Lease Sale 193 and the Beaufort Sea than use by seals tagged near Kotzebue. On the other hand, if seals tagged near Kotzebue go to the Yukon-Kuskokwim area and Bristol Bay, seals tagged in the Bering Sea may also use the Chukchi and Beaufort seas.

Adult ringed seals are the most ice adapted and are known to use the heaviest ice concentrations throughout winter and spring and it was assumed that juveniles occupied similar habitats in winter. Movements of adult and juvenile ringed seals tagged near Kotzebue, however, showed juveniles travelling to and wintering near the

ice edge in the Bering Sea while adults wintered in heavy ice in the northern Bering and Chukchi seas. It is likely that other similar patterns of use by species or sex/age classes will be documented during this tagging study.

Objectives: To better understand movements and habitat use of ice seals in the Beaufort, Chukchi, and northern-Bering seas.

Methods: Using the tagging project conducted in Kotzebue Sound by the Native Village of Kotzebue as a model, develop similar collaborations between local Village Councils, seal hunters, the Ice Seal Committee, NSB, ADF&G, NMFS, BOEM, to establish seal tagging projects near several Native villages selected for their importance in providing seal movement information. Biologists will train hunters in seal capture and tag deployment and provide weekly maps of seal tracks to the hunters and their communities. Movement data will be analyzed relative to ice edge, ice concentration, bathymetry, and residence times. To the extent feasible, passive acoustic recordings of vocalizations from acoustic arrays deployed in other BOEM studies such as BOWFEST and CHAOZ will be used to estimate relative local calling-rates for bearded and other ice seals. Native deployed “dipping hydrophones” will be used to document call rates and types near coastal villages.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (AK-12-07)

BOEM Information Need(s) to be Addressed: Whale species listed as threatened and/or endangered are known to, or potentially could, occur in areas that may be affected by oil and gas activities within the Chukchi Sea planning areas. These include, but are not limited to the humpback (*Megaptera novaeangliae*), the fin (*Balaenoptera physalus*), and the bowhead (*Balaena mysticetus*), all of which are listed as endangered. Recent sightings of both humpback and fin whales in the Chukchi and/or Beaufort seas, indicate a range expansion by one or both species. Gray (*Eschrichtius robustus*) and beluga (*Delphinapterus leucas*) whales also use these waters in large numbers. Under NEPA and the ESA, BOEM will be required to evaluate if and how Federal actions associated with oil and gas development may affect these whales. The occurrence, distribution and habitat use of these species in the areas concerned may play an important role in determining where and when exploration or access to petroleum reserves may be conducted.

Total Cost: \$4,502,000

Period of Performance: FY 2012-2017

Conducting Organization: NOAA-NMFS

BOEM Contact: [Jeff Denton](#)

Description:

Background: Research underway on the Bowhead Whale Feeding Ecology Study (BOWFEST) indicates that large concentrations of bowhead whales feeding in the Barrow arch (Wainwright to Smith Bay) are attracted by prey and nutrients transported from the Bering Sea through Barrow Canyon and upwelled onto the Beaufort shelf near Barrow. Other large concentrations of whales, pinnipeds and water birds are found in the area and may be attracted by elements of the same mechanism. However, it is not clear exactly how this transport mechanism operates as these resources could be transported through the Chukchi Sea on the Alaska Coastal Current or by other sources of Bering Sea waters. This study will undertake to determine relationships between dominant currents passing through the Chukchi Sea and resources delivered to the Barrow Arch area and will provide information about the dynamic nature of those relationships relative to whale distribution and habitat utilization in the eastern-Chukchi and extreme western-Beaufort seas.

The relationships between Chukchi Sea currents and the transport of nutrients and prey may be more dynamic than formerly appreciated and may be changing as a result of the warming of the surface waters and increasing retreat of summer sea ice in the Chukchi. Recent observations of humpback and fin whales in the Chukchi are likely a climate

change-related range expansion that will continue in future years. Even as the range of these cetaceans appears to be expanding, with the exception of the bowhead whale, little is known about the population identities of any of the whales observed there. In the case of the humpback whales, it is possible that they are part of the relatively small western North Pacific stock. Virtually nothing is known about the extent to which the region is important for humpback or fin whales. Gray whales make extensive use of the Chukchi for feeding and at least some gray whales have been documented in the area during every calendar month. Gray whales potentially could belong to stocks associated with either North America or Asia; the latter is considered to be critically endangered, with fewer than 150 animals remaining. Although gray whales have been documented in the Chukchi Sea by surveys over the past three decades, the ecology of the species has not been studied in the area. Over 10% of the Eastern Pacific Stock may use the Chukchi for summer feeding. They are known to make extensive summer use of waters near the Burger Prospect and Peard Bay, areas of significant interest for industrial development. Beluga whales are frequent visitors to lagoons and coastal waters along the eastern Chukchi Sea coast. They are prized as a traditional species taken for subsistence and ceremonial purposes by Natives resident along that coastline. Beluga stock associations are not well known but belugas in the region are probably from a mixture of several stocks inhabiting the Chukchi Sea and Arctic Ocean.

Since all five species winter in, or south of, the Bering Sea, large numbers must pass through the Bering Strait during seasonal migrations to feeding grounds further north. Beginning at the Bering Strait, this research will investigate the currents and nutrient/prey transport process using methods and equipment developed for physical and biological oceanography. Additional work on the distribution, stock identity, and ecological relationships is needed for all five whale species and this all will be accomplished in a cooperative, highly-integrated study involving scientists supported by BOEM, the NSB DWM, and the NSF.

Objectives:

- Assess spatial and temporal patterns of use of the Chukchi Sea by endangered bowhead, fin and humpback whales, and beluga and gray whales.
- Assess population structure and origin of animals.
- Evaluate ecological relationships for the species, including physical and biological oceanography.
- Extend existing studies of bowhead whale foraging ecology into the Chukchi Sea to further understand the sources, transport and advection of krill from the Bering Strait.

Methods: This study requires technologies including satellite tracking, passive acoustic monitoring, genetic analyses, and oceanographic and biological methodologies and technologies.

Northern Bering Sea. Satellite tags will be attached to humpback and fin whales, and their movements through the Chukchi Sea will be monitored through the Argos system.

No fin whales have been satellite tagged in this region. Up to 20 tags per species would be deployed in each of 4 years. Population structure and origin will be assessed by genetic analysis of biopsy samples. Areas where aggregations of whales occur will be targeted to increase the probability of successful tagging. For example, an aggregation of humpback whales tends to occur in the northern Bering Seas southwest of St. Lawrence island (around the M8 oceanographic mooring). Sonobuoys will be used to target fin whales which use a triplet call that occurs in both the Bering and Chukchi seas. An array of listening devices will be deployed through the Bering Sea to monitor occurrence and movement of large whales transiting through the area to facilitate tagging efforts and target whales that move into the Chukchi Sea.

Chukchi Sea/Bering Strait. In the Chukchi, arrays of listening devices will be deployed in the Bering Strait and near Wainwright, Alaska, with the intention of monitoring the occurrence and movements of large whales transiting through the area. The study proposed here will also permit a full visual and acoustic survey to be conducted between Dutch Harbor and the Bering Strait/Wainwright. In addition, photo-id, biopsy sampling and satellite tagging will be attempted if humpback, fin and gray whales are found en route. Humpback, fin, and gray whales will be tagged in the region as practical. Cruises will be organized to extend similar research activities to those areas during years 3-4 of the study. Whales will be tagged in the region as practical. Oceanographic surveys, including prey sampling, will be conducted in association with cruises, and will include studies of foraging ecology of bowheads using similar methods to those employed in the Beaufort Sea. Instrumented moorings may be deployed for year-around monitoring of oceanography and sound. The study will be integrated with other ongoing studies in the regions including aerial surveys, passive acoustic monitoring and oceanography. Analysis of acoustic data from new and existing recording packages will investigate the occurrence of gray, humpback, fin and bowhead whales on a year-round basis.

Revised Date: October 2013

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Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea, Bering Sea

Title: Abundance Estimates of Ice-Associated Seals: Bering Sea Populations that Inhabit the Chukchi Sea – Aircraft Support (AK-12-x10a)

BOEM Information Need(s) to be Addressed: BOEM needs reliable abundance estimates of ice-associated seal species for NEPA analysis and the future development of sound plans for management, conservation, and mitigation of potential environmental impacts from oil and gas activities and climate change. Improved monitoring of ice-associated seals is also fundamental for ensuring compliance with Federal management and regulatory mandates for stock assessments under the Marine Mammal Protection Act (MMPA) and establishing extinction risk assessments under the Endangered Species Act (ESA). Study findings will be used in pre-lease analyses and documentation for potential future Chukchi Sea lease sales, as well as post-sale NEPA analysis, review of EPs, DPPs and other reviews for post-sale and post-exploration BOEM decision making and mitigation.

Total Cost: \$471,000

Period of Performance: FY 2012-2014

Conducting Organization: USDOJ National Business Center

BOEM Contact: [Dr. Dan Holiday](#)

Description:

Background: Bearded, spotted, ribbon, and ringed seals, collectively referred to as ice seals, are key components of Arctic marine ecosystems and are important subsistence resources for northern coastal Alaska Native communities. These seals are protected under the MMPA and bearded seals are under consideration for listing through the ESA. More comprehensive abundance estimates for these ice-associated seals are needed to establish extinction risk assessments under the ESA and to ensure compliance with Federal management and regulatory mandates for marine mammals under the MMPA. Obtaining reliable abundance estimates for ice seals is also a key requirement for developing sound plans for response to potential environmental impacts of oil and gas activities and the impacts to ice seal populations due to climate change. The seals' geographic distributions are broad and patchy, and the extent, locations, and conditions of their sea ice habitats change rapidly.

Scientists at NOAA's National Marine Mammal Laboratory (NMML) have been collaborating with Russian colleagues to conduct synoptic aerial surveys of ice-associated seals in the Bering and Okhotsk Seas. This procurement provides logistics support for travel of NMFS staff conducting aerial surveys for ice seals (bearded, spotted, and ribbon seals) over the Outer Continental Shelf (OCS) areas of the Bering and southern Chukchi seas. In addition, the project allows for BOEM financial support

toward contracting temporary staff to compliment the NMFS-NMML team and facilitate image processing and data analysis of high-resolution digital imagery and thermal output photography. A large volume of images and data are anticipated from the surveys; annually these data files will be approximately 20 terabytes, including more than 1 million high-resolution photos.

Objectives: Obtain the necessary aircraft services (planes, fuel, maintenance, pilots, etc.) via Interagency Agreement between NBC-AMD and BOEM required by the study titled “Abundance Estimates of Ice-Associated Seals: Bering Sea Populations that Inhabit the Chukchi Sea – Logistics Support.”

Methods: The USDOJ National Business Center’s Aviation Management Directorate will issue contracts to private companies to obtain the needed aircraft services.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea, Bering Sea

Title: Abundance Estimates of Ice-Associated Seals: Bering Sea Populations that Inhabit the Chukchi Sea – Logistics Support (AK-12-x10b)

BOEM Information Need(s) to be Addressed: BOEM needs reliable abundance estimates of ice-associated seal species for NEPA analysis and the future development of sound plans for management, conservation, and mitigation of potential environmental impacts from oil and gas activities and climate change. Improved monitoring of ice-associated seals is also fundamental for ensuring compliance with Federal management and regulatory mandates for stock assessments under the Marine Mammal Protection Act (MMPA) and establishing extinction risk assessments under the Endangered Species Act (ESA). Study findings will be used in pre-lease analyses and documentation for potential future Chukchi Sea lease sales, as well as post-sale NEPA analysis, review of EPs, DPPs and other reviews for post-sale and post-exploration BOEM decision making and mitigation.

Total Cost: \$240,000 plus joint funding **Period of Performance:** FY 2012-2014

Conducting Organization: NMFS-NMML

BOEM Contact: [Dr. Dan Holiday](#)

Description:

Background: Bearded, spotted, ribbon, and ringed seals, collectively referred to as ice seals, are key components of Arctic marine ecosystems and are important subsistence resources for northern coastal Alaska Native communities. These seals are protected under the MMPA and bearded seals are under consideration for listing through the ESA. More comprehensive abundance estimates for these ice-associated seals are needed to establish extinction risk assessments under the ESA and to ensure compliance with Federal management and regulatory mandates for marine mammals under the MMPA. Obtaining reliable abundance estimates for ice seals is also a key requirement for developing sound plans for response to potential environmental impacts of oil and gas activities and the impacts to ice seal populations due to climate change. The seals' geographic distributions are broad and patchy, and the extent, locations, and conditions of their sea ice habitats change rapidly.

Scientists at NOAA's National Marine Mammal Laboratory (NMML) have been collaborating with Russian colleagues to conduct synoptic aerial surveys of ice-associated seals in the Bering and Okhotsk Seas. This procurement provides logistics support for travel of NMFS staff conducting aerial surveys for ice seals (bearded, spotted, and ribbon seals) over the Outer Continental Shelf (OCS) areas of the Bering and southern Chukchi seas. In addition, the project allows for BOEM financial support

toward contracting temporary staff to compliment the NMFS-NMML team and facilitate image processing and data analysis of high-resolution digital imagery and thermal output photography. A large volume of images and data are anticipated from the surveys; annually these data files will be approximately 20 terabytes, including more than 1 million high-resolution photos.

Objectives:

- Conduct aerial surveys to collect high-resolution digital and thermal imagery of ice seals over OCS areas of the Bering and southern Chukchi seas.
- Effectively retrieve, manage, and process sensor imagery for analyses to facilitate calculation of abundance estimates for bearded, spotted, and ribbon seals in the Bering and Chukchi Seas.

Methods: 1) U.S. surveys will begin April 1, 2012, out of Anchorage. A total of 17,000 – 22,000 km of survey transects at an altitude between 800 -1000 ft. will be conducted during an estimated 6 week time period. 2) Surveys will be conducted using two aircraft: a NOAA Twin Otter aircraft and a chartered long range aircraft. The charter aircraft efforts will be focused on the central Bering Sea, an important concentration and breeding area for bearded, spotted, and ribbon seals that is inaccessible to the Twin Otter. 3) New instrument-based methods rather than traditional observer-based methods will be utilized. Multiple high-resolution digital cameras (Canon Mark III 1Ds) will allow surveys to be flown at altitudes too high for on-board observers to identify species. The increase in altitude will reduce disturbance to ice seals being surveyed while providing areal coverage equivalent to surveys flown at lower altitudes during observer-based surveys. 3) Temperature data from a thermal camera (FLIR SC645) paired with each Canon digital camera image will be used to identify when seals are present in the survey area. Utilizing these data will be a thermal automated count and camera-trigger system (Snowflake), a new system that will be tested during this study. This new system allows for images to be collected at regular intervals to monitor sea ice habitat throughout the survey in addition to collecting images when seals are present in the thermal signal. The purpose of this fully automated image collection system is to greatly reduce the number of images collected, thus reducing time for analysis and reducing computer storage space of raw imagery data. 4) After each survey, the digital images, thermal data, and GPS records will be downloaded, duplicated, and stored with appropriate metadata for later analysis. 5) Abundance estimations will be achieved using hierarchical models for seal abundance developed at NMML.

