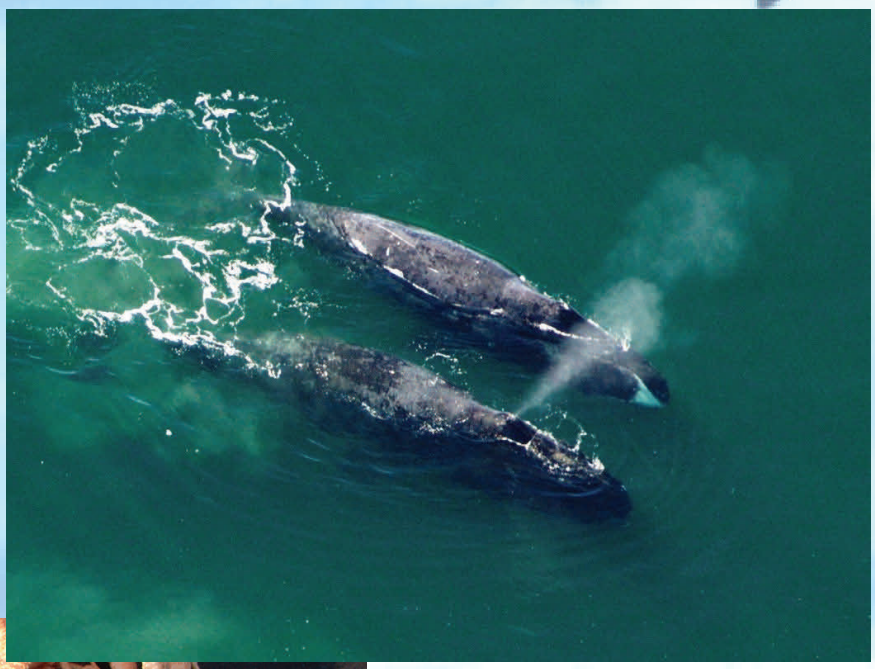
ALASKA

ANNUAL STUDIES PLAN



FY 2012

BOEM
BUREAU OF OCEAN ENERGY MANAGEMENT

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

OCTOBER 2011

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

October 2011

This document may be accessed electronically at http://alaska.boemre.gov/ess/index.htm. 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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United States Department of the Interior

BUREAU OF OCEAN ENERGY MANAGEMENT

Alaska OCS Region

3801 Centerpoint Drive, Suite 500

Anchorage, Alaska 99503-5823

October 3, 2011

Dear Stakeholder:

Thank you for your interest in the Environmental Studies Program (ESP) of the Bureau of Ocean Energy Management (BOEM). Fiscal Year (FY) 2011 has been a year of significant transition for us, including national reorganization, personnel changes, enhanced studies coordination, and exciting new research initiatives. One event of particular importance was the June release of the USGS report on science needs in the Beaufort and Chukchi seas. Please see Section 1.1.3 for our brief discussion of that report and a summary of initial responsive changes.

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. We are interested to know your perspectives and to receive any suggestions you may have for the BOEM *Alaska Annual Studies Plan, FY 2013*, which we are now beginning to formulate. For your convenient reference, we are providing the *Alaska Annual Studies Plan FY 2012*, developed from submissions we received over the past year. For FY 2013 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; enter keywords "Alaska Annual Studies Plan."

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 November 15, 2011, to assure consideration for the 2013 fiscal year. Following revisions to the plan, we will issue a final *Alaska Annual Studies Plan FY 2013* in the autumn of 2012.

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 Studies Section

Bureau of Ocean Energy Management
Alaska Environmental Studies Program

Proposed Study for FY 2013

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: Alaska *[Standard for all.]*

Planning Area(s): *[e.g., Beaufort Sea, Chukchi Sea as applicable. See Fig.1 of the Plan.]*

Title: *[Fill in concise title.]*

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 2013-20*XX*

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, such as "Final report is needed by December 2015." If the product of the study is something additional to the scientific report (e.g. database, model, bibliography), explain in this section.*

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ACRONYMS

ADCP	Acoustic Doppler Current Profiler
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
AEWC	Alaska Eskimo Whaling Commission
AKMAP	Alaska Monitoring and Assessment Program
AMSS	Alaska Marine Science Symposium
ANIMIDA	Arctic Nearshore Impact Monitoring in Development Area
AOOS	Alaska Ocean Observing System
AUV	Autonomous Underwater Vehicle
BEST	Bering Sea Ecosystem Study
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	British Petroleum Exploration Alaska
BRD	Biological Resources Division (USGS)
BSMP	Beaufort Sea Monitoring Program
BSEE	Bureau of Safety and Environmental Enforcement
BSIERP	Bering Sea Integrated Ecosystem Research Program
BWASP	Bowhead Whale Aerial Survey Project
CAB	Chemistry and Benthos
cANIMIDA	Continuation of Arctic Nearshore Impact Monitoring in Development Area
CCSM	Community Climate System Model
CESU	Cooperative Ecosystem Studies Unit
CIAP	Coastal Impact Assistance Program
CMI	Coastal Marine Institute
COMIDA	Chukchi Offshore Monitoring in Drilling Area
DFO	Canadian Department of Fisheries and Oceans
DPP	Development and Production Plan
EA	Environmental Assessment
ECS	Eastern Chukchi Sea
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EP	Exploration Plan
ESA	Endangered Species Act
ESP	Environmental Studies Program
EVOS	*Exxon Valdez* Oil Spill
FY	Fiscal Year

GIS	Geographic Information Systems
GPS	Global Positioning System
GSA	General Services Administration
HF	High Frequency
HHIA	Human Health Impact Assessment
IFO	Intermediate Fuel Oil
IPCC	International Panel on Climate Change
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
MRB	Modeling Review Board
NAB	North Aleutian Basin
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NEP	Net Ecosystem Production
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMML	National Marine Mammal Laboratory
NOAA	National Oceanic and Atmospheric Administration
NOPP	National Oceanographic Partnership Program
NPPSD	North Pacific Pelagic Seabird Database
NPRB	North Pacific Research Board
NSB	North Slope Borough
NSSI	North Slope Science Initiative
NSF	National Science Foundation
NSL	National Studies List
OCS	Outer Continental Shelf
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
RFP	Request for Proposals
ROV	Remotely Operated Vehicle
RUSALCA	Russian-American Long-term Census of the Arctic

SDI	Satellite Drilling Island
SEIS	Supplemental Environmental Impact Statement
SOAR	Synthesis of Arctic Research
TAR	Technology Assessment and Research
TK	Traditional Knowledge
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
UAS	Unmanned Aircraft System
uERD	ultra Extended Reach Drilling
URI	University of Rhode Island
USCG	U.S. Coast Guard
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UW	University of Washington
VLOS	Very Large Oil Spill
WHOI	Woods Hole Oceanographic Institution
WRF	Weather Research and Forecasting model

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SECTION 1.0 PROGRAMMATIC OVERVIEW

1.1 Introduction to the Region

1.1.1 Background

The Environmental Studies Program 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 (ESP) was administered originally by the Bureau of Land Management 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 information needed for assessment and management of potential impacts from oil and gas development on the Outer Continental Shelf (OCS) and coastal environments. 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 guidelines 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. The basic mission of BOEM is to manage the safe and environmental responsible development of energy and mineral resources on the OCS. 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, including 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 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 and/or review Environmental Impact Statements (EISs), Environmental Assessments (EAs), Exploration Permits (EPs), and Development and Production Plans (DPPs). Of course, a wide range of arctic scientists, stakeholders and decision-makers also make use of our study products.

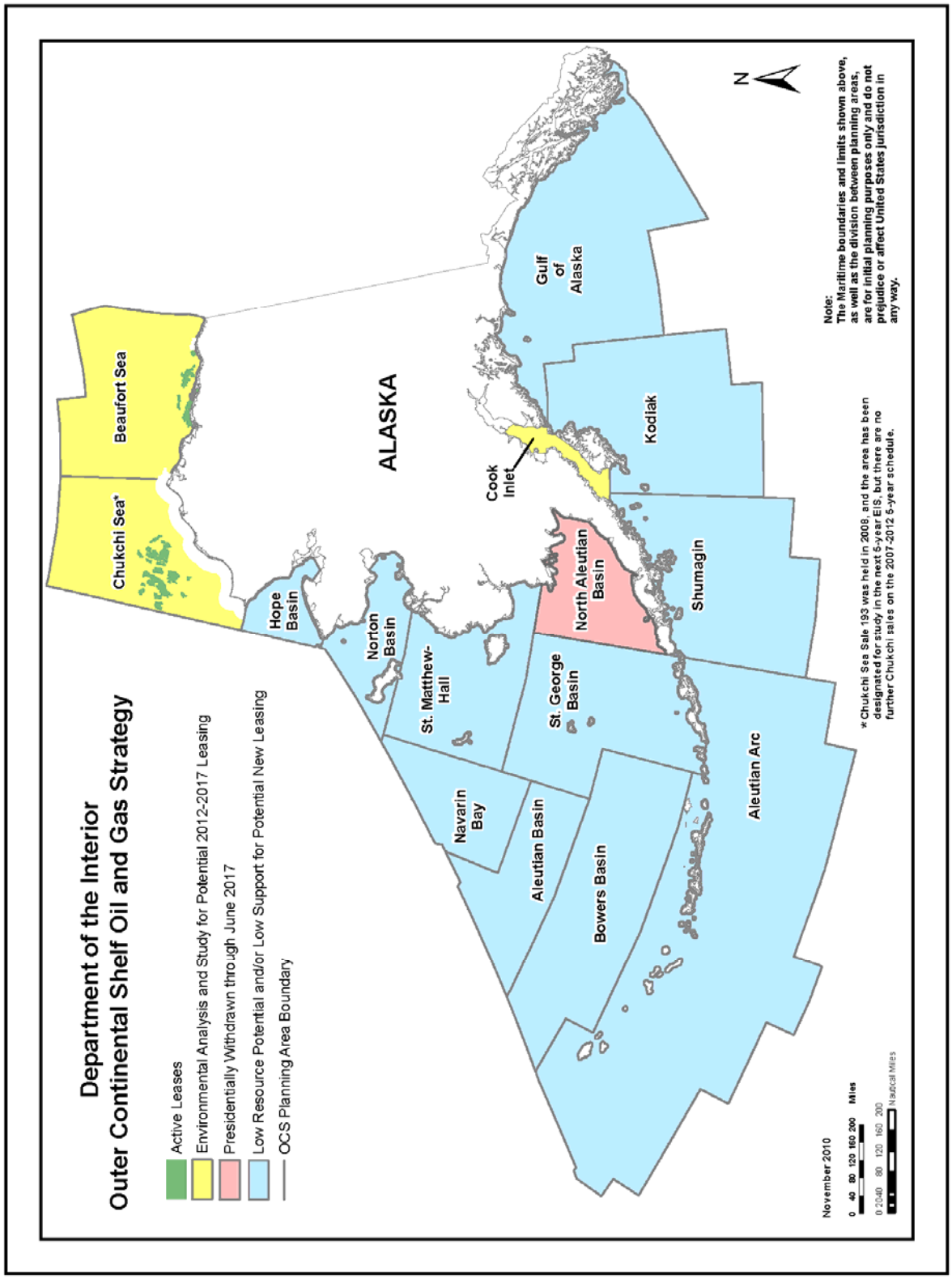
Since the ESP began, the USDOI and the MMS/BOEM have funded nationally more than $935 million for environmental studies through fiscal year (FY) 2011. More than $350 million of that amount has funded studies in Alaska across 15 planning areas in the Arctic,

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, fate and effects of pollutants, protected and endangered species, wildlife biology, and the social sciences. Completed study reports are posted on our website at http://alaska.boemre.gov/ref/AKPUBS.HTM.

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 to BOEM decision needs. Of course, additional research coordination with groups external to BOEM occurs continuously through a variety of institutional mechanisms, as discussed in the following section.

Figure 1 Alaska OCS Region Planning Areas



1.1.2 Scientific Studies are Conducted in Partnership

The Alaska ESP, 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 Alaska ESP is conducted on a collaborative basis with an extensive range of bilateral and multilateral partnerships. The Alaska ESP 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); Bureau of Land Management (BLM) and the North Slope Science Initiative (NSSI); National Aeronautics and Space Administration (NASA); National Science Foundation (NSF); Arctic Research Commission; and the Polar Research Board.

The ESP also 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), Oregon State University (OSU), University of Washington (UW), Idaho State University, and University of Rhode Island (URI). The ESP also coordinates closely with active industry research and monitoring programs in Alaska conducted by British Petroleum, 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. In its first 16 years of operation, the CMI match has come from more than 50 different organizations and has leveraged over $15 million of agency funds into $30 million worth of relevant marine-based research. During that time, the CMI program has also provided roughly 120 years of graduate student support and completed over 60 studies. In 2008, the cooperative agreement was extended until April 2013. Under the current 5-year agreement with the CMI, the Alaska OCS Region has committed $750,000 per year with a dollar-for-dollar match arrangement. More information can be found at http://www.sfos.uaf.edu/cmi.

The Alaska Region 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 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. The BOEM currently participates in six CESUs that encompass the state of Alaska, the Pacific Northwest, California, 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 Alaska ESP 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.

Studies also address recommendations from programmatic reviews. For example, the National Ocean Council established by Executive Order 13547 has adopted a list of nine National Priority Objectives as recommended by the Interagency Ocean Policy Task Force. Objectives that are particularly relevant to the ESP include: adopting a system of ecosystem-based management for the ocean and coasts; implementing comprehensive, integrated, ecosystem-based coastal and marine spatial planning and management; and addressing environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes. Also, the report *An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska* from USGS (2011) summarizes key existing scientific information, identifies information needs and provides initial guidance of what new or continued research could improve decision-making.

Another key source of input derives from discussion and advice generated through the OCS Scientific Advisory Committee, an external peer review body that meets on an annual basis. Other involvement of external scientists occurs through forums such as participation on project-management review boards, which greatly facilitates ESP collaboration and coordination. Significantly, the ESP also systematically seeks out and includes the knowledge of coastal community residents in planning (see Section 1.3).

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 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 2011 USGS Recommendations

In March 2010, U.S. Department of the Interior Secretary Salazar asked the U.S. Geological Survey (USGS) to conduct an independent evaluation of the science needs that would inform consideration of "the right places and the right ways" in which to develop oil and gas resources in Federal arctic waters, with particular focus on the Chukchi and Beaufort seas. The Secretary asked USGS to: summarize key existing scientific information; develop a rapid process to identify where knowledge gaps exist; and provide initial guidance of what new or continued research could improve decision-making.

The full report, released on June 23, 2011, under the title *An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska*, is posted online at http://pubs.usgs.gov/circ/1370/. More than 50 findings and an equal number of recommendations are contained in the 279 page report. The report identifies several major categories where additional scientific research, analysis, and synthesis could reduce uncertainties, which include:

- Developing a better understanding of the effects of climate change on physical, biological and social conditions as well as resource management strategies in the Arctic;
- Developing foundational geospatial data of the Arctic Outer Continental Shelf;
- Synthesizing existing scientific information on a wide range of topics on the Arctic;
- Building upon advances in spill-risk evaluation and response knowledge by developing better information on key inputs to spill models (such as oceanographic, weather, and ecological data);
- Improving dialogue and using collaborative, comprehensive science planning, both domestically and internationally.

The USGS report represents the most recent effort to summarize systematically and comprehensively the large volume of existing scientific information of relevance to offshore energy development planning in Alaska. The science of offshore energy development involves and concerns a wide array of research entities, scientists, stakeholder groups, and regulatory institutions. We understand the report properly addresses this entire network of arctic operations, but since that network does prominently include the USDOI Bureau of

Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE), we take particular interest in the findings.

Within BOEM, the Environmental Studies Program (ESP) funds and manages a broad array of research on potential impacts to the marine, coastal, and human environment, including studies pertaining to physical oceanography, biology and habitat, protected species, and social systems. We welcome the USGS report and seek to enhance its value by: 1) adding specificity to the ongoing dialogue over arctic studies coordination; and 2) pursuing immediate adjustments to our evolving research program. We briefly discuss each in turn.

Science always proceeds by identifying and filling knowledge gaps. The ESP systematically undertakes on an annual basis its own thorough review of science needs and proposals to inform ongoing decisions about resource management on the arctic OCS. Numerous external groups also conduct similar reviews on a frequent basis.[1] These review processes always feed our own efforts to prioritize science information needs as we plan and procure new studies through our public Annual Studies Plan, with formal scientific peer review provided by our external OCS Scientific Committee.

The USGS report consistently affirms the direction of research recently undertaken by the ESP, validating our annual cycle of studies planning and procurement for arctic research over the last five years. The ESP is currently undertaking a large number of ongoing studies that address the very same information needs as those identified by the USGS report. The table in the Appendix at the end of this document (pages 211-217) demonstrates the one-to-one correspondence between USGS report recommendations and the ESP inventory of current and recently completed research. These active studies, which total more than $70 million, explicitly include:

- long-term monitoring studies that can be used to address the ecological and social impacts of climate change effects on Alaska and the Arctic;
- GIS-based studies of subsistence hunting patterns;
- long-range migration patterns of marine mammals and birds;
- syntheses of recent data collection across multiple projects to elucidate ecosystem relationships between oceanographic conditions, lower trophic prey species (food webs) and marine mammal distribution and behavior;
- syntheses of individual species and taxa;
- syntheses of ocean circulation and meteorological modeling.

In addition to our list of active studies and completed reports, the ESP has made attempts to fill information needs on many complex topics identified by the USGS report that did not yield conclusive results. Some prominent examples include ESP attempts to: construct a local and traditional knowledge database; construct an arctic "co-variance of human activities" database

[1] Some of the more recent relevant reports include: Arctic Council Oil and Gas Effects Assessment; National Ocean Policy Strategic Action Plan for Changing Conditions in the Arctic; Interagency Arctic Research Policy Committee 5-Year Research Plan; North Slope Science Initiative Emerging Issues Papers; Arctic Ocean Synthesis (edited by UAF Institute of Marine Sciences); National Research Council report on Cumulative Effects; and recurring reports conducted under the auspices of the National Academy of Sciences.

(including cumulative impacts from industrial noise); provide economic valuation of ecosystem services; provide support for marine mammal tissue archives; develop wildlife hazing techniques in the event of an oil spill; and improve scalar resolution within oceanographic models. The ESP applies adaptive strategies as we attempt to move forward with new research projects on complex topics.

As part of an immediate response to the USGS report, the Environmental Studies Program has made adjustments to our own information collection process and priorities. In general terms, the ESP will continue to fund foundational research focused in the Beaufort and Chukchi seas, and will redouble its search for collaborative opportunities with other research efforts that may inform OCS decisions and activities. The ESP will intensify efforts to support and complement external initiatives as appropriate within its mission, time-lines, and budget.

More specifically, the ESP is pursuing the following adjustments in our Alaska Region FY2012-2013 program:

- create new opportunities to receive public input to our studies planning process (see details in the "Stakeholder letter" inside the front cover of this document);
- expand the Studies priority list with more regional funding;
- require more public outreach as a deliverable for every project;
- allocate more funds to support data synthesis efforts;
- update and improve oil spill risk analysis models;
- promote enhancement of spill detection technologies and "nowcast" instrumentation where feasible;
- improve baseline for monitoring shore zone habitat;
- expand research into biological effects of dispersants in cold water;
- generate a new baseline of social indicators in North Slope communities.

Just as we value the USGS report, we look forward to receiving stakeholder input for additional suggestions. Continued dialogue and extensive planning coordination with other agencies, stakeholders, and the public remain our steadfast goal as we move forward.

1.1.4 Issues To Be Addressed

The *Alaska Annual Studies Plan FY 2012* 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

To be responsive to ongoing leasing plans and changing offshore 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 Alaska ESP remains especially flexible in planning and implementing needed studies.

At each step of the offshore leasing 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 by mitigating measures?

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

- What refinements are there 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 development prospects?

- What long-term changes in heavy metal and hydrocarbon levels may occur near Beaufort Sea development prospects, such as Liberty, or regionally along the Beaufort Sea coast?

- 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 species that are potentially sensitive, 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 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 Alaska ESP?

1.2 Projected OCS Activities

The ESP funds studies that have strong applicability to pending pre- and post-lease decisions under the upcoming (and previous) 5-Year OCS Program(s). The most important considerations for establishing priorities within the national needs context include:

- Mission/OCS 5-Year Program relevance
- Timing in relation to decision/environmental assessment needs
- Study design/scientific methods/feasibility
- Availability of needed information from other sources

1.2.1 Pre-lease Considerations

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 Alaskan 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.

Preparation of an EIS is an essential part of the pre-lease process that requires environmental information. In particular, information is needed in time to prepare draft EISs for proposed lease sales. Although much information exists for certain Alaska OCS lease areas, data are sparse in other areas. In addition, changing conditions and environments often lead to the need to update past studies so that EIS information is current and accurate.

Three lease sales were held under the *Final Outer Continental Shelf Oil and Gas Leasing Program 2002-2007* (USDOI, MMS, 2002), all of them in the Beaufort Sea Planning Area (see Figure 2). Other lease sales in that *Program* were postponed or were cancelled due to lack of industry interest. The first lease sale under *Final Outer Continental Shelf Oil and Gas Leasing Program 2007-2012* (USDOI, MMS, 2007) was held in February 2008 in the Chukchi Sea Planning Area (see Figure 3). This *Final Program* also proposed lease sales in the Beaufort Sea, the Chukchi Sea, the North Aleutian Basin, and special interest sales in Cook Inlet. In March 2010, the President issued a memorandum withdrawing the North Aleutian Basin from consideration for leasing through June 2017. In addition, in December 2010, the Bureau released a *Revised Program Outer Continental Shelf Oil and Gas Leasing Program 2007-2012* (USDOI, BOEMRE, 2010) that cancelled the lease sales planned for the Beaufort and Chukchi seas. Cook Inlet Sales 211 and 219 were cancelled due to lack of industry interest.

The *Revised Program* cited the need for additional exploration and scientific, environmental and oil spill risk analysis before more area in the Arctic is considered for leasing. The Beaufort Sea and Chukchi Sea planning areas, as well as Cook Inlet (see Figure 4), are being evaluated for possible leasing under the upcoming *Outer Continental Shelf Oil and Gas Leasing Program 2012-2017*. Publication of the proposed *2012-2017 Program* will likely occur in late 2011.