Aircraft support is funded under the companion study titled “Abundance Estimates of Ice-Associated Seals: Bering Sea Populations that Inhabit the Chukchi Sea – Aircraft Support.”

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Chukchi Acoustic, Oceanography and Zooplankton Study:
Hanna Shoal (Extension of CHAOZ) (AK-13-02)

BOEM Information Need(s) to be Addressed: Information from this study will document the physical and biological dynamics in the Hanna Shoal region, including the temporal and spatial distribution of marine mammals. Findings may be used for evaluating potential deferral areas and other potential limitations on offshore leasing, exploration, and development. This study will provide useful information to support NEPA analysis and documentation for Beaufort and Chukchi Sea Lease Sales, exploration plans, development and production plans, consultations under the ESA and MMPA, and monitoring protocols for adaptive management.

Total Cost: \$3,933,671 plus joint funding **Period of Performance:** FY 2013-2016

Conducting Organization: NOAA-NMML

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

Description:

Background: The western Arctic physical climate is rapidly changing. The summer minimum sea ice extent in 2007, 2008 and 2011 covered an area which was 37% less than the areal coverage of two decades ago and 20% less than the previous minimum coverage in 2005. The reduction in sea ice coverage also opens up vast new regions of the Arctic Ocean to increased absorption of sunlight and storage of heat. The rapidity of these changes was unexpected, as the consensus of the climate research community just a few years ago was that such changes would not be seen for another 30 years. The observed northward retreat of the minimum extent of summer sea ice has the potential to expand oil and gas-related exploration and development into previously closed seasons and localities in the Alaskan Arctic.

Baleen whales (bowheads [*Balaena mysticetus*], gray whales [*Eschrichtius robustus*], fin whales [*Balaenoptera physalus*], humpbacks [*Megaptera novaeangliae*], and minke [*Balaenoptera acutorostrata*]) are subject to changes in environmental variables such as oceanographic currents, sea temperature, sea ice cover, prey availability, and anthropogenic impacts. Furthermore, extreme ice-retreat and climate warming in the western Arctic over the last decade are expected to lead to changes in species composition and distribution, evidenced already through local knowledge and opportunistic observations.

Hanna Shoal in the northeast Chukchi Sea is an area of special biological concern bordering the boundary between Chukchi and Arctic Ocean waters. The reason for this, however, is poorly understood. The shallower waters of the shoal have long been known

as traps for grounding of sea ice, and a reoccurring polynya is created down current of the grounded ice. In most recent years, floating pack ice in summer persists in this area longer than elsewhere in the Chukchi, often surrounded by open water even to the north. Biological “hot spots” in the Chukchi Sea are thought to be related to coupled pelagic and benthic productivity. The importance of the Hanna Shoal region to bowhead, gray and other whales, as well as walruses and ice seals, is not well known.

The study “COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales” combines passive acoustic detection and tracking of whales, active acoustic detection of zooplankton, and biophysical measurements from long-term moorings on the Chukchi Shelf to examine relationships between primary production, zooplankton biovolume and the presence/absence of whales. Passive acoustic detection and tracking is a proven tool for assessment of large whales in Alaskan seas. Specifically, acoustic detection has proven a key addition to the census of bowhead whales (*Balaena mysticetus*) during their spring migration past Barrow, and in relation to oil and gas development activities offshore Prudhoe Bay. The proposed study will refocus this monitoring to the region of Hanna Shoal. These measurements will complement the biological, oceanographic and contaminant data collected by the “Hanna Shoal Ecosystem Study.”

Objectives: This study will to refocus the acoustic and biophysical monitoring begun under the study “COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales” to the region of Hanna Shoal. Specific objectives include:

- Assess the spatial and temporal distribution of marine mammals near Hanna Shoal.
- Implement a tonal detector/classifier for all marine mammal species of interest to BOEM in the Arctic.
- Describe patterns of current flow, hydrography, ice thickness, light penetration, and concentrations of nutrients, chlorophyll and large crustacean zooplankton.
- Evaluate the extent to which variability in environmental conditions such as sea ice, oceanic currents, water temperature and salinity, and prey abundance influence whale distribution and relative abundance.
- Develop a quantitative description of the Chukchi Sea’s noise budget, as contributed by biotic and abiotic sound sources, and continuous, time-varying metrics of acoustic habitat loss for a suite of arctic marine mammal species.

Methods: This study will deploy long-term passive acoustic recorder moorings in the vicinity of Hanna Shoal to provide information on marine mammal distribution. Researchers will also opportunistically deploy sonobuoys to monitor vocalizing marine mammals while the ship is underway. Annual data will be analyzed for whale calls to estimate: seasonal occurrence by species, inter-annual differences in occurrence by species, variation in occurrence due to changes in ice extent, and types and strengths of anthropogenic noise in the study area. Biophysical moorings and active acoustic moorings for zooplankton deployed on the flanks of Hanna Shoal will collect

information on currents, hydrography, ice, nutrient and chlorophyll concentrations, etc. These instruments will be refurbished and redeployed annually.

The study will also use autonomous and real-time passive acoustic recording systems to monitor the Chukchi acoustic ecosystem and quantify changes in its acoustic habitat as a function of natural and man-made noise contributors. The systems will automatically collect, detect and report via satellite species-specific sounds from a broad suite of marine mammals in the Chukchi Sea, including: beluga, bowhead, fin, humpback and killer whales; bearded, ribbon and ringed seals; walrus; and fishes. These data will populate models of the acoustic environment that are currently under development.

Revised Date: October 2013

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Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Walrus Seasonal Distribution and Habitat Use in the Eastern Chukchi Sea (AK-13-06)

BOEM Information Need(s) to be Addressed: Data on the seasonal distribution, abundance, and habitat use of Pacific walruses (*Odobenus rosmarus*) are an integral part of assessing and managing anthropogenic risks from Chukchi Sea OCS development. Information on these ecological parameters in the Chukchi Sea are coming to light from current USGS walrus studies, but require further research and monitoring, especially in light of the loss of sea ice habitat and ongoing ecological changes.. This study will provide information for NEPA analyses of proposed OCS oil and gas activities, MMPA authorizations, and ESA conferences. This study will contribute information useful for developing mitigation strategies to reduce impacts to walruses from proposed oil and gas development activities. In addition, walruses in the Chukchi Sea are an important subsistence resource to Russian and Alaska Natives.

Total Cost: \$1,750,000

Period of Performance: FY 2013-2018

Conducting Organization: USGS

BOEM Contact: [Catherine Coon](#)

Description:

Background: Joint US-Russia aerial surveys of walruses were conducted in the Chukchi Sea in the fall of 1975, 1980, 1985, 1990, and 1995. A joint US - Russia walrus aerial survey was conducted in spring of 2005 in the Bering Sea. Recent declines in summer/fall sea ice in the Chukchi Sea have resulted in walruses hauling out at coastal sites in Alaska in fall when sea ice completely disappears over the eastern continental shelf. This situation may provide an opportunity to count walruses along the coast of Alaska from aerial surveys. The BOEM-funded COMIDA program has conducted opportunistic surveys of the coast to enumerate walruses over the past few years.

The USGS initiated a study in 2007, and expanded the study in subsequent years, to determine the seasonal distribution and habitat use of walruses in the Chukchi Sea. A report on walrus utilization areas in 2008-2011 is forthcoming. However, patterns of utilization are still being established by walruses in response to continued reductions in sea ice habitats in the Chukchi Sea. Also, BOEM funded a satellite tagging project in 2009 to study the movements and habitat use of selected walruses in the Chukchi Sea.

Exploration drilling activities in the Chukchi Sea are expected to begin in 2012 and continue through at least 2014. Therefore, walrus monitoring needs to continue without interruption through at least the next five years to provide pre-development information and describe changes in walrus distribution and abundance associated with changing

sea ice habitats. Information regarding the seasonal distribution, abundance, habitat use, and diet of walruses across the planning area will assist in assessing potential impacts and mitigating disturbances associated with proposed exploration and development scenarios. The monitoring activities described in this study profile follow recommendations of the national Ocean Research Priorities Plan (ORPP).

Objectives: The overarching objective of the study is to obtain information on the seasonal abundance, distribution, and habitat use of walruses in the Chukchi Sea. Specific objectives of this study include:

- Estimate the abundance of walruses in the eastern Chukchi Sea in late summer/fall.
- Delineate the areas that are most important to walruses during critical times of their annual life history cycles such as feeding.
- Determine seasonal distribution and movements of walruses in the Chukchi Sea lease sale area.
- Identify habitats of importance to walruses (e.g., feeding and resting).
- Determine whether prey selection and/or foraging areas are changing over time with increased use of nearshore habitats.

Methods:

8. Conduct aerial surveys in late summer and early fall to enumerate walruses at coastal haulouts in Alaska. Effort will focus on development of necessary correction factors.
9. Deploy radio-tag instruments on a sufficient sample of walruses.
10. Use GIS and spatial analysis methods to define important habitats, identify migration pathways, and to identify areas for potential deferral from future lease sales.
11. Collect appropriate walrus tissue, fecal and/or biopsy samples and perform molecular analysis to identify prey taxa and trends in dietary taxa composition over time.
12. Utilize sound source information and satellite-tag data to track walrus location relative to industry activities.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: A Year in the Life of a Bowhead Whale: An Animated Film
(AK-08-12-10)

BOEM Information Need(s) to be Addressed: The project is for public outreach. It serves to promote an aware and informed public, and in so doing, strengthens public voices in crafting policy.

Total Cost: \$87,587.00 plus joint funding **Period of Performance:** FY 2012-2014

Conducting Organization: CMI, UAF; University of Alaska Museum of the North

BOEM Contact: [Jeff Denton](#)

Description:

Background: Science and technology increasingly play important roles in the development of public policies relating to a wide range of societal issues. Science outreach serves to promote an aware and informed public and, in so doing, strengthens public voices in crafting policy. Research has been underway on bowhead whale ecology, movements and distribution for decades, and significant body of knowledge regarding annual migrations, seasonal ranges, movements and bowhead feeding concentrations in the Barrow arch attracted by prey and nutrients transported from the Bering Sea through Barrow Canyon and upwelled onto the Beaufort shelf near Barrow. Other large concentrations of whales, pinnipeds and water birds are found in the area and may be attracted by elements of the same mechanism.

This project will undertake to produce an animated film for outreach purposes that will visualize processes relating how bowhead whales feed on zooplankton (krill and copepods) and how winds, ocean currents, and bathymetry interact to create favorable feeding opportunities for bowhead whales and animate the year-long cycle of bowhead seasonal movement and areas of habitat use. An animated film was chosen as the outreach medium because the aforementioned processes are best visualized through a medium that conveys motion. The narrative script will be translated from English to Iñupiaq by a native speaker and the Iñupiaq language track will be narrated by a native speaker.

Objectives:

- To produce an animated film to improve public understanding of the arctic marine ecosystem (a BOEM framework issue), with emphasis on those components associated with the bowhead whale and its zooplankton prey.

- To synthesize of some recent and ongoing MMS/BOEM-funded (directly or indirectly) research projects (whale tagging, aerial surveys, oceanography) conducted in the Chukchi and Beaufort Seas.

Methods: The organizing framework for the proposed animated film will be the annual migration of the bowhead whale encompassing the wintering grounds in the Bering Sea, northward and eastward migration through the Chukchi and Beaufort Seas during spring to the summer feeding grounds in the Canadian Beaufort Sea, westward and southward migration during fall, and return to their wintering grounds in the Bering Sea.

Production of the animated film is broken into three overlapping phases. Pre-production includes intensive scripting by museum writers/editors, museum educators and researchers; storyboarding; and initial work on existing data collection and processing, and production graphic and sound design. The pre-production phase sets production parameters and style, and determines level of detail for all following project components. The production phase of the project will entail computer-graphic modeling, rigging, determined environment layouts, animation, lighting, textures, and effects. The post-production phase includes shot editing, sound editing, output to DVD media, printing, promotion, and distribution.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Social Indicators in Coastal Alaska: Arctic Communities (AK-11-09)

BOEM Information Need(s) to be Addressed: This study will update key socio-cultural and economic baseline data for analysis of potential local and regional impacts from offshore exploration and development activities that may occur in federal waters off the North Slope of Alaska. Information from this study will be used for Outer Continental Shelf Lands Act (OCSLA) and National Environmental Policy Act (NEPA) analyses, for documentation, and may serve as the basis for long-term monitoring for Chukchi and Beaufort oil and gas exploration and development in the region.

Total Cost: \$669,659

Period of Performance: FY 2011-2014

Conducting Organization: Stephen R. Braund and Associates

BOEM Contact: [Chris Campbell](#)

Description:

Background: The goal of this study is to update baseline data measuring the pace, direction, and magnitude of regional socio-economic changes, as well as the sense of well-being as expressed by residents in select Arctic coastal communities. These data will assist in NEPA evaluation of the effects of exploration and possible development of offshore energy resources in the Chukchi and Beaufort Seas on local populations through the formulation of social indicators nested within sets of key social domains. This study will facilitate evaluation of current conditions and trends in: economic prosperity; the status of health and safety; cultural continuity and well-being; changes in the status of indigenous rights and local control; quality of the physical environment; and education. Likely communities for sampling will include: Pt. Lay, Wainwright, Barrow, Nuiqsut, and Kaktovik.

Objectives:

- Formulate a set of key social indicators nested within domains that will facilitate the monitoring of changes in human well-being in coastal communities of the Alaskan Arctic most proximate to proposed oil and gas exploration and development.
- Obtain an OMB control number for a longitudinal survey instrument that can be repeated to identify long term trends, periodic changes, and fluctuations in the rate of change throughout coastal Alaska.
- Provide useful information on regional socioeconomic conditions and regional aspirations from which government officials and stakeholders can monitor and

evaluate potential changes in well-being resulting from oil and gas exploration and development.

Methods: Establish formal contact with potential host communities and develop a written protocol to facilitate community participation and meaningful collaboration in the performance of this research. Conduct a literature search on previous northern social indicator studies. Utilize existing identified arctic social indicators or develop alternative relevant social indicators in conjunction with BOEM. Prepare a strategic survey instrument, pre-test it, and obtain the necessary approvals for use from relevant BOEM review offices and the Office of Management and Budget, and administer it. Organize data into a workable database and analyze with appropriate multivariate statistical techniques. Conduct a comprehensive analysis of the results of all prior tasks and prepare a draft report of the study findings. Circulate the draft report to the BOEM and host community leaders to facilitate parallel reviews by peer scientists and interested stakeholders; respond to review comments and prepare a final report, incorporating reviewer edits and comments where appropriate; report the study results to participating communities through public meetings or workshops.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Alaska Marine Science Symposium (AK-10-03)

BOEM Information Need(s) to be Addressed: This Symposium provides technical analysts and Principal Investigators for BOEM Alaska OCS Region studies a unique forum to share their research findings on the Alaska marine environment and to network with other scientists from around Alaska, the Pacific Northwest, and the nation. Since it is impossible for any one agency or group to conduct all of the needed research within the Alaska OCS Region, this forum provides marine scientists with the opportunity to gather information on other areas of similar research and foster important future collaborative efforts.

Total Cost: \$100,000

Period of Performance: FY 2010-2015

Conducting Organization: North Pacific Research Board (NPRB); Alaska SeaLife Center

BOEM Contact: [Warren Horowitz](#)

Description:

Background: The Alaska Marine Science Symposium (AMSS) is the largest and most comprehensive annual marine science conference within the State of Alaska (<http://www.alaskamarinescience.org/>). The AMSS is unique since it brings together government and non-government sponsored marine scientists within the State of Alaska, from around the nation, and from other nations in a forum to discuss their common interests in the dynamic and ever changing Alaska marine ecosystem. The Symposium is organized into three large marine ecosystems of Alaska which includes the Arctic (Alaska Beaufort and Chukchi seas), the Bering Sea, and the Gulf of Alaska. The presentations, poster sessions, and workshops showcase the ocean research within these areas. Daily sessions are focused on the main components of the marine ecosystem including climate and oceanography, lower trophic level productivity, fish and fish habitat, seabirds, marine mammals, and human dimensions.

Over 1100 people attended the most recent Symposium, and many organizations pitched in to make it a success. The BOEM project investigators attended the Symposium and provided important information on the Arctic and the Bering Sea from information collected under the Environmental Studies Program. The BOEM staff and sponsored scientists connected with other scientists that were conducting concurrent research in the Arctic and the Bering Sea regions.

Last year, in addition to daily presentations, there were evening sessions on bowhead whale feeding ecology, panel discussions on the beluga whale, and workshops on community involvement. In addition, there were other workshops on shipboard

observation systems, Alaska Ocean Observing System (AOOS), on communicating ocean science, and metadata standards. The Symposium also encourages presentations on the Alaska marine environment from graduate students from local universities and from universities within the lower 48. The Symposium presents awards to the best student poster and oral presentation at the meeting.

Objectives:

- Produce a successful Alaska Marine Science Symposium, which provides a forum for marine scientists and local communities to present their information on the changing marine environment in Alaska.
- Provide a venue for BOEM Alaska OCS Region environmental studies research for the Arctic and Bering Sea
- Provide a forum for Alaska OCS Region scientists and Principal Investigators to come together with other researchers that are conducting similar scientific studies within the Alaska OCS or adjoining areas of the Alaska marine ecosystem.

Methods: As a member of the AMSS organizing committee with other scientists and officials from Federal and State agencies, assist in producing a forum for BOEM staff and marine and coastal scientists, and local communities to present their findings on the changing marine environment in Alaska. Provide monetary support for scientists from within the State of Alaska and from around the nation to present their findings at the meeting. Provide abstracts and workshop discussions from the Symposium to the general public for distribution.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Management, Logistics, and Warehouse Storage of Oceanographic Equipment (AK-10-04)

BOEM Information Need(s) to be Addressed: Without funding of this program-support element, it would not be possible to maintain or deploy the 36-foot Launch 1273 that provides a mobile, cost-effective, and specialized research vessel for a variety of biological and oceanographic studies throughout the coastal waters of Alaska. Costs for certain studies would increase significantly if more expensive marine-support alternatives were chartered. Additionally, it would not be possible to maintain an equipment warehouse that allows us to re-use and share equipment effectively among projects and agencies. This is a fundamental program-support element related to studies that support all current leases.

Total Cost: \$200,000/year

Period of Performance: FY 2010-2013

Conducting Organization: Kinnetic Laboratories Inc.

BOEM Contact: [Catherine Coon](#)

Description:

Background: The BOEM Alaska OCS Region has responsibility for equipment management and other storage needs in support of Alaska studies. In 1996 the General Services Administration (GSA) obtained a new storage facility for ESP use. Equipment is stored in a small warehouse in Anchorage, where it is maintained and made available for ongoing projects. The equipment includes off-season vessel safety and operating equipment, as well as equipment to support ongoing marine mammal and oceanographic studies. This support element also provides funds for maintenance of the BOEM Alaska Region Launch 1273, a small research vessel needed for various oceanographic studies, as well as funds for other equipment maintenance and shipping. Supported efforts include the Alaska Coastal Ecosystem Survey (nearshore fishes in the Chukchi) and the cANIMIDA Boulder Patch monitoring project.

Objectives: The purpose of this program-support element is to efficiently manage and store oceanographic equipment and provide other support to ESP needs.

Methods: The GSA arranges for an appropriate warehouse facility for our use.

Launch 1273 was commissioned in 1983. The BOEM contractors use it for a number of oceanographic studies in the Arctic. We include the costs of operating Launch 1273 in the management costs listed above.

Revised Date: October 2013

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Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: ShoreZone–Shoreline Mapping of the North Slope of Alaska (AK-11-07)

BOEM Information Need(s) to be Addressed: ShoreZone mapping is a technique that will provide BOEM with the most comprehensive biological, physical, and geomorphologic data of the Beaufort and Chukchi coastal areas. The BOEM analysts and decision makers will use shoreline mapping information for identifying high priority fish and wildlife habitats in NEPA and ESA (Endangered Species Act) analyses and documentation for Lease Sales, EPPs and DPPs and in post-sale and post-exploration decision making. The data will also provide an improved level of detail for coastal contingency planning, oil spill response activities, and habitat recovery efforts in the context of future offshore oil, gas and mineral development activities upland of Beaufort and Chukchi Seas; and a value added benefit from more accurately append the current Environmental Sensitivity Indices (ESI).

Total Cost: \$561,621

Period of Performance: FY 2011-2015

Conducting Organization: Nuka Research and Planning Group

BOEM Contact: [Catherine Coon](#)

Description:

Background: The ShoreZone program is a partnership of scientists, GIS specialists, web specialists, nonprofit organizations, and governmental agencies. The multi-agency program offers the opportunity to build a contiguous, integrated coastal resource database that extends from the mouth of the Columbia River through BC, the Gulf of Alaska, Bristol Bay, and now northward to the Arctic Coast (on the order of 100,000 km).

ShoreZone is a powerful coastal habitat classification, mapping, and inventory system that relies on the collection and interpretation of aerial imagery of the intertidal zone, nearshore, and estuarine environments. Aerial video and high resolution still photos are collected by geologists and biologists at extreme low tides. This imagery is georeferenced and then mapped, providing a recording of the physical and biological features of the intertidal zone, nearshore, and estuarine environments, including archaeological resources and manmade features. The digital imagery and associated data are made accessible to the public through the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries website as a collaborative partnership with BOEM.

Coastal video imagery of the North Slope from Barrow to Harrison Bay (1,090 km) and from Flaxman Island to the Canadian border (890 km) was collected in 2001 under an

MMS contract (Polaris Applied Sciences Inc. and Environmental Mapping Ltd) for the purpose of Environmental Sensitivity Indices (ESI). This aerial video exists in the form of 11 DVDs and may be suitable for ShoreZone mapping. The USGS has also collected topographical imagery (LIDAR) in the Arctic in 2009-2010 for shoreline change that can be applied to morphological changes of the tundra. These imagery sets will be described, cataloged, and summarized for historical perspective for BOEM use. This project will provide an additional imagery necessary, combined with a ground verification component through a series of shore stations, to describe the shoreline and the physical and biological features of the intertidal zone, nearshore, and estuarine environments.

Objectives:

- Summarize existing historic coastal video imagery.
- Assess the use of USGS topographic LIDAR for research on shoreline change and how it can apply to coastal inundation of slopes for spill scenarios and shoreline position change of the barrier islands.
- Conduct new video imagery along the Arctic Coast of Alaska.
- Groundtruth imagery with shore stations to verify geomorphic features. Map video imagery using the ShoreZone methodology.
- Create a new ShoreZone protocols that includes habitats common in the Arctic
- Develop the completed imagery and mapping package available to BOEM and the public via the NOAA ShoreZone website (<http://www.fakr.noaa.gov/maps/szintro.htm>).
- Assess the feasibility of extending the project to include a bathymetric LIDAR component.

Methods: The *ShoreZone Coastal Habitat Mapping Protocol for the Gulf of Alaska* will be used to map the imagery collected in the North Slope, Alaska. (http://www.fakr.noaa.gov/habitat/shorezone/goa_protocol.pdf). A new protocol for Coastal Alaska is in progress.

Groundtruthing will occur with a series of shore stations over many separate habitat types (i.e. inside lagoons, lagoon passes, barrier islands) along the Arctic coast. Across-shore profiles will be measured to describe the geomorphic features at each shore station. Data will provide site-specific details of slope, substrate, and widths on the ground, and help with confirming assumptions made in mapping features observed from the air.

The completed ShoreZone Mapping will provide a comprehensive region-wide database of nearshore habitat and physical attributes and will also be linked to the existing web interface hosted by NOAA 'Nearshore Fish Atlas of Alaska' (<http://www.fakr.noaa.gov/habitat/fishatlas/>).

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Coastal Marine Institute (AK-13-03)

BOEM Information Need(s) to be Addressed: This cooperative agreement supports improved leasing decisions and NEPA analyses pertinent to lease sales in the Beaufort Sea, Cook Inlet and Chukchi Sea. Final reports will be available for lease sales and post-sale decisions; interim data products and inputs will be used to address information needs. Topical areas to be addressed under the Coastal Marine Institute have been identified through this Annual Study Plan, previous Alaska Region study plans, and the Framework Issues. The study also will develop information that addresses public concerns raised during outreach efforts.

Total Cost: \$463,668

Period of Performance: FY 2013-2017

Conducting Organization: CMI, UAF

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

Description:

Background: This study provides management of a large ongoing program of scientific research into framework issues related to potential future lease sales in the Alaska OCS Region. It is a cooperative program between BOEM and the University of Alaska, with State of Alaska participation. The Coastal Marine Institute (CMI) is expected to leverage additional scientific results and logistics capability at levels comparable to the BOEM contribution of \$1,000,000 per year. The Coastal Marine Institute will update and expand our understanding of OCS environmental information and address future needs related to the offshore oil and gas program in Alaska.

Objectives: The purpose of the CMI is to support BOEM's commitment to environmental stewardship and generate scientific information for BOEM and State of Alaska decision makers that is consistent with the needs outlined by the Framework Issues. The Framework Issues are:

- Scientific studies for better understanding marine, coastal or human environments affected or potentially affected by offshore oil and gas or other mineral exploration and extraction on the OCS.
- Modeling studies of environmental, social, economic, or cultural processes related to OCS gas and oil activities in order to improve scientific predictive capabilities.
- Experimental studies for better understanding of environmental processes, or the causes and effects of OCS activities.
- Projects which design or establish mechanisms or protocols for sharing data or scientific information regarding marine or coastal resources or human activities

in order to support prudent management of oil, gas and marine mineral resources.

- Synthesis studies of scientific environmental or socioeconomic background information relevant to the OCS gas and oil program.

Methods: A proposal process is initiated each year with a request for letters of intent to address one or more of the Framework Issues. The proposals are requested from university researchers and other scientific researchers in State agencies. A Technical Steering Committee, made up of scientific representatives of the cooperators, reviews letters of intent and proposals to be evaluated for possible funding. External peer reviews may be requested for new projects. Principal investigators give presentations at ITMs, scientific conferences and various public meetings.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Enhancement of the Environmental Studies Program
Information System and the Multipurpose Marine
Cadastre to Provide Environmental Studies Program Data
(NT-12-01)

BOEM Information Need(s) to be Addressed: The offshore energy extraction process requires physical, biological, oceanographic and social science information at all stages from leasing through exploration and production, to decommissioning. Regulatory agencies and prospective lease holders rely on scientific studies and other data mining exercises to build their knowledge base from past and ongoing work conducted in the Alaska OCS Region. A web-based visual display of completed and ongoing study efforts will assist BOEM in (1) planning new research, (2) promoting collaboration with other agencies on similar projects, (3) evaluating exploration and development plans, and (4) improving BOEM decision making to safeguard activities on the OCS.

Total Cost: \$1,700,000

Period of Performance: FY 2012-2015

Conducting Organization: NOAA-Coastal Services Center

BOEM Contact: [Rick Raymond](#)

Description:

Background: BOEM places digital copies of final study reports online. However, it remains challenging to process some report information efficiently, such as study boundaries, data collection efforts, or conclusions from multiple study efforts. It is also a challenge for internal BOEM staff to remain current with all research due to the volume of activities conducted within the OCS Planning areas. BOEM as well as other agencies and academia have identified a statewide need for a centralized database of past, present and future projects with associated observations.

This study will design, develop, document, and implement a BOEM Internet Geospatial Web Portal utilizing the online Environmental Studies Program Information System (ESPIS) database Browser and the Marine Cadastre spatial data tool for BOEM completed and ongoing environmental studies that can be queried and displayed by internal BOEM staff and other agencies. The project is national in scope and will include a subcontract dedicated to service information needs for the Alaska OCS Region.

Objectives:

- Develop a BOEM Environmental Studies project database that can be fully utilized to query, graphically display, and extract project specific information.

- Develop programming tools that would allow BOEM staff and others to query, display, and extract available spatial data sets collected from each study.
- Automate the updating of new studies project information through development of programming tools that can seamlessly import BOEM Environmental Studies project information from newly completed or existing studies into ESPIS and the Marine Cadastre.
- Develop programming tools that can automatically search, retrieve, upload and merge project specific information and data from other State and Federal agencies, and industry, into the BOEM project database and data directories.
- Develop a BOEM Geospatial Website User Interface and Graphical Display whereby users can query, display, and extract project specific information, and display and extract BOEM Environmental Studies data sets covering the Alaska OCS.
- Provide complete documentation on the database and user interface application.
- Provide a user manual and train internal staff on the use of the BOEM Geospatial Web Portal.
- Provide online documentation for external users.

Methods: Under this study, NOAA-Coastal Services Center and BOEM internal staff will gather environmental studies project information and available data in a concerted effort to make information readily available to BOEM staff and other agencies. This effort will centralize functions to collect, catalogue, and distribute BOEM environmental studies project information and associated project studies data gathered since 2000. A BOEM web link will interface with ESPIS and the Marine Cadastre displaying maps of project boundaries, link to project specific information, data, metadata, and reports.

Revised Date: October 2013

2.2 Profiles of Studies Proposed for FY 2014 NSL

Table 1. BOEM Alaska OCS Region Studies Proposed for the FY 2014 NSL

Page Number	Discipline	Ranking	Study Title
139	SE	1	Subsistence Mapping of Wainwright, Point Lay, and Point Hope
141	FE	2	Physical and Chemical Analyses of Crude and Refined Oils: Laboratory and Mesoscale Oil Weathering
143	MM	3	Developing BOEM's Access to Protected Species Occurrence Data for Impact Analyses and Rule-making
145	HE	4	Genomics of Arctic Cod: A Sentinel Species in a Changing Environment
147	PO/HE	5	Ecological Processes in Lower Cook Inlet and Kachemak Bay: A Partnership in Monitoring
149	SS	6	Traditional Knowledge Implementation: Establishing Arctic Community Panels of Subject
151	HE	7	Benthic Invertebrate Habitats in Cook Inlet
153	MM	8	Polar Bear Habitat Use, Ecology, and Population Status in the Chukchi Sea
155	PO/SE	9	Integrated Seabed Surveys in the Arctic Ocean: Bathymetry, Archaeological Resources, and Ice Gouge Magnitude and Recurrence Rates
157	MM	10	Baleen Whale Distribution, Abundance, and Ecology in Cook Inlet and Shelikof Strait
AQ = Air Quality IM = Information Management PO = Physical Oceanography			FE = Fates & Effects MM = Marine Mammals & Protected Species SE = Social & Economic Sciences HE = Habitat & Ecology

Shaded area indicates studies unlikely to be funded this year due to budgetary constraints. BOEM welcomes any efforts by external partners to pursue these research projects with us as collaborative, jointly-funded studies.