Figure 2 Beaufort Sea Oil and Gas Leasing Activity

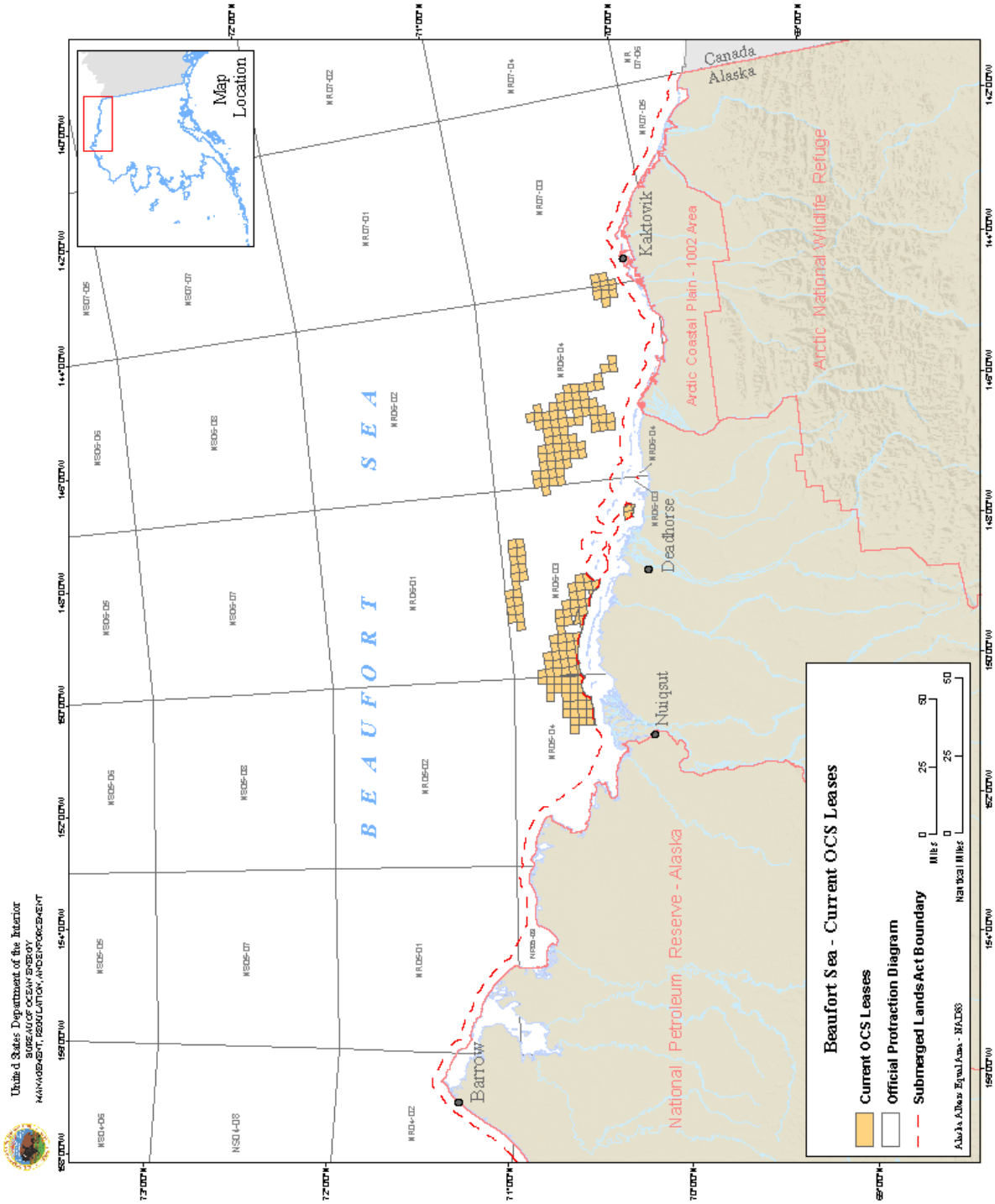


Figure 3 Chukchi Sea Oil and Gas Leasing Activity

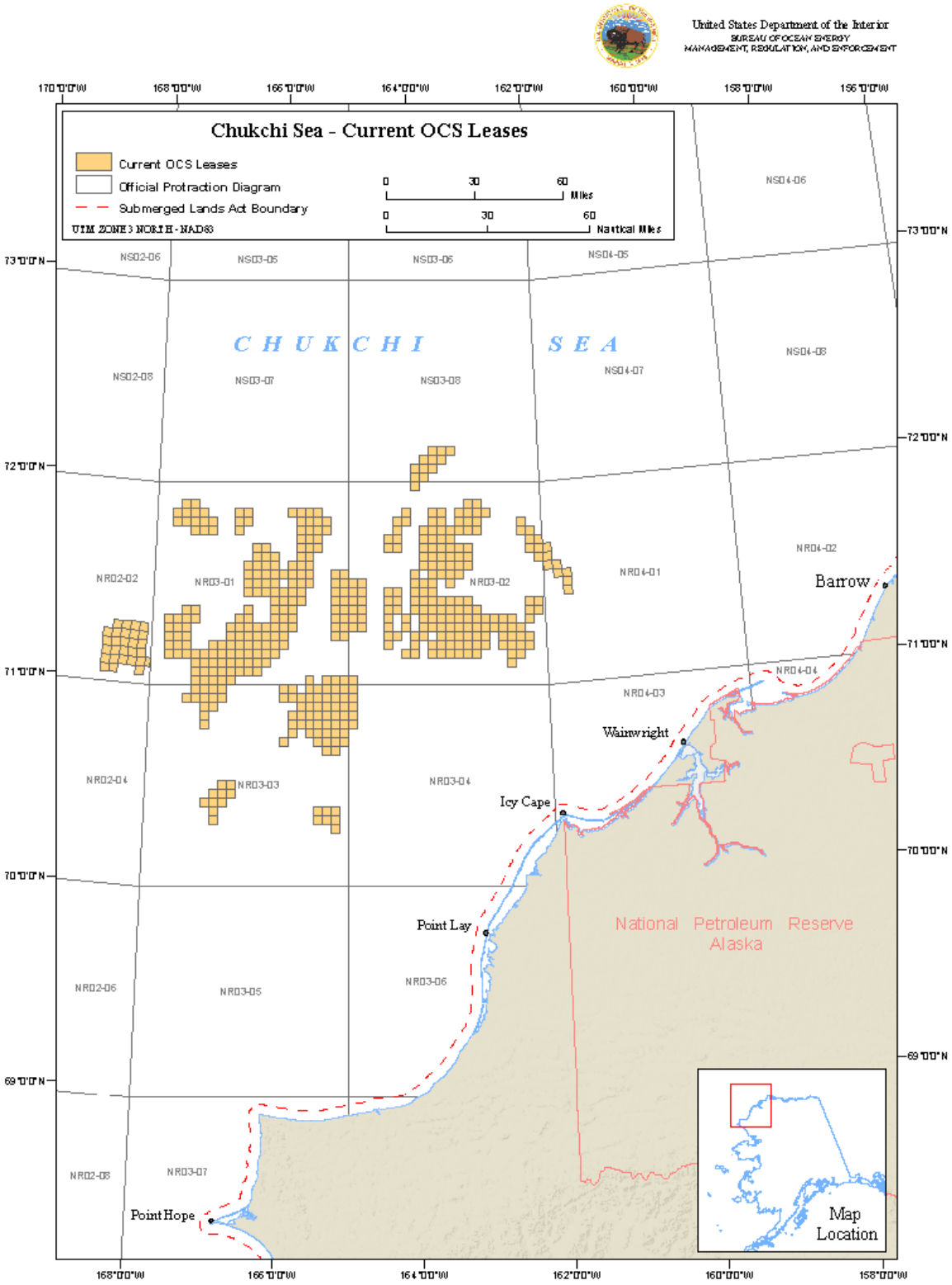
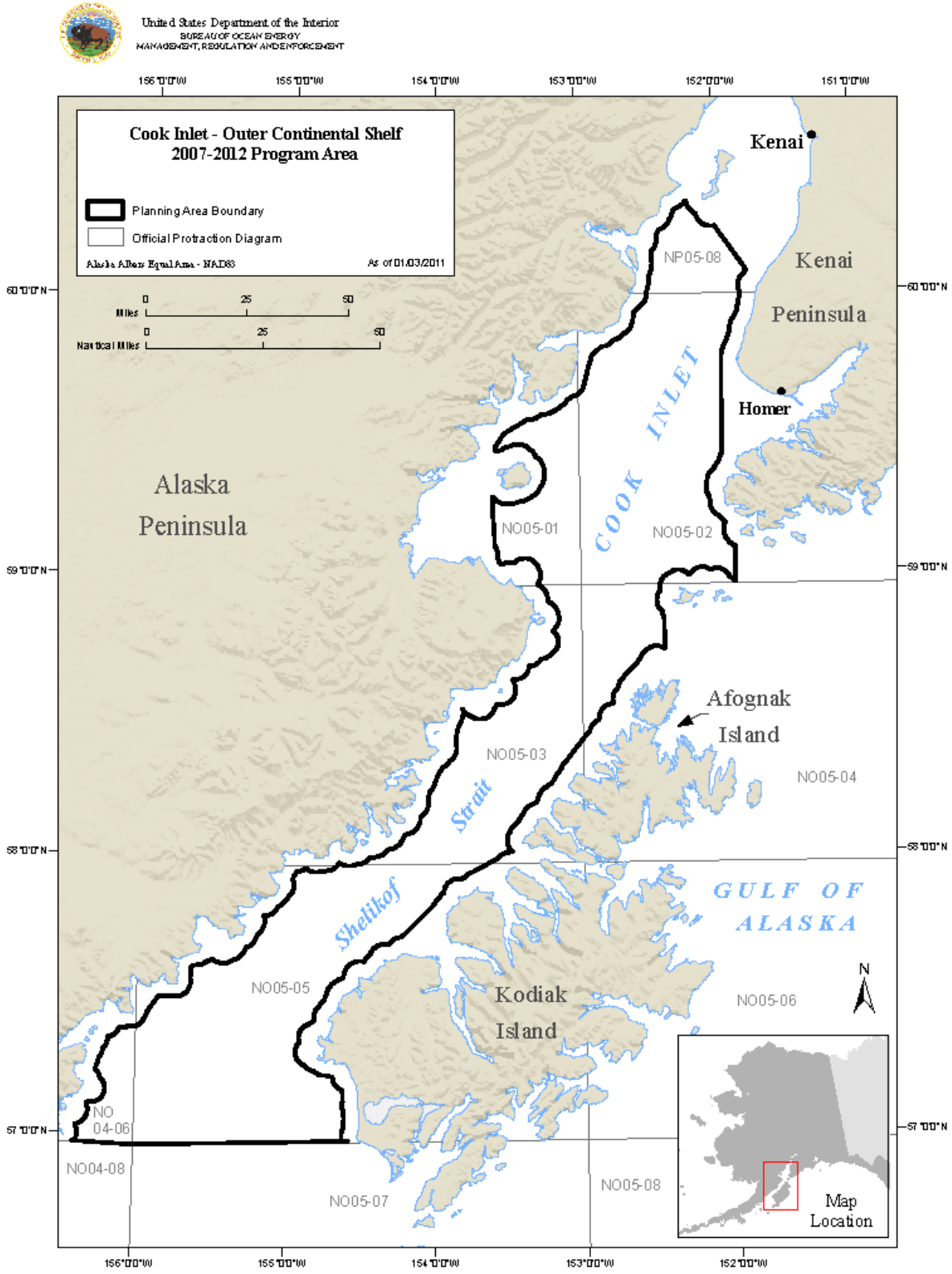


Figure 4 Cook Inlet Planning Area



1.2.2 Post-lease Considerations

Prior to FY 1982, most studies of the Alaskan offshore were planned, conducted, and concluded before a sale was held in order to provide information for decision making and EISs. However, not all needed information can be obtained prior to a 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 developments. The ESP acquires additional information for environmental analyses related to development and production in the post-lease phase. Thus, an increasing number of studies have become more closely related to development schedules and monitoring and evaluation in addition to those broader studies related to the pre-lease phase. As with the pre-lease phase, 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:

- Geophysical surveys
- Preparation of Exploration Plans (EPs)
- Exploration drilling
- Preparation of Development and Production Plans (DPPs)
- Development, construction and production activities
- Oil transportation, including pipelines and tankers
- Lease termination or expiration (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 31 exploratory wells and determined 11 to be producible. As of January, 2011, there are more than 180 active leases in the Beaufort federal offshore area. Lease Sale 193 in February 2008 resulted in 487 leases being issued in the Chukchi Sea Planning Area. 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.

Legal Challenges: Litigation remains a factor for Alaska OCS activities. Currently, there are two 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 Federal recognized tribe, and an Alaska Native organization challenged the Chukchi Sea Sale 193 regarding compliance with the National Environmental Policy Act. On July 21, 2010, the U.S. District Court of Alaska remanded to the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) the Chukchi Sea Sale 193 Final EIS to satisfy its obligations under NEPA in accordance with the Court's opinion. Specifically, BOEMRE was instructed to address three concerns, as follows: (1) analyze the environmental impact of natural gas development; (2) determine whether missing information identified by BOEMRE 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.

The BOEMRE released a Draft Supplemental EIS (SEIS) in October 2010. The Draft SEIS augmented the analysis in the Sale 193 Final EIS by analyzing the environmental impact of natural gas development and evaluating incomplete, missing, or unavailable information pursuant to 40 CFR 1502.22. The Draft SEIS was made available for a 45-day public comment period. Over 150,000 comments were submitted. Many commenters requested that BOEMRE perform an analysis that takes into account the possibility of a blowout during exploration activities in view of the *Deepwater Horizon* event. In March 2011, BOEMRE announced a Very Large Oil Spill analysis (VLOS) would be included in the SEIS process. On May 27, 2011, BOEMRE released the Revised Draft SEIS, which included an analysis of a hypothetical VLOS, for a 45-day public comment period. At the conclusion of the public comment period, BOEMRE received over 360,000 comment letters and cards from Federal Agencies, state and local governments, Alaska Native tribes, interested groups, and members of the public.

On August 19, 2011, BOEMRE released the Final SEIS for Sale 193. In the Final SEIS BOEMRE has responded to the public comments and considered information from the U.S. Geological Survey's report: *An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska* (USGS, 2011). The Final SEIS comment period closed September 26, 2011, and BOEMRE received about 50,000 comments. Information relevant to these comments will be presented to the Secretary of Interior for his Sale 193 decision.

The Final SEIS satisfies the concerns addressed by the District Court in its remand order, provides a comprehensive VLOS analysis, and together with the Sale 193 FEIS provides the Secretary with sufficient information to make the decision to reaffirm, modify, or cancel Lease Sale 193. The Record of Decision from the Secretary is due to the District Court by October 3, 2011.

The BOEMRE issued a Suspension of Operations on all Sale 193 Chukchi Sea leases on September 13, 2010, as no exploration activities can be conducted until resolution of this litigation.

Native Village of Point Hope, et al. v. Kenneth Salazar, Secretary of the Interior, and Bureau of Ocean Energy Management, Regulation and Enforcement (9th Cir. filed Sept. 29, 2011). In September 2011, the Native Village of Point Hope; Alaska Wilderness League; Center for Biological Diversity; Defenders of Wildlife; Greenpeace, Inc.; Natural Resources Defense Council; National Audubon Society; Northern Alaska Environmental Center; Oceana; Pacific Environment; Resisting Environmental Destruction on Indigenous Lands (REDOIL); Sierra Club; and The Wilderness Society filed a petition for review with the U.S. Court of Appeals for the Ninth Circuit. The petitioners requested the court to review BOEMRE's approval with conditions of Shell Offshore, Inc., Revised Camden Bay (Beaufort Sea) Exploration Plan. The petitioners allege that BOEMRE violated the Outer Continental Shelf Lands Act and the National Environmental Policy Act.

Development:
Liberty – The Liberty prospect is located in the central Beaufort Sea about 6 miles east of the existing Endicott Satellite Drilling Island (SDI). British Petroleum Exploration Alaska (BPXA) will use ultra Extended Reach Drilling (uERD) technologies to lengths of 5-8 miles, allowing the Liberty unit to be developed from an expansion of the existing Endicott Satellite Drilling Island. All drilling activity will be from surface locations on State lands using a land-based rig and surface blowout preventer. BPXA has delayed the initial wells pending better understanding of Federal and State requirements due to changes from the Deepwater Horizon incident. Both the USDOI Bureau of Safety and Environmental Enforcement (BSEE) and the State must approve applications for permit to drill and are reviewing requirements for blowout preventers and relief wells for projects. BPXA estimates that the reserves for the Liberty project are 105 million barrels of oil.

Production:
Northstar – Northstar (see Figure 5) is a joint Federal/State of Alaska unit located 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 BSEE regulatory authority, the State wells fall under the State's oversight. Production started in 2001 and peaked in 2004. Total production through August 2011 is more than 151 million barrels; with the Federal portion about 27 million barrels.

Figure 5 Northstar Island, August 2000

1.3 Identification of Information Needs

The Alaska OCS Region assesses its mission information needs continuously, and systematically develops new study profiles on an annual basis. The Alaska ESP distributes the *Alaska Annual Studies Plan* to more than 200 Federal, State, local, environmental, Native, industry, international and other stakeholders each September. We also distribute a letter to the same stakeholders requesting suggestions for new studies for the next cycle. We consider comments in response to that request and previous program reviews. In addition, we request suggestions for new studies from all components of the Alaska OCS Region staff and actively seek their input throughout the profile development process.

The ESP also relies heavily on information needs identified through solicitation of public comment and suggestions on how to enhance our information base at scientific and information meetings. For example, BOEM, along with numerous organizations and agencies, sponsors the Alaska Marine Science Symposium held in Anchorage, Alaska, each year. The Alaska OCS Region also has conducted eleven Information Transfer Meetings (ITMs). In addition, Alaska OCS Region has sponsored a number of workshops and conferences over the years with topics that include: using high frequency radar to map surface currents; various aspects of physical oceanography; arctic cisco in the Beaufort Sea; and social and economic impacts associated with oil and gas development. The meetings, which were attended by experts in the respective fields and other interested stakeholders, identified information needs and recommended studies to support the BOEM mission.

In preparation for possible oil and gas exploration in the Chukchi Sea (see Figure 3), the Alaska OCS Region conducted a three day *Chukchi Offshore Monitoring in Drilling Area* (COMIDA) planning workshop November 1-3, 2006, in Anchorage. The purpose of the workshop was to identify potential monitoring tasks for a COMIDA field effort to meet information needs. Invitations were sent to over 150 scientists and stakeholders, including local and regional governments, tribes, native associations, oil industry and environmental groups. Over 100 scientists and stakeholders attended. Thirteen monitoring study profiles were developed by four working groups, discussed by the workshop participants, and submitted to the agency for prioritization and inclusion in the COMIDA field effort. The workshop report was published in April 2007 (USDOI, MMS, Alaska OCS Region, 2007) and has become a useful planning tool that continues to influence our study priorities. Many of these same priorities have been reiterated by the 2011 USGS report.

1.3.1 Beaufort Sea General Information Needs

Monitoring of Interdependent Physical, Biological and Social Processes: 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. Interagency reviews of related EISs, EPs and DPPs are expected to lead to additional recommendations for monitoring impacts of Northstar and other possible developments. Key constituents have identified the need to monitor under-ice currents, sedimentation and

potential effects on social systems/subsistence in the vicinity of Northstar and Liberty. Related questions that need to be addressed are the characteristics of major oceanographic and meteorological processes and how they influence the human, marine and coastal environment.

The "Arctic Nearshore Impact Monitoring in Development Area" (ANIMIDA), a program started in 1999, was developed to address these issues. This suite of studies provided baseline data and monitoring results for chemical contamination, turbidity, and subsistence whaling in the vicinity of Northstar and Liberty development sites (see Figure 6). The recently concluded continuation of ANIMIDA (cANIMIDA) has gathered long term monitoring data to provide a basis of continuity and consistency in evaluation of potential effects from site-specific, recently initiated development and upcoming production in the Beaufort Sea OCS. The final study reports from cANIMIDA are available on our website of completed study reports and at the cANIMIDA website: http://www.duxbury.battelle.org/canimida/home/index.cfm.

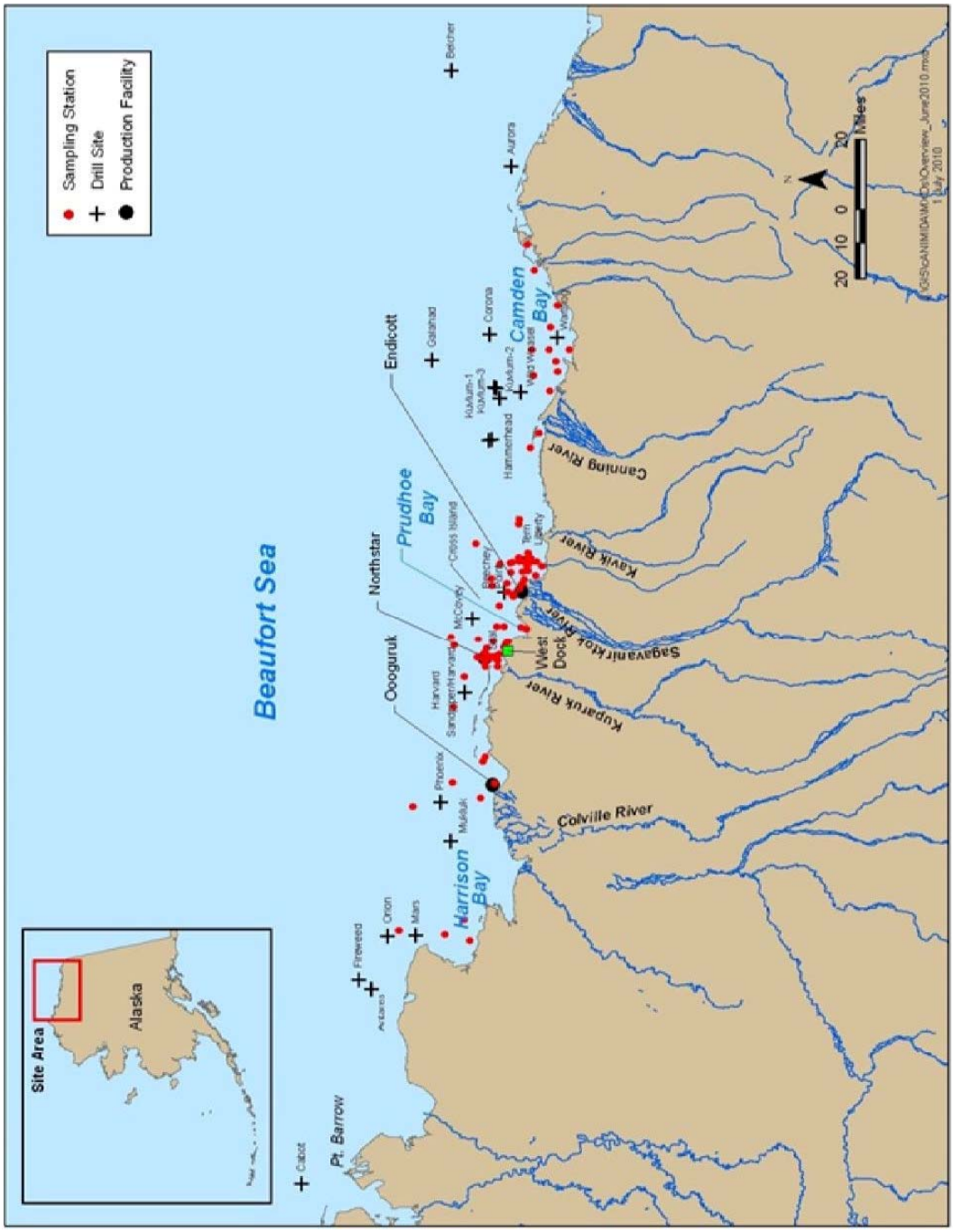
Much of this work is planned to extend beyond the cANIMIDA project. The final field season for the five-year "Continuation of Impact Assessment for Cross Island Whaling Activities" will occur this fall. The study "ANIMIDA III: Boulder Patch and other Kelp Communities in the Development Area" is proposed for FY 2012. Also, a companion study, "ANIMIDA III: Contaminants, Sources, and Bioaccumulation" proposed for FY 2013, comprises a continuation of monitoring of sediment chemistry, turbidity and suspended sediment dispersion, and bioaccumulation of contaminants. This proposed study has been expanded in area to include Camden Bay, where drilling to delineate existing oil discoveries is planned.

A number of currently ongoing studies 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 1.3.4.

Pollutants: North Slope villagers 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. The new study "The Hanna Shoal Ecosystem Study" in the area between Barrow and the Chukchi Sea drilling area and the proposed study "ANIMIDA III" in the Beaufort industrial development area will continue contaminant monitoring in biota and sediments.

Concern has also been raised over increasing spillage from corroded pipelines on the North Slope. The new 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 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 2013, will conduct laboratory and mesoscale oil weathering tests on a number of Alaskan crude or condensate oils, as well as refined oils.

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



Information on Bowhead Whales and Other Wildlife: Iñupiat whale hunters 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 their migration route. A concern is that deflection around oil and gas-industry activity (including drilling activity and associated icebreaker support) makes whales skittish and more difficult to hunt. Bowhead whales also feed along the fall migration route and information about bowhead feeding and habitat use is needed. 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. It is important to assess the factors that may be affecting the habitat use, health, population status and migration routes of bowhead whales. Figure 7 depicts a synthesis of tracks from 32 satellite-tagged bowhead whales during fall 2006–2009.

The populations of bowhead whales, polar bears, beluga whales, spectacled eiders and other endangered species are an ongoing concern of environmental groups, Federal agencies and others. North Slope villages are also concerned about potential disturbance of ringed seals, waterfowl and other subsistence-wildlife species by oil industry 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 themselves providing a food resource for larger fishes, birds, marine mammals, and people. 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. 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.

Native Culture: The Iñupiat report in public testimony that their culture is vulnerable to short-term, long-term and cumulative effects from OCS activities. There are concerns 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 lifestyle 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 8 provides an example of a synthesis map depicting bowhead whale subsistence hunting areas near Barrow over time. The Iñupiat are concerned about mitigation, including compensation for potential losses. An anticipated decline in oil revenues to the NSB is an issue of concern also. Another concern is the use of local and

Figure 7 Tracks of 32 satellite-tagged bowhead whales during fall 2006–2009. (Quakenbush et al. 2010)