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Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Subsistence Mapping of Wainwright, Point Lay, and Point Hope

BOEM Information Need(s) to be Addressed: This study will provide baseline subsistence mapping data to monitor community impacts in the vicinity of the Chukchi Sea Lease Sale area. Systematic mapping of last decade and last twelve months subsistence harvest in Wainwright, Point Lay, and Point Hope will complement and add value to OCS Study 2009-003 (*Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow*). BOEM analysts and decision makers will use the information in NEPA analysis and documentation for lease sales, EPs and DPPs and in post-sale and post-exploration decision-making in the Chukchi Sea.

Approx. Cost: TBD

Period of Performance: FY 2014-2017

Description:

Background: The oil and gas industry has invested significant resources leasing tracts in the Chukchi Sea and is interested in exploring and potentially developing these leases. To assure methodological continuity over time for a potentially large exploration area, appropriate planning and implementation of post-lease monitoring baselines are needed. BOEM would benefit from an updated geospatial baseline in the communities of Wainwright, Point Lay, and Point Hope, and identify key harvest areas, trails, camps, and intensive use areas. This effort will enable more precise assessment of impacts and contribute to cumulative effects analyses.

Objectives: This study will parallel and match the objectives expressed in OCS Study MMS 2009-003, and will be a companion volume for providing baseline information on the Chukchi Sea. The study will gather and map long term (10 years) subsistence data and associated traditional and local knowledge to help assess whether OCS oil development activities in the Chukchi Sea will result in changes to onshore subsistence hunting practices. It will provide a time series or longitudinal record of subsistence activities over the last decade to document land use patterns and to develop a baseline from which to understand the potential impacts of any future development action. Specific objectives include:

- Consulting subsistence harvesters from Wainwright, Point Lay, and Point Hope about land use activities – where they hunted and what they harvested – delineating use over the past decade and then depicting use over the past year on map overlays.
- Recording discussion and topics of interest to provide supporting data.
- Addressing the methodological problem of respondent recall and accuracy, especially as related to “time.”

- Correlating hunter tract lines with environmental variables and socio-economic variables that explain land-use patterns.
- Drawing upon local knowledge and best available science as sources of information.
- Defining the intensity of use per species harvested over a 10-year period and in the last year (or last trip as duration).
- Developing geospatial layers to be used for modeling purposes.

Methods: This project will entail extensive community engagement. Early procedures will involve organizations such as the North Slope Borough Wildlife Management Department, the Alaska Eskimo Whaling Commission, the Iñupiat Community for the Arctic Slope, the Native Village Traditional Councils for Wainwright, Point Lay, and Point Hope and others as appropriate. The effort will include the compilation of information regarding subsistence geospatial patterns from BOEM and other studies conducted in Wainwright, Point Lay, and Point Hope. It will assess the quality of existing geospatial data and convert to GIS format where possible. The study will gather primary source data regarding current subsistence effort, and use of resources from knowledgeable residents of Wainwright, Point Lay and Point Hope. The data collection effort will coordinate with other relevant BOEM studies.

Contractors will disseminate ongoing and final products of study to local residents through community workshops and integrate workshop feedback into the final analysis. All final spatial information on subsistence and industry activity will be put into a GIS or GIS compatible format for use by BOEM for NEPA analyses. The final product will include a descriptive report that is at least as explicit as OCS Study MMS 2009-003.

BOEM will seek to establish partnerships in this work with other organizations and agencies, including NSF and BLM.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea, Cook Inlet

Title: Physical and Chemical Analyses of Crude and Refined Oils:
Laboratory and Mesoscale Oil Weathering

BOEM Information Need(s) to be Addressed: The Alaska OCS Region uses an oil weathering model (OWM) to provide NEPA analysts with a common, quantitative set of spill weathering parameters. Weathering of spilled oil and persistence of its most toxic components vary depending on the specific characteristics of the oil. Currently, NEPA analysts in the Alaska OCS Region must make assumptions about these processes because only a small subset of oil samples specific to the Alaska OCS and North Slope have been analyzed for use in the SINTEF OWM. In particular, the addition of new low-sulfur marine diesel fuels to the library would be especially useful information for analysts to use in upcoming NEPA assessments.

Approx. Cost: TBD

Period of Performance: FY 2014-2016

Description:

Background: The rate of oil dispersion into the water column calculated by the OWM is used to estimate whether State and Federal water quality standards and criteria would be exceeded by a spill, over what area and for how long. The model calculates the area covered by a spill, an important parameter for estimating effects, but the OSRA does not. The model also calculates the persistence of the lighter, but most toxic components of the oil slick. This calculation allows analysts to directly estimate persistence of toxicity, rather than assume for purposes of analysis that these toxic components persist over the first three days of a spill. Because the size of a spill affects its weathering, the model helps distinguish between effects of large ($\geq 1,000$ bbl) and small ($< 1,000$ bbl) spills. The *in situ* viscosity and degree of emulsification provided by the model are used in assessing the mitigation by and effectiveness of oil spill countermeasures such as mechanical recovery, dispersant, and in-situ burning.

This proposed research will be informed by results from the study “Validation of the Two Models Developed to Predict the Window of Opportunity for Dispersant Use in the Gulf of Mexico” conducted by the Bureau of Safety and Environmental Enforcement’s Technology Assessment and Research Program. That project aims to validate and improve two correlation models that were developed to predict the window of opportunity for successful chemical dispersant use in the Gulf of Mexico (GOM). That project will also evaluate the sensitivity of the models to various oil weathering parameters.

Objectives: This study will provide weathering characteristics of representative Alaskan OCS crude and marine fuel oils and expand the existing SINTEF oil weathering model library of oil compositions.

Methods:

- Research and compile existing updated oil weathering data for Alaska State and OCS crude oils within the last 5 years.
- Enter existing lab weathering data for Alaska State and OCS crude and marine fuel oils into the SINTEF oils library.
- Conduct lab and mesoscale oil weathering on 8-10 Alaskan crude or condensate oils (including: Oooguruk, Nikiakchuq, Badami, Endicott, Northstar, Point Thompson, Alpine, Alaska North Slope, Cook Inlet) and 2-4 refined oils (low-sulfur marine diesel, IFO and Bunker C).

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea, Cook Inlet

Title: Developing BOEM's Access to Protected Species Occurrence Data for Impact Analyses and Rule-making

BOEM Information Need(s) to be Addressed: BOEM needs ready access to information on marine protected species distribution for marine spatial planning, environmental impact assessments, rulemaking, and adaptive management decisions. To enhance ready access, registry of protected species datasets is needed to provide BOEM analysts and decision-makers with a basic tool for the discovery and use of information resources. This study will help increase the speed at which data is analyzed to make it available to resource managers and decision-makers.

Approx. Cost: TBD

Period of Performance: FY 2014-2016

Description:

Background: Observations of protected species come from many and various monitoring programs and scientific research projects. Biogeographic databases are integrative tools for combining the scientific knowledge on species distribution. These databases focus on common elements of species observational effort, such as the record of a species occurrence. The Ocean Biogeographic Information System of the United States of America (OBIS-USA), residing within the U.S. Geological Survey, has developed an archive for protected species observations. However, processing of these observations into an archival format can be time-consuming, causing delays of months or longer between collection of observations and when the information is available to the public and often limiting their applicability for a particular resource management issue. These data have many applications beyond the initial program or project, and in many cases, there are routine aspects of these observational efforts that could be automated for more timely delivery of the information. OBIS-USA plays an important coordination role, interfacing with other federal entities, such as the U. S. Integrated Ocean Observing System (IOOS) and the National Oceanographic Data Center (NODC), as well as international entities such as the International OBIS and the Global Biodiversity Information Facility (GBIF). Of particular relevance, OBIS-USA leverages its relationship with OBIS-SEAMAP to provide for federal needs for protected species data, including NOAA's CetMap marine mammal modeling project.

Objectives:

- Improve timeliness and quality of data availability to BOEM personnel
- Use existing federal resources for data management, including NODC and IOOS
- Engage in data sharing arrangements with interagency partners such as NOAA and the US Navy while maintaining a secure venue to conduct operations

- Implement automation of routine tasks such as enrollment, dissemination, modeling, and mapping for recently collected data on protected species

Methods: This study will evaluate experimental tools from the biogeographic community, such as the GBIF Integrated Publishing Toolkit, to develop techniques to better interface with data producers. Additionally, the project will evaluate the benefits and dangers of early data sharing, and trade-offs that this may present in terms of data quality and publication. Subjects of interest include 1) methods to develop the adequate context to understand recent marine mammal location observations for siting decisions, 2) modeling to detect patterns and trends in marine mammal distribution, 3) tools to identify outlier observations to target adaptive sampling capabilities, and 4) visualizations of protected species data that help identify information needs for future research.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Genomics of Arctic Cod: A Sentinel Species in a Changing Environment

BOEM Information Need(s) to be Addressed: To evaluate potential development effects in NEPA documents BOEM needs to understand whether Arctic cod on the OCS are part of a single pan-mictic population or part of more vulnerable sub-populations, and whether or not they exhibit genetic characteristics that will enable them to adapt to retreating sea ice and continue to feed their upper trophic predators. Thus, Arctic cod dynamics are important to multiple EFH- and ESA-related NEPA analyses.

Approx. Cost: TBD

Period of Performance: FY 2014-2017

Description:

Background: Arctic cod (*Boreogadus saida*) are estimated to funnel 93% of lower trophic energy to upper trophic predators including birds, seals, polar bears, beluga whales, and eventually to humans. Although Arctic cod are considered a sentinel species in the U.S. Arctic marine ecosystem, information about them is limited because of the difficulty of studying this ice-associated species. Despite the recognized importance of Arctic cod it is unknown whether there is a single pan-mictic population or whether there are sub-populations. This is an important distinction with respect to potential impact assessment. A sub-population limited to a smaller geographic location or a specialized habitat in the OCS would be more vulnerable to impact from an offshore development than a pan-mictic population spread across the circumpolar Arctic. BOEM needs a greater understanding of the ecological role this sentinel species plays as the primary pathway funneling lower trophic production to many marine mammals, birds and fish.

In 2012, a successful BOEM-funded pilot study conducted by USGS in collaboration with a Canadian genetics lab demonstrated that there is in fact a genetic break somewhere between the Chukchi/Western U.S. Beaufort and far eastern Canadian waters. This genetic break indicates that, rather than a single pan-mictic Arctic cod population, there may indeed be sub-populations. The pilot study relied on samples collected in 3 separate BOEM surveys in the northeast Chukchi and the western and central Beaufort seas. Now that a genetic break has been identified, it is important to fill in the large spatial area between the Central U.S. Beaufort and the far eastern Canadian Beaufort with additional genetic samples and analyses to delineate sub-populations.

Additionally, a greater understanding of the ability of Arctic cod to survive and adapt as the ice retreats is needed to separate potential effects of oil and gas development on Arctic cod and its predators from the cumulative effects of climate change. Recent climate-change modeling suggests that as the arctic ice retreats Arctic cod may be at risk of extirpation in the OCS by 2030. Genetics, transcriptomes and genomics can provide insight into whether any Arctic cod lifestyles are truly ice-obligate or whether they are

simply ice-associated or ice-dependent and can potentially adapt to retreating ice conditions. Identifying whether there are genetically separated sub-populations, particularly near-shore and off-shore populations, could provide a clue that there may be differential adaptability due to differential gene expression rather than different genes. Transcriptomes can identify differential expression of the single ‘antifreeze’ gene that may confer adaptability to loss of ice habitat. Genomics can facilitate transcriptomics by identifying additional genes associated with possible ice-obligation.

The large spatial gap from the eastern U.S. Beaufort Sea across the Mackenzie River Canyon into the Western Canadian Beaufort coincides with the footprint of the current field study “US-Canada Transboundary Fish and Lower Communities.” That field study will collect the genetic samples needed for the work described here. The USGS Alaska genetics lab, which recently published similar groundbreaking Polar Bear genetics research, will lead the Arctic cod lab research.

Objectives:

- Identify genetic differences that would change the BOEM approach to Arctic cod effects analyses from evaluating Arctic cod as a single pan-mictic population to evaluating several geographic sub-populations of Arctic cod.
- Test hypotheses that onshore/offshore differences in the extent of ice-obligation genes may be related to differences in either genes (genetics) or gene expression (transcriptomics).
- Test hypothesis that ability to survive loss of Arctic ice may be related to differences in gene expression (transcriptomes).
- Test the ice-obligate hypothesis by identifying both differential genetic (‘deep’ genomic) and differential gene expression (targeted transcriptomic) pathways.
- Archive genetic specimens for future use in new hypothesis tests or with new technologies and methods.

Methods: The USGS genetics lab will analyze the field samples (supplied by the US-Canada Transboundary survey) for both mitochondrial and microsatellite DNA to identify sub-populations. Genetics results will direct how the next year's samples should be spaced to test the hypothesized dichotomies of coastal vs. continental slope populations; eastern vs. western; warm freshwater inputs vs. cold saline marine waters populations. Laboratory analyses of samples collected during 2012 and 2013 fieldwork will be used to identify optimal sampling locations for the 2014 field season. Initial profiles of the ‘antifreeze’ gene transcriptome will be analyzed for variation in gene expression across and within hypothesized sub-populations. A complete genomic sequence of a single individual will be constructed to identify additional genes that may provide adaptive expression to climate change. The investigators will continue to coordinate and collaborate with a parallel Canadian collection and genetic analysis effort.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Cook Inlet

Title: Ecological Processes in Lower Cook Inlet and Kachemak Bay: A Partnership in Monitoring

BOEM Information Need(s) to be Addressed: The BOEM *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program 2012-2017* includes a lease sale in the Cook Inlet Planning Area in 2016. An OCS Cook Inlet Lease Sale NEPA analysis hasn't been undertaken since 2003. Updated information regarding the physical and biological environment, including variability in oceanographic conditions and plankton communities, as well as data related to sensitive species, is needed to support NEPA analyses conducted for the planned lease sale. The results will be used in NEPA analyses and documentation for lease sales, Explorations Plans (EPs), and Development and Production Plans (DPPs). Collected oceanographic data will support validation and sensitivity testing of ocean circulation models to BOEM's Oil-Spill Risk Analysis efforts.