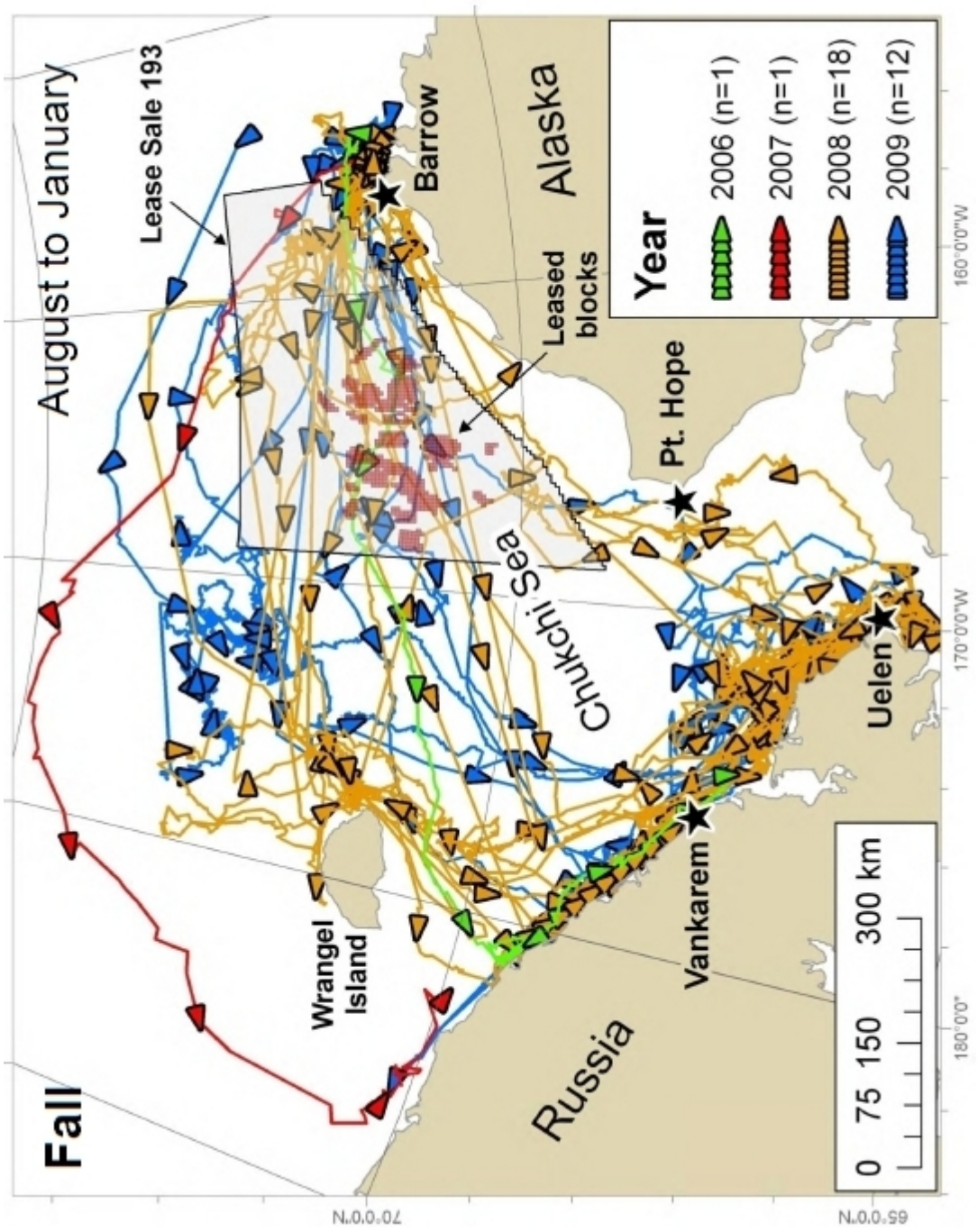
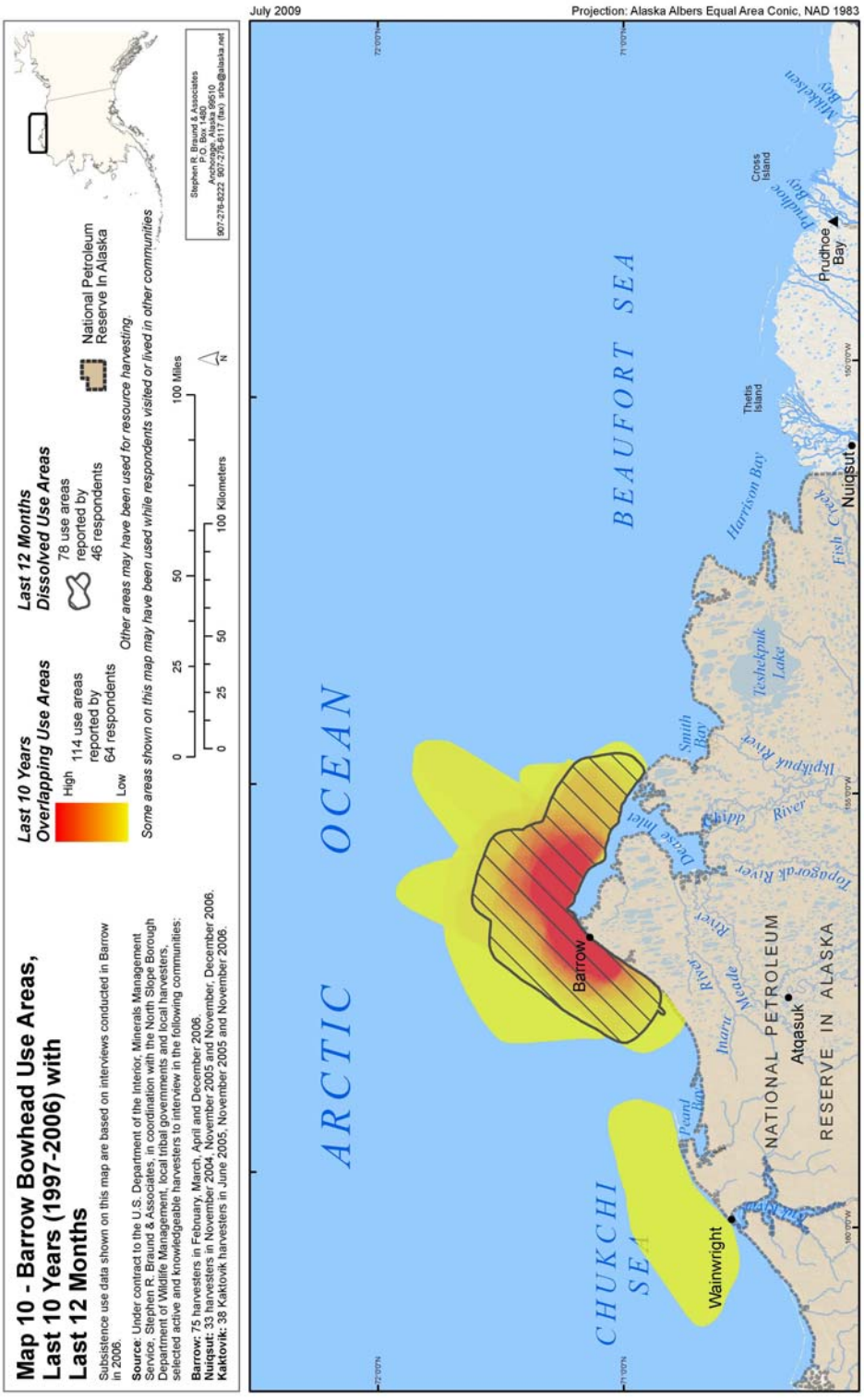


Figure 8 A synthesis map depicting bowhead whale subsistence hunting use areas for the community of Barrow over time. (Stephen R. Braund & Associates, 2009)



traditional knowledge in analysis of potential environmental effects. We continue to seek and include firsthand knowledge of local subsistence hunters to augment the scientific knowledge base.

1.3.2 Chukchi Sea General Information Needs

Native cultural activities that rely on subsistence, particularly on marine resources, predominate in these regions. The fundamental issues in the Chukchi Sea are very similar to 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. Knowledge of the spatial and temporal variability of leads, polynyas and landfast ice is dated, although new projects are underway. This information is important for determining the fate of spilled oil in this region and the impacts on biota associated with these systems. The status of many animal populations may also have changed since the earlier studies were conducted. Climate change may have triggered many spatial and temporal changes in the distribution of a variety of species.

Since 2007, the Alaska OCS Region has developed a new suite of studies in the Chukchi Sea, leveraging more than $50 million (through FY 2011) 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 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 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 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 new 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.

The topic “Renewable Energy Capacity Inventory in Coastal Alaska” has been advertised as a Broad-Agency Agreement RFP (request for proposals) under the auspices of the National Oceanographic Partnership Program and the President’s Interagency Committee on Ocean Science and Resource Management Integration. The RFP was eventually terminated as premature for the State of Alaska. In that context, we encourage input from regional stakeholders to help us assess the extent of industrial interest to lease and develop renewable resources on the Alaska OCS. The Alaska ESP is staying informed about renewable energy activity by attending meetings with NOAA and the State of Alaska.

1.3.4 Current Keystone Studies

Physical Oceanography:

Mesoscale Meteorology: Accurate specification of the surface wind and stress field is essential to predict ocean and ice circulation, and to improve oil spill models. In partnership with UAF, this study conducts a long-term hindcast simulation with an optimized data-modeling system to produce a high resolution meteorological dataset and to document climatological features of the Beaufort/Chukchi Seas. This study included development of a database that synthesizes meteorological observations from nearly 200 locations across northern Alaska, covering the period 1979-2009 and encompassing several different observational networks (see Figure 9).

Surface Current Circulation Mapping: In collaboration with UAF, ocean current circulation fields are being mapped and analyzed along the northeastern coast of the Alaskan Chukchi Sea through the deployment of coastal High Frequency radar systems and offshore bottom mounted Acoustic Doppler Current Profilers. Such direct circulation measurements improve understanding of the ocean currents that drive oceanographic processes and influence the transport and fate of spilled oil.

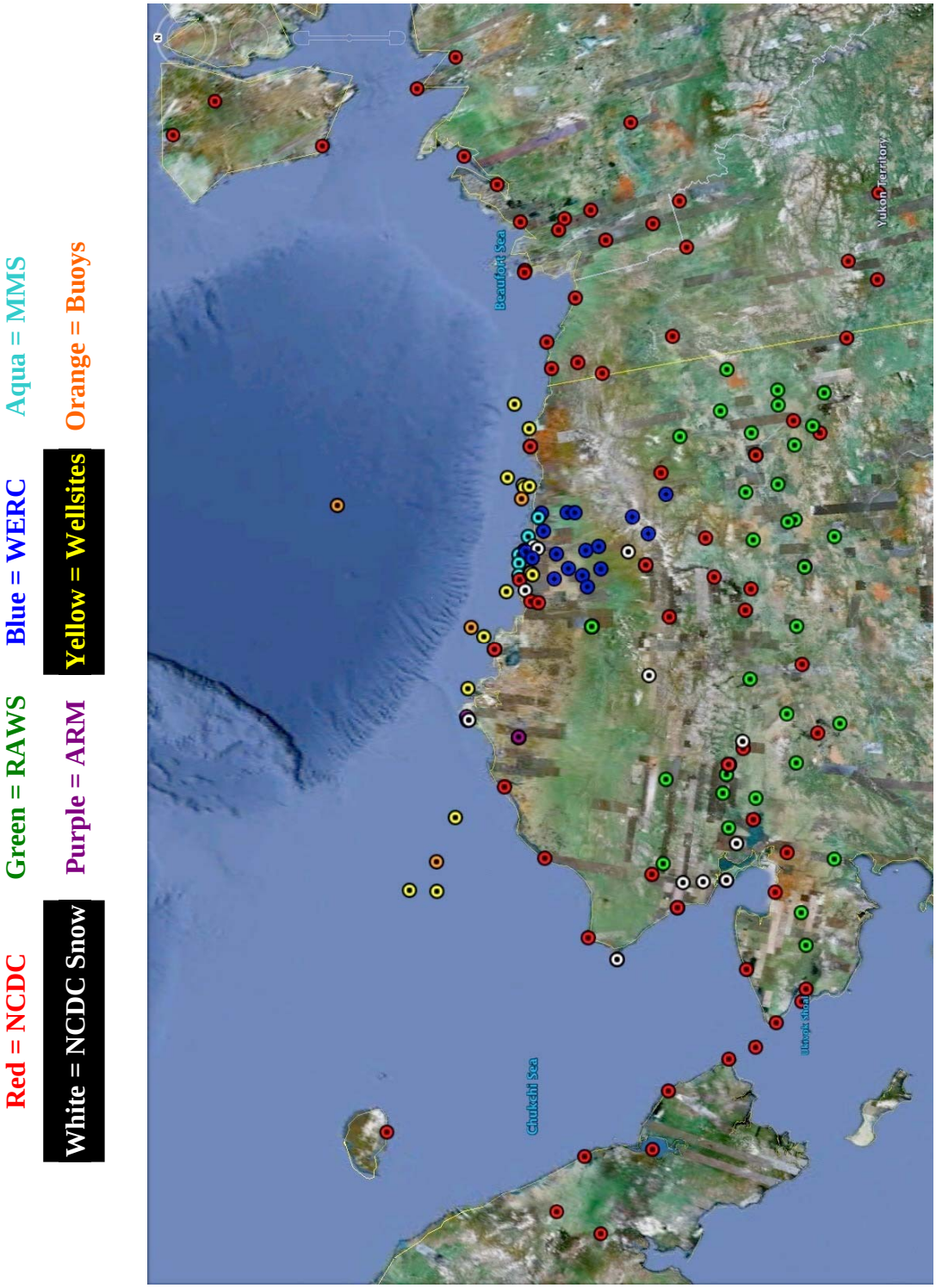
Polynyas and Landfast Ice: In collaboration with CMI, this study extends previous research along the Beaufort/Chukchi coast to quantify through high resolution satellite imagery the spatial and temporal extent of the leads, polynyas and landfast ice, including any recent changes in their extent south of Icy Cape. The analysis also provides mean, minimum, and maximum measurements and examines the effects of climate state on ice characteristics.

Ecosystem Observations in the Chukchi Sea: The oceanographic component of a new passive acoustic monitoring study utilizes biophysical moorings, hydrographic measurements, and numerical climate models to monitor the changing ecosystem of the Chukchi Sea. The moorings measure ocean temperature, salinity, nutrients, chlorophyll (a measure of phytoplankton abundance), oxygen, photosynthetic radiation, ice thickness, ocean circulation, and zooplankton abundance (volume). The study partners BOEM with NOAA-Pacific Marine Environmental Lab and the Alaska Fisheries Science Center, National Marine Mammal Laboratory.

Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemistry and Benthos (CAB): This study establishes a baseline for benthic biomass, species composition, and oil industry anthropogenic chemicals to detect changes as a result of future oil and gas activities. It initiates past and future time-trend analyses for benthic populations and anthropogenic chemicals and seeks to distinguish among changes due to development, climate, and food web structure.

Hanna Shoal Ecosystem Study: This study will continue the ecological monitoring of COMIDA CAB and extend 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.

Figure 9 Locations of meteorological data synthesized as a part of the Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study Phase II. (http://mms-meso.gi.alaska.edu/)



Synthesis of Arctic Research: Between the years 2005 and 2015 MMS/BOEM will invest approximately $50,000,000 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.

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 Suvey Project (BWASP) 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.

The 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.

Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic: A collaboration with NMFS, 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 will fund the fabrication and deployment of arrays of long-term acoustic recorders that are capable of continuous year-round recording.

Bowhead Whale Feeding Variability: In collaboration with NMFS, WHOI, ADF&G, and the AEWC, BOEM combines targeted oceanographic sampling with biological sampling and satellite tracking of individual whales (involving Alaska Native whalers and traditional knowledge) 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 (also known as BOWFEST) was extended for two additional field seasons in FY 2010. When recommending added field seasons for this study, NMFS cited the importance of continued data collection for the purpose of informing management decisions. The North Slope Borough has also urged BOEM to continue ongoing, long-term studies such as this.

The study "Use of the Chukchi Sea by Endangered Baleen and Other Whales" proposed for FY 2012 will extend this research into the Chukchi Sea and expand the scope to include other cetacean species.

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.

Pinniped Movements and Foraging: Bearded Seals: Large numbers of pinnipeds migrate through and potentially occupy prospective oil and gas areas 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. In collaboration with NMFS, this study develops a phased cooperative project with Native subsistence hunters to track the movements and habitat use of bearded seal in the western Chukchi Sea.

Pinniped Movements and Foraging: Walrus: In collaboration with the Alaska Department of Fish and Game, this study develops a phased cooperative project with Native subsistence hunters to track the movements and habitat use of walruses in the Chukchi Sea. The project trains Native hunters to deploy satellite transmitters on walruses in the vicinity of coastal villages and to conduct shore-based monitoring of tagged-walrus behaviors and general haul-out use patterns.

Monitoring Marine Birds of Concern in the Eastern Chukchi Nearshore Area (Loons): This collaboration with USGS-Biological Resources Division (BRD) provides updated information on marine bird distribution, species composition, molting, staging and timing of use in the vicinity of Peard Bay, Ledyard Bay, and Kasegaluk Lagoon of the eastern Chukchi nearshore environment.

Migration and Habitat Use by Threatened Spectacled Eiders: This study in collaboration with USGS estimates the spatial distribution, demographic composition, timing of use, and residence times of male and female spectacled eiders in the Chukchi and Beaufort Seas.

Habitat and Ecology:
Beaufort Sea Marine Fish Monitoring: In collaboration with UAF, this study designs a long-term fish monitoring plan for the central Beaufort Sea and implements a survey to establish baseline knowledge of fish species, distribution and relative abundance in the region.

Current and Historic Distribution and Ecology of Demersal Fishes: In partnership with CMI, this study provides information on fish presence, abundance, distribution, geographic range, species assemblages, and habitat diversity that is needed to evaluate and mitigate the effects of offshore development. The project assembles data into a searchable database and analyzes water mass characteristics that define demersal fish habitat.

Arctic Fish Ecology Catalogue: Arctic fish ecological and behavioral information is only available piecemeal from a wide range of peer-reviewed and gray literature. This study, in collaboration with USGS, synthesizes ecological and behavioral information for freshwater, diadromous, and marine fish species occurring in the Beaufort and Chukchi Seas.

Biogeochemical Assessment of the OCS Arctic Waters: In collaboration with the Coastal Marine Institute at UAF, this cooperative study measures ecosystem productivity in the northern Bering Sea and in the Chukchi Sea and evaluates its vulnerability to climate change.

The study involves three years of oceanographic sampling focused on measurements of dissolved organic and inorganic nutrients and carbon, total alkalinity, particulate organic matter, and pCO_2.

Subsistence Use of Salmon Populations: In partnership with CMI, this study will document local observations of increasing numbers of salmon in subsistence fisheries and conduct ethnographic fieldwork among Iñupiat communities about changing salmon populations/ species composition. This data updates information on subsistence harvest and traditional knowledge about salmon and maps the spatial and temporal distribution of salmon species in streams.

Recovery in a High Arctic Kelp Community: In partnership with CMI, this study monitors rates of vegetative re-growth in the Boulder Patch kelp community to provide a better understanding of how sessile communities recover from disturbances.

Social Systems:
Study of Sharing Networks to Assess the Vulnerabilities of Local Communities to Oil and Gas Development Impacts in Arctic Alaska: In collaboration with UAF, this study investigates contemporary subsistence food distribution and consumption patterns for residents living near offshore oil and gas operations. It identifies key nodes and thresholds in community food distribution networks to assess their relative vulnerabilities and resiliency to change. Study areas include Wainwright, Kaktovik and Venetie.

Continuation of Impact Assessment for Cross Island Whaling Activities: This synthesis study extends the long-term ethnographic monitoring effort for subsistence whaling activities that occur from the base camp at Cross Island. This data aids understanding of Cross Island subsistence whaling variation over time and supports evaluation of the relationship of offshore oil and gas industrial activities to whaling variability.

Aggregate Effects Research and Environmental Mitigation Monitoring of Oil Operations in the Vicinity of Nuiqsut: This synthesis study investigates and documents the history of negotiated mitigation measures for select oil related exploration and development activities near Nuiqsut. It identifies and analyzes both the formal and informal mitigation mechanisms that have emerged over time.

Impact Monitoring for Offshore Subsistence Hunting: There is acute need for more information about offshore subsistence activities along the Chukchi coast, especially in the vicinity of Wainwright and Point Lay, where future offshore development might make landfall. This study gathers long-term monitoring data to allow BOEM to assess whether OCS activities in the Chukchi Sea will result in changes to offshore subsistence hunting practices.

OCS Economic Impact Model for Alaska: This project updates and refines agency procedures for estimating the onshore economic effects of OCS activities, such as forecasts of employment and personal income, by improving data inputs and model structure for frontier planning areas.

SECTION 2.0 STUDY PROFILES

2.1 Profiles of Ongoing Studies

Information about ongoing studies can be found at:
http://alaska.boemre.gov/ess/index.htm

This website is updated three times each year and includes:
1. An updated status of each study.
2. Report due dates.
3. Related publications.
4. Affiliated websites.

For completed Alaska OCS Region Studies, go to:
http://alaska.boemre.gov/ref/AKPUBS.HTM

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study Phase II (AK-06-05)

BOEM Information Need(s) to be Addressed: The final modeled data will improve the predictive capabilities of the BOEM oil-spill trajectory model and the Foundation for Scientific and Industrial Resources of the Norwegian Institute of Technology (SINTEF [Norwegian acronym]) weathering model for the Beaufort Sea. Information will be used in NEPA analysis and documentation for Beaufort Sea Lease Sales, Exploration Plans (EPs), and Development and Production Plan (DPPs). This study addresses aspects of USGS recommendations 3.01, 4.01, and 7.04.

Total Cost: $1,750,000 **Period of Performance:** FY 2006-2012

Conducting Organization: UAF Geophysical Institute

Principal Investigator: Dr. Xiangdong Zhang, Dr. Jing Zhang, Jeremy Krieger, Dr. Martha Shulski

BOEM Contact: Warren Horowitz

Description:
Background: An initial phase of the Beaufort Sea mesoscale meteorology was conducted during 2006–2008 by the University of Alaska Fairbanks. The Phase I study conducted a literature review with the aim of summarizing past and present research efforts concerning the mesoscale meteorological models that would best support BOEM objectives for the study of the Beaufort Sea mesoscale meteorology. Based on the review, the Weather Research and Forecasting (WRF) model was selected as the preferred model to be used in this study. Initial sensitivity tests with WRF were conducted in the Phase I study, which included an analysis of sensitivity to forcing data and to the modeling configuration, including the horizontal resolution, model physics, and the nudging technique. The model's performance in simulating the wind field was analyzed, with emphasis placed on evaluating the capabilities of WRF to accurately simulate the sea breeze and topographic effects. A Phase II study plan has been developed with the aim of achieving accurate simulation of the Beaufort and Chukchi seas surface wind and associated mesoscale meteorology. The final products from the Phase II study will be a 30-year (1979-2009) observational database; a 5 and 30-year hindcast simulation of the Beaufort/Chukchi seas; as well as a final report documenting the observational database quality control methods, final model sensitivity analysis, and climatological analysis of both the collected observations and long-term model simulation.

Objectives:

- Produce a geospatial surface meteorological database for the Beaufort and Chukchi seas and the adjacent coastal areas by collecting available conventional and unconventional surface and atmospheric data and conducting field work;
- Establish a well-tuned Beaufort/Chukchi seas mesoscale meteorology model through further modeling studies for the optimization and improvement of the model physics and configuration;
- Conduct a long-term hindcast simulation with the optimized data-modeling system and produce a high resolution meteorological dataset for the Beaufort and Chukchi regions;
- Document the high-resolution climatological features of the Beaufort/Chukchi seas surface winds, including an analysis of the interannual variability and long-term change, as well as the physical processes and mechanisms for shaping the Beaufort/Chukchi seas wind field climatology.

Methods: The contractor shall research the availability of observational data from all sources, including both conventional in situ and satellite, which are present across the project study area for the period 1979–2009. The contractor will collect and store the QuikSCAT SeaWinds and COSMIC soundings for the Beaufort and Chukchi regions. The contractor shall deploy meteorological buoy(s) out to 80 km off the coastline, to be monitored for a period of two (2) to three (3) months during the open water season in the first year (2009) of the project. The contractor shall import the existing MMS/BOEM database, plus all newly collected and quality-controlled data, including the observations collected in the field work, into an Oracle version 10g database, named as the Beaufort/Chukchi Seas Mesoscale Meteorology Surface Observational Database. The contractor shall conduct a climatological analysis of the collected in situ data over the entire thirty-year period (1979-2009). The contractor shall continue the sensitivity analysis for the evaluation of WRF model simulations based on the initial results achieved in the Phase I study. The contractor shall implement a thermodynamic sea ice model into WRF. The contractor shall produce a five-year experimental wind field simulation (2005-2009) and a thirty year hindcast simulation. The contractor shall use the new high spatial- (10 km) and temporal- (hourly) resolution surface wind data from the 30-year production simulation to examine its climatological features, interannual variability, and long-term change. The contractor shall analyze the output of the 30-year production simulation and perform a climatological analysis of the model output. The contractor shall investigate the physical processes and mechanisms along with the diagnostic and statistical analyses of various aspects of the wind field climatology, variability, and long-term change.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Support of the Collection of Meteorological Data on the North Slope and Beaufort Sea, Alaska (AK-06-x13)

BOEM Information Need(s) to be Addressed: The data and analysis from the collection of these meteorological data is invaluable to ongoing BOEM scientific studies. These data are presently being used to validate the output from the Beaufort Sea Mesoscale Meteorological Model, currently under development by the University of Alaska-Fairbanks. Other uses of the data would be testing of oceanographic and oil-spill trajectory models in the Beaufort Sea region and assisting with the validation of surface current measurements collected by high frequency radar and subsurface currents collected by Acoustic Doppler Current Profilers (ADCP).

Total Cost: $40,000 **Period of Performance:** FY 2007-2011

Conducting Organization: UAF

Principal Investigator: Dr. Horacio Toniolo, Michael Lilly

BOEM Contact: Warren Horowitz

Description:
Background: The US Department of the Interior, MMS operated five meteorological stations along the Beaufort Sea Coast, Alaska. Data collection at four of the meteorological stations began on January 1, 2001. A fifth station at Cottle Island was added to the study area on August 21, 2002. These stations operated until September 30, 2006. These five meteorological stations collected data on wind speed, wind direction, barometric pressure, relative humidity, solar radiation, and air temperature. The MMS produced two final reports from the analysis of these and other coastal meteorological station data from Barrow, Alaska to the Mackenzie delta. The analysis can be found within OCS MMS final reports 2005-069 and 2007-011.

At the end of the contract period in 2007, instead of demobilizing the stations and warehousing them, MMS transferred the stations to the University of Alaska-Fairbanks so they would be incorporated into a larger network of stations previously established by the University of Alaska (http://www.uaf.edu/water/). The University of Alaska is planning to integrate these stations into a larger network of stations that will support multiple organizations. The lead organizations for operating and maintaining the network will be the University of Alaska-Fairbanks, Water and Environmental Research Center (WERC). The location of these stations will also help serve as a linkage between terrestrial and ocean observing network in the Arctic. The Network approach is also consistent with the major recommendations of key variables needing long-term monitoring for an Arctic Observing Network (National Research Council, 2006).

Objectives: The collection of meteorological data along the North Slope and nearshore Beaufort Sea in support of other BOEM study efforts and field surveys.

The data collection network will be upgraded to help meet current project needs and those of the project partners. The upgrades will enhance data collection and objectives of the network, such as adding precipitation gauges and measurements at the stations. The identified priority stations are Milne Point, Badami, and Cottle Island. The objectives of the modified data network will include:

- Provide data to help characterize the west-east distribution of winter and summer precipitation. Applications include area-wide precipitation analysis for North Slope lake water use research and management.
- Provide wind data for research efforts on coastal atmospheric models, including coastal erosion applications and oil-spill evaluation and response modeling efforts.
- Provide data on the Internet in hourly updates to benefit field operations, traveler weather information, and emergency response.
- Provide data for National Weather Service forecasting use to help improve daily forecasts in network region.

Methods: This study will: 1) update meteorological and communication equipment at three meteorological stations along the Beaufort Sea coast; 2) provide real time meteorological data to BOEM via a server at the University of Alaska-Fairbanks; 3) provide annual data quality reports and an annual quality controlled database to BOEM.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. The data from this task would be used in validation and skill analysis of the current circulation and oil-spill-risk models being used for potential future Chukchi and Beaufort Sea lease sales. The data would also be used for post-lease, site-specific modeling of circulation in oil-spill contingency planning and National Pollutant Discharge Elimination System (NPDES) permitting. In addition, this study will provide information necessary for ground-truthing and tuning of the numerical models, particularly the climate models and oil trajectory models. This study addresses aspects of USGS Recommendations 3.01, 3.02, 3.05, 3.07, 4.01, 5.24, 6.08 and 6.09.

Total Cost: $2,069,000 plus Joint Funding **Period of Performance:** FY 2010-2015

Conducting Organization: NOAA-Pacific Marine Environmental Laboratory

Principal Investigator: Dr. Phyllis Stabeno, Dr. James Overland, Dr. Sue Moore, Dr. Jeffrey Napp

BOEM Contact: Dr. Heather Crowley

Description:

Background: During the last three decades there has been a northward shift of some fish species in the eastern Bering Sea. It is hypothesized that these changes are a result of global climate change and the loss of sea ice. 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. 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, as expected from the CO_2 anthropogenic contribution alone. 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. Previous sea ice and climate analyses and projections for the Chukchi Sea are out of date.