Approx. Cost: TBD

Period of Performance: FY 2014-2017

Description:

Background: Cook Inlet circulation patterns are influenced by intrusions of the Alaska Coastal Current, large seasonal changes in freshwater input, geographically-influenced wind forcing and a large tidal range. The lower Cook Inlet and Kachemak Bay also support rich nearshore and pelagic biological communities. Improving understanding of this complex marine environment will improve understanding of biological variability and potential impacts from oil and gas development activities.

The *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) and state and federal agencies are currently supporting a five-year, \$12 million long-term monitoring program in the Gulf of Alaska region affected by the 1989 *Exxon Valdez* oil spill, including lower Cook Inlet. The multidisciplinary monitoring program, called GulfWatch Alaska, seeks to build upon the extended restoration research and monitoring by providing data to identify and help understand the impacts of multiple ecosystem factors on the recovery of injured resources. This program, headed by the Alaska Ocean Observing System (AOOS), Prince William Sound Science Center, and the NOAA Kasitsna Bay Laboratory, links changes in environmental conditions with population trends in nearshore benthic and pelagic species. In lower Cook Inlet and Kachemak Bay, the program includes seasonal oceanographic and plankton surveys, annual near-shore benthic surveys, and opportunistic seabird and marine mammal surveys. BOEM will utilize the results of 4 primary transects within these surveys to support NEPA analysis and documentation for the initial lease sale in 2016, and subsequent assessments.

Data management for the GulfWatch Alaska program is coordinated by AOOS and science synthesis is led by the NOAA Kasitsna Bay Laboratory. Oceanographic data from this study will also be used by NOAA for ongoing validation of the NOS circulation

model to improve model use in environmental assessments and oil spill response planning. Collaboration with the GulfWatch Alaska program and partner organizations (AOOS, NOAA, USGS, UAF, ADF&G, USFWS, etc.) presents a unique opportunity for BOEM to leverage funds and obtain needed information through support of expanded ecosystem monitoring efforts in lower Cook Inlet.

Objectives:

- Quantify seasonal and inter-annual variability in oceanographic conditions and plankton communities and provide information to assess long-term trends.
- Enhance monitoring of sensitive species (seabirds, sea otters) in conjunction with monitoring of environmental conditions.
- Improve understanding of water mass movement in lower Cook Inlet/Kachemak Bay for use in environmental analysis and circulation model validation.

Methods: This study will enhance existing oceanographic surveys, plankton surveys, near-shore benthic surveys, and upper trophic level surveys of seabirds and marine mammals to support NEPA analyses. Collected data include: temperature, salinity, phytoplankton and zooplankton samples, water samples for acidification analyses, benthic surveys, and seabird and sea otter observations when possible. Currently, oceanographic and plankton surveys are conducted quarterly along three transects in lower Cook Inlet and two transects in Kachemak Bay. Based upon consideration of results from analysis of data collected in 2012, surveys will be expanded in time and/or space to improve assessment of seasonal conditions. The need for expanded benthic monitoring will be assessed and implemented if appropriate. This study will also provide for addition of seabird and marine mammal observers to all surveys in Cook Inlet. Standard agency protocols are used for benthic, at-sea seabird and marine mammal monitoring.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Traditional Knowledge Implementation: Establishing Arctic Community Panels of Subject Matter Experts

BOEM Information Need(s) to be Addressed: This project aims to identify and organize Local and Traditional Ecological Knowledge (TK) subject matter experts from Arctic communities into recognized panels of paid consultants, so they may be authorized and made accessible to function with authority on TK domains. By facilitating the creation of these institutional arrangements, this project will actively advance prospects for TK integration into scientific research sponsored by BOEM and other federal agencies. The full range of BOEM-funded studies, including physical oceanography, biology, and social systems would benefit from more direct consultation and collaboration with local TK subject matter experts.

Approx. Cost: TBD

Period of Performance: FY 2015-2020

Description:

Background: Government dialogue about TK is often preoccupied with integration of TK data rather than with integration of TK experts into a meaningful resource management process. This study will identify key individuals in North Slope communities who are locally recognized for subject matter expertise and available to serve on one or more “community of practice” TK panels. The TK panels would be consulted by external scientists working on BOEM-funded projects and would be pre-authorized locally to speak with authority on specific resource management topics of interest including: (1) ocean currents; (2) ice movement and behavior; (3) subsistence hunting of marine mammals; (4) subsistence harvest of seabirds and waterfowl; (5) subsistence sea-run fish; and (6) subsistence terrestrial species and nearshore use. Currently, formalized panels do not exist to serve in this capacity.

Objectives: The successful integration of TK into decision-making processes requires unprecedented collaboration between scientists and local communities. This will be achieved by the following:

- Enhance TK authority and integration of TK with western science by promoting its dissemination to external scientists through consistent methods and directly involving local subject matter experts.
- Provide a roster and orientation information for use by external scientists about how to access and integrate TK on a more systematic basis into specific projects undertaken on the North Slope. This information would be accessible to scientists of all disciplines, from physical oceanography to sociocultural studies, and funded by a variety of sources, including federal and state agencies, National Science Foundation (NSF), and academia.

- Enhance dialogue about science through exchange of information between external scientists and the communities.
- Integrate the traditional Iñupiaq model of linking youth with elders.
- Achieve greater timeliness between project award and report. Currently, studies may be delayed as long as a year to that a community can achieve review consensus.

Methods: All eight North Slope communities would be involved, and panels in each would augment local capacity building. Three TK panels will be created in each North Slope coastal community: marine subsistence; terrestrial hunting; and birding and fishing. The inland communities of Atqasuk and Anaktuvak, would each have 2 TK panels (there being no need for a marine subsistence panel in either one). Social network methods will be used to identify knowledgeable subject matter experts to participate on each panel through a reliable and credible process using referral techniques. Village tribal leaders will be asked to review the generated list of nominees to recommend finalists who might serve on each TK panel. It is possible that one individual could be a member of more than one TK panel, depending upon community referrals. Panel members will receive honoraria in recognition of their service. Barrow will be the first community to develop a strawman charter that would serve as a template for other communities. The process will replicate social network methodology as described in *Variation in the Abundance of Arctic Cisco in the Colville River* (MMS study 2007-0042).

The study will develop protocols to facilitate engagement of the pre-authorized TK panels and promote dissemination of TK to external scientists with consistent methods. Western scientists would initiate dialogue through describing information about their project goals, methods, objectives and findings with the TK panel. The panels' engagement and comprehension may lead to suggestions, guidance, and other forms of support. A debriefing on the use of TK and panel involvement in decision-making will encourage a respectful dialogue between the local experts and BOEM. The study will also explore ways to engage the North Slope Borough School District or other appropriate entity to collaborate with youth involvement on TK panels as ex-officio delegates. Involvement of youth would facilitate cross-generational transfer of TK and promote local institutional capacity. BOEM will seek to establish partnerships in this work with other organizations and agencies, including NSF, the North Slope Borough Department of Wildlife Management, and NSSI.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Cook Inlet

Title: Benthic Invertebrate Habitats in Cook Inlet

BOEM Information Need(s) to be Addressed: The BOEM *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program 2012-2017* includes a lease sale in the Cook Inlet Planning Area in 2016. Recent expansions of on-shore and off-shore exploration efforts in State lands and waters in the region demonstrate increased industry interest in Cook Inlet oil and gas development. Updated and readily accessible habitat information is needed to conduct environmental analyses for offshore continental shelf development in Cook Inlet, as well as for ongoing spill response planning. The intertidal is particularly susceptible to oil spills and updated information will be important to understanding and assessing potential impacts of an oil spill in Cook Inlet.

Approx. Cost: TBD

Period of Performance: FY 2014-2017

Description:

Background: Benthic invertebrates and their habitats are susceptible to effects from industry exploration and development activities. The intertidal invertebrates and habitats adjacent to the OCS are particularly susceptible to oil spills and updated information is needed to assess impacts from a potential large oil spill in Cook Inlet. There are collaborative efforts underway and in planning stages to improve habitat mapping and the ability of a range of different users to more easily access habitat, imagery and related information.

In the past five years significant new information sources have become available for Cook Inlet. Examples of recently available habitat-related data, on-going surveys and planned studies that can help supply the information include BOEM's current collaboration in several multi-agency efforts such as the Rocky Intertidal surveys (including strong leadership and participation by the BOEM Pacific Region) and the multiagency ShoreZone program. Both the National Park Service and the NOAA's National Ocean Service are actively engaged in collecting aerial shoreline imagery while the Cook Inlet Regional Citizens Advisory Council (CIRCAC) has collected sediment and shellfish contaminant data. New data delivery tools are also available, such as the Cook Inlet Response Tool developed by CIRCAC and the Alaska Ocean Observing System (AOOS) that is directly aimed at improving delivery data and use of spatial information in spill response planning and response.

Objectives:

- Quantify variability in habitat and invertebrate abundance of invertebrate communities
- Integrate results with existing shoreline geospatial data and BOEM Environmental Sensitivity Index and other NEPA analysis tools

- Provide robust spatial and temporal information that can be used in NEPA analyses
- Incorporate spatial data into GIS data tool (e.g. Cook Inlet Response Tool) that does not require GIS expertise to use and can be accessed online
- Develop new derived products to supplement data coverage in sparsely sampled areas
- Facilitate improve understanding of the influence of exploration and development activities on sensitive habitats
- Support National Park Service razor clam (*Siliqua patula*) and soft shelled clam (*Macoma sp.*) collections where available

Methods: This study will identify important historical temporal and geospatial habitat and benthic abundance data. It will merge methods and scientific survey protocols with existing BOEM and other agency monitoring programs and provide spatial and temporal information for lower trophic communities to incorporate into BOEM oil-spill risk analyses. Researchers will conduct targeted benthic surveys of epibenthic and infaunal populations and habitats on OCS and adjacent intertidal substrates and integrate results with existing data delivery systems to provide updated baselines and habitat map layers to BOEM NEPA analysts for oil-spill risk analyses and for assessing the potential impact on sensitive intertidal and subtidal habitats. Researchers will investigate potential multi-agency and industry collaborations.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Polar Bear Habitat Use, Ecology, and Population Status in the Chukchi Sea

BOEM Information Need(s) to be Addressed: This study will provide additional baseline data by identifying important polar bear habitat and patterns of habitat use, targeting bears in the geographic region of the Chukchi Sea that includes the Outer Continental Shelf (OCS); and examining relationships between inter-annual variation in sea ice conditions and polar bear distribution, habitat use, and ecology. Information on feeding ecology, nutritional status, and reproduction in relation to inter-annual and long-term environmental variation, will be used to establish measures for monitoring polar bear status as oil and gas industry exploration and future lease sales occur in the Chukchi Sea OCS. Results will be used by BOEM in Section 7 consultations under the Endangered Species Act (ESA) for polar bear and polar bear critical habitat, as well as in NEPA analyses of Chukchi Sea lease sales, EPs, and DPPs. Data on patterns of polar bear habitat use provided by this study will be used in OSRA to improve NEPA analysis of potential oil spill effects on polar bears. This study will also provide information to improve mitigation measures and monitoring efforts required under BOEM plan approvals and MMPA take authorizations.

Approx. Cost: TBD

Period of Performance: FY 2014-2019

Description:

Background: Recent declines in sea ice habitat are exposing polar bears (*Ursus maritimus*) in the Chukchi Sea to human-caused removal and expanding industrial exploration and development. The declining sea ice is exposing bears to increased open water conditions and longer swims with impacts to both fitness and recruitment, and interaction with open water exploration activities. Exploration drilling operations in the Chukchi Sea in 2012 reported numerous bears approaching vessels in open water. To effectively monitor and mitigate potential impacts to this population, accurate and up-to-date biological information is needed. Research conducted by the U.S. Fish and Wildlife Service (USFWS) in the Chukchi Sea 2008–2011 focused on obtaining preliminary information on the ecological status and distribution of bears, and targeted bears in the core range of the Chukchi Sea subpopulation by sampling over a limited geographic distribution. Habitat use and indices of population growth (e.g., reproduction) varied greatly among years, resulting in the need for longer-term studies to understand demographics.

This collaborative BOEM-USFWS-USGS study builds upon the results of the previous Chukchi Sea study to examine relationships between annual variation in sea ice conditions and bear habitat use, distribution, and ecology; and to estimate survival rates and population size. Sampling will target bears on the western and eastern peripheries of the subpopulation range. Study at the eastern periphery will provide better

information on the seasonal distribution of bears that use areas of industry interest within the Chukchi Sea. This information will lead to improved mitigation and monitoring measures in the currently leased area by providing habitat use data in the area of overlap between the Chukchi Sea and Southern Beaufort Sea subpopulations.

Objectives:

- Evaluate distribution and population delineation in relation to industry exploration and development to improve oil-spill risk assessment.
- Relate habitat use, including the seasonal use of land and ice as a resting and denning platform, to individual fitness using individual-based models.
- Assess changing habitat use through comparison of current resource selection data with historic data collected in the late 1980s and early 1990s.
- Evaluate foraging ecology, nutritional status, and indices of polar bear reproduction in relation to inter-annual variation in environmental conditions and a potentially changing prey base.
- Estimate population size and growth rate of the Chukchi Sea polar bear subpopulation using capture-recapture methods and distribution information.
- Evaluate population persistence under forecasted sea ice scenarios incorporating human-caused removals, and other management scenarios.

Methods: This study will expand sampling locations (beyond those used in 2008–2011) north and east of Point Hope, Alaska and into areas of the Chukotkan coast to obtain a representative sample of the biological population. Data collection in the U.S. will consist of the live-capture and release of 50-150 polar bears by helicopter each spring. Captures will occur on the sea ice to ensure representation of habitat use offshore, including the current OCS lease areas. Potential logistical bases could include the Red Dog Mine port facility and communities to the north. Field researchers will apply individual marks and obtain physical measurements and a suite of biological samples (e.g., hair, fat, and blood) from all captured polar bears. Radio-telemetry tags will be placed on adult females.

The Chukchi Sea subpopulation of polar bears moves freely between the U.S. and Russian coasts, and a large proportion of Chukchi Sea females are believed to den on Wrangel Island. This study will collect data in Russia, including genetic samples on Wrangel Island and the Chukotkan coast using hair snares, biopsy darting, and opportunistic collection at den sites. Additionally, field efforts will seek to complement radio-telemetry data obtained in the U.S. via the live-capture and release of bears in Russia in autumn. The autumn timing of fieldwork will provide key information on the nutritional cycle of polar bears in relation to reproduction and survival.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Integrated Seabed Surveys in the Arctic Ocean:
Bathymetry, Archaeological Resources, and Ice Gouge
Magnitude and Recurrence Rates

BOEM Information Need(s) to be Addressed: Potential pipeline routes are under consideration in association with oil and gas exploration in the Beaufort and Chukchi seas. Regional information for integrative marine spatial planning is needed for evaluation of any proposed Development Production Plans (DPPs) and for development of mitigation and monitoring strategies to avoid irreparable impacts on nonrenewable resources and costly pipeline construction errors. Seabed and sub-seabed geophysical surveys will be combined with archaeological work to support regional assessments in support of the National Historic Preservation Act and analysis of prehistoric archaeology potential needed for NEPA analyses. Detailed information on ice gouge recurrence rates and gouge width and depth will help refine the Arctic effects portion of the fault tree model that is used to develop oil-spill occurrence probability distributions.