One of the methods to be applied to the Chukchi Sea includes measuring the changing ecosystem in the eastern Bering Sea through long term biophysical moorings coupled with shipboard observations. These will provide critical 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. The coupling of the passive listening device for whales with active acoustics for zooplankton size distribution and biovolume from the moorings has provided some interesting relationships between primary production, zooplankton biovolume and the presence/absence of fin whales. 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.

Euphausiids are important prey items for bowhead whales in the Chukchi Sea. Availability and prey concentrations are important factors in the habitat utilization of whales in the study area. Euphausiids are thought to be transported from the northern Bering Sea as reproduction of euphausiids within the Chukchi has not been observed. Modeled trajectories of passively floating particles to simulate euphausiid transport have been analyzed. The results suggest that the majority of euphausiid prey in the study area is derived from the northern Bering Sea. Furthermore, particles in close association with the bottom were more likely to be transported to the study area than particles in the surface waters.

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: A pair of 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.") Moorings will be deployed in August for one year, to be recovered the following August. Each mooring site has two moorings; one is a bottom mounted upward-looking ADCP with instruments that measure fluorescence, temperature, and oxygen deployed beneath the ADCP; the second mooring will contain the instrument to measure ice thickness with instruments that will measure nitrate, temperature and salinity beneath it. 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 (60-cm frame with 0.333 mm mesh and 20-cm frame with 0.150 mm mesh) 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. Within a year a new round of IPCC models will be available for analysis and we will evaluate them 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 are critical data to evaluate climate change as well as the numerical climate models. These data together with data from the moorings will be used for model verification.

Revised Date: September 2011

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Mapping and Characterization of Recurring Polynyas and Landfast Ice in the Chukchi and Beaufort Seas (AK-09-04)

BOEM Information Need(s) to be Addressed: Because the predominant oil-spill movement in the Chukchi OCS Planning Area would be from east to west, the potential interaction of oil and wildlife in the polynya system is a major concern. A better understanding of locations and characteristics of the polynyas and landfast ice would allow for a more accurate estimate of oil-spill trajectories. In addition, this information is useful for validating ice models. This study addresses aspects of USGS recommendations 3.01, 3.02, and 4.01.

Total Cost: $462,000 plus Joint Funding **Period of Performance:** FY 2009-2012

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Hajo Eicken, Dr. Andy Mahoney, Lewis Shapiro, Allison Graves Gaylord

BOEM Contact: Warren Horowitz

Description:
Background: Polynyas in the Chukchi Sea reoccur every year to the west of Barrow. The size, frequency, and latitudinal extent of these polynyas are poorly defined south of Icy Cape along the U.S. eastern Chukchi coast and along the Russian Chukchi coast. A recently completed MMS study by Eicken et al. (OCS Study MMS 2005-068) mapped and quantified the spatial and temporal extent of landfast ice and leads, including Polynyas along the Beaufort Sea coast and a portion of the Chukchi coast utilizing high resolution satellite imagery. Data from this completed study was incorporated into the MMS Oil-Spill-Risk Analysis (OSRA), and in our EIS for the Beaufort Sea. In the study, polynyas along a small northeast segment of the Chukchi Sea coast and lease area were mapped, but areas to the south of Icy Cape, consisting of most of the Chukchi lease sale area were not. This new study effort will quantify the spatial and temporal extent of the leads, polynyas and landfast ice, including any recent changes in their extent south of Icy Cape, and update the information from the previous study effort for the Chukchi Sea and the Beaufort Sea.

It is also important to obtain better information on how polynyas and the mobile ice pack interact because this interaction is the key to how much spilled oil gets encapsulated in pack ice and impacts biota associated with these systems. Bowhead whales migrate to Barrow along these leads and head eastward toward the Canadian Beaufort in the spring. Polar bears are also found along these leads during the winter months. The leads are also heavily used by spring migrating waterfowl.

Objectives:

- Document spatial and temporal extent of recurring polynyas and leads to the west and south of Icy Cape, and their extent across the Chukchi Sea.
- Document temporal and spatial occurrence of shoreward landfast ice line across the Alaskan and Russian and Chukchi Sea.
- Update the spatial and temporal extent of the landfast ice and leads for the Beaufort and Chukchi seas based upon the previous work done for MMS OCS study 2005-068.
- Examine the effect of Climate State on polynya and landfast ice characteristics.
- Provide mean, minimum, and maximum monthly shoreward land fast ice line.
- Provide monthly mean, minimum, and maximum polynya extent along the Chukchi and Beaufort seas coasts. Provide monthly probability lead statistics as gridded data.
- Provide summaries of ice dynamics within the Beaufort and Chukchi seas.
- Develop a web site that documents the studies progress and provides interim products to the study team.
- Conduct a literature search on the impacts of sea ice by Icebreakers
- Develop a comprehensive ArcGIS database and final report

Methods: Collect and analyze current and historical remote-sensing imagery for recurring polynyas and shoreward landfast ice line. Review and synthesize literature and local information sources. Create a Geographic Information System (GIS) database which quantifies the spatial and temporal distribution of spring leads in the Alaskan Chukchi Sea, in addition to updated information for the Beaufort Sea. Provide individual years as well as statistical representation of polynya/lead occurrence and distribution. Create a GIS database and statistical summaries showing the monthly distribution of the shoreward landfast ice line across the Chukchi Sea to the Russian Chukchi Coast at 174 W. Provide individual months per year as well as statistical representation of landfast ice occurrence and distribution. Analyze ice dynamics within the Beaufort and Chukchi seas. Provide relevant attributes to spatial data for use in a GIS. Provide a final report, database, and database documentation. Provide a project team web site.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Surface Current Circulation High Frequency (HF) Radar Mapping in the Chukchi Sea (AK-09-06)

BOEM Information Need(s) to be Addressed: The collection of surface current data will be used to validate the BOEM ocean circulation model for the Chukchi Sea. These data will support the BOEM Oil-Spill-Risk Analysis (OSRA). OSRA is a cornerstone to regional EISs, environmental assessments (EAs), and oil-spill contingency planning. Information from this study will be used in NEPA analysis and documentation for Chukchi, DPPs, and oil-spill contingency plans. This study addresses aspects of USGS recommendation 3.01.

Total Cost: $994,000 plus Joint Funding **Period of Performance:** FY 2009-2013

Conducting Organization: UAF

Principal Investigator: Dr. Tom Weingartner, Dr. Peter Winsor, Hank Statscewich, Rachel Potter

BOEM Contact: Warren Horowitz

Description:
Background: Ocean currents play a critical role in the transport and fate of spilled oil, but there is lack of direct circulation measurements for the Chukchi Sea either within the open leads, during breakup and ice melt-out, or during the open water season. Presently, ocean circulation and oil-spill trajectory models do not capture the nearshore surface current circulation fields or the finer scale circulation patterns that are an important consideration for the Chukchi Sea. Surface circulation currents captured by HF radar would be extremely important in the validation of a Chukchi ocean circulation model.

The University of Alaska-Fairbanks, under contract to MMS successfully collected surface current measurements within the central Beaufort Sea Outer Continental Shelf out to 70 km, covering an area over 2500 km^2. These measurements were collected during break up of the landfast ice zone, under mixed ice and open water conditions, and during the fall freeze-up period. The processed data will be used to validate surface currents generated by the Beaufort Sea ocean circulation model in the near future. This knowledge and experience in the Beaufort Sea will be applied to the Chukchi Sea where surface current information is also needed for model validation and in support of OSRA.

Ocean current circulation fields will be collected and analyzed within the northeastern Alaskan Chukchi Sea through the deployment of coastal HF radar systems and offshore bottom mounted Acoustic Dopper Current Profilers (ADCPs). These instruments shall

capture the changes in surface and subsurface currents. Surface current fields will be collected on an hourly basis out to 180 km from shore from three coastal locations proposed for Barrow, Wainwright, and Point Lay. Automated Underwater Vehicles (AUV) shall be deployed to measure the changes in water stratification. Data collection will continue throughout the open water season, approximately July through mid November. The Principle Investigator will work with industry and government agencies in a collaborative effort to deploy, maintain, and to collect data from these instruments.

Objectives:

- The deployment of HF radar instruments along the Chukchi Sea coast for the purpose of collecting high resolution surface currents within a portion of the proposed OCS Chukchi lease sale boundary from July through October for four field seasons.
- Provide hourly data measurements in near real time over the internet.
- Analyze surface current data against existing temperature and salinity measurements, sub-surface currents from existing ADCPs, surface drifters, wind data from coastal meteorological stations, and varying ice conditions from satellite imagery.
- Provide final report, and spatial database.

Methods: This study will: 1) field test potential locations to deploy long range HF Doppler radar systems along the Chukchi Sea coast beginning near Barrow and extending down the Chukchi coast to Point Lay; 2) work with Alaska Native groups and scientific organizations on the North Slope and along the Chukchi coast to enhance their participation in the project; 3) collect surface current measurements on an hourly basis between the months of July and November for three to four field seasons in near real time and distribute over the Internet; 4) collaborate with other agencies and industry to obtain needed data on subsurface currents and surface current parameters; 5) deploy ADCPs to measure subsurface currents, changes in bottom temperature and salinity; 6) deploy AUVs to measure the changes in water stratification; 7) analyze the changes and connectivity between the surface current and subsurface current circulation fields for the northeast Chukchi Sea; 8) compare changes in surface and subsurface currents to the changes in measured wind fields; 9) provide surface and subsurface current flow fields to modeling group for model validation; 10) provide final report of results.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS recommendation 3.01.

Total Cost: $452,000 plus Joint Funding **Period of Performance:** FY 2011-2013

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Tom Weingartner, Seth Danielson

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: The objectives of the drifter deployment program are to:

- 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 (Global Positioning System) 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.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Adaptation of Arctic Circulation Model (NT-08-02)

BOEM Information Need(s) to be Addressed: Oil spill trajectory analysis for impact assessment is needed for the Beaufort and Chukchi Planning Areas. Oil Spill Risk Analysis (OSRA) is a cornerstone foundation for evaluating alternatives in OCS oil and gas leasing EIS preparation and for evaluating mitigation, such as oil spill contingency plans. Development and application of state-of the-art circulation models are essential to future OSRA-based EIS analyses. This study addresses aspects of USGS Recommendations 3.01, 3.02, 4.01 and 7.04.

Total Cost: $350,000 **Period of Performance:** FY 2011-2012

Conducting Organization: Rutgers University

Principal Investigator: Dr. Enrique Curchitser, Dr. Katherine Hedstrom, Dr. Thomas Weingartner, Seth Danielson

BOEM Contact: Dr. Walter Johnson

Description:
Background: The BOEM proposes to lease within the Beaufort and Chukchi Sea Planning Areas. To maintain its state-of-the-art in oil-spill-risk analysis, BOEM seeks to take advantage through time of the increasing skill of circulation models supported by more and better data. A coupled ice/ocean model can be modified and expanded to capture provide multi-year circulation, ice, and forcing fields for use in BOEM NEPA oil-spill-risk analysis and post-sale oil spill response planning.

Objectives: Adapt and maximize the utility of an existing, coupled ice-ocean circulation model to represent the physical processes, especially circulation, within the Chukchi and Beaufort Sea Planning Areas. Provide BOEM with ten-to-twenty years of relevant modeled fields, such as gridded wind, surface water, and ice velocity, ice cover; and limited other modeled fields as agreed on between contractor and BOEM.

Methods: A coupled ice/ocean model will be modified to maximize utility in the Chukchi and Beaufort seas and to capture the agreed upon model fields. Three-hour gridded velocity fields (wind, surface water, ice) and ice cover will be provided to BOEM in agreed format for a ten-to-twenty year hindcast simulation. Sensitivity testing and validation of the model and results will be conducted. The BOEM anticipates providing HF-radar results for Beaufort and Chukchi coasts to aid in validation. Documentation would be through the model manual, final report, and submittal of a peer-reviewed journal article.

Revised Date: September 2011

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemistry and Benthos (CAB) (AK-08-03)

BOEM Information Need(s) to be Addressed: This study will constitute a key component of Chukchi Sea environmental studies pertinent to Chukchi Sea Lease Sale 193 scheduled for 2008. Industry has expressed strong interest in leasing in this area, likely followed by exploration and possibly development. 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. This study addresses aspects of USGS Recommendations 3.02, 3.04, 4.01 and 5.24.

Total Cost: $2,560,000 **Period of Performance:** FY 2008-2012

Conducting Organization: University of Texas at Austin

Principal Investigator: Dr. Kenneth H. Dunton, Dr. Steven M. Lanoux

BOEM Contact: Dr. Richard Prentki

Description:
Background: The November 2006 COMIDA workshop described the importance of benthos and chemical monitoring to evaluate the health of the Chukchi ecosystem. The MMS/BOEM Scientific Committee (SC) recommended an adaptive initial two year sampling program that closely coordinated separate chemical and benthos monitoring efforts. This document combines those two efforts.

Benthic biological monitoring needs to be initiated in order to establish a current benthic community baseline prior to new oil and gas exploration activities. Our knowledge of the benthic fauna along the Chukchi shelf is largely based on MMS/Outer Continental Shelf Environmental Assessment Program (OCSEAP) surveys between the 1970s and early 1990s. A review of this information revealed "hot spots" of high and highly variable benthic biomass in several regions of the Chukchi Sea. The high abundance of bottom fauna was correlated with high pelagic primary production, possibly associated with the ice-edge and most of which reached the seabed ungrazed. With the retreat of the summer ice-edge to deeper, more northern waters in recent years, this pelagic/benthic coupling may be weakening. Recent changes in seabird and marine mammal distributions described in the COMIDA workshop may reflect undocumented changes in benthic hot spots in the Chukchi Sea as well as greater retreat of the ice pack.

Among the primary concerns about offshore oil and gas are anthropogenic inputs of metals and hydrocarbons. Earlier MMS/OCSEAP-sponsored monitoring design workshops for the Beaufort Sea and Bering Sea recommended that MMS (now BOEM) develop multiyear contaminant baselines prior to offshore development. The Oceanography/Fate and Effects working group of the COMIDA Workshop considered multi-year monitoring of sediment metals, hydrocarbons, and other anthropogenic compounds to be a priority.

Objectives:

- Establish baseline for benthic biomass, species composition, and oil industry anthropogenic chemicals to detect changes as the result of future oil and gas activities.
- Initiate past and future time trend analyses for benthic populations and anthropogenic chemicals
- Distinguish among changes due to development, climate, and food web structure
- Identify natural or other anthropogenic sources of contaminants to the study area.
- Initiate and develop a conceptual food web related to bioaccumulation and risk of trophic transfer of oil industry anthropogenic chemicals.

Methods: The BOEM anticipates substantial collaboration and coordination of CAB with other Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA) projects: Distribution and Relative Abundance of Marine Mammals: Aerial Surveys and Impact Monitoring of Offshore Subsistence Hunting. CAB will collaborate directly with the Alaska Monitoring and Assessment Program (AKMAP) and more site-specific oil industry studies. We are sharing logistical platforms and samples.

For anthropogenic chemicals, the 2-year sampling strategy collects surface sediments for the determination of standard sediment hydrocarbon parameters such as polycyclic aromatic hydrocarbon (PAH), relevant metals, including the Environmental Protection Agency (EPA) priority metals [total iron (Fe), manganese (Mn), aluminum (Al), barium (Ba), chromium (Cr), vanadium (V), lead (Pb), copper (Cu), cadmium (Cd), nickel (Ni), arsenic (As), silver (Ag), mercury (Hg), selenium (Se), beryllium (Be), thallium (Tl), tin (Sn), antimony (Sb), and zinc (Zn)]; supporting/normalizing parameters such as grain size, organic carbon or organic matter, etc.; and sourcing parameters such as diagnostic hydrocarbon ratios. The biological sampling is combined with the sediment sampling and Contractor-selected other sampling/assays/analyses to complete a sediment triad approach to evaluating effects of ambient anthropogenic chemical levels.

There is a full Quality Assurance/Quality Control (QA/QC) program with inter-laboratory comparisons and reference standards. Normalization techniques developed in MMS/BOEM Beaufort Sea monitoring will be adopted to minimize sample variability.

Pre-drilling activity baseline sampling was conducted in 2009, emphasizing the area leased by industry in the proposed Chukchi Sea oil and gas lease sale held in February, 2008. Additional adaptive sampling will occur in 2010, predicated on the findings and success in 2009 and locations of likely oil industry post-sale activities. Dated sediment cores are used to capture interannual variability of anthropogenic chemicals and normalization techniques to minimize effects of sample variability. Sampling design will be adaptive to incorporate locations of

concentrated bird and marine mammal feeding and their prey within the COMIDA area. To identify sources of anthropogenic chemicals to the study area, limited sampling will be conducted of sources such as water column, air, drilling mud, river input, seeps, or shoreline erosion.

A conceptual food web model related to bioaccumulation and trophic transfer of potential oil industry contaminants is part of initial study planning based on literature review and data-mining. Water and biota sampling are conducted to better understand pelagic/benthic coupling and other trophic transfer. The food-web model will be risk-based, conceptually considering mechanism, magnitude, and likelihood of contaminant transfer. The model will continue to be developed and updated throughout COMIDA, incorporating COMIDA results and other information, and will also be used as a tool to refine sampling strategy during COMIDA and recommend post-COMIDA monitoring strategy.

Revised Date: September 2011

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea, Hope Basin, Norton Basin

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 contingency planning. Oil-spill issues constitute a significant portion of public comments submitted on sale or development EISs in the Alaska OCS Region. This study is necessary to incorporate fault-tree spill occurrence estimators into NEPA analyses for Arctic oil and gas lease sales or Arctic development in the expected BOEM 2012-2017, 5-Year Plan. This study addresses aspects of USGS Recommendations 5.03 and 5.22.

Total Cost: $230,000 **Period of Performance:** FY 2011-2016

Conducting Organization: Bercha International

Principal Investigator: Dr. Frank Bercha

BOEM Contact: Dr. Richard Prentki

Description:
Background: The OCS spill occurrence rates used in non-Arctic BOEM NEPA analyses are based on historical platform, pipeline or tanker crude oil-spill rates, almost entirely from the Gulf of Mexico and Pacific OCS. 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 (including Norton Basin) 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Oil Spill Occurrence Estimators for Onshore Alaska North Slope Crude and Refined Oil Spills (AK-11-02)

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. Oil-spill issues constitute a significant portion of public comments submitted on sale or development EISs in the Alaska OCS Region. Information from this study will be used by Alaska OCS Region staff to estimate small oil spill occurrence (<1,000 bbl) in preparing future, approximately biannual, Arctic exploration and development EISs or EAs, future developmental EISs, and in reviewing oil-spill-contingency plans for OCS and coastal facilities. This study addresses aspects of USGS Recommendations 5.03 and 5.22.

Total Cost: $199,000 **Period of Performance:** FY 2011-2014

Conducting Organization: Nuka Research and Planning Group

Principal Investigator: Tim Robertson

BOEM Contact: Dr. Richard Prentki

Description:
Background: Because of lack of developed hydrocarbon and road transportation systems onshore of areas of Arctic OCS oil and gas interest, BOEM is required to analyze the effects of onshore infrastructure development in NEPA analyses. Local stakeholders are particularly concerned with possible effects of oil spills. In Alaska environmental assessments and environmental impact statements, the BOEM uses various datasets and models to estimate the likelihood of large spills (≥1,000 bbl) and small spills (<1,000 bbl) occurring at sea and on land. For the Liberty EA, British Petroleum Exploration, Alaska (BPXA) collated industry data through 2006 for crude and refined oil spills and developed statistical estimators based on spills per billion barrels of production for spills greater than or equal to 200 bbl. The industry data for spills greater than or equal to 50 bbl were made available to BOEM, but the data for smaller spills were not.

The MMS last collated and analyzed Alaska North Slope small spill data in 2000. More than a decade has passed since a comprehensive analysis of Alaska North Slope crude and refined small spills has been completed by MMS/BOEM. As oil production continues to decline on the North Slope, concern has been raised that spill rates may increase, as hypothesized in the bathtub curve model of industry spillage. In this model, spillage rates are initially higher in early years of development as part of a learning curve, decrease during maturity, and increase again as the infrastructure ages. Since the analysis in 2000, concern has been raised over increasing spillage from corroded pipelines on the North Slope, and industry has been sued by

both State and Federal governments for not properly maintaining pipeline integrity in recent years.

Recent stakeholder criticisms have stated that MMS/BOEM must do a better analysis and reporting of sources of variance and magnitude of confidence intervals for spillage estimates. A full study of sources of variance and confidence intervals in small oil spill occurrence estimators for the Alaska North Slope has not been attempted by MMS/BOEM in the past because of limited data availability.

The MMS/BOEM has worked hard to improve spill data sets along with associated infrastructure data sets. Statistical findings and assumptions merit reanalysis with a more extensive and improved data string. This study will test the assumptions of Poisson distribution for small spills, reconsider the suitability of pipeline length or blended spill estimators, and develop confidence intervals for spill occurrence estimators used by BOEM.

Objectives:

- Update and collate crude and refined oil spills on the Alaska North Slope from industry, U.S. Coast Guard (USCG), Environmental Protection Agency (EPA), USDOI, BLM, BOEM and Alaska Department of Environmental Conservation (ADEC) data sets through 2010.
- Develop relative spill occurrence estimator(s) suitable for use for onshore small oil spills on the Alaskan North Slope using an appropriate exposure variable.

Methods: Investigators will conduct a preliminary meeting to discuss acceptable statistical methods. This will require an understanding of historical statistical approaches, BOEM rationales for estimating oil spill occurrence rates, and possible sources of variance. The discussion will include: methods for deriving historical spill frequencies from Alaska North Slope spill records; exposure variables for spill frequency such as North Slope pipeline miles, volume of throughput, age, and well years; implications for using different exposure variables; and recommended standard data format for exposure variables and accident data.

The investigators will collect, examine and reconcile spill records and cleanup reports for the North Slope and Canadian Beaufort Sea coastal areas for spills >1 bbl into an electronic database in a standard format. Exposure data for Alaska North Slope and Canada will be collected and the number of wells, flow, and pipeline miles by year provided when available. The investigators will also calculate accident frequencies for small spills and perform appropriate statistical analyses, including trend analysis.

Deliverables will include user-friendly models and/or algorithms to allow BOEM staff to recalculate the contractor's measures of variability as additional information or data become available.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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: $475,000 plus Joint Funding **Period of Performance:** FY 2008-2011

Conducting Organization: USGS

Principal Investigator: Lyman Thorsteinson

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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS study recommendations 3.05, 3.07 and 4.01.

Total Cost: $1,764,000 plus Joint Funding **Period of Performance:** FY 2010-2013

Conducting Organization: University of Alaska

Principal Investigator: Dr. Brenda Norcross

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^{o} and 152^{o} 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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: $135,000 **Period of Performance:** FY 2010-2012

Conducting Organization: Various

Principal Investigator: 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All 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: $100,000 **Period of Performance:** FY 2010-2013

Conducting Organization: USFWS

Principal Investigator: Dr. Kathy J. Kuletz

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 North Aleutian Basin (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 and NSF-funded research vessels. Based on on-going NOAA and NSF programs, we anticipate availability of at least two 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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 Lease Sale 193 held in 2008. 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. This study addresses aspects of USGS Recommendations 3.01, 3.02, 3.04, 3.05, 3.07, 4.01, 5.06 and 5.24.

Total Cost: $5,645,000 **Period of Performance:** FY 2011-2016

Conducting Organization: University of Texas at Austin

Principal Investigator: Dr. Kenneth H. Dunton, Dr. Steven M. Lanoux, Dr. David R. Maidment

BOEM Contact: Dr. Heather Crowley

Description:
Background: The ongoing COMIDA CAB study is highlighting 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 with global warming, 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. Taylor columns may be responsible for maintaining ice in the regions of Herald and Hanna shoals. 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 Beaufort, 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 acoustic Doppler current profilers (ADCP) units capable of distinguishing copepod and euphausid 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 such as the proposed extension of the Chukchi oceanographic study, these data include: HF radar, moored ADCPs, meteorological buoys, and gliders. 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.

This study will use numerical ocean process model simulations for the Chukchi Sea, with focus on Hanna Shoal, to better understand the physical processes controlling circulation patterns in the region. Analyses will be performed on the model results to examine interactions of the flow field and density structure with the topography and their relation to productivity and biomass distribution. An ecosystem model also may be incorporated into the simulations.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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 addresses aspects of USGS Recommendations 3.06 which 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. This study addresses aspects of USGS Recommendation 3.06.

Total Cost: $237,000 **Period of Performance:** FY 2011-2016

Conducting Organization: USGS

Principal Investigator: Dr. Abby Powell

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, potentially impacting their prey and the benthic invertebrate community. The impacts of oil on aquatic invertebrates can be significant. Some components of the infaunal invertebrate community would be extirpated, while in others recovery may take 3-5 years depending on the conditions of the oil and environment. 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 anthropogenic 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.

Quality foraging habitat for shorebirds is determined by the abundance of benthic invertebrates, but can also be influenced by lagoon water levels that can inundate the delta making the habitat inaccessible to shorebirds. Most of the change in water level on delta mudflats comes from wind driven waves. If wind patterns are consistent then available habitat is predictable, but changes in tide due to westerly storms can be significant and may inundate the whole delta for several days. Climate change may change the frequency of storms and seems to have changed the intensity of the storms by increasing the size of waves because the reduced amount of ice results in fewer impediments to wave build up. This has the potential to change the availability of shorebird feeding areas, making the occurrence of this habitat less predictable to birds during the post-breeding period.

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.

This study will survey the shorelines and consist of taking core samples for laboratory analysis for chemical analysis, population structure, numbers of individuals, and diversity of populations from the interstitial spaces within the littoral zone of coastlines along the Beaufort Sea.

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 through body condition measurements and increased 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: September 2011

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendation 5.06.

Total Cost: $365,000 **Period of Performance:** FY 2011-2015

Conducting Organization: University of Alaska Fairbanks

Principal Investigator: Dr. Abby Powell

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; and
- 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Arctic Cod Pilot Genetics and Toxicity Study (AK-11-13a)

BOEM Information Need(s) to be Addressed: A major element of NEPA analyses in the Alaska OCS program is the assessment of effects of accidental releases of oil and gas in arctic waters and on arctic species. A greater understanding of the keystone species Arctic cod is necessary to assess the potential effects of offshore development in arctic waters. Arctic cod plays a critical ecological role as key prey species and the primary pathway through which lower trophic production gets funneled to marine mammals, birds and fish. Thus Arctic cod dynamics are critical to EFH- and ESA-related NEPA analyses. The extent of its ice dependency makes Arctic cod itself a potential ESA species. In order to assess effects from potential oil and gas development on Arctic cod and the cumulative effects from climate change, it is important to understand the ability of Arctic cod to survive and adapt as the ice retreats. Understanding how Arctic cod are affected by oil and dispersants under arctic conditions will support both impact assessments and development of oil spill response and monitoring protocols. This study addresses aspects of USGS study recommendations 5.15 and 5.17.

Total Cost: $30,000 **Period of Performance:** FY 2011-2013

Conducting Organization: USGS-BRD

Principal Investigator: Dr. Sandra Talbot

BOEM Contact: Kate Wedemeyer

Description:

Background: Arctic cod is a key species in Arctic food webs and occupies nearly all depths during its life cycle. Whether Arctic cod is likely to be driven to extinction as the arctic ice retreats is a subject of discussion in scientific circles. Genetics can shed light on whether Arctic cod (*Boreogadus saida*) are truly ice dependent or whether there is potential to adapt to retreating ice through differential expression of existing genes.

The genetics and toxicity testing feasibility analysis will benefit from close association with an ongoing BOEM study and an ongoing international Joint Industry Program (JIP) Arctic species toxicity study. The pilot genetics study has ties to the ongoing Central Beaufort Fish Survey under ice and open water survey (AK-10-09). Opportunistic samples from an international Chukchi Sea fish survey in September 2010 have been committed for the pilot BOEM genetic survey. The genetic study also has ties to an ongoing Canadian Department of Fisheries and Oceans (DFO) Arctic cod genetic study to assess genetic differentiation of the Arctic cod population and provide international collaboration.

A workshop held in Anchorage in March 2008 facilitated the discussion of the effects of dispersed oil on two Arctic species, Arctic Cod and a copepod (*Calanus glacialis*). The workshop was followed by fieldwork in 2009 and 2010. The results of the JIP study of toxicity to Arctic species at surface pressures could parlay into an assessment of what broader research may prove beneficial in terms of assessing effects at depth.

The effects of subsurface blowouts are receiving renewed focus following the *Deepwater Horizon* explosion and subsequent oil and gas release in the Gulf of Mexico. Although the question of subsurface oil, gas and dispersant behavior in the Gulf of Mexico is currently on the forefront, these same questions need to be addressed separately and proactively under conditions unique to the U.S. Arctic. Assumptions and practices from different geographic locations may not accurately translate to the U.S. Arctic. Carefully designed toxicity laboratory research on Arctic cod at controlled temperatures, pressures (i.e. depth) and light would begin to address some of these complex questions of effects of oil, gas and dispersants on species at various depths in the Arctic. This proposed study will evaluate the feasibility of conducting such research and provide recommendations for study design and implementation.

This genetic and toxicity testing will help analysts respond to basic questions under NEPA review that address future oil and gas developments in the Arctic. Examples of the questions to be answered include: Are Arctic cod a single pan-Arctic population that exhibits varied genetic responses under different conditions or are Arctic cod a number of genetically distinct stocks that are individually at risk to offshore development? How do the oil spill effects on and the responses of Arctic cod vary in relation to a complex of different oil/gas/dispersant mixtures, different life stages, different body mass, different temperatures and different depths typical of the U.S. Arctic? How do the toxicity test results at depth compare to results of the ongoing JIP toxicity study at surface pressure?

Objectives:

- Conduct mitochondrial DNA Assessments of Chukchi and Beaufort Sea Arctic cod.
- Provide recommendations for a pan-arctic genetic stock separation and genetics study of Arctic cod.
- Assess the feasibility of conducting an Arctic cod and zooplankton toxicity study.

Methods: Conduct mitochondrial DNA profiles of Chukchi and Beaufort Sea Arctic cod samples presently held by John Nelson at the BC Canada DFO lab. Provide protocols and sampling supplies for field collection of central Beaufort Sea Arctic cod genetic samples in August 2011. Develop recommendations for a circumpolar effort to evaluate whether all or a portion of Arctic cod are ice dependent. In 2012, conduct mitochondrial DNA on Arctic cod samples collected in the 2011 central Beaufort Sea Marine Fish field survey. Final report to include recommended future directions for Arctic cod genetic research.

Conduct a feasibility analysis for an Arctic cod and zooplankton toxicity study project design based on the results of the JIP study of toxicity to Arctic species at surface pressures. Review the results of the JIP study of toxicity to Arctic species at surface pressures, Arctic Oil Dispersant Toxicity Study. Provide recommendations for design and implementation of

controlled laboratory studies to test the toxicity effects of gas/oil/dispersant mixtures on Arctic cod at critical lifestages, and at a range of temperatures and depths (pressures) typical of the U.S. Arctic OCS. Search for and review facilities capable of conducting toxicity tests simulating a minimum of 50 meter depths. Provide a range of recommended options and budgets to assess the effects on Arctic cod (and perhaps other species) of accidental subsurface release of gas/oil/dispersant mixtures at low temperatures and at pressures and oceanographic conditions typical of the U.S. Arctic OCS.

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Recovery in a High Arctic Kelp Community (AK-08-12-02)

BOEM Information Need(s) to be Addressed: Information from this study will be used by Alaska OCS Region staff to acquire a better understanding of how sessile communities recover after disturbances in the Boulder Patch, a high Arctic kelp community. This will be needed in preparing future, Beaufort Sea exploration and development EISs, future developmental EISs, and in reviewing oil-spill-contingency plans for OCS and coastal facilities. This study addresses aspects of USGS study recommendation 3.04.

Total Cost: $123,000 plus Joint Funding **Period of Performance:** FY 2008-2012

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Brenda Konar

BOEM Contact: Kate Wedemeyer

Description:

Background: The Boulder Patch kelp community in the Prudhoe Bay area of the Beaufort Sea is a sensitive habitat which has the potential of being impacted by oil and gas activities. Some rocks there were cleared in 2002 and have been monitored from 2002 to 2006. Because of the very slow natural recruitment observed then it is necessary to continue this monitoring for another four years to clarify the reasons for this slow recruitment, how the communities naturally recover from disturbances, the initial recruitment, and possibly the natural succession.

Objectives:

- Assess the timing of natural recruitment onto hard substrates.
- Assess the effect of grazers to the timing of recruitment.
- Assess the effect of sedimentation to the timing of recruitment.
- Assess the rate of vegetative re-growth of various sessile organism groups.
- Assess fish occurrence.

Methods: This project will be completed in the Boulder Patch at Dive Site 11 (DS-11) in Stefansson Sound, Alaska. This site has nearly complete rock and kelp cover, is in a water depth of 6-7 m, and is the logical location for this study because this is the location of previous recovery studies in the Boulder Patch. All cleared and uncleared boulders from the 2002 study will be monitored yearly. Two additional new experiments will also be part of this project to assess the effects of sedimentation on recruitment and recovery rates via vegetative re-growth.

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): 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: The oil and gas industry has expressed interest in leasing part of the North Aleutian Basin (NAB) to search for and possibly develop oil and gas deposits. 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 initiated for NEPA analysis and documentation for the North Aleutian Basin but has shifted emphasis north into the Chukchi Sea. This study addresses aspects of USGS Recommendations 4.01, 7.03 and 7.04.

Total Cost: $757,000 plus Joint Funding **Period of Performance:** FY 2008-2012

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Jeremy Mathis

BOEM Contact: Dr. Richard Prentki

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 Sea. 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 and this study is an Alaska Coastal Marine Institute Task Order being conducted in conjunction with BEST and also the Bering Sea Integrated Ecosystem Research Program (BSIERP).

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 and Chukchi Sea.

Methods: The Task participates in multiple cruises in Bering and Chukchi Sea, including samples from 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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 sorely 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 is needed to meet Essential Fish Habitat and Marine Mammal Protection Act and NEPA requirements in the EISs for the 2010 and 2012 Chukchi Lease Sales. This study addresses aspects of USGS study recommendations 3.05 and 6.15.

Total Cost: $532,000 plus Joint Funding **Period of Performance:** FY 2009-2013

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Brenda Norcross, Dr. Lara Dehn, Brenda Holladay

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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Population Connectivity and Larval Dispersal in Bering, Chukchi and Beaufort Sea Snow Crab Populations: Estimating Spatial Scales of Disturbance Impacts. (AK-08-12-06)

BOEM Information Need(s) to be Addressed: This study will provide information on genetic population structure in the snow crab, *Chionoecetes opilio*, in terms of population connectivity between exploited and unexplored regions. This information is needed 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, EPs and DPPs, mitigation, and monitoring in the Beaufort and Chukchi Seas. This study addresses aspects of USGS Recommendation 4.01.

Total Cost: $120,000 plus Joint Funding **Period of Performance:** FY 2009-2011

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Sarah Mincks Hardy, Dr. Katrin Iken

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. Range extension and colonization of new habitat may appear to benefit the invading species, but these shifts also alter competitive and predatory interactions within existing communities. For commercially important species in particular, we must understand the ecological and environmental parameters that influence population structure and species distributions if we are to predict how human activities such as oil and gas exploration will affect both new and established populations in sensitive areas.

Despite fairly thorough stock assessments in fishing-intensive areas (Bering Sea), virtually no attention has been paid to *C. opilio* stocks in the Chukchi and Beaufort seas where sizeable populations do appear to exist. These unexplored populations may well be sources or sinks for genetic exchange with other, more intensively fished populations. Thus, knowledge of dispersal patterns and degrees of genetic connectivity between populations are essential in determining the spatial scales over which localized disturbances will be felt, and over which environmental impact studies should be conducted.

This study will utilize genetic tools to investigate population structure in *C. opilio* in the N Bering, Chukchi and Beaufort Seas, and the degrees of genetic exchange between these regions. This information will also help define the general distribution for crab species' Essential Fish Habitats (EFH).

Objectives: The objectives of this project are to establish genetic population structure for adult *C. opilio* in the N Bering, Chukchi, and Beaufort Seas, and assess whether populations are truly panmictic, given potential long-distance dispersal of larvae;

- Complete 20 adult females from each three putative populations (Bering, Beaufort, and Chukchi) as preliminary analysis.
- Consult with BOEM and determine if complete analyses (Steps 3-7) are warranted.
- 300 plus adult specimens of *C. opilio* from sites throughout the study areas in the Bering, Chukchi, and Beaufort seas will be examined using a microsatellite approach.
- 300 additional adult specimens of *C. opilio* from five locations in the Northern Bering Sea will be examined using a microsatellite approach.
- Additional samples during the RUSALCA 2009 cruise in the Russian sector of the Chukchi Sea will be examined.
- A limited number of mitochondrial gene sequences for inclusion in phylogenetic studies and for DNA barcoding purposes will occur.
- Isolate 8 – 10 highly polymorphic DNA microsatellite loci from adult specimens, and compare genotypes of adult crabs between regions using isolation by distance models, which indicate spatial scales of genetic exchange.
- Complete quality control to test within-lab variability including a blind re-run of 3-4% of samples.
- Complete larval component: Remove and identify larvae from plankton samples and design of alternate PCR protocol for working with small amounts of tissue.
- Complete data archiving with NODC and made available to BOEM in a GIS compatible format.

Methods: Collected adult specimens of *C. opilio* 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Epifaunal Communities in the Central Beaufort Sea (AK-08-12-07)

BOEM Information Need(s) to be Addressed: Information from this study will be used by Alaska OCS Region staff to acquire a better understanding of the benthic community of the Central Beaufort Sea. This will be needed in preparing future, Beaufort Sea exploration and development EISs and in reviewing oil-spill-contingency plans for OCS and coastal facilities. This study addresses aspects of USGS study recommendations 3.04 and 4.01.

Total Cost: $489,000 plus Joint Funding **Period of Performance:** FY 2011-2012

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Brenda Konar

BOEM Contact: Kate Wedemeyer

Description:

Background: One of BOEM's target science interests is to learn more about the current spatial use patterns in the Beaufort Sea by potentially sensitive organisms, such as the epibenthics. Currently little is known about the epibenthic communities in the central Beaufort Sea. This proposed project is piggybacking an existing BOEM project that will characterize fish communities in the targeted area of the central Beaufort Sea. The study will characterize the epibenthic invertebrates in this area and relate these communities to the fish communities and to various physical drivers, such as sediment grain size, bottom temperature and salinity.

Objectives:

- Characterize the epibenthic communities in the central Beaufort Sea (between 147° and 150° west longitude)
- Compare these communities to those found in the adjacent Chukchi Sea.
- Compare these communities to those found in other areas around the Beaufort Sea.
- Determine whether epibenthic communities are distributed in patches or all species evenly distributed throughout the study area.
- Determine which species are most important in determining community structure in terms of abundance and biomass.
- Determine the current population structure of the most dominant species; i.e., size frequency, abundance, biomass and male to female sex ration.
- Identify how the community varies with environmental (depth, grain size, temperature, salinity) or fish community parameters.
- Compare how these epibenthic communities and the patterns found within them compare to the communities in the Chukchi Sea and in other areas of the Beaufort Sea.

Methods: In conjunction with the Central Beaufort Fish Survey, five to ten transects will be conducted perpendicular to shore and between 10 and 100 m water depth (Figure 2). This sample plan will use a stratified, random sampling technique, with the strata based on water depth and distance from shore. Within each transect, replicate stations will be sampled for fish and epibenthic invertebrates using a fine mesh plumb-staff beam trawl deployed by an A-frame. Trawl catches will be sorted and placed into larger taxonomic groups and epibenthic species lists will be compiled by station during the cruise to create a presence/absence database. Voucher specimens also will be prepared by station for organisms that cannot be identified in the field. Voucher specimens of unknown species will be fixed and shipped to UAF for further taxonomic identification. In addition to a species list for each station, target organisms from the trawls will be selected for a more detailed community examination. Target organisms will include species that are trophically important or exhibit relatively high abundance and/or biomass. In similar Chukchi Sea studies, these taxa included various crabs, echinoderms, and gastropods. The community examination will include measures of abundance, biomass, and population size structure. In addition, for crabs we will examine the size at which females become gravid, the overall size frequency of all gravid females, and the percentage of females in the population that are gravid. Environmental data including vertical profiles of temperature and salinity will also be collected. A non-parametric multivariate approach will be used to analyze the data, including similarity, multidimensional scaling, community structure and importance of individual species, groups of species and physical factors.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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, EPs and DPPs, mitigation, and monitoring in the Beaufort and Chukchi Seas. This study addresses aspects of USGS Recommendation 3.04.

Total Cost: $176,000 plus Joint Funding **Period of Performance:** FY 2011-2014

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Bodil Bluhm, Dr. Katrin Iken

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: The objectives of this project are as follows:

- 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Current and Historic Distribution and Ecology of Demersal Fishes in the Chukchi Sea Lease Area (AK-93-48-67)

BOEM Information Need(s) to be Addressed: This study will provide information on the past and present fish presence, distribution, and abundance that is needed to evaluate and mitigate the effects of offshore development. The BOEM analysts and decision makers will use the information from this study in NEPA analysis and documentation for Lease Sale(s), EPs and DPPs, and in post-sale and post-exploration decision making, mitigation, and monitoring in the Chukchi Sea. This study addresses aspects of USGS Recommendation 3.05.

Total Cost: $343,000 plus Joint Funding **Period of Performance:** FY 2007-2012

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Brenda Norcross

BOEM Contact: Catherine Coon

Description:
Background: After a two-decade hiatus, Offshore Oil and Gas leasing is to commence in the Chukchi Sea. Very little historic fisheries information has been collected in the lease sale area. Like the Bering Sea, the Chukchi Sea has historically been a benthic dominated ecosystem. With arctic climate change, however, the Bering Sea is now shifting from a shallow, ice-dominated system in which bottom-dwelling fishes prevail to one more dominated by pelagic fishes. Further examination of the Chukchi Sea may indicate similar changes.

At present, we can only speculate what may be occurring in the Chukchi Sea, as there is a paucity of information about fishes in this area. The Chukchi Sea is outside the range of the NOAA Alaska Fishery Science Center regular fish trawls surveys, thus information on fishes in the Chukchi is limited to a few historic surveys. Currently the niche of benthic consumers in the Arctic, including the Chukchi Sea, is filled by seabirds and marine mammals. However, with decreasing sea ice in the Chukchi Sea, demersal fishes moving northward from the eastern Bering Sea might usurp the place of birds and mammals as benthic consumers. Without current baseline data, effects of offshore development cannot be separated from recent changes due to other factors.

This project will assemble data into a searchable database and collect additional field data to meet BOEM needs.

Objectives: The overall project is to document the abundance and distribution of fishes in the Chukchi Sea. Specific objectives include:

- Collect fishes and document species presence, abundance, distribution, geographic range, species diversity, species assemblages, and habitat parameters.
- Assess physical and oceanographic feature (water mass) characteristics that define demersal fish habitat.
- Assess physical characteristics that define juvenile and adult fish communities and compare among collection periods and with historic collections.
- Correct the identification of historical archived fish specimens for accurate comparison with the proposed collections in the Chukchi Sea Planning Area.
- Synthesize historic distribution patterns of fish species in and near the Chukchi Sea Planning Area, and compare with 2007-2008 collections.
- Incorporate both historic and current scientific fish collection data from the northeast Chukchi Sea into electronic format suitable for incorporation into the BOEM database.
- Provide a basis for post-sale monitoring of fishes in the Chukchi Sea.

Methods: Two years of sampling during July 2007 and 2008 will provide new collections of fish specimens and habitat data in the northeastern Chukchi Sea aboard the *Oshoro-Maru*. Additionally, relevant historic collections of fish specimens will be evaluated for species correctness. These two sets of data (both current and historic) will be summarized by the habitat types occupied by species in the Chukchi Sea Planning Area. A relational data base will be provided to BOEM that will contain data on species presence and abundance from both past and present collections. This will expand the current BOEM fish database and be suitable for GIS.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Populations and Sources of Recruitment of Polar Bears (AK-05-02)

BOEM Information Need(s) to be Addressed: The study will enhance BOEM analysis of oil-spill/polar bear mortality models and provide direct input to population-recovery models currently under development for the Alaskan Beaufort Sea Region. Study information will be used for NEPA analysis and documentation for Beaufort Sea Lease Sales. It will also contribute information used for mitigation related to Northstar, Liberty, if approved, and DPPs. This study addresses aspects of USGS Recommendations 3.05 and 6.14.

Total Cost: $1,139,000 plus Joint Funding **Period of Performance:** FY 2005-2012

Conducting Organization: University of Alberta, Canada

Principal Investigator: Dr. Andrew Derocher

BOEM Contact: Mary Cody

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 well being of these animals." Other stakeholders have recommended that MMS/BOEM expand the scope of the research to include the entire Alaskan Beaufort Sea.

This profile describes the satellite tracking task in support of the Bowhead Feeding Variability Study. Overall, the study, aims at 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, 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 statuses from the Beaufort Sea and Chukchi Sea within, into and out of the study area.
- Document feeding and other behaviors at locations in the Beaufort and Chukchi seas with emphasis on timing and dynamics/variability.
- Estimate the rate and timing of travel of whales during migration.

Methods: Collaborations will be developed between whaling captains, AEWC, NSB, ADF&G, NMFS, BOEM and other interested parties to resolve roles in permitting, co-sponsorship and implementation. Satellite transmitters will be deployed on bowhead whales near Native villages in the Beaufort, Chukchi and Bering seas during spring and fall migrations. Transmissions would be monitored and data analyzed. The study will 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 directly in the conduct of the study.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

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

Title: Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01; AK-10-01)

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. This study addresses aspects of USGS Recommendations 3.05, 3.06, 6.08, 6.09, 6.13 and 7.03.

Total Cost: $2,000,000 plus Joint Funding **Period of Performance:** FY 2005-2012

Conducting Organization: ADF&G

Principal Investigator: Lori Quakenbush

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 well being of these animals." Other stakeholders have recommended that MMS/BOEM expand the scope of the research to include the entire Alaskan Beaufort Sea.

This profile describes the satellite tracking task in support of the Bowhead Feeding Variability Study. Overall, the study, aims at 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, 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 statuses from the Beaufort Sea and Chukchi Sea within, into and out of the study area.
- Document feeding and other behaviors at locations in the Beaufort and Chukchi seas with emphasis on timing and dynamics/variability.
- Estimate the rate and timing of travel of whales during migration.

Methods: Collaborations will be developed between whaling captains, AEWC, NSB, ADF&G, NMFS, BOEM and other interested parties to resolve roles in permitting, co-sponsorship and implementation. Satellite transmitters will be deployed on bowhead whales near Native villages in the Beaufort, Chukchi and Bering seas during spring and fall migrations. Transmissions would be monitored and data analyzed. The study will 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 directly in the conduct of the study.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendations 3.05, 3.07, 4.01, 5.24, 6.06, 6.07, 6.08, 6.09, 6.16, 6.18 and 7.03.

Total Cost: $8,188,000 plus Joint Funding **Period of Performance:** FY 2006-2012

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

Principal Investigator: Kim Shelden, Dr. Catherine Berchok, Dr. Carin Asjian, Dr. Steve Okkonen, Dr. Craig George, Dr. Mark Baumgartner

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 well being 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 proposed 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 statuses 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Monitoring Marine Birds of Concern in the Eastern Chukchi Nearshore Area (Loons) (AK-07-04a)

BOEM Information Need(s) to be Addressed: The initial MMS environmental impact analysis for the 5 Year Program, 2007-2012, identifies species of concern in the Chukchi Sea and recent Conservation Recommendations to MMS/BOEM (Section 7 Consultation, Beaufort Sale 186) recommended research on migratory species of concern. Thus, updated information on marine bird distribution, species composition, molting, staging and timing of use in the eastern Chukchi coastal area between Barrow and Point Hope is needed. Avian species of moderate-high concern include the Spectacled Eider, Yellow-billed Loon, Red-throated Loon, and Pacific Black Brant. Both the threatened Spectacled Eiders and the Yellow-billed Loon occur in coastal and marine environments from Barrow south to Cape Lisburne. Ledyard Bay is ESA Critical Habitat for the Spectacled Eiders, and limited surveys indicate Peard Bay may also be an important molting area.

Study findings will be used in post-sale NEPA analysis, ongoing ESA Section 7 Consultations, review of EPs, DPPs and other reviews for post-sale and post-exploration decision making and mitigation. Also, study results will be used in similar pre-lease analyses and documentation for potential future Chukchi Sea Lease Sale(s). This study addresses aspects of USGS Recommendation 3.05.

Total Cost: $750,000 plus Joint Funding **Period of Performance:** FY 2007-2012

Conducting Organization: USGS-BRD

Principal Investigator: Dr. Joel Schmutz

BOEM Contact: Catherine Coon

Description:
Background: Specific areas identified for study in this profile are very important Chukchi Sea coastal lagoons and embayments where waterfowl seasonally concentrate. These locations are vulnerable to industrial disturbance or oil spills potentially associated with offshore oil and gas exploration and development. Scientists have identified the lagoons, bays, and barrier islands along the Alaskan coast of the Chukchi Sea as important feeding, staging, and molting areas for relatively large numbers and a diverse assemblage of water birds breeding in both Alaska and Canada. Peard and Ledyard Bays and Kasegaluk Lagoon, in particular, appear to represent important staging and/or molting habitat for a variety of shorebirds, seabirds (nesting colonies at Point Hope, Cape Lewis, Cape Lisburne, Point Lay, Icy Cape, and Cape Thompson), and waterfowl. In particular, it is critical to identify high-use areas by threatened

Spectacled Eiders. Also, the USFWS was petitioned in 2004 to list the Yellow-billed Loon under the ESA and thus this species is of concern to BOEM. USFWS aerial surveys recorded fairly sizeable concentrations of Spectacled Eiders in Peard Bay, particularly in August which are presumably molting birds. Scientists have identified Kasegaluk Lagoon as a major fall staging area for a large proportion of the Pacific Flyway population of Black Brant (approximately 40%). Coastal aerial surveys and on-shore migration surveys encountered Yellow-billed Loons, particularly in the fall. Recent satellite telemetry locations of post-breeding Yellow-billed Loons provide additional evidence of the importance of nearshore habitat at Peard and Ledyard Bays, and offshore habitat near Point Hope in the Chukchi Sea. Though the OCS Environmental Assessment Program completed several avian studies in this region, most were done 15-20 years ago.

The BOEM share shown above represents 50 percent of the estimated total joint funding needed for a single component, loons only. Joint funding may be established through coordination with NSSI, BLM, USFWS, or USGS.

Objectives: Document spatial distribution, species composition, timing of use and residence times by foraging, molting, and staging Spectacled Eider, Yellow-billed and Red-throated Loons, and Pacific Black Brant in the vicinity of Peard Bay, Ledyard Bay, and Kasegaluk Lagoon in the eastern Chukchi nearshore environment.

Methods: Periodic low-level (45-50 meters) aerial surveys will be conducted along transects established perpendicular to the shoreline (late summer) and along open-water leads (spring) to document spatial distribution, species composition and timing of use by marine birds and waterfowl. Using a combination of implanted satellite and VHF transmitters, both local and long-distance movements of marked individuals will be documented during the breeding and post-breeding period for Yellow-billed and Red-throated Loons and staging Pacific Black Brant. A combination of behavioral observations and monitoring of implanted transmitters will be used to estimate distance flown/feeding flight, time away from nest, and food items provisioned to young for Yellow-billed and Red-throated Loons. Either satellite telemetry or transmitters and remote stations will be used to estimate peak arrival and departure times, as well as residence times, for a sample of Pacific Black Brant in Kasegaluk Lagoon. Using either focal or scan sampling techniques, proportion of time spent feeding (versus other behaviors) by staging Pacific Black Brant will be documented. Foraging behavior (e.g., foraging bout length, pecks/minute) and foods consumed will be quantified via direct observation. Collection of birds on various dates post-arrival would provide invaluable information on both diets and nutrient acquisition and energetics.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Pinniped Movements and Foraging: Bearded Seals (AK-07-08)

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 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 pre-lease analyses and documentation for potential future Chukchi Sea Lease Sale(s). This study addresses aspects of USGS Recommendations 3.05, 3.06 and 6.15.