Approx. Cost: TBD

Period of Performance: FY 2014-2018

Description:

Background: Remote sensing techniques, such as echo sounding, have been used to map the seabed since the early twentieth century, and modern multibeam and side scan sonar can survey to less than one-meter resolution. In addition to efficiently supplying high-resolution bathymetry data across relatively large areas, these technologies can be used to locate and provide detailed images of features on the seabed. In combination with sub-bottom profiler data, these images can be used to discover specific characteristics of features on and under the seabed, such as ice gouges and archaeological resources.

Ice gouging. Available data is insufficient to conclusively assess the age, recurrence, extent, and depth of ice gouging on the U.S. Chukchi and Beaufort continental shelf areas of the Alaska OCS. Only single year surveys were done in siting exploration wells, therefore the age and recurrence rates of the gouges found within the Alaska OCS planning areas have not been ascertained. Recently, Upward Looking Sonar measurements within the Chukchi Sea have measured ice keels of almost thirty meters and there have been recent unpublished surveys of grounded multi-year ice at water depths greater than thirty meters. MODIS satellite imagery has provided additional evidence that large ice masses may have been grounded offshore in recent years.

Data sets clarifying the magnitude and recurrence rates of ice gouging are needed to establish guidelines for burial of oil production pipelines that cross the shelf. Collecting new, contemporary data coincident with the old survey lines will extend the site survey data sets to the present. Collection and analysis of several years of contemporary ice gouge data will help document present ice gouge characteristics and recurrence rates.

Archaeology. Current guidance calls for an Archaeological Baseline Study for each planning area to provide NEPA analysts with information for establishing the extent and potential for prehistoric resources in the area. At present, there is limited information available regarding potential submerged cultural resources in areas of potential future industry activity, even though there is high possibility that archeological sites exist in these locations. Alaska has unique importance in the study of prehistoric archaeology since it has long been believed that a major corridor for human migration to the New World was across a land bridge that formerly linked Asia with North America. Holocene features may have been occupied by humans and the potential exists for finding similar conditions in the Chukchi Sea. There is also the potential for shipwrecks associated with commercial whaling during the nineteenth century.

Objectives:

- Document ice gouge recurrence rate and physical characteristics, including: ice gouge incision depth, gouge orientation, and width.
- Incorporate the collected data into the BOEM Geohazard Database and produce statistics on ice gouge recurrence rates, incision depth, orientation, and width for fault tree analysis.
- Map Holocene and Pleistocene horizons as old as 35,000 years ago.
- Assess archaeological potential in areas of active and potential industry activity in the Beaufort and Chukchi seas based on geophysical and geologic information, including geomorphological features, shipwrecks, and sea-level indicators that can be used to hypothesize sea level curves.
- Synthesize existing geologic, paleoenvironmental, archaeological and historical data to more clearly define the relationship of prehistoric human populations to the prehistoric landscape into an Archaeological Baseline Study.

Methods: This integrated multi-year study will conduct high-resolution surveys of the seabed in areas of potential industry interest the Beaufort and Chukchi seas. Surveys using marine geophysical techniques, including side scan sonar, multibeam bathymetry, chirp sub-bottom profilers and precision GPS navigation will be conducted in areas of active and potential industry activity, including potential pipeline routes. Autonomous Underwater Vehicles (AUV) may also be deployed to expand the survey effort during the short open water season. Ice gouge surveys will transect older site specific surveys in order to compare contemporary and historical ice gouge occurrence. The sub-bottom profiler will provide detailed information on archaeological features, as well as characteristics of the shallow sub-seabed stratigraphy, in all surveyed areas. Historical and newly collected core data will be analyzed and integrated with the geophysical data across the survey area to better define the continuity of the Holocene and Pleistocene horizons. Potential partnerships with relevant government research conducted by the Navy, USGS, NOAA-NOS and others will be pursued.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Cook Inlet

Title: Baleen Whale Distribution, Abundance, and Ecology in Cook Inlet and Shelikof Strait

BOEM Information Need(s) to be Addressed: Information gained from this study is needed to establish spatial and seasonal distribution and abundance of several species of baleen whales, including multiple endangered species, in areas that will be, and potentially can be, affected by oil and gas exploration, development, and production activities in the Cook Inlet Planning Area, including the proposed 2016 Lease Sale for Cook Inlet. Findings from this study will facilitate informed evaluations of the potential effects of such activities on whales, including listed species and designated critical habitat, that are required under NEPA, the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA). Such information can help inform future evaluation of potential limitations on offshore leasing, exploration and development, thereby reducing impacts. Information gained from the study can aid in the design of temporal and spatial mitigation for such activities, in the monitoring of effects of the activities, in the estimation of take (under the MMPA and ESA) from activities, and to long-term efforts to apply the best available science to adaptively manage impacts of oil and gas on such whales to reduce those impacts to the lowest practicable level. Results will support future Section 7 ESA consultations and the related preparation of future Biological Evaluations and Biological Opinions.

Approx. Cost: TBD

Period of Performance: FY 2014-2019

Description:

Background: There are numerous species of baleen whales that can occur within or near the Cook Inlet Planning Area. These species potentially include: humpback whales, fin whales, North Pacific right whales, blue whales, Sei whales, and gray whales. At least two species of endangered baleen whales (humpback and fin whales) have been commonly sighted in areas within or very near the Cook Inlet Planning Area. Fin whales can be present in Shelikof Strait year-round, but their use of the entrances to Cook Inlet and of southern Cook Inlet is not well-studied. Humpback whales are known to feed seasonally in the area near the Barren Islands, and to occur seasonally in southern Cook Inlet and Shelikof Strait. However, neither abundance in, nor seasonal-use patterns of, these areas are well documented. The pattern of use by individual whales and by populations is not well-defined. Sei whales have been, but are rarely, sighted in Shelikof Strait. However, current studies are inadequate to define their use of these areas. Individuals from the eastern stock of the North Pacific right whale, the most highly endangered large cetacean population in the world, have been sighted in the Gulf of Alaska, outside of the Kenai Peninsula and off of Kodiak Island. Critical habitat has been designated in this area for this endangered species. Previous studies are inadequate to determine if North Pacific right whales may occur in lower Cook Inlet or Shelikof Strait, and potential use of the areas near the Barren Islands by this species is

unclear. However, on the outer coast of Kodiak Island, this species has been sighted in areas in which humpback whales also feed. Large numbers of gray whales pass through the southern portion of the lease area during seasonal migrations. Blue whales are resident in the deeper waters of the Gulf of Alaska and may occasionally pass through the deeper portions of lower Cook Inlet and Shelikof Strait.

Some species of cetaceans may be adversely affected by routine and accidental operations associated with OCS oil and gas activities. For example, the acoustic environment used by many species of whales is notably altered by industry activities, including seismic surveys, shipping, drilling, construction, etc. There are resultant potential effects on their ability to use sound to communicate, detect predators, find prey, and navigate. Data indicate that underwater noise associated with high energy seismic exploration may cause some species or some segments of some species of whales to avoid areas where seismic exploration is occurring. For example, it is known that female humpbacks with calves are sensitive, in some situations, to noise from seismic exploration. Other types of activity associated with oil and gas development also may disturb, and modify the behavior of whales or put them at risk from boat strikes.

Objectives:

- Document the spatial, temporal, and functional use patterns of the proposed Cook Inlet Planning Area, and of adjacent areas that may be affected by oil and gas activities within the Cook Inlet Planning Area (e.g., areas "downstream" of potential activity and areas within the Gulf of Alaska adjacent to Cook Inlet and Shelikof Strait) by individuals and populations of baleen whale species.
- Investigate ecological factors responsible for the distribution of large whales in the study area with emphasis on the relationships between baleen whale occurrence, distribution of potential prey and oceanographic conditions.
- Estimate minimum abundances of baleen whale species in the proposed multi-sale area.
- Assess potential overlap of important whale habitat and the planning area and associated ship traffic.

Methods: This study will deploy an array of continuous seafloor acoustic recorders in the deeper waters of lower Cook Inlet, Shelikof Strait, and nearby and downstream areas of the Gulf of Alaska and analyze data to address the aforementioned objectives. Sonobuoys will be used to assist aircraft and vessels for locating individual whales for detailed study and tagging. Satellite-linked transmitters will be deployed on individuals of each species for year-round monitoring of movements and short-term recoverable archival tags will be used to explore fine-scale movements and feeding behavior in relation to the acoustic environment. Ship-based and/or aerial surveys will obtain information on temporal, spatial, and functional use patterns. Appropriate oceanographic methodologies will be applied to examine prey and habitat relationships related to whale habitat usage.

Revised Date: October 2013

2.3 Profiles of Studies Proposed for FY 2015 NSL

Table 2. BOEM Alaska OCS Region Studies Proposed for the FY 2015 NSL

Page Number	Discipline	Study Title
161	PO	Assessment of Multiple Ocean Circulation Models to Support Ensemble OSRA Experiments
163	HE	Arctic Seafloor Ecology: Benthic Ecosystem Assessment
165	FE	Oil Seeps in the Chukchi and Beaufort OCS: Location, Magnitude, Persistence, and Composition
167	PO	Synthesis of Oceanographic and Climate Data for Environmental Analysis and Model Validation
169	HE	Status and Trends of Seabirds and Forage Fish in Lower Cook Inlet
171	IM	Coastal Habitat Maps: Closing Spatial Gaps in ShoreZone Imagery and Data
173	MM	Development and Assessment of Unmanned Aerial Systems for Estimation of Regional Abundance and Demographic Rates of Pacific Walruses
AQ = Air Quality FE = Fates & Effects HE = Habitat & Ecology IM = Information Management MM = Marine Mammals & Protected Species PO = Physical Oceanography SE = Social & Economic Sciences		

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Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea, Cook Inlet

Title: Assessment of Multiple Ocean Circulation Models to Support Ensemble OSRA Experiments

BOEM Information Need(s) to be Addressed: Oil-Spill-Risk Analysis (OSRA) is a cornerstone foundation for evaluating alternatives in OCS oil and gas leasing NEPA analyses and oil spill response plans. This study would support continuing improvement of the BOEM oil-spill trajectory model and its application in the Arctic and provide additional baseline information for NEPA analyses. Oil-spill issues constitute a significant portion of public comments submitted on NEPA documents related to proposed lease sales, EPs, and DPPs in the Alaska OCS Region.

Approx. Cost: TBD

Period of Performance: FY 2015-2017

Description:

Background: To assess potential changes in the marine and coastal environment associated with offshore oil and gas development activity, it is important to understand how key environmental variables (e.g., surface winds, oceanography, and sea ice) fluctuated in the past and are predicted to act in the future in association with climate variations. To maintain its state-of-the-art in oil-spill-trajectory analysis, BOEM seeks to take advantage through time of the increasing skill of circulation models supported by more and better data. Over the past decades, BOEM and other federal and state agencies have invested a significant amount of resources to measure and model the circulation and variability in the Alaska coastal waters. It has been an ongoing challenge to converge on a well-validated and finer-scale ocean circulation model. Modeling the coastal circulation around Alaska is particularly challenging given its complex coastline, rapidly changing weather conditions and the relative large freshwater input from river discharge and melting ice. Thus, any single model hindcast likely has large uncertainties, and a systematic effort is required to validate these hindcast model simulations against available measurements. A multi-model ensemble is the ultimate approach to providing retrospective analyses and estimating model uncertainties for surface wind, ocean currents and waves, and sea ice in Alaska coastal waters.

Objectives:

- Assess the performance and estimate the uncertainty of simulations of ocean currents and sea ice in Alaska coastal waters from multiple ocean circulation models.
- Apply short-term surface fields from multiple ocean circulation models for the Arctic to identify the physical processes most important to oil-spill trajectory analysis and evaluate sensitivities of the various models to relevant parameters.

Methods: This study will assemble model simulations for ocean currents and sea ice from multiple ocean circulation models to support ensemble and intercomparison OSRA experiments. Observational data sets will be assembled and aggregated from a variety of sources to facilitate data-model comparisons. Local observations include flow measurements from acoustic Doppler current profilers and drifters and water mass data from conductivity-temperature-depth (CTD) profilers. Deliverables would include a report outlining the strengths and weaknesses of each model in relation to processes relevant to oil-spill trajectory analysis, as well as short-term (five years) surface circulation fields from the suite of models.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Arctic Seafloor Ecology: Benthic Ecosystem Assessment

BOEM Information Need(s) to be Addressed: Updated and accessible information on benthic habitats, from the nearshore to the offshore is needed along the continental shelf in the Beaufort and Chukchi seas to support NEPA analyses for lease sales, Exploration Plans, and Development and Production Plans, and to develop potential mitigation measures for the avoidance of sensitive and vulnerable habitats used by the Pacific Walrus and migratory birds, as well as Essential Fish Habitat.

Approx. Cost: TBD

Period of Performance: FY 2015-2016

Description:

Background: The Arctic hosts many complex benthic ecosystems that play key roles in habitat and food web support. Chukchi sea benthic communities are among the most abundant and diverse in Arctic regions due to the primary productivity created by phytoplankton populations.

In 2006 the BOEM-sponsored Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA) workshop described and discussed the importance of benthos in the Chukchi ecosystem. Knowledge of the benthic fauna along Alaskan arctic shelves at that time was largely based on a series of intensive surveys between the 1970s and early 1990s under the Outer Continental Shelf Environmental Assessment Program (OCSEAP). The massive datasets collected under these programs were recently synthesized under the Arctic Shelf Basin Interactions (SBI) project sponsored by NSF. This synthesis revealed “hot spots” of high benthic biomass in several regions of the Chukchi Sea, particularly in the northeastern sector between Point Lay and Icy Cape at Hanna Shoal, which lies about 200 km west of Point Lay. Recent work in the area includes the BOEM-funded study “COMIDA: Chemistry and Benthos (CAB),” completed in 2012 that involved a two-year field effort to characterize the biota and chemistry in the offshore portions of the Chukchi Sea. A more discrete analysis of the benthos has been conducted by the oil industry on smaller geographical areas inside the Chukchi Sea lease areas. In addition, the Alaska Monitoring and Assessment Program (AKMAP) by the Alaska Department of Environmental Conservation has performed benthic sampling as part of a broader program in 2011 and 2012 in closer proximity to the coast in areas greater than 10 meters depth.

These benthic sampling efforts in the mid-shore to offshore areas of the northeastern Chukchi Sea reveal a highly productive and complex system characterized by significant spatial heterogeneity in both the benthic infauna and epifaunal populations. However, benthic information in the nearshore (<20m) areas is lacking in this area, particularly within lagoons. This project prioritizes sampling in lagoon areas, with a focus on

characterizing lagoon species and habitat quality, including contaminant concentrations in environmental media and biota.