Total Cost: $1,163,000 plus Joint Funding **Period of Performance:** FY 2007-2012

Conducting Organization: NMFS NMML

Principal Investigator: Dr. Peter Boveng

BOEM Contact: Dr. Dan Holiday

Description:

Background: Bearded seals are one of the most important resources for Alaska Native subsistence hunters of coastal northern and western Alaska. Early estimates of the Bering-Chukchi Sea population range from 250,000 to 300,000, and surveys flown from Shishmaref to Barrow during May-June 1999 and 2000 provided preliminary results indicating densities up to 0.652 seals km-2. However, densities could not be converted into abundance estimates without information on the proportion of animals hauled out. As adult bearded seals in these areas have never been live captured and instrumented with devices for estimating the haul-out proportion, a reliable estimate for the abundance of the Alaska stock of bearded seals is considered unavailable. Therefore, understanding the timing of haul-out behavior is important because abundance estimates are needed for developing sound plans for conservation, management, and response to potential environmental impacts of planned oil and gas activities.

Little is known of bearded seals' distribution throughout much of the year; however they are known to concentrate in specific areas for breeding and molting. Identification of these areas is important to assessment of potential impacts from industrial activities. Any potential industrial impacts on bearded seals could potentially be mitigated or magnified by climatic-induced change in the physical and biological habitat. Magnification of impacts seems the most likely, especially because reductions in sea ice may de-couple the co-occurrence of suitable ice and suitable benthic prey communities in those areas that have become traditional breeding and molting grounds for bearded seals.

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 alter the availability of walrus 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.

Objectives:

- Estimate the seasonal movements and patterns of distribution and behavior of bearded seals in the Chukchi Sea Planning Area.
- Identify and evaluate the priority of importance of specific marine habitats used by bearded seals in the Chukchi Sea Planning Area associated with key life history events such as breeding, pup rearing, foraging, and molting. Emphasis will be placed on movements of seals between nearshore areas where they are hunted for subsistence and offshore areas where industrial development is anticipated, such as potential high biomass areas in the vicinity of the Burger Prospect and Hanna Shoal.
- Improve the accuracy and precision of estimates of bearded seal abundance in the Chukchi Sea Planning Area by developing a haul-out correction factor that can be used to adjust existing survey counts for the proportion of seals that are at sea and not observed during aerial surveys.

Methods: Phases I & II will involve cooperation with Alaska Natives in northwestern Alaska.

Phase I will include: 1) communicating with hunters in villages along the coastline of northwest Alaska and St. Lawrence Island and other interested parties, to evaluate levels of interest in the proposed study and holding a workshop if useful; 2) evaluating satellite tagging technology, including equipment, deployment and attachment methods and making recommendations for proposed study(s); 3) considering the above, preparing an implementation plan for satellite tagging and data collection and exploring joint funding opportunities.

Phase II will include: 1) review of literature and data to develop hypotheses about habitat use and seasonal movements between winter and summer habitat; 2) training Native hunters or other coastal village residents to deploy satellite transmitters on selected pinnipeds in the vicinity of respective villages; 3) deployment of 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 pinnipeds; 4) analyzing data to test hypotheses and developing recommendations for mitigations of any likely effects of development on habitat use and migration; 5) maintaining data in a GIS and providing summaries of individual movements regularly on a public website. Results will be shared with residents of communities near the study area and participation of local Natives, especially young people, in analysis and interpretation of findings and conclusions will be encouraged.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): North Aleutian Basin

Title: Distribution, Abundance, and Habitat Use of North Pacific Right Whales (AK-07-x13)

BOEM Information Need(s) to be Addressed: The *Final Outer Continental Shelf Oil and Gas Leasing Program 2007-2012* (USDOI, MMS, 2007) considers a North Aleutian Basin (NAB) oil and gas lease sale for 2011. The proposed sale area (or areas adjacent) supports very important commercial and subsistence fisheries, provides habitat to numerous marine mammals, and is an important migration and staging area for internationally important waterfowl. Marine mammal species known to occur in or near the NAB include the listed Endangered or Threatened North Pacific right whale, fin whale, humpback whale, and Steller sea lions; the recently delisted gray whale; and the sea otter, which is proposed for listing. The study described here will provide information that was identified by the Alaska OCS Region as a highly time-sensitive and important decision-applicable information need for proposed oil and gas leasing. Information obtained is planned to be used in Section 7 Endangered Species Act consultation, for enhancing compliance with provisions of the Marine Mammal Protection Act and for pre- and post-sale NEPA/EIS analysis, documentation, and mitigation of potential effects of OCS exploration and development.

Total Cost: $5,450,000 plus Joint Funding **Period of Performance:** FY 2007-2011

Conducting Organization: NMFS, NMML

Principal Investigator: Dr. Phillip Clapham

BOEM Contact: Catherine Coon

Description:

Background: The eastern population of the North Pacific right whale (*Eubalaena japonica*) is arguably the rarest stock of whales anywhere in the world. Right whales throughout the North Pacific were drastically reduced by commercial whaling beginning in 1835, and the remnant eastern population was almost wiped out by illegal Soviet catches in the 1960s. Today, the surviving population likely numbers fewer than 100 whales, although little is known of its abundance, movements and current habitat use. Because of its endangered status under the Endangered Species Act (and designated as "critically endangered" by the IUCN), the eastern North Pacific right whale is among the highest priorities for recovery efforts by NOAA Fisheries. Historical data as well as recent observations confirm that the NAB lease-sale area is used by right whales for at least the period May-September; although it is generally assumed that the animals migrate out of the area during winter, this is based on very little information and has never been confirmed. It is also assumed that right whales occupy the NAB area to feed upon copepods, but oceanographic and foraging ecology studies of the region are lacking.

Objectives:

- Estimate seasonal distribution, abundance and movement patterns in and adjacent to the lease sale area.
- Characterize right whale habitat, foraging behavior, health, and prey distribution.

Methods: Activities will be coordinated with other programs (e.g. Bering Ecosystem Study [BEST], North Pacific Research Board's Integrated Ecosystem Research Program) so these relatively small-scale observations can be put into the broader context of conditions and processes occurring over the Bering Sea. Integrated ship-based research activities will provide information on right whale ecology and behavior at various spatial scales. Specifically, methods to be used include: 1) fixed-winged aircraft and ship-based surveys (focused in lease sale and adjacent area); 2) acoustic and satellite tagging of individual whales (lease sale area and critical habitat); 3) ship-based passive acoustic methodology to locate whales for tagging and observation; 4) passive acoustic methodology for year-round monitoring of presence and relative abundance (lease sale area, critical habitat, and potential migration routes from Bering Sea; 5) biopsy samples of right whales will be taken during tagging operations for analysis of genetics, pollutants and diet. In addition, samples of copepods will be taken during oceanographic operations to establish a baseline for contaminants in right whale prey prior to oil and gas development activity.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendations 3.05, 3.06 and 6.19.

Total Cost: $1,529,000 **Period of Performance:** FY 2009-2014

Conducting Organization: ADF&G

Principal Investigator: Lori Quakenbush

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 walruses 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 walrus 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendations 3.07, 6.06, 6.07, 6.08, 6.09, 6.11, 6.16 and 6.18.

Total Cost: $4,304,000 plus Joint Funding **Period of Performance:** FY 2010-2015

Conducting Organization: NOAA, NMML

Principal Investigator: Dr. Catherine Berchok

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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendation 3.05.

Total Cost: $2,000,000 **Period of Performance:** FY 2009-2014

Conducting Organization: USGS

Principal Investigator: Dr. Margaret Peterson

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 CSPA and BSPA.
- 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

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

BOEM Information Need(s) to be Addressed: A jointly-funded study could address information needs identified in a 2005 MMS funded study by 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, MMPA permitting, and development of related mitigation. This study addresses aspects of USGS Recommendations 3.05 and 6.14.

Total Cost: $1,361,000 plus Joint Funding **Period of Performance:** FY 2009-2014

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

Principal Investigator: Dr. Lily Peacock, Dr. Eric Regehr

BOEM Contact: Mary Cody

Description:
Background: ESA candidate 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 deep Arctic sea ice 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.

Partnership opportunities, such as those with other USDOI Bureaus, may be available and will be explored as a potential means for initiating this study.

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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendations 3.07, 6.08 and 6.09.

Total Cost: $4,787,000 **Period of Performance:** FY 2011-2016

Conducting Organization: NOAA-NMML

Principal Investigator: Dr. Megan Ferguson, Janet Clarke

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:

- 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 for use in protection of this Endangered Species, if needed.
- 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.
- Determine seasonal distribution of endangered whales in other planning areas of interest to BOEM.

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 the 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: September 2011

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendations 3.07, 6.08 and 6.09.

Total Cost: $8,750,000 **Period of Performance:** FY 2011-2016

Conducting Organization: USDOI 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.) 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 USDOI National Business Center's Aviation Management Directorate will issue contracts to private companies to obtain the needed aircraft services.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendations 5.23, 5.24, 5.26, 6.01, 6.06, 6.08, 6.09, 7.01 and 7.03.

Total Cost: $1,798,000 **Period of Performance:** FY 2011-2016

Conducting Organization: NOAA- Pacific Marine Environmental Laboratory

Principal Investigator: Dr. Sue Moore, Dr. Phyllis Stabeno

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, 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, as expected from the CO_2 anthropogenic contribution alone.

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.

Given the continuing retreat of sea ice and the known high-latitude range of these species in other oceans, it is likely that the recent sightings represent a climate-related range expansion that will continue in future years. Other changes in behavior and/or expansion of feeding areas also may accelerate as ice continues to degrade and water temperatures rise.

Between the years 2005 and 2015 MMS/BOEM will invest approximately $50,000,000 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
- Arctic marine research studies supported through NOPP
- Studies conducted by the State of AK and the North Slope Borough under the USDOI Coastal Impact Assistance Program (CIAP)

Objectives:

- Increase scientific understanding of the inter- and intra-relationships of oceanographic conditions, lower trophic prey species, such as small fish and krill, 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 synthetic approach, PIs will analyze data available from BOEM supported, and related, studies in the Chukchi Lease Sale Area and adjacent waters, 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 (with significant data preparation and analysis beforehand). 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. If useful, PIs may integrate data with

on-going oceanographic programs (e.g. RUSALCA and the Distributed Biological Observatory) to inform ecosystem models and enhance their predictive capability. After analyses are completed, sub-groups will 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: September 2011

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Social and Economic Assessment of Major Oil-Spill Litigation Settlement for the Alaska OCS Region (AK-03-12)

BOEM Information Need(s) to be Addressed: The potential social costs of major coastal oil spills are a public concern associated with OCS development in the U.S. Insofar as the effects of EVOS continue to frame community response to oil and gas development, comprehensive understanding of the event and its various effects are of great interest to the BOEM and the Alaska OCS Region. This study will be used in EAs and EISs for predicting and mitigating social effects potentially resulting from major oil spills and resulting oil-spill litigation. This information will be used for NEPA analysis and documentation for Beaufort Sea Lease Sales, Cook Inlet Lease Sales, Chukchi/Hope Basin Lease Sales, and DPPs.

Total Cost: $252,000 **Period of Performance:** FY 2003-2011

Conducting Organization: Impact Assessment, Inc.

Principal Investigator: Dr. Edward Glazier

BOEM Contact: Chris Campbell

Description:
Background: Major oil spills such as the 1978 *Amoco Cadiz* and 1989 *Exxon Valdez* oil spill (EVOS) events led to a variety of documented social and economic effects. But spill-related litigation and settlement processes and their effects have not been a common topic of socioeconomic research. Regarding EVOS, social scientists speculate that final settlement and distribution of award monies will lead to various beneficial and detrimental secondary effects in addition to those related to the original spill and cleanup events and subsequent phases of litigation. The nature and intensity of such effects hypothetically relate to socioeconomic, demographic, and other attributes of recipients, and to the nature of experience with the spill and litigation.

A recently completed MMS-sponsored study about EVOS, its cleanup and litigation, which collected social impacts information and analysis, provides a comprehensive qualitative overview of general information which will provide useful background to the present quantitative effort.

Objectives: Analyses of data collected in spill-affected communities soon after the EVOS event report that existing social problems were heightened in relation to the influx of spill clean-up monies and resources, particularly in rural-Native communities where access to subsistence resources was limited. Subsequent analyses suggest that larger communities have benefited from opportunities such as eco-tourism that were not extant before the spill. It may

be hypothesized that spill clean-up and restoration monies and resources served to amplify social, demographic, and economic trends and attributes of the awardees in all cases at individual, familial, and community levels of analysis. The objective of this study is to test this hypothesis given potential future influx of monies and resources via final litigation settlement.

Methods: The study will require compilation and analysis of existing data, collection of new pertinent information, coordination with similar research conducted in the region, detailed comparative analysis, and development of summary conclusions. The methods are:

1. Compile and summarize existing data and scholarship regarding pre- and post-EVOS socio-economic conditions and trends on Kodiak Island. Continue to monitor annually updated public access data for changes in demographic trends throughout the study period.
2. Secure ethnographic research access from appropriate local authorities in two different Kodiak village communities. Also secure ethnographic research access to the City of Kodiak.
3. Conduct ethnographic fieldwork in all three Kodiak locations. The fieldwork will involve community level participant-observation in relevant public forums, as well as open ended conversations with a sample of community households in each location from different levels of socioeconomic strata. The fieldwork is intended to gather information about potential changes in key socioeconomic indicators such as: residency and migration patterns, occupational profiles, patterns of investment and return, specialization vs. diversification in commercial fishing operations, specialization vs. diversification in traditional subsistence activities, and other selected social practices.
4. Conduct focus-group forums in all three fieldwork locations to supplement and compare with insights gained from step 3 above. It is expected that different community-level concerns and issues relevant to the litigation settlement process will surface in a focus-group forum that go unexpressed at household level conversations.
5. Analyze the various data compiled above to develop a descriptive comparative analysis of the interim socioeconomic effects and expectations of the litigation experience in each community under investigation. Report the findings at the end of project Phase One (prior to final spill litigation settlement/award distribution).
6. After a final litigation settlement is reached, conduct a second round of fieldwork to gather comparable data for the same categories of variables from all three communities. Analyze the data and report the findings at the end of project Phase Two (some months after the final distribution of settlement awards).
7. Produce a detailed written summary analysis that is responsive to the original hypothesis of the project. Report on major insights and general recommendations relevant to the effective management of future potential oil spills and related litigation and settlement.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Study of Sharing Networks to Assess the Vulnerabilities of Local Communities to Oil and Gas Development Impacts in Arctic Alaska (AK-05-04a)

BOEM Information Need(s) to be Addressed: The information from this will be used for NEPA analysis and documentation for Beaufort Sea and Chukchi Sea Lease Sales and DPPs. This study addresses aspects of USGS Recommendations 3.06, 3,08, and 6.10.

Total Cost: $785,000 plus Joint Funding **Period of Performance:** FY 2007-2012

Conducting Organization: UAF, Resilience and Adaptation Program

Principal Investigator: Dr. Gary Kofinas, Dr.Shauna BurnSilver

BOEM Contact: Chris Campbell

Description:

Background: Many previous MMS studies have documented various aspects of subsistence harvest throughout Coastal Alaska. These studies have identified and hypothesized patterns of change within subsistence-oriented behaviors that occur in association with local changes in income level, demographics, access to resources, and wildlife population/habitat change. Subsistence issues always dominate the public testimonial record, amply demonstrating the continued importance of food harvest, distribution, and consumption to coastal communities and the persistence of their concern over potential cumulative impacts from oil and gas development on social and cultural continuity.

Over the years, MMS has produced a wealth of information about household subsistence harvests by quantity, location, species, and month of harvest. But our research has not yet explored systematically the equally important latter half of the subsistence process: the complex social dynamics of sharing and consuming resources after they are harvested. In Native communities, the distribution and exchange of subsistence resources have traditionally operated under complex codes of participation, partnership, and obligation. It is thus plausible that incremental changes in subsistence activities could have corresponding social system effects. This study seeks to identify key nodes and thresholds in community food distribution networks to assess their vulnerabilities and resiliency to change.

Objectives:

- Explore, quantify, and document the social dynamics and significant changes of subsistence resource distribution and consumption for residents of selected coastal communities of the Beaufort Sea and Chukchi Sea.

- Quantify (through baseline and trend data) and explain (through ethnographic fieldwork) any identifiable changes in the social distribution of subsistence resources over time and geographic space.
- Evaluate from the empirical research the need for further research by assessing whether any documented changes in subsistence activities might feasibly produce substantial changes in the dietary behaviors and health status of identifiable Native groups (such as elders, single women, children, adolescent males, unskilled hunters, etc.).

Methods:

1. Conduct a literature search on the social dynamics of distributing and consuming subsistence resources in the Arctic region of Alaska; Identify what has been documented to date.
2. Evaluate the utility of building upon previous data sets to establish the needed statistical validity and power to establish adequate baseline and trend data for this study.
3. Prepare a strategic survey instrument that is both statistically and socially appropriate, and obtain OMB approval to use it.
4. Coordinate with local communities and appropriately conduct the surveys where feasible.
5. Conduct supplementary ethnographic fieldwork to secure the reliability of collected survey data and to obtain the "emic" perspective necessary to interpret and explain survey results.
6. Assess the field data and estimate confidence in / significance of changes in distribution or consumption of subsistence resources.
7. Explain any documented changes by reference to fieldwork and published literature.
8. Conduct post-fieldwork meetings with appropriate individuals in surveyed communities to cross-check and review fieldwork results.
9. For statistically significant observed relationships, assess the plausibility of linkages between a) regional changes in subsistence and oil development activities and b) changing dynamics in the social distribution and consumption of subsistence resources; assess the need for further research to explore any implications for changing dietary behaviors and health status for identifiable members of coastal communities.
10. Report the results to participating communities through public meetings or workshops.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Continuation of Impact Assessment for Cross Island Whaling Activities (AK-08-01)

BOEM Information Need(s) to be Addressed: Offshore production at the Northstar facility started in November 2001. The Liberty prospect continues to indicate promise of future production on the OCS. Long-term study efforts to monitor potential effects of such development activities have occurred through the ANIMIDA and cANIMIDA projects, 1999-2007. There remains a continuing, ongoing need to monitor Cross Island whaling activities for potential impacts over the next five years. The information will be used for NEPA analysis and documentation for Beaufort Sea Lease Sales and DPPs. This study addresses aspects of USGS Recommendations 3.06, 3.07, 3.08, and 6.10.

Total Cost: $250,000 **Period of Performance:** FY 2008-2012

Conducting Organization: Applied Social Cultural Research

Principal Investigator: Michael Galginaitis

BOEM Contact: Chris Campbell

Description:
Background: The Northstar facility is in State waters, but includes production of some OCS oil through directional drilling. The Liberty prospect may access OCS oil deposits through directional drilling from an onshore facility. The last field season for previous ANIMIDA and cANIMIDA multi-disciplinary monitoring efforts in the near-shore Beaufort Sea environment was 2007. This proposed study, however, intends to extend the long-term ethnographic monitoring effort for subsistence whaling activities that occur from the base camp at Cross Island.

Objectives: This study will gather long-term monitoring data to help assess whether OCS oil development activities at Northstar and/or Liberty result in changes to bowhead whale subsistence hunting practices, or to hunting success at Cross Island. The first objective is to understand Cross Island subsistence whaling variation over time. The second objective is to evaluate the relationship of offshore oil and gas industrial activities to whaling variability.

Methods: This study continues the essential methods established during the ANIMIDA and cANIMIDA phases of research. It calls for systematic observational and interview data collection from local informants about: 1) number of whales taken; 2) Global Positioning System (GPS) location of whale strikes, with direction and distance from Cross Island; 3) number of crews, composition of crews, total number of crew; 4) periodic “census” of

whaling participants on Cross Island, 5) duration of whaling season by active days; 6) timing of whaling; 7) length of trips and area searched while whaling; 8) records of catch per unit effort; and 9) observations of whaling participants. The study will also record systematic and observational/interview data collection on 1) non-whaling subsistence activities on and near Cross Island; 2) observations of local subsistence users. Hard copy maps will be appended as necessary for clarification of location information. The recorded data will be presented in an annual report using tabular information on harvest levels and locations of subsistence resources taken on or near Cross Island.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: COMIDA: Impact Monitoring for Offshore Subsistence Hunting (AK-08-04)

BOEM Information Need(s) to be Addressed: This study will constitute a key component of Chukchi Sea environmental studies pertinent to Chukchi Sea Lease Sale 193 scheduled for 2007. Industry has expressed strong interest in leasing in this area, likely followed by exploration and possibly development. The COMIDA Workshop in November 1-3, 2006 recommended the monitoring of offshore subsistence hunting. The BOEM needs to establish an early baseline in the area and to monitor on an annual basis any significant changes in subsistence activities over time. In particular, monitoring efforts should be directed toward the hunt for marine mammals, including bowhead and beluga whales, walrus, polar bears, and seals. 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. This study addresses aspects of USGS Recommendations 3.06, 3.07, 3.08, and 6.10.

Total Cost: $785,000 **Period of Performance:** FY 2009-2012

Conducting Organization: Stephen R. Braund and Associates

Principal Investigator: Stephen R. Braund, Dr. Jack Kruse

BOEM Contact: Chris Campbell

Description:

Background: The oil and gas industry has expressed strong interest in leasing in this Planning Area under Sale 193, which may be followed by further exploration and possibly development. In order to assure methodological continuity over time for a potentially large exploration area, appropriate planning and implementation of post-lease monitoring baselines are needed. There is very little up-to-date information about offshore subsistence activities along the Chukchi coast, and there is acute need for more information in the vicinity of Wainwright and Point Lay, where development might make landfall.

Objectives: This study will gather long-term monitoring data to help assess whether OCS oil development activities in the Chukchi Sea will result in changes to offshore subsistence hunting practices. The first research question is whether subsistence hunting in the Chukchi Sea displays significant variation over time. The second question is whether such variation can be attributed to offshore oil and gas industrial activities.

- Monitoring Hypothesis 1: Offshore subsistence hunting patterns in the vicinity of Wainwright and Point Lay do not vary significantly from year to year.
- Monitoring Hypothesis 2: Variations in offshore subsistence hunting patterns are not related to offshore oil and gas activities.

Methods: This project will entail extensive community engagement. Early procedures will involve issue nomination and/or confirmation from the North Slope Borough Fish and Game Management Committee and community representatives. Researcher must establish a protocol or mechanism to facilitate community participation and a meaningful role in the technical aspects of monitoring efforts. Use of focus groups and community dialogue will help to establish acceptable fieldwork procedures for systematic observations and data collection, including: harvesting patterns and numbers; locations of strikes, with direction and distance from shore; number of hunting groups and composition; duration of hunting activities by active days; length of hunt and area searched; estimated costs per unit effort; report of any accidents or mishaps; and report of weather conditions and ice conditions. Much of the technical data may be recorded by Global Positioning System (GPS) instruments that the project will provide to cooperating local hunters, and may be supplemented by ethnographic observation and conversation. Researchers will then analyze collected information and provide a summary report at the end of each hunting season, with review opportunities by respective host communities to achieve collaborative results.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): North Aleutian Basin

Title: Subsistence Study for North Aleutian Basin (AK-08-06)

BOEM Information Need(s) to be Addressed: The proposed North Aleutian Basin (NAB) sale area (or areas adjacent) supports very important commercial and subsistence fisheries, provides habitat to numerous marine mammals, and is an important migration and staging area for internationally important waterfowl. Subsistence is a major and sensitive component of the social and economic system of the area potentially affected by proposed offshore oil and gas leasing in the NAB. The information from this study will be used for pre- and post-sale NEPA/EIS analysis, documentation, and mitigation of potential effects of OCS exploration. Study results will also serve as community baselines to monitor and mitigate any significant future changes in subsistence activities over time.

Total Cost: $340,000 **Period of Performance:** FY 2009-2012

Conducting Organization: Idaho State University

Principal Investigator: Dr. Kate Reedy-Maschner

BOEM Contact: Chris Campbell

Description:
Background: More than 20 communities in the SW Alaska-Bristol Bay area rely heavily on subsistence or commercial fisheries. For example, Dutch Harbor processes a peak of 70 million lbs. per week - ½ the total US annual catch and is the largest seafood port in the world. It would be difficult to identify an area in the Bering Sea, or possibly anywhere in the world that has greater fisheries, protected species, or human use issues than this proposed sale area. The MMS-sponsored "North Aleutian Basin Information Status and Research Planning Meeting" recently identified 31 studies that could provide useful information to upcoming National Environmental Policy Act (NEPA) Environmental Impact Statements, analysis of potential mitigation of impacts, and post-sale needs such as for use in NEPA reviews of exploration or development plans. Of those, this study profile has been identified by the Alaska OCS Region as a highly time-sensitive and important decision-applicable information need, and of such mission importance that it should be initiated as soon as possible to assure information availability if NAB remains in the proposed 5 year program. This study would provide key subsistence baseline data for the region. There is an acute need for information in the vicinity of False Pass, Nelson Lagoon, Port Heiden, and other representative communities. Phase I of the study is intended to initiate data collection in those named communities most proximate to the proposed sale area where exploration activities may soon occur. Later phases are anticipated that will increase the range of surveyed communities to establish a broader regional baseline, as potential exploration or development in the NAB achieve greater definition.

Objectives:

- Gather current household and community data on subsistence harvest and sharing activities.
- Supplement survey data with local ethnographic and qualitative context, including household economics and local/traditional knowledge.
- Identify predominant patterns of subsistence activities by household and community, and identify approximate ranges of variation.

Methods: All phases of this study shall be conducted in close collaboration with the BOEM and relevant stakeholder institutions at the regional and community level. Researchers will conduct a focused literature search to review and assess the current state of knowledge about subsistence food harvest and distribution behaviors in the region of interest. The researchers will create and implement a survey instrument as appropriate for the study objectives, and obtain formal approval to use it from the US Office of Management and Budget. The researchers shall also conduct focused ethnographic fieldwork on subsistence food harvest and sharing behaviors in host communities. The researchers shall comprehensively analyze the quantitative and qualitative field data to achieve interpretation and explanation of relevant behaviors and submit the full analysis in a final technical report.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Aggregate Effects Research and Environmental Mitigation Monitoring of Oil Industry Operations in the Vicinity of Nuiqsut (AK-08-09)

BOEM Information Need(s) to be Addressed: The study will serve to verify and/or improve the effectiveness of pre-lease mitigation strategies and post-lease operations for future development activities on the OCS. 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 Beaufort Sea. This study addresses aspects of USGS Recommendations 3.06, 3.08, 6.10, and 7.03.

Total Cost: $350,000 **Period of Performance:** FY 2009-2012

Conducting Organization: Stephen R. Braund and Associates

Principal Investigator: Stephen R. Braund, Dr. Jack Kruse

BOEM Contact: Chris Campbell

Description:
Background: The recent completion of several oilfield development projects, both onshore and offshore, in the vicinity of subsistence use areas for the village of Nuiqsut creates an opportunity to study and evaluate empirically the effectiveness of specific mitigation measures and processes in village Alaska. Social research can ascertain and document a wide range of information about some of the following pertinent questions:

- What is the track record for implementing mitigation plans over the life of a project?
- Have formal mitigation efforts been effective in reducing anticipated effects?
- What types of mitigation effort seem to work best to reduce social conflict?
- Have informal mitigation mechanisms emerged, and with what effect?
- What is the cumulative effectiveness of regional mitigation across multiple projects?
- How do various responsible agencies actually monitor and measure mitigation effects?
- Have industry operations been responsive to community feedback?
- What scientific parameters are appropriate to evaluate mitigation retrospectively?
- What specific data sets are most useful to collect before, during, and after a project?
- Are there significant social nuances to the mitigation process that merit further research?

This study will proceed as an inter-agency project, with at least collaborative manpower contributions from both federal and state agency representatives. Other cooperative funding may be established through coordination with NSSI, BLM, USFWS, and/or the State of Alaska and private industry.

The study is intended to pilot-test the prospects for a more comprehensive future undertaking by limiting the initial scope of research to a few recent exploration and development projects. The projects to review would likely include Northstar, McCovey, Endicott, Alpine and satellites, NPR-A exploration, and the most recent fields in Kuparuk (Meltwater and Tarn). The most substantial topics would likely derive from mitigation efforts affecting the human environment in and around the Colville Delta. For example, Alpine provides some concrete manifestations of publicly contested outcomes that might warrant focused research in the proposed study. Nuiqsut residents have asserted prominent discrepancies between pre-development guarantees and post-development realities with regard to many specific issues. The study would encompass research and documentation of both objective and subjective interpretations of mitigation effects.

Objectives:

- Systematically identify the formal and informal mechanisms that relevant actors have negotiated and implemented in Development and Production Plans or Exploration Plans to mitigate specific anticipated impacts from oil development in the vicinity of Nuiqsut and its subsistence area, both onshore and offshore.
- Develop a rigorous analytic method to evaluate the social effectiveness of mitigation measures and their predictability as they pertain to North Slope residents.
- Establish an empirical basis to distinguish offshore/onshore oil related social impacts.
- Provide socio-cultural insights into the challenge of mitigation to enhance government performance in predicting, monitoring, and managing the oil development process.

Methods: Project sponsors will need to establish an appropriate steering committee across federal/state agencies to facilitate the study execution and to achieve a specific division of labor. Researchers will conduct a literature search to investigate and annotate the documented social nuances of mitigating social impacts within the framework of NEPA. Researchers will record a concise history of recent oilfield exploration and development near Nuiqsut. This may involve literature search, interviews, and fieldwork. Researchers will investigate and document the history of negotiated mitigation measures for select oil related exploration and development activities near Nuiqsut. They will identify and analyze both the formal and informal mitigation mechanisms that have emerged over time. Researchers will quantify industry/community interactions in relevant categories of analysis. Researchers will analyze the collected data to develop an objective narrative of events and interactions, including alternative stakeholder interpretations of past interactions to emphasize relevant subjective features of the mitigation process. Researchers will then summarize the findings and provide explicit analysis to improve agency understanding and management of the social process of mitigating impacts from oil development.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska

Title: MAG-PLAN Modification: New Data Collection, Testing, and Streamlining of OCS Economic Impact Model for Alaska (AK-08-10) (Short Title: MAG-PLAN Alaska Upgrade Study)

BOEM Information Need(s) to be Addressed: MAG-PLAN provides the quantitative basis for the mandatory equitable sharing analysis in 5-year program development and the required employment forecasts for 5 year and lease sale Environmental Impact Statements (EISs) and Environmental Assessments. Testing and improvement of MAG-PLAN Alaska, along with incorporation of the most recent data available, will substantially improve confidence in user efficiency and BOEM forecasts of employment and personal income expected to result from proposed OCS activities on the Alaska OCS. Better data will aid broader BOEM efforts to understand the local and regional consequences of the program as industry activities expand or contract. This study addresses aspects of USGS Recommendation 7.02.

Total Cost: $589,000 **Period of Performance:** FY 2009-2012

Conducting Organization: Northern Economics, Inc.

Principal Investigator: Patrick Burden

BOEM Contact: Jerry Brian

Description:

Background: The BOEM maintains two versions of an OCS Economic Impact Model (EIM) called MAG-PLAN to provide a consistent bureau-wide approach to estimating employment, personal income, and similar results of OCS activities. Each version is a Microsoft Access-based, 2-stage model that uses OCS-specific "cost functions" to estimate the industry expenditures required to complete a given activity, such as drilling an exploration well or operating a production facility. The second stage uses region-specific economic multipliers from the commercial economic modeling system IMPLAN to forecast employment, personal income, and other variables resulting from the initial industry expenditures.

There are four major reasons to upgrade MAG-PLAN Alaska:

1. BOEM employees used MAG-PLAN for the latest round of 5-year program and EIS analyses and identified certain problems in the model including file instabilities.
2. Almost all model data came from engineering cost estimates (extrapolating from onshore and State-waters projects) developed for two studies (Arctic IMPAK and Sub-Arctic IMPAK) about a decade ago. MAG-PLAN Alaska adjusts this data to account for inflation, but that adjustment does not fully account for changes that have occurred over the interim, including advances in technology and significant industrial investment in the Alaska OCS.

3. Much of the supporting model data is inadequate for frontier planning areas, which have attracted far more industry interest than was apparent when earlier model planning decisions were made. The frontier planning areas are sufficiently different from the Beaufort Sea and Cook Inlet, respectively, that more targeted data and revised cost functions are needed.
4. The internal sector-allocation equations in the model will have to be changed to make MAG-PLAN compatible with recent changes in the way industry inputs data to IMPLAN.

The BOEM has created a Modeling Review Board (MRB) to assist in the technical oversight of this MAG-PLAN upgrade effort. The MRB consists of a group of consultants (including the project manager for the two studies that provided the current MAG-PLAN Alaska data) who will provide expert advice to BOEM regarding all aspects of this contract. The MRB will provide expertise in evaluating the review and testing of the actual model, suggest possible improvements and solutions to problems, and provide review and comments on all deliverables.

Objectives: The objective of the MAG-PLAN Alaska Upgrade Study is to strengthen and refine the Bureau's procedures for estimating the onshore economic effects of OCS-related activities by updating and enhancing the current version of MAG-PLAN Alaska.

Methods: This project will involve coordinating five linked but separate research efforts:
1. testing and streamlining MAG-PLAN functionality;
2. identifying and collecting industry expenditure data;
3. creating better "Offshore Modeling Area" data and model structure for frontier planning areas;
4. revising industry sector codes to match current IMPLAN sectoring scheme and incorporating the new codes into MAG-PLAN equations; and
5. documenting all efforts.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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: $670,000 **Period of Performance:** FY 2011-2014

Conducting Organization: SRB & Associates

Principal Investigator: Dr. Jack Kruse

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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea

Title: Subsistence Use and Knowledge of Beaufort Salmon Populations (08-12-04)

BOEM Information Need(s) to be Addressed: This study will collect information on subsistence harvest and traditional knowledge (TK) of salmon that will be used to meet Essential Fish Habitat and NEPA requirements for Beaufort Sea lease sales. This research will inform local communities, local and State resource managers, and BOEM of ecosystem health, which is so important to subsistence lifestyle. This study addresses aspects of USGS Recommendation 3.06.

Total Cost: $120,000 plus Joint Funding **Period of Performance:** FY 2009-2012

Conducting Organization: CMI, UAF

Principal Investigator: Dr. Courtney Carothers

BOEM Contact: Chris Campbell

Description:
Background: The National Marine Fisheries Service has defined the entire OCS of the Beaufort Sea as Essential Fish Habitat (EFH) for all five Alaskan salmon species (king, sockeye, coho, chum & pink). As a result, BOEM and NMFS must consult about the effects that proposed oil and gas developments in the Beaufort OCS might have on essential salmon habitat. Although salmon EFH has been designated, salmon are rare in the Beaufort Sea. During the summer, adult pink and chum salmon are present in the Colville River and its tributaries, and caught in small subsistence fisheries by Native Alaskans living in the area. Previous studies have not demonstrated significant numbers of adults of other species. Immature life stages and successful spawning have not been found in the Beaufort Sea area. However, local residents have testified in MMS hearings that more and different salmon are being caught in their subsistence fisheries. Salmon populations on the North Slope could expand if the recent trend of mild winters continues. There are no recent estimates on the extent of subsistence use of salmon along the Beaufort Sea.

This study will document local observations of increasing numbers of salmon in subsistence fisheries and close the knowledge gap by synthesizing relevant research and conducting ethnographic fieldwork among the Iñupiat communities about changing salmon populations/species composition. This data will update information on subsistence harvest and TK about salmon. The study will also map and document the spatial and temporal distribution of salmon species in streams, and may provide more specific information about effects of warming temperatures in Arctic waters upon signal species like salmon.

Objectives:

- Establish a strong rapport with local community residents and regional experts.
- Document the current subsistence use of various Beaufort Sea salmon populations in Barrow, Nuiqsut, and Kaktovik or Atqasuk.
- Document the local and traditional knowledge of historic and recent trends in salmon use, abundance, and distribution.
- Better understand the Iñupiaq context for ecological observation and appropriate uses of such knowledge.
- Use spatial and ethnographic data to identify streams and coastal areas where salmon have been harvested or observed.
- Locate and document the principle areas used by various salmon species near OCS developments in the Beaufort Sea.

Methods: This study has two phases, with the second phase being contingent upon recommendations resulting from analyses conducted in Phase I. In Phase I, the investigator will: 1) conduct a literature review; 2) complete about 20 formal interviews with key informants; 3) generate a master map of each community region to mark salmon presence areas as identified by informants; 4) annotated bibliography of relevant literature; 5) prepare a synthesis report encompassing literature, interviews, TK, and spatial data; 6) recommend whether Phase II field research is needed and the methodology to be used to conduct field investigations necessary to fill data gaps. In Phase II, the investigator will: 1) conduct fieldwork using methodology and study designs developed in Phase I; 2) prepare a report updating information, about species composition salmon in the Beaufort Sea, including population sizes, spawning habitat, and rearing habitat.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Conference Management and Reports on BOEM Results (AK-07-06)

BOEM Information Need(s) to be Addressed: Conference management supports formal information transfer meetings (ITMs) to disseminate study results and to resolve environmental and technical issues for BOEM program managers. ITMs also increase public confidence in the data used by the OCS program. Workshops may be coordinated with future lease sales and for NEPA analyses and documentation focusing primarily on the Beaufort Sea and Chukchi Sea. This study addresses aspects of USGS Recommendations 5.23, 5.26 and 7.01.

Total Cost: $200,000 **Period of Performance:** FY 2008-2011

Conducting Organization: BGES, Inc.

Project Manager: Robert N. Braunstein

BOEM Contact: Rick Raymond

Description:
Background: The transfer of scientific information is continuous and the Alaska Environmental Studies Program (ESP) needs to constantly organize and conduct ITMs and workshops. Conference participants have the opportunity to exchange environmental studies information with experts and interested parties on selected topics oriented to formulating concepts for new research projects and/or to address study needs. During the past decade the Alaska ESP has held information status meetings and planning workshops for the exchange of studies information among scientists, stakeholders and the general public.

To improve the accessibility, use and exchange of study results, the Alaska OCS Regional office conducts public meetings with a variety of formats. Generally, ITMs are 3-day events and workshops of shorter duration (1 to 2 days in length) that may focus on a single discipline or topic. ITM conferences make clear the scope and detail of information-gathering activities relating to the Alaska OCS. They give interested parties an opportunity to participate in discussions of important topics dealing with oil and gas leasing, exploration, and development in the Arctic region. They also serve as opportunities for regional staff to learn about the information that has been gathered and, therefore, help ESP to formulate study plans for future years.

Objectives: The objective of this procurement is to provide the logistical support for small meetings and workshops to highlight the work of the Environmental Studies Program in Alaska and foster sharing of information among researchers and interested parties through small meetings, workshops and publications on OCS environmental studies information.

Methods: The primary method is to manage meetings and workshops and assist with preparation, coordination, logistics, program agenda, and invitation of speakers and participants.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska OCS 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. This study addresses aspects of USGS recommendations 5.23, 5.26, and 7.01.

Total Cost: $100,000 **Period of Performance:** FY 2010-2015

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

Project Manager: Katie Blake

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 comingle 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 with 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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 2010-2012

Conducting Organization: Kinnetic Laboratories Inc.

Project Manager: Mark Savoie

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 Bowhead Whale Feeding Variability studies, the meteorological station at Cottle Island, 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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). This study addresses aspects of USGS Recommendation 3.08.

Total Cost: $482,000 **Period of Performance:** FY 2011-2015

Conducting Organization: Nuka Research and Planning Group

Principal Investigator: Tim Robertson

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.
- 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).

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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: BOEM / University of Alaska / State of Alaska / Coastal Marine Institute – Management (AK-08-12-01)

BOEM Information Need(s) to be Addressed: By adopting this cooperative agreement, improved leasing decisions and EIS analyses pertinent to lease sales in the Beaufort Sea, Cook Inlet, Gulf of Alaska, and Chukchi Sea/Hope can be made. 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. This study addresses aspects of USGS Recommendations 5.26 and 7.01

Total Cost: $750,000 plus Joint Funding **Period of Performance:** FY 2008-2013

Conducting Organization: CMI, UAF

Project Manager: Dr. Michael Castellini

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 $750,000 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 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: September 2011

2.2 Profiles of Studies Proposed for FY 2012 National Studies List (NSL)

Table 1 Alaska OCS Region Studies Proposed for the FY 2012 NSL

Page No.	Discipline	Title	Ranking
151	HE	Distribution of Fish, Crab and Lower Trophic Communities in the Chukchi Sea Lease Area (AK-11-08)	1
153	FE	Maximum Credible Blowout Occurrence and Size Estimators for the Alaska OCS (AK-11-12)	2
155	FE	ANIMIDA III: Boulder Patch and other Kelp Communities in the Development Area (AK-11-14a)	3
157	IM	Conference Management and Reports on BOEM Results	4
159	IM	Alaska Environmental Database (AK-11-15)	5
161	IM	Workshop—Interagency Protocols for Immediate On-Scene Arctic Oil Spill Impact Science (AK-11-11)	6
163	MM	Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring	7
165	PO	Characterization of the Circulation on the Continental Shelf Areas of the Northeast Chukchi and Western Beaufort Seas	8
167	PO	**Applications for Mapping Spilled Oil in Arctic Waters	9
169	HE / PO	U.S.-Canada Transboundary Fish and Lower Trophic Communities	10
171	HE	Distribution and Habitat Use of Fish in the Nearshore Ecosystem of the Beaufort and Chukchi Seas	11
173	PO	High-Resolution Digital Bathymetry Dataset	12
177	MM	**Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST)	13
179	MM	**Ice Seal Movements and Foraging: Village-based Satellite Tracking and Acoustic Monitoring of Ringed, Bearded, and Spotted Seals	14

AQ = Air Quality
IM = Information Management
PO = Physical Oceanography
FE = Fates & Effects
SS = Social Systems
HE = Habitat & Ecology
MM = Marine Mammals and Protected Species
REN = Renewable Energy

** Denotes project that remains contingent on collaboration with external groups.

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Distribution of Fish, Crab and Lower Trophic Communities in the Chukchi Sea Lease Area (AK-11-08)

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. This study addresses aspects of USGS Recommendations 3.07 and 4.01.

Total Cost: TBD **Period of Performance:** FY 2012-2014

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 2009 study "Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemistry and Benthos (CAB)." This will also complement the 2010 LGL component of COMIDA CAB that undertook midwater and benthic fishery samples at 20 sites 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. This study would contribute to further knowledge of pelagic fishes in the northeast Chukchi Sea. Data from this study will provide abundance and distribution information for NEPA analysis on fish and invertebrate species. This study will coordinate with the BOEM central Beaufort Sea Fish Survey for under-ice pilot survey which will occur near Barrow, Alaska, and examine the potential for using icebreakers for fish samples in the ice-covered season. The pilot under-ice marine survey will implement a design outlined in the 2007 MMS "Under-Ice Sampling Workshop."

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. A MMS Beaufort Sea fish survey in 2008 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 their subsistence foods critical to their way of life. Although the Chukchi has historically been considered a benthic dominated system, the data that are available 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, ice-dependent 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: Conduct a one-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 such that it compliments and extends recent work in the COMIDA CAB, and could provide for collaboration with the logistics and project goals of the Arctic Ecosystem Integrated Survey scheduled for 2012 in the northeastern Bering Sea to the southern portion of the Chukchi Sea. 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 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.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska OCS Planning Areas

Title: Maximum Credible Blowout 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. This study addresses aspects of USGS Recommendation 5.22.

Total Cost: TBD **Period of Performance:** FY 2012-2014

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 analysis and probabilities of blowout 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 worst case spills from well control incidents in NEPA analyses.

A blowout is defined as uncontrolled flow of formation or other fluids from the reservoir to an exposed formation (an underground blowout) or at the surface (a surface blowout). *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 blowout frequency information through 2010 for the Gulf of Mexico, the North Sea, Australia and other areas with a comparable regulatory regime.
- Apply statistical procedures to develop blowout 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.

Methods: The investigators will collate and analyze available data on offshore blowouts in the Gulf of Mexico, the North Sea, Australia and other areas with a comparable regulatory regime. Existing maximum credible blowout examples (probability, size, and basis) from regional (Alaska) oil spill contingency plans and environmental assessments will also be reviewed. The investigators will calculate blowout frequencies and perform appropriate statistical analyses, including trend analysis.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendations 3.04, 3.07, 4.01 and 5.24.

Total Cost: TBD **Period of Performance:** FY 2012-2017

Description:

Background: The ANIMIDA started monitoring of the Boulder Patch in 2000. These and multiple other research projects on the Boulder Patch by BOEM, 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 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, an area with known but poorly mapped kelp beds. Ongoing industry activities necessitate ongoing monitoring projects.

Objectives:

- Evaluate the impact from additional activities at the Liberty prospect on the Boulder Patch kelp community.
- Monitor the impact to the Boulder Patch community of 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 patch surveys and monitoring will be conducted from 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Conference Management and Reports on BOEM Results

BOEM Information Need(s) to be Addressed: Conference management supports formal information transfer meetings (ITMs) to disseminate study results and to resolve environmental and technical issues for BOEM program managers. ITMs also increase public confidence in the data used by the OCS program. Workshops may be coordinated with future lease sales and for NEPA analyses and documentation focusing primarily on the Beaufort Sea and Chukchi Sea. This study addresses aspects of USGS Recommendations 5.23, 5.26 and 7.01.

Total Cost: TBD **Period of Performance:** FY 2012-2015

Description:

Background: The transfer of scientific information is continuous and the Alaska Environmental Studies Program (ESP) needs to constantly organize and conduct ITMs and workshops. Conference participants have the opportunity to exchange environmental studies information with experts and interested parties on selected topics oriented to formulating concepts for new research projects and/or to address study needs. During the past decade the Alaska ESP has held information status meetings and planning workshops for the exchange of studies information among scientists, stakeholders and the general public.

To improve the accessibility, use and exchange of study results, the Alaska OCS Regional office conducts public meetings with a variety of formats. Generally, ITMs are 3-day events and workshops of shorter duration (1 to 2 days in length) that may focus on a single discipline or topic. ITM conferences make clear the scope and detail of information-gathering activities relating to the Alaska OCS. They give interested parties an opportunity to participate in discussions of important topics dealing with oil and gas leasing, exploration, and development in the Arctic region. They also serve as opportunities for regional staff to learn about the information that has been gathered and, therefore, help ESP to formulate study plans for future years.

Objectives: The objective of this procurement is to provide the logistical support for small meetings and workshops to highlight the work of the Environmental Studies Program in Alaska and foster sharing of information among researchers and interested parties through small meetings, workshops and publications on OCS environmental studies information.

Methods: The primary method is to manage meetings and workshops and assist with preparation, coordination, logistics, program agenda, and invitation of speakers and participants.

Revised Date: September 2011

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

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

Title: Alaska Environmental Database (AK-11-15)

BOEM Information Need(s) to be Addressed: The BOEM and other state-wide research efforts for the Chukchi, Beaufort and Bering seas, in addition to other areas of the Alaska outer continental shelf will be made available to the Environmental Studies Section, Environmental Analysis Section and BOEM Management via an online web browser. A web-based visual display of ongoing, recently completed and possibly planned study efforts will assist BOEM in the writing of new study descriptions, Statements of Work, in preparation and planning for new meetings (e.g., North Aleutian, Chukchi, etc.); promoting collaboration with other agencies on similar projects; provide significant savings of funds; expand our research potential; and improve BOEM decision making in the writing of EISs, EAs and commenting on exploration and development plans for the OCS. This study addresses aspects of USGS recommendations 7.01 and 7.03.

Total Cost: TBD **Period of Performance:** FY 2012-2015 (deferred in FY 2010)

Description:

Background: The BOEM places the digital copies of their final study reports online, but it's difficult to quickly access the study boundary, data collection efforts, or conclusions from multiple study efforts, without expending significant personal time and effort. In addition, it is a challenge for internal BOEM staff to remain current with all research in the OCS due to the quantity of government and industry activities conducted within these areas. The BOEM as well as other agencies (NPRB, AOOS, UAF, University of Alaska-Anchorage, USFWS, USGS-Alaska Science Center, NOAA, National Park Service, BLM, Alaska Department of Natural Resources, ADEC, Alaska Department of Transportation, ADF&G, Barrow Arctic Science Consortium, etc.) have identified a statewide need for a centralized database of past, present and future projects and associated observations and observing plans. Representatives from these agencies held a Data Integration Meeting in August of 2008 to plan how to integrate studies projects from these agencies into one unified project browser. A technical steering committee was formed among the participants. The technical steering committee succeeded in establishing the fields necessary to integrate the agency project information. The NPRB started the project browser several years ago with a focus on NPRB projects. This BOEM study shall design, develop, document, and implement a BOEM Internet Geospatial Web Portal whereby BOEM project information and data from completed and ongoing BOEM Alaska OCS Region Environmental Studies can be queried and displayed by internal BOEM staff and other agencies.

Objectives:

- Develop a BOEM Environmental Studies project database that can be fully utilized to query, graphically display, and extract project specific information from all fields within the database.
- Develop programming tools that would allow internal BOEM staff and external non–BOEM users to query, display, and extract available spatial data sets collected from each study.
- Automate the updating of new studies project information: Develop programming tools that shall import new BOEM Environmental Studies project information from newly completed or existing studies in a seamless manner. Specifically, a program that incorporates information from a technical summary and other sources to update the project database.
- Develop programming tools that can automatically search, retrieve, upload and merge project specific information and possibly data from other state, federal agencies, and industry into the BOEM project database and data directories.
- Develop a BOEM Geospatial Web Site User Interface and Graphical display whereby internal BOEM staff and other agencies can query, display, and extract project specific information, and display an extract BOEM environmental studies data sets covering 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, internal staff and contractors hired by BOEM will gather environmental studies project information and available data in a concerted effort to make the information readily available to BOEM staff and other agencies. This effort will centralize the function to collect, catalogue, and distribute BOEM environmental studies project information, associated project studies data, initially collecting studies project information and data going back to 2000. A BOEM web interface shall display maps of the project boundaries, links to the project specific information, data, metadata, and reports.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Workshop—Interagency Protocols for Immediate On-Scene Arctic Oil Spill Impact Science (AK-11-11)

BOEM Information Need(s) to be Addressed: This study would seek to develop a mechanism, should a spill occur, to improve multilateral coordination in the effort to obtain interdisciplinary environmental data about the immediate effects of an oil spill in Alaskan seas. The resulting information will provide improved analyses and mitigation measures as required by the National Environmental Policy Act. This study addresses aspects of USGS Recommendation 5.22.

Total Cost: TBD **Period of Performance:** FY 2012-2013

Description:

Background: Many of the impacts of oil spills happen in the first three days after oil or gas is spilled. In the past 20 years, two major marine oil spills, the *Exxon Valdez* and the *Selendang Ayu*, have occurred in Alaska. Most recently, the *Deepwater Horizon* blowout in the Gulf of Mexico has triggered the need for a fresh look at lessons learned, including new preparations for spill response planning in arctic waters. In all these cases, collection of scientific data in the critical initial period was hampered by the lack of standing interagency collaborative agreements with pre-established sampling protocols. Information produced by planned spill response research would potentially improve the government's ability to track, monitor, and mitigate oil spill impacts and long-term environmental consequences. Successful completion of Alaskan protocols and agreements would facilitate replication in other OCS areas.