Objectives: The overall goals of this study are to perform a retrospective analysis of information on the benthic environment in the Beaufort and Chukchi seas to better define the seafloor ecology and to locate vulnerable habitats or those utilized as feeding areas for upper trophic level organisms. Specific objectives include:

- Providing a benthic habitat classification manual and supplemental geospatial data, similar to work completed for the nearshore waters of the main Hawaiian Islands which will assist in a comprehensive database of sensitive habitats.
- Determining “hot spot” areas characterized by high benthic biomass that are critical feeding areas for upper trophic level organisms.
- Assessing key habitat characteristics (fauna, sediment type) that define sites that are highly sensitive to anthropogenic activities.
- Developing a strategy for conducting a survey of Arctic nearshore waters (<20m), including an assessment of baseline conditions for contaminants in environmental media and biota in lagoon systems of the Chukchi Sea.

Methods: The researchers will conduct a literature review and associated data mining and synthesize the information to produce a benthic habitat classification manual. Data mining will be coordinated with efforts from North Pacific Research Board’s Pacific Marine Arctic Regional Synthesis of the Northern Bering, Chukchi, and Beaufort seas (PacMARS) benthic data synthesis efforts. A rigorous statistical design will be developed to establish a baseline description of nearshore areas with focus on prospective development areas already identified in both the Beaufort and Chukchi seas. The sampling plan should include benthic surveys near Point Lay, Kasegaluk Lagoon, and Camden Bay with side scan or similar technology and collection of high-resolution bathymetry, backscatter imagery and underwater video/photography of these nearshore marine habitats to map the seafloor and facilitate description of nearshore benthic habitat complexity. The sampling plan should employ standard quantitative methods for infaunal, epifaunal and demersal nearshore benthic surveys, including abundance, community structure and biomass similar to previous collections.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Oil Seeps in the Chukchi and Beaufort OCS: Location, Magnitude, Persistence, and Composition

BOEM Information Need(s) to be Addressed: BOEM needs information on the location, magnitude, persistence and composition of oil seeps in the Beaufort and Chukchi seas. Natural seeps represent a large portion of the petroleum input to the sea and are a natural background. However, total seep volume in the Arctic is uncertain. Refined information of area seeps provides insight into assessing the effects from seeps and to provide additional context when considering estimated oil spills in agency NEPA analyses for leasing, exploration, and development in the Alaska OCS.

Approx. Cost: TBD

Period of Performance: FY 2015-2018

Description:

Background: Natural oil seeps in the Chukchi and Beaufort seas are not mapped in the open or gray literature, and we have limited information of their spatial extent or volume of environmental release, or of the deposition of the oil in the environment and its residence time. Some information about the location and extent of natural oil seeps in the Chukchi and Beaufort OCS does exist, but this was obtained in cooperation with industry and is proprietary.

The physical properties of Alaska OCS seep oils can be estimated from equivalent oil types in onshore formations: how it is affected by weathering of the environment, how it compares to known crude types in other development areas, or the deposition of the oil within the environment. The presence of natural oil seeps is indicative of resident organisms adapted to metabolize the hydrocarbons. These organisms in turn indicate the capacity for microbial remediation of hydrocarbons in the environment, or natural bioremediation through the means of reducing pollutants. Oil-eating, cold-water bacteria in the Gulf of Mexico waters were a major factor in the removal of spilled oil from the Macondo spill in 2010.

Objectives: This study has three objectives:

- Identification of the location and extent of oils seeps in the Chukchi and Beaufort OCS
- Collection and chemical characterization of oil (water column and/or sediment) samples
- Collection and characterization of oil-associated heterotrophic microbes

Methods: Likely techniques will include remote sensing and ground truthing. Aerial and/or satellite remote sensing will be used to detect, locate, and estimate size of oil

slicks from seeps during the open water season. Multiple passes over two open water seasons will be made to estimate seep persistence. A subset of seeps will be chosen for vessel sampling of surface slick (or surface layer if no slick), water, and bottom sediments beneath the remote-sensed slick locations. Oil, surface layer, and sediment samples will undergo hydrocarbon fingerprinting analyses and remaining oil samples will undergo oil weathering characterization. Heterotrophic activity/potential and identification of primary heterotrophic microbe species will be ascertained from collected water, surface layer, and bottom sediments. Chosen oil (hydrocarbon) and microbial techniques would allow comparison with existing Alaska Arctic OCS data. Potential for industry and other government agency partners (e.g., NOAA's Office of Ocean Exploration and Research) to aid in pursuit of project goals will be investigated and pursued if appropriate.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Synthesis of Oceanographic and Climate Data for Environmental Analysis and Model Validation

BOEM Information Need(s) to be Addressed: Information from physical measurements of the ocean, sea ice and the atmosphere will be brought together into an integrated set of data results and be incorporated into a newly created Climatic Atlas for the Beaufort and Chukchi seas. The data and summary statistics will support NEPA analyses for lease sales, EPs and DPPs, and support efforts to improve Marine Spatial Planning. These results may also be used to provide skill assessments for ocean circulation and oil-spill trajectory modeling.

Approx. Cost: TBD

Period of Performance: FY 2015-2018

Description:

Background: Oftentimes, BOEM analysts are dependent upon difficult to find environmental information about oceanography, meteorology, and sea ice for use in NEPA analyses. A Climatic Atlas provides a resource reference for analysts and the general public by making available detailed, integrated information on the environment. The last Climatic Atlas for the Alaska Beaufort and Chukchi seas was completed almost thirty years ago and needs to be updated. As a result of climate change, environmental conditions during some months have transformed significantly since the completion of the last atlas, especially with regard to sea ice.

Oceanographic, sea ice, and atmospheric data derived from previous field collections can be readily synthesized, summarized, and provided to analysts for quickly incorporating into the writing of environmental analyses. The information will be provided in the format of a digital Climatic Atlas that will provide a regionally integrated picture of the climatology, along with summary statistics that can be queried for specified regions of the Beaufort and Chukchi OCS.

Available measurements from high frequency radar, ADCPs, CTDs, gliders, ice profiling sonar, meteorological buoys, ships of opportunity and other instruments will be compiled and synthesized. Analysis of these data will provide an accurate depiction of the distribution and variation of water temperature, salinity, density, and wind speed and direction, as well as seasonal and interannual summaries of surface and subsurface currents, wave heights, wind speed and direction, and ice properties and drift velocities. Interpreted satellite imagery from the National Ice Center and other sources can provide the seasonal changes in ice conditions and the timing of freeze-up and break-up.

Objectives:

- Produce an interactive digital Climatic Atlas for the Beaufort and Chukchi seas that synthesizes oceanographic, sea ice and meteorological measurements, including: water temperature, salinity, and density, as well as seasonal and interannual summaries of surface and subsurface currents, wave heights, wind speed and direction, and ice properties and drift velocities.
- Provide analytical tools that will allow the user to easily extract and display data and summary statistics for specified regions of the Beaufort and Chukchi OCS.

Methods: This study will compile all available ADCP, CTD, ice profiler, high frequency radar, meteorological, and other data into a common dataset for the Chukchi and Beaufort seas. The period of analysis will be determined by data availability, but shall be no less than 10 years. The atmospheric, oceanographic, and sea ice datasets will be analyzed to establish their spatial and temporal interdependencies. Program code will be developed for the user to extract summary statistics needed by Alaska OCS Region NEPA analysts. The primary deliverable will be a dataset and analytical tools suitable for use with GIS applications and integration with other relevant environmental data, such as species distribution and habitat use. Potential partnerships with other federal agencies, including BSEE, NOAA-NODC, NOAA-NCDC, the Navy, NSF, etc., will be pursued for this study. This project will be coordinated with the proposed study “Data Interface Tools to Support Environmental Analyses: Interpretation of Existing Marine Mammal Data” and additional efforts supported by BOEM and other entities.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Cook Inlet

Title: Status and Trends of Seabirds and Forage Fish in Lower Cook Inlet

BOEM Information Need(s) to be Addressed: The BOEM *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program 2012-2017* includes a lease sale in the Cook Inlet Planning A in 2016 and recent expansions of on-shore and off-shore exploration efforts in state lands and waters in the region demonstrate increased industry interest in Cook Inlet oil and gas development. Large populations of marine birds are located in lower Cook Inlet, especially at colonies on Chisik, Gull and the Barren Islands. A variety of important forage fish species (herring, sand lance, smelts) are also abundant in marine waters of lower Cook Inlet, especially between the Barren Islands and Kachemak Bay. However, collection of seabird and forage fish data in lower Cook Inlet has been sporadic and not systematically reported for more than a decade. Results from this study will be used for NEPA analyses for future lease sales, Exploration Plans and Development and Production Plans.

Approx. Cost: TBD

Period of Performance: FY 2015-2019

Description:

Background: Seabird and forage fish studies were conducted in lower Cook Inlet during 1995-2000 with joint funding from BOEM (formerly MMS), USGS, and the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) in large measure because of concerns about our ability to assess the recovery of seabird populations following the *Exxon Valdez* oil spill. Results of this work been reported in over 40 publications, and synthesis of the work continues. The original project was designed to measure the foraging and population responses of six seabird species to fluctuating forage fish densities around three seabird colonies in lower Cook Inlet (LCI). These studies involved at-sea surveys for forage fish (hydroacoustics, trawling, seining) and some characterization of oceanography while measuring aspects of seabird breeding biology (egg and chick production, chick growth, population status and trends) and foraging behavior (diets, feeding rates, foraging time) at adjacent colonies. The most detailed data were collected on Common Murres (*Uria aalge*) and Black-legged Kittiwakes (*Rissa tridactyla*), the most commonly monitored seabird species in Alaska. The goal of the study was to achieve a better understanding of relationships between seabirds and forage fish in a variable environment, and to assess whether current environmental conditions were favorable to seabirds in the Gulf of Alaska (GOA). Results indicated that the upwelling of cold, nutrient-rich GOA waters at the entrance to the shallow LCI estuary supports a high density of juvenile pollock, sand lance, and capelin; which in turn are exploited by high densities of breeding seabirds (murre, kittiwakes, puffins, etc.) on the east side of LCI. Waters on the west side of LCI are oceanographically distinct (warmer, less saline, outflowing), and much less productive for forage fish and seabirds. Patterns of seabird foraging behavior, productivity and population change reflected patterns of forage fish

abundance and distribution, which in turn depended on local oceanography. Most seabird parameters varied with forage fish density in a non-linear fashion, and productivity was limited by food availability in some areas and years.

More than a decade has passed since these studies were completed, and little comparable work has been conducted during the interim. Anecdotal reports suggest that ecosystem changes have occurred (including a possible climate regime shift after 2000) that have influenced the timing of breeding and reproductive success of birds on Gull and Barren Islands. Assessment of food availability to the health of these bird populations in context to relative importance compared to contaminants, loss of nesting sites, anthropogenic disturbance, and whether these changes cumulatively have resulted in changes to the population trajectories observed in the 1990s remains unknown. This project proposes a return to lower Cook Inlet to gather new data on seabird demography and forage fish communities, as well as physical and chemical measurements to provide a benchmark for future studies on the effects of climate change.

Objectives:

- Assess forage fish species abundance (CPUE, catch composition) relative to results of historical studies around each of three seabird colonies.
- Measure reproductive success, chick growth and foraging success of murres and kittiwakes at Gull, Chisik and Barren islands, and compare with historical studies.
- Census murre and kittiwake populations on established monitoring plots, and conduct whole-island censuses at Gull, Chisik and Barren islands and analyze monitoring time series to estimate recent population trends.
- Resume banding studies to measure annual adult survival rates of murres and kittiwakes, and determine whether survival rates have changed since the 1990s.

Methods: In order to facilitate comparisons with data from prior studies, the consistent techniques for measuring food availability, seabird reproductive biology and feeding behavior will be employed. These techniques were developed from protocols established during APEX studies funded by BOEM and EVOSTC. In short, forage fish abundance will be assessed using mid-water trawl and acoustic surveys around each colony. Kittiwake and murre reproductive success (laying success, clutch size, hatching success, fledging success, productivity) and timing of breeding will be monitored as in the previous study. Plot and colony counts of total birds in attendance will be conducted at the prescribed times within the breeding season. Adult murres and kittiwakes will be color-banded and re-sighting will take place in subsequent breeding seasons.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Cook Inlet

Title: Coastal Habitat Maps: Closing Spatial Gaps in ShoreZone Imagery and Data for the Cook Inlet Area

BOEM Information Need(s) to be Addressed: The BOEM *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program 2012-2017* includes a lease sale in the Cook Inlet Planning Area in 2016 and recent expansions of on-shore and off-shore exploration efforts in state lands and waters in the region demonstrate increased industry interest in Cook Inlet oil and gas development. ShoreZone mapping is a technique that will provide BOEM with the most comprehensive biological, physical, and geomorphologic data of Alaska coastal areas. The BOEM analysts and decision makers will use shoreline mapping information for identifying high priority fish and wildlife habitats in NEPA and ESA analyses and documentation for lease sales, EPs and DPPs, and in post-sale and post-exploration decision making. The data will also provide an improved level of detail for coastal contingency planning, oil spill response activities, and habitat recovery efforts in the context of future offshore oil and gas and mineral development activities.

Approx. Cost: TBD

Period of Performance: FY 2015-2016

Description:

Background: The spatial distribution of nearshore habitats is important information for resource managers and coastal decision-makers, and numerous shoreline classification methods have been applied to our coasts. Recent efforts, however, have focused on a partnership of numerous scientists, GIS and web specialists, non-government organizations, and local, state, and federal agencies. This partnership is applying ShoreZone protocols to build a contiguous, integrated dataset of coastal habitats and imagery for Alaska's coast.

In 2001, the Cook Inlet Regional Citizens' Advisory Council (RCAC) began a program to apply the ShoreZone mapping protocols to Cook Inlet and led the development of the first web-based access to the data and imagery. This program was later expanded to include the outer Kenai Peninsula coast, Kodiak Island, and the Alaska Peninsula (with funding by the EVOS Trustees, the Alaska Department of Natural Resources, Kenai Peninsula Borough, and the National Park Service). Cook Inlet RCAC also initiated an Alaska ground-station program that has now expanded to include hundreds of stations throughout the Gulf of Alaska and North Slope. By 2005, NOAA's National Marine Fisheries Service stepped forward to provide web-site and data-support and currently provides the necessary personnel to manage, update, and serve the data to the public and has also led efforts to map southeast Alaska and develop a larger statewide partnership. By 2012, the program had expanded to the Alaskan Arctic with BOEM-sponsored aerial and on-the-ground surveys.

Despite the successful expansion of the ShoreZone program to include much of Alaska's coast, there are still several significant spatial gaps, including portions of the coastline within or adjacent to the Cook Inlet Planning Area. These areas include the Alaska Peninsula coastline from the Katmai National Park boundary to the Cold Bay area. Also, the Barren Islands were not attempted during earlier surveys in the Cook Inlet area and are an obvious spatial gap to the contiguous, continuous habitat data and imagery for the Gulf of Alaska. A survey along these coastlines would also provide the opportunity to re-fly sections of the Katmai National Park coastline to conduct a pilot project for assessing ShoreZone's applicability for detecting large-scale changes to some biological or geomorphic classifications. Recent studies by the NPS along this coast have shown large-scale loss of mussel bed habitats along portions of the coast. Since ShoreZone maps mussel beds as an along-shore and across-shore bioband, it would be an opportunity to assess whether ShoreZone data (and imagery) can provide a baseline for detecting or illustrating significant changes between periodic surveys in areas determined to be of high interest or sensitivity.

Objectives:

- Map the along-shore and across-shore geomorphic and biological habitat features using the aerial survey imagery and narration by a biologist and a geomorphologist.
- Ground-truth aerial survey results through shore-station surveys along this coast to verify geomorphic features and to describe invertebrate and seaweed assemblages.
- Publicly disseminate all data and imagery via the ShoreZone website, and Cook Inlet Response Tool
- Assess whether ShoreZone imagery and mapped data can capture some of the larger-scale changes that have been observed in some areas along the Katmai National Park shoreline since the original ShoreZone surveys were conducted in the area in 2003.

Methods: Conduct ShoreZone aerial surveys of the Barren Islands and along the Alaska Peninsula coastline from the northern border of the Katmai National Park coastline to the Cold Bay area where the 2011 Alaska Peninsula surveys ended. The aerial surveys and mapping would take place according to the ShoreZone Coastal Habitat Mapping Protocol for the Gulf of Alaska (http://www.fakr.noww.gov/habitat/shorezone/goa_protocol.pdf). Any appropriate revisions to the protocols will be incorporated, based on surveys and mapping that have taken place since the last protocols were published (revisions due June 2013). Shore-stations surveys should take place at a series of stations over a range of habitat types known to occur along these shorelines (e.g. exposed rocky, rock platforms, exposed boulder beaches, semi-exposed and semi-protected cobble beaches, salt marshes, eelgrass beds). These proposed surveys would close a spatial gap in the Gulf of Alaska ShoreZone data and imagery that has precluded queries of coastal habitat data in areas downstream of existing and potential future oil exploration, development, and production activities.

Revised Date: October 2013

Environmental Studies Program: Alaska Annual Studies Plan FY 2014

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Development and Assessment of Unmanned Aerial Systems for Estimation of Regional Abundance and Demographic Rates of Pacific Walruses

BOEM Information Need(s) to be Addressed: Large numbers of Pacific walruses (*Odobenus rosmarus divergens*) utilize areas of high resource potential in the OCS waters of the northeast Chukchi Sea. BOEM needs reliable estimates of abundance and demographic rates of Pacific walruses in the northeast Chukchi Sea for use in planning, management, and mitigation of potential environmental impacts from oil and gas activities. Abundance and demographic rates of walruses are also important for stock assessments under the Marine Mammal Protection Act (MMPA) and for extinction risk assessment under the Endangered Species Act (ESA). This study will develop methodologies and assess the use of unmanned aerial systems (UAS) for estimation of abundance and demographic rates of walruses in the northeast Chukchi Sea. Results from aerial surveys of walruses would be used in pre-lease analyses for future Chukchi Sea lease sales as well as in post-sale and post-exploration BOEM decision making and mitigation.

Approx. Cost: TBD

Period of Performance: FY 2015-2019

Description:

Background: Walruses are an ice associated pinniped inhabiting the OCS waters of the Bering and Chukchi Seas and are an important subsistence resource for the region. Over the past three decades the extent of sea ice habitat vital to walruses has declined, particularly during summer and autumn when walruses occur in the OCS waters of the Chukchi Sea. Walruses are a protected species under the MMPA and are considered warranted but precluded under the ESA. As part of a 2011 Multi-district Settlement Agreement, the U.S. Fish and Wildlife Service must make a decision by September 2017 on whether to propose the Pacific walrus for listing under the Endangered Species Act or remove it as a candidate species. Demographic estimates would be an important contribution to this decision, the results of which will be important for BOEM decision making. Furthermore, oil and gas activities in the OCS areas of the Chukchi Sea have increased dramatically in the last five years and this trend is expected to continue. Therefore, estimates of the number of walruses using the northeast Chukchi Sea would be important for regulatory and mitigation activities associated with oil and gas development in the region.

Past efforts to estimate abundance of walruses were based on manned aerial surveys. Manned flights have strict limitations since they must adhere to stringent requirements regarding wind, visibility, and minimum flight elevation due to safety and noise concerns. In recent years, there has been increasing interest in using UAS technology to study marine wildlife populations in the Arctic and UASs have been suggested as an

alternate survey platform for studying walruses in the northeast Chukchi Sea. For example UAS technology could be useful for estimating numbers of walruses occupying land based haulouts. When corrected for animals in the water and unavailable for survey, a regional abundance estimate could be produced. Furthermore UASs could potentially be used to estimate age ratios of walruses hauled out on sea ice that, when combined with other sources of information, can be used to estimate demographic rates such as fecundity and survival. A small number of limited field tests with other arctic marine mammals (e.g. ice seals and Steller sea lions) have been conducted and have provided initial insight into the levels of success that may be achieved using UAS technology. The results from these preliminary studies suggest that further investigation into the use of UAS technology for studying walruses is warranted. The study proposed here will explore the feasibility of using UAS technology for estimating regional abundance and conducting age ratio surveys for estimating demographic rates of walruses in the northeast Chukchi Sea. This information would be valuable for MMPA incidental take regulations and ESA Section 7 analyses as well as for developing regulatory and mitigation measures relative to oil and gas development in the OCS regions of the northeast Chukchi Sea.

Objectives:

- Evaluate detection rates and ability to identify walruses hauled out on sea ice and on land using available UAS technology.
- Assess the ability of UAS technology to identify age and sex composition of walruses hauled out on sea ice in the northeast Chukchi Sea for estimation of demographic rates.
- Evaluate the ability of UAS technology to enumerate walruses at land-based haulouts for estimation of regional abundance in the northeast Chukchi Sea.

Methods: In partnership with other Federal agencies, this study will use a ship based approach to conduct aerial surveys of walruses hauled out on sea ice in the northeast Chukchi Sea utilizing UAS technology. The researchers will develop methods to collect data for determination of sex and age composition of walrus herds and total number of walruses hauled out at any one time. Sex and age composition estimates will be combined with other sources of information to estimate demographic rates using a maximum likelihood approach. Satellite radio tags will be applied to walruses hauled out on shore to estimate the proportion of the population in the northeast Chukchi that is currently hauled out during each coastal aerial survey. Data from repeated coastal surveys will be assimilated to quantify the regional abundance of walruses in the northeast Chukchi Sea. Methodologies developed here could facilitate use of UAS technology for many other study applications.

Revised Date: October 2013

SECTION 3.0 TOPICAL AREAS FOR FUTURE RESEARCH

This section presents a general forecast of significant topical issues and concerns to be addressed by studies for FY 2016 and beyond. In general, these topics conform with the research themes of the ESP. Due to the great differences existing between Alaskan environments and other OCS areas, the uniqueness of issues in Alaska has dictated the need to anticipate new topical areas for implementation. These projects will focus on BOEM mission needs within the context of increasing offshore exploration and development, and potential trends in a changing climate.

Many of the studies proposed for FY 2014 and FY 2015 address the topical areas described below. These will be re-assessed as part of the FY 2015 planning process.

As noted in Section 1.2.1 of this document, the *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program 2012-2017* (USDOJ, BOEM, 2012) pointed to a need for further development of scientific information prior to additional leasing. Particular topics include the sensitive habitats, unique conditions, and distinctive subsistence hunting and fishing activities found in the Arctic, as well as the oil and gas resource potential. Development of additional information for the Cook Inlet Planning Area is also needed to support updated analysis of the potential effects of OCS activities on its environment and uses in anticipation of proposed Lease Sale 244.

3.1 Climate Change

Climate change is accelerating in the Arctic, leading to a rare but true baseline environmental change. In recent years, the extent of summer ice cover is decreasing more rapidly than was predicted by most global change models. The extent, duration, and thickness of summer ice cover in the Arctic region have decreased to record historical lows. The loss of ice cover is causing changes to both physical oceanography and ecosystem productivity and has significant ramifications for marine mammals, bird and fish species that live on, below, or near the ice.

Climate change will also lead to altered water chemistry. In particular, the average pH of the surface ocean is projected to decrease by as much as 0.5 pH units by 2100 due to the uptake of excess carbon dioxide (Sigler et al., 2008). In addition, higher water temperatures can result in increased biological production and decomposition.

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 that are now occurring 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 incorporate forecast data.

Climate change also entrains many socio-economic 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.

3.2 Air Quality

In December 2011, Congress transferred jurisdiction and authority for the control of air emissions on the OCS in the Beaufort and Chukchi seas from the EPA to BOEM. While implementing this authority, BOEM will need air quality monitoring information to assess the cumulative air quality impact of off-shore Arctic oil and gas activity and to support compliance with the Clean Air Act and environmental justice initiatives.

3.3 Physical Oceanography

An ongoing challenge in the Alaska OCS Region 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. Continued development and application of state-of-the-art circulation models is important for future OSRA-based EIS analyses.

Improvements are also needed in sea ice aspects of the modeling. The resolution of ice models and ice data needs to be increased to address the propagation of fine scale non-random interactions across hundreds of miles of pack ice in the case of ice leads, as evidenced by recent improvements in satellite oceanography.

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, would inform and improve regional EISs, EAs, and oil-spill response planning. In particular, more information is needed to assess the impact of ice on the nature and amplitude of the upwelling/downwelling and to gain a better understanding of the dynamics associated with river outflow plumes, especially under ice.

3.4 Fate and Effects

The Region has collected baseline biological and chemical monitoring data in the vicinity of the Liberty Prospect and Northstar since 1999, as part of the studies “Arctic Nearshore Impact Monitoring in the Development Area (ANIMIDA)” and its continuation, cANIMIDA. The summer of 2007 was the last field season for the cANIMIDA project. ANIMIDA 3, which is a continuation of ANIMIDA/cANIMIDA sediment chemistry monitoring, has been expanded to include Camden Bay where drilling is planned to delineate discoveries in the Sivulliq and Torpedo prospects.

In addition to site-specific monitoring, ANIMIDA and cANIMIDA re-examined the regional sediment quality in the nearshore U.S. Beaufort Sea. The ESP set up the Beaufort Sea Monitoring Project (BSMP) in the 1980s to monitor sediment quality. The BSMP monitored trace metal and hydrocarbon levels in sediments and benthic biota at

specific locations on a regional basis. The ANIMIDA and cANIMIDA projects have resampled many of the BSMP stations from Harrison Bay to Camden Bay and Coastal Marine Institute studies resampled BSMP areas further west (Point Barrow) and east (Beaufort Lagoon).

The Chukchi Sea Ocean Monitoring in the Drilling Area (COMIDA): Chemistry and Benthos study and the Hanna Shoal Ecosystem Study have been collecting similar chemical and biological data within and downstream of the leased areas of the Chukchi Sea. The need for additional monitoring will continue to be re-evaluated as oil and gas development in the Alaska Region OCS evolves.

3.5 Endangered and Protected Species

Oil and gas-related activities, including production at the Northstar site and other potential sites, may lead to risks of oil spills from buried pipelines, other discharges, noise from various industrial and support activities and increased human interaction with arctic offshore species. Species protected under the ESA, MMPA and the Migratory Bird Treaty Act are of particular concern if impacted by such factors. Study of the effects of oil and gas-related activities on protected mammals and the need for monitoring of endangered species are expected to be continued. Related to this is the need for assessment of how any changes in the bowhead whale migration's distance from shore could relate to subsistence success (see below). Future bowhead studies are expected to continue to explore use of satellite tagging for information on bowhead whale residence times in development areas. BOEM anticipates pursuit of new opportunities to obtain and update information on bowhead behavior in response to industrial noise through the use of appropriate research partnerships.

Effects of construction activities on polar bears, especially on denning bears, and concerns about the adequacy of information about all age/sex categories of the bear population will need to be addressed by additional research. Several ongoing studies are expected to lead to recommendations for additional information regarding polar bears and continued study of the bear population's vulnerability to oil spills through improved models.

Other key subsistence species potentially exposed to short-term or cumulative impact factors for which behavioral or monitoring studies may be needed include beluga whales, walrus, ringed seals, ribbon seals and bearded seals.

3.6 Marine Fish Migrations, Recruitment and Essential Fish Habitat

BOEM needs information to assess and manage the potential environmental effects of offshore development on marine fish. More detailed information about the biology and ecology of many marine fish species inhabiting the Alaska lease areas 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. As offshore oil development interest expands to deeper and more widespread areas, additional fisheries information is required.

As a result of the Magnuson Fishery Conservation and Management Act, effects on Essential Fish Habitat must be evaluated. In the Bering and Chukchi Seas, more information is needed to evaluate Essential Fish Habitats in the Chukchi Sea as commercial fish species move northward from the Bering Sea. Beaufort waters are also considered Essential Fish Habitat for salmon, and future research on salmonid reproduction in Beaufort Sea drainages is indicated to clarify environmental assessment and mitigation needs.

Seismic exploration and its effects on fish is a high-priority issue for Arctic residents. More information 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 would be valuable for NEPA analyses.

Alaska Native villagers are concerned that OCS activities will affect subsistence fish populations and reduce availability for subsistence harvest. Thus, additional research on arctic fisheries and recruitment to nearshore feeding populations should be considered. Several fish species used for subsistence migrate through, or are found in, the Northstar and Liberty areas of the Beaufort Sea, including arctic and least cisco, Dolly Varden, arctic char, and humpback and broad whitefish. Intermittent occurrences of pink and chum salmon also take place in Beaufort coastal waters.

A need for more information on the forage fish resources and their relation to apex predators in the Bering, Chukchi and Beaufort seas is also indicated. A good understanding of the seasonal distribution, abundance and habitat use of forage fish, including key spawning and migration events that quickly transfer large amounts of energy to upper trophic levels, is fundamentally important to monitoring the potential environmental impacts associated with offshore development.

3.7 Subsistence

Residents of the North Slope coastal communities frequently express concern about cumulative impacts of offshore and onshore developments on their subsistence lifestyle. Some of the concerns of the Iñupiat include diminished access to hunting and fishing areas around oil industry infrastructure, reduced harvests, increased hunter efforts and increased hunter cost. How, and to what degree, subsistence activities have been affected by industry infrastructure and industry activity is a concern that may be further addressed by additional research. Consideration of cumulative impacts is an increasingly 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 potential changes in the recruitment of youth into subsistence activities. Social indicators should be maintained to serve as a basis for estimating long-term aggregate impacts.

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CONTRIBUTING ALASKA OCS REGION STAFF

Chris Campbell, Sociocultural Specialist

Mary Cody, Wildlife Biologist

Cathy Coon, Marine Biologist

Dr. Heather Crowley, Oceanographer

Jeff Denton, Ecologist

Nancy Deschu, Fishery Biologist

Carol Fairfield, Marine Ecologist

Dr. Dan Holiday, Wildlife Biologist

Warren Horowitz, Oceanographer

Virginia Raps, Meteorologist

Rick Raymond, Program Coordination Analyst

Caryn Smith, Oceanographer

Kate Wedemeyer, Fisheries Oceanographer

Marty Byrne, Cartographer

Dr. Dee Williams, Chief, Environmental Sciences Management