Objectives:

- Assemble a collection of relevant "lessons learned" from the Deepwater Horizon oil spill to improve environmental data collection in the event of a spill in arctic waters.
- Develop a protocol for sampling during the initial stages of an Alaska marine oil or gas spill.
- Develop interagency working agreements or other instruments necessary to implement immediate scientific sampling should an oil spill occur in marine waters.

Methods: Workshop participants, including NEPA analysts and other interagency scientists, would be systematically queried about information needed at onset of an oil spill. Sampling protocols to meet those information needs will be drafted. Appropriate framework documents will be developed to initiate pursuit of broader operational agreements across multiple relevant agencies, including the U.S. Coast Guard and NOAA.

Revised Date: September 2011

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

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

Title: Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring

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. This study addresses aspects of USGS Recommendations 3.05, 3.06, 3.07, 4.01, 5.24, 6.07, 6.12 and 6.13.

Total Cost: TBD **Period of Performance:** FY 2012-2016

Description:

Background: A previous MMS 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 inter-annual 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 go prevent any interference with subsistence whaling and hunting. All necessary research and access permits will be obtained by the PI.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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

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 needed 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 the Oil Spill Risk Analysis that BOEM conducts, (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. This study addresses aspects of USGS Recommendations 3.01 and 5.06.

Total Cost: TBD **Period of Performance:** FY 2012-2017

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 and moored ADCPs and 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Applications for Mapping Spilled Oil in Arctic Waters

BOEM Information Need(s) to be Addressed: The results from this study will benefit 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 will use the results to improve NEPA analysis and documentation for any future Alaska OCS lease sales.

Total Cost: TBD plus Joint Funding **Period of Performance:** FY 2012-2016

Description:

Background: Based upon the recent tragic event in the Gulf of Mexico, there is a strong 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea

Title: U.S.-Canada Transboundary Fish and Lower Trophic Communities

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. This study addresses aspects of USGS Recommendations 3.05, 3.07 and 4.01.

Total Cost: TBD **Period of Performance:** FY 2012-2016

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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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

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 assessments. 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. This study addresses aspects of USGS Recommendations 3.05, 3.07 and 4.01.

Total Cost: TBD **Period of Performance:** FY 2012-2014

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: The objectives of this study are to:

- 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 2012 two primary areas will be at sites between Prudhoe Bay and Camden Bay to establish a baseline of fish and habitat use and as reference sites to Camden Bay. Camden Bay has an Exploration plan in place for 2011.

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.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: High-Resolution Digital Bathymetry Dataset

BOEM Information Need(s) to be Addressed: A high resolution regional bathymetry data set is a necessary component in the agency's efforts to develop an ocean circulation model for the Beaufort and Chukchi seas. The accuracy of ocean circulation fields are closely linked to the accuracy of the bathymetric grids for the area. Currents steer around topographic features such as Hanna Shoal and Herald Shoal in the Chukchi Sea, and waters are exchanged through deep passageways of Barrow Canyon and Herald Valley. More data are needed to better define the seafloor topography in and around these features. In addition, improved bathymetry data would be extremely useful in analyzing the relationship between changes in seafloor topography and observed currents presently being collected from HF radar, ADCPs and AUVs within the Chukchi Sea Lease Area. A high resolution bathymetry data set would also be used to better define the seafloor linkages to stable landfast ice extent, acoustic models, and critical biological habitat. This study addresses aspects of USGS Recommendation 5.06.

Total Cost: TBD **Period of Performance:** FY 2012-2014

Description:

Background: High-resolution regional bathymetric survey data in digital format is required for BOEM mapping, analysis, and modeling purposes over the Beaufort and Chukchi Sea Shelf areas. Improved high-resolution bathymetric data on a regional scale would increase our ability to interpret the habitats of invertebrates, fish and marine mammals. Better bathymetry can assist scientists in the study of ice gouges and strudel scour and obtain better information on the modeling of oil spill trajectories, locate potential archeological sites and assist current BOEM studies to position oceanographic instruments and conduct sediment sampling. The acquisition of high resolution bathymetric data will provide maps charts and interpretive results that would be extremely beneficial to biologists, oceanographers, geologists, archeologist and managers in multiple agencies (BOEM, NOAA, NMFS, USGS/BRD), and would improve the accuracy of our data analysis and model results.

Oceanographic studies that seek to understand the marine environment require accurate depictions of the ocean's bathymetry. Because ocean circulation and the other components of the climate system do not recognize national boundaries, it is necessary to assemble datasets from beyond our national borders and integrate them into a coherent product. Two MMS-sponsored workshops, Small-Scale Sea-Ice and Ocean Modeling (SIOM) in the Nearshore Beaufort and Chukchi Seas (OCS Study MMS 2003-043) and Physical Oceanography for the Beaufort Sea (OCS Study MMS 2003-045) have both identified need for better bathymetry data as high priority.

Objectives: The primary objective will be to produce a high-resolution regional bathymetric data set for the Beaufort and Chukchi seas to assist BOEM in interpreting physical and chemical oceanographic conditions, improve the output from our ongoing data collection efforts (Physical and Biological), including improved analysis of our observations of currents within the Chukchi Sea, improvements to ocean circulation models, oil spill trajectory analysis, and better defining critical biological habitats.

Methods: This project will aggregate and combine available bathymetry data for the Beaufort and Chukchi seas in digital format. Data will be aggregated from industry surveys, research programs such as SCICEX, Shelf Basin Initiative (SBI) and JAMSTEC, BOEM physical and biological studies, NSF Office of Polar Programs, and vessels of opportunity. Researchers will perform quality control error-checking and then assimilate the information into a single dataset. In addition, researchers will produce a report that describes coverage and accuracy of collected data sets and identifies areas where new surveys are needed to improve coverage.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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)

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. This study addresses aspects of USGS Recommendations 3.05, 6.06, 6.08, 6.09, 6.12 and 6.13.

Total Cost: TBD plus Joint Funding **Period of Performance:** FY 2012-2017

Description:

Background: Research underway on the Bowhead Feeding Study 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. 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:

- Estimate 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 transport and advection of krill from the Gulf of Anadyr.

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.

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. 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.

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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, Bearded, and Spotted Seals

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. This study addresses aspects of USGS Recommendation 6.15.

Total Cost: TBD plus Joint Funding **Period of Performance:** FY 2012-2016

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 provided missing 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.

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2.3 Profiles of Studies Proposed for FY 2013 NSL

Table 2 Alaska OCS Region Studies Proposed for the Fiscal Year 2013 NSL

Page No.	Discipline	Title
183	FE	ANIMIDA III: Contaminants, Sources, and Bioaccumulation (AK-11-14b)
185	FE	Physical and Chemical Analysis of Crude and Refined Oils: Lab and Mesoscale Oil Weathering
187	SS	**Baseline Nutritional Survey: Inventory and Content Analysis of Subsistence and Market Foods as Consumed by North Slope Communities
189	HE	Arctic Cod Genetics and Toxicity Study (AK-11-13b)
191	IM	Synthesis Report Generation: Technical Support for Environmental Analyses on Select Regional Topics (AK-11-04)
193	MM	Polar Bear Movement Patterns and Habitat Use in Relation to Oil and Gas Activities in the Chukchi Sea
195	MM	Improving Estimates of Abundance and Distribution of Avian Species during Peak Spring and Fall Migration Pathways through Near Shore Areas of the Eastern Chukchi Sea
197	MM	Ecology of Beluga Whales in the Eastern-Chukchi, Western-Beaufort Seas
199	MM	Field Evaluation of an Unmanned Aircraft System (UAS) for Studying Cetacean Distribution, Density, and Habitat Use in the Arctic
201	SS	Enclave Development: Alternative Approaches for Housing Transient Workers in Rural Alaska
203	MM	Pacific Walrus Foraging Habitat and Prey Identification from Seasonal Haulouts Along the Chukchi Sea Coastline

AQ = Air Quality FE = Fates & Effects MM = Marine Mammals and Protected Species
IM = Information Management SS = Social Systems
PO = Physical Oceanography HE = Habitat & Ecology REN = Renewable Energy

** Denotes project that remains contingent on collaboration with external groups.

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

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. This study addresses aspects of USGS Recommendations 3.04, 3.07, 4.01 and 5.24.

Total Cost: TBD **Period of Performance:** FY 2013-2018

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

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 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 use 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: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Physical and Chemical Analysis of Crude and Refined Oils: Lab and Mesoscale Oil Weathering

BOEM Information Need(s) to be Addressed: The Alaska OCS Region uses an oil weathering model (OWM) to provide EIS analysts with a common, quantitative set of spill weathering parameters. The OWM model calculates the area covered by a spill, an important parameter for estimating effects, but the BOEM oil-spill-risk-analysis trajectory model (OSRA) does not. The OWM calculates the persistence of the lighter, but most toxic components of the oil slick and the dispersion of oil into the water. The calculations allow analysts to estimate persistence of toxicity, rather than assume, as in the OSRA, that these toxic components persist over the first three days of a spill. The model helps distinguish between effects of large (≥1,000 bbl) and small (<1,000 bbl) spills on rate of oil weathering. 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 study addresses aspects of USGS Recommendations 5.01, 5.04, and 5.11.

Total Cost: TBD **Period of Performance:** FY 2012-2014

Description:

Background: The weathering of spilled oil is very dependent on the specific composition and physicochemical properties of each oil. The Alaska OCS Region has helped develop and currently uses the SINTEF OWM to estimate the fate and persistence of spilled oil. The OWM has recently been improved as part of the Oil-in-Ice Joint Industry Program (JIP) to better incorporate Arctic and cold weather conditions. The BOEM is licensed to use the JIP-updated Sintef OWM because of our contribution of oil weathering information to the JIP.

Objectives: Expand the existing SINTEF OWM library of oil compositions to cover additional representative Alaskan OCS crude and marine fuel oils through a suite of standard oil composition analyses and mesoscale empirical weathering measurements.

Methods: The BOEM is licensed to use the JIP-updated Sintef OWM because of our contribution of oil weathering information to the JIP. This study will research and compile existing updated weathering data for Alaska State and OCS crude oils within the last 5 years. Existing lab weathering data for Alaskan State and OCS crude and marine fuel oils will be entered into the SINTEF oils library. This study will conduct laboratory and mesoscale oil weathering tests on approximately eight Alaskan crude or condensate oils (such as Oooguruk, Nikiakchuq, Northstar, Point Thompson, Alaska North Slope) and 2-4 refined oils (such as low-sulpher marine diesel, IFO and Bunker C).

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ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Baseline Nutritional Survey: Inventory and Content Analysis of Subsistence and Market Foods as Consumed by North Slope Communities

BOEM Information Need(s) to be Addressed: This study will facilitate scientific understanding and analysis of potential health impacts that could derive from oil and gas industrial activities. It will also address longstanding concerns about potential cumulative effects of oil and gas activities on the North Slope. Additionally, it will provide useful information to decision-makers in Environmental Assessments and Environmental Impact Statements for upcoming and future Beaufort Sea and Chukchi Sea Lease Sales. The study will strengthen BOEM compliance with Executive Order 12898 on Environmental Justice and will facilitate BOEM research coordination with multi-agency initiatives.

Total Cost: TBD plus Joint Funding **Period of Performance:** FY 2012-2014

Description:

Background: Many previous MMS/BOEM studies have documented various aspects of Native subsistence production, distribution, and consumption in coastal Alaskan communities over the last three decades. However, more research is needed on the nutritional composition of representative dietary patterns for various resident groups on the North Slope. This study will involve a nutritional survey and analysis of subsistence and market foods as actually consumed, using standard methods of nutritional epidemiology to characterize the mixed and changing nutritional system of three villages, preferably Wainwright, Point Lay, and Kaktovik. Key sampling variables for each community would likely be at the household level, and include ethnicity, gender, age group, and lifestyle attributes, especially level of subsistence effort. The project will remunerate informants to reduce non-response.

The study would seek to establish interim baseline data regarding normative dietary patterns and corresponding nutritional content for a broad range of discrete social groups. The study would thereby contribute toward understanding whether and how incremental changes to subsistence activities on the North Slope might produce substantial impacts on the dietary behaviors and health status of identifiable Native groups. A significant body of research has emerged to indicate that different categories of North Slope residents increasingly manifest serious health problems that are related to changes in diet and consumption patterns, including diabetes, botulism, iron deficiency anemia, caries, heart disease, obesity, and substance abuse. This study would contribute to a better understanding of the social complexities of emergent pathologies and investigate if any are attributable to incremental subsistence sector disruptions that may be reasonably associated with oil and gas activities.

The study is envisioned as a collaborative, inter-agency effort, with a state agency such as Alaska Department of Health and Human Services or the North Slope Borough possibly assuming the lead role. Other cooperative funding institutions may include NSSI, BLM, USFWS, the U.S. Department of Agriculture, Alaska Native Tribal Health Consortium (ANTHC), the North Slope Borough, and private industry.

Objectives: This study will investigate if any emergent pathologies are attributable to incremental subsistence sector disruptions that may be reasonably associated with oil and gas activities to assess if there is a direct or indirect causal relationship between oil and gas activities and food choices. The project will:

- Improve understanding of contemporary patterns of food consumption within each sampled community.
- Analyze representative food consumption patterns and portions for nutritional value and potential contaminants.
- Estimate the percentage and dosage of food energy derived from subsistence and market sources for sampled subgroups in each community.
- Link nutritional data to existing subsistence surveys and sharing network studies to enhance analysis of potential health impacts from oil and gas development.

Methods: Investigators will: 1) secure collaborative participation of selected host communities with appropriate input on final study design and methods; 2) conduct a nutritional analysis using standard methods to characterize the mixed market-subsistence nutritional system of participating communities and provide incentives to ensure participation in survey; 3) create an inventory of market foods by purchase and consumption preference; 4) create a food consumption database of subsistence and market foods for sampled individuals based on a combination of informant journals and empirical observation; 5) assess the nutritional value of foods consumed to establish an estimate of food energy per person per day (grams/person/day) for a variety of resident groups; 6) collaborate with health science data collection activities already initiated among North Slope communities to integrate household subsistence data with dietary questionnaires; 7) compare and assess study findings against other relevant research and traditional knowledge within each community; and 8) report the results to North Slope communities through public meetings or workshops.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Arctic Cod Genetics and Toxicity Study (AK-11-13b)

BOEM Information Need(s) to be Addressed: A major element of NEPA analyses in the Alaska OCS program is the assessment of effects of accidental releases of oil and gas in arctic waters and on arctic species. A greater understanding of the keystone species Arctic cod is necessary to assess the potential effects of offshore development in Arctic waters. Arctic cod plays a critical ecological role as key prey species and the primary pathway through which lower trophic production gets funneled to marine mammals, birds and fish. Thus Arctic cod dynamics are critical to EFH- and ESA-related NEPA analyses. The extent of its ice dependency makes Arctic cod itself a potential ESA species. In order to assess effects from potential oil and gas development on Arctic cod and the cumulative effects from climate change, it is important to understand the ability of Arctic cod to survive and adapt as the ice retreats. Understanding how Arctic cod are affected by oil and dispersants under arctic conditions will support both impact assessments and development of oil spill response and monitoring protocols. This study addresses aspects of USGS Recommendations 3.07, 5.15 and 5.17.

Total Cost: TBD **Period of Performance:** FY 2012-2014

Description:

Background: Arctic cod is a key species in Arctic food webs and occupies nearly all depths during its life cycle. Whether Arctic cod is likely to be driven to extinction as the arctic ice retreats is a subject of discussion in scientific circles. Genetics can shed light on whether Arctic cod (*Boreogadus saida*) are truly ice dependent or whether there is potential to adapt to retreating ice through differential expression of existing genes.

The genetics pilot and toxicity testing feasibility analysis will benefit from close association with an ongoing BOEM study and an ongoing international Joint Industry Program (JIP) Arctic species toxicity study. The pilot genetics study has ties to the ongoing Central Beaufort Fish Survey under ice and open water survey (AK-10-09). Opportunistic samples from an international Chukchi Sea fish survey in September 2010 have been committed for the pilot BOEM genetic survey. The genetic study also has ties to an ongoing Canadian Department of Fisheries and Oceans (DFO) Arctic cod genetic study to assess genetic differentiation of the Arctic cod population and provide international collaboration.

A workshop held in Anchorage in March 2008 facilitated the discussion on the effects of dispersed oil on two Arctic species, Arctic Cod and a copepod (*Calanus glacialis*). The workshop was followed by fieldwork in 2009 and 2010. The results of the JIP study of toxicity to Arctic species at surface pressures can parlay into an assessment of what broader

research may prove beneficial in terms of assessing depth. Under Option 1, the anticipated research on Arctic Cod Toxicity would commence based on the feasibility analysis.

The effects of subsurface blowouts are receiving renewed focus following the *Deepwater Horizon* explosion and subsequent oil and gas release in the Gulf of Mexico. Although the question of subsurface oil, gas and dispersant behavior in the Gulf of Mexico is currently on the forefront, these same questions need to be addressed separately and proactively under the conditions unique to the U.S arctic. Assumptions and practices from different geographic locations may not accurately transfer to the U.S. Arctic. Under Option 1 a carefully designed toxicity laboratory research on Arctic cod at controlled temperatures, pressures (i.e. depth) and light would begin to address some of these complex questions of effects of oil, gas and dispersants on species at various depths in the Arctic.

This proposed combination of genetic and toxicity testing will help analysts respond to basic questions under NEPA review that address future oil and gas developments in the Arctic. Examples of the questions to be answered include: Are Arctic cod a single pan-Arctic population that exhibits varied genetic responses under different conditions or are Arctic cod a number of genetically distinct stocks that are individually at risk to offshore development? How do the oil spill effects on and the responses of Arctic cod vary in relation to a complex of different oil/gas/dispersant mixtures, different life stages, different body mass, different temperatures and different depths typical of the US Arctic waters? How do the toxicity test results at depth compare to results of ongoing JIP toxicity study at surface pressure?

Objectives:

- Participate in pan-arctic genetic stock separation study of Arctic cod.
- Base year: Conduct a feasibility analysis for project design based on the results of the JIP study of toxicity to Arctic species at surface pressures. The analysis will provide recommendations to conduct further research under Option 1 to assess the affects of Arctic cod toxicity test to broader life stages and add a depth component.
- Option 1: Assess the effects on Arctic cod (and perhaps other species) of accidental subsurface release of oil/gas and the effects of dispersants at low temperatures and at pressures and oceanographic conditions typical of the U.S. Arctic OCS.

Methods: Conduct a pilot full-sequence RNA transcriptome on a sample of approximately five Arctic cod individuals to assess feasibility of a genetic study of Arctic cod. Compare results to resolution from international collaborators conducting genetic DNA micro-satellite studies of Arctic cod population separation. Develop recommendations for further genetics study and incorporate results into planning of future joint US/Canada fisheries surveys and Arctic cod ecology studies. Obtain results of the JIP toxicity study and conduct a feasibility analysis to design and conduct controlled laboratory studies to test the toxicity effects of gas/oil/dispersant mixtures on Arctic cod at critical lifestages, and at a range of temperatures and depths (pressures) typical of the U.S. Arctic OCS.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): All Alaska Planning Areas

Title: Synthesis Report Generation: Technical Support for Environmental Analyses on Select Regional Topics (AK-11-04)

BOEM Information Need(s) to be Addressed: The BOEM Alaska OCS Region increasingly requires short-term technical synthesis reports and literature searches that cannot be adequately developed through in-house effort. The purpose of this study allocation is to develop a longstanding procurement vehicle through cooperative agreement to facilitate information management on an "indefinite delivery, indefinite quantity" basis. Each project task will be reviewed on its own merits. Projects such as this would help meet BOEM objectives under the OCSLA, NEPA and other laws such as the Fishery Conservation and Management Act, Endangered Species Act, the Archaeological Resources Protection Act and the Clean Air Act.

Total Cost: TBD **Period of Performance:** FY 2011-2016

Description:

Background: The Alaska Region BOEM science and environmental assessment staff often encounter short-term information needs that, if conducted through a university source, would enhance the efforts of BOEM Alaska science and environmental assessment programs. A synthesis report on Higher Trophic Linkages in the Beaufort Sea is a case in point. Higher trophic food web linkages are important to consider in preparing sound analyses required under various laws. This study would use existing literature to bring together in one report (and a large journal-referenced graphic) Beaufort Sea higher trophic connections in the U.S. A particular emphasis would be placed on fish as prey, particularly in the Alaskan Beaufort Sea.

A Cooperative Ecosystem Studies Unit (CESU) or other cooperative agreement could provide a mechanism to obtain short-term technical university assistance through a standing source and administrative structure for projects such as literature searches and bibliographic review, topical papers, database searches and cleanup, analysis of historic databases, mapping of existing data, and summary papers. The goal of the nationwide CESU network is to provide high quality scientific research, technical assistance and education through their working partnerships among universities, government agencies and non-governmental organizations. The CESUs could provide BOEM with standing administrative agreements and access to a wide range of university research faculty, staff and students at a reasonable overhead cost. A CESU can provide assistance in biological, physical, social, and cultural sciences and address interdisciplinary problems.

In addition to the proposed "Synthesis Report on Higher Trophic Linkages in the Beaufort Sea" examples of the type of short-term technical projects envisioned include:

- Conduct a literature review concerning the effects of oil, gas and dispersants on biota at various depths in the U.S. Arctic;
- Conduct a literature and data review of air quality and meteorology information on the Alaska OCS to establish baselines for pollutant emissions and climate, and estimate annual emissions anticipated during potential exploration and development;
- Conduct a literature search to facilitate the future study effort "Enclave Development: Alternative Approaches for Housing Transient Workers in Rural Alaska" with a special emphasis on identification of industrial housing policies in the past in Alaska.
- Conduct a multivariate statistical analysis from existing Beaufort Sea Community Data to generate descriptive statistics of relationships within households and between communities;
- Conduct a database search and literature review on invasive species (marine and terrestrial) that have been documented in or near arctic, subarctic and Antarctic environments worldwide;
- Complete the task of geo-referencing the records in the Shipwreck database managed by BOEM Alaska (which contains approximately 5000 records);
- Use existing NOAA Observer bycatch data to establish the occurrence of squid and jellyfish in the Bering and southern Chukchi Sea regions;
- Research ice breaker activities and obtain scientific information and research documents that were collected within and adjacent to the Alaska OCS for the Chukchi and Beaufort seas but are not available in existing databases.

Objectives:
- Establish an agreement through CESU or other academic entity to obtain short-term technical products on an IDIQ basis.
- Initiate Task 1 within this procurement framework. The proposed Task 1 will develop a Statement of Work to synthesize existing information on higher trophic interactions in the Beaufort Sea in a summary report and in graphical form.

Methods: This study will conduct a thorough literature search on higher trophic interactions in the Beaufort Sea, with a particular emphasis on post-1980s studies; prepare a synthesis report of this literature, including summary tables of the information and bibliography; and prepare a large graphic poster depicting the main trophic linkages with literature referenced on the linkages.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Polar Bear Movement Patterns and Habitat Use in Relation to Oil and Gas Activities in the Chukchi Sea

BOEM Information Need(s) to be Addressed: This study examines the seasonal distribution and habitat use of polar bears in the Alaska Chukchi Sea in relation to areas of oil and gas exploration and provides information necessary for Marine Mammals Protection Act permitting and development of related mitigation measures. Information would be used to: 1) identify areas and time periods where polar bear ranges overlap with oil- and gas-related activities, and use this information to develop appropriate mitigation measures; 2) understand the movement patterns and habitat use of polar bears in the near-shore Chukchi Sea area; 3) evaluate the body condition and diet of bears in this population in relation to annual variation in sea ice conditions; and 4) evaluate vital rates and population status. Information from this study may be used for NEPA documentation and ESA Section-7 consultations.

Total Cost: TBD **Period of Performance:** FY 2013-2018

Description:

Background: The MMS has funded considerable research on polar bears and their populations in the Beaufort Sea during the past decade, including methodological studies evaluating RFID and FLIR technologies. Other studies are documenting the movements of satellite-tagged bears in both the U.S. and Canadian Beaufort Sea. However, much less research has been conducted in the Chukchi Sea and there is an urgent need to better understand the distribution, movement patterns and population status of polar bears in that Region. The Chukchi Sea has experienced a significant reduction in sea ice in the past several decades. The response of polar bears to the loss of sea ice as a platform for movement and foraging, and to changes at lower trophic levels is currently unknown. Simultaneous to environmental changes has been increased activity in the region to explore for and potentially develop access to oil reserves within open-water areas of the Chukchi Sea. As a result, information is currently needed on the distribution, seasonal movement patterns, and swimming behavior of polar bears in relation to current and planned oil and gas activities in the Chukchi Sea for analysis and spatial planning purposes. This information would serve to complement on-going studies, funded partially by MMS, to examine bear movement patterns and condition in the fall in the Southern Beaufort Sea. Since seasonal distributions appear to be changing, a better understanding of the distribution and overlap of bear populations along both the Chukchi and Southern Beaufort Sea coasts would aid in mitigating industrial activities occurring in both habitat regions and monitoring the changes since 1995 for spatial planning and assessment of long term changes. Basic information on the status of the Chukchi Sea population is also needed, including body condition, health, vital rates, and population size to better inform management of the population vitality and viability.

Objectives:

- Estimate the seasonal distribution of the polar bear population in the Chukchi Sea and the potential for interactions with oil- and gas-related activities in and near the Chukchi Sea Outer Continental Shelf lease area.
- Estimate habitat use patterns of radio-collared female polar bears through using resource selection functions. These analyses will identify seasonal habitat use patterns and will be compared to pre-1995 habitat use for evaluating climate change effects on polar bear distribution.
- Evaluate the condition and health of polar bears in the Chukchi Sea and identify the best methodology for assessing vital rates and determining population size.

Methods: Capture polar bears in the spring of each year in the eastern Chukchi Sea to collect samples, evaluate diet and body condition, and deploy approximately 25 satellite-radio collars on adult females to study movements and other behaviors. Diet will be estimated using standard laboratory techniques including fatty acid analysis. Body condition will be estimated using morphological measurements taken at capture. Develop resource selection models of contemporary seasonal habitat use to determine the potential overlap between industrial activities and bear habitat use. Use saltwater sensors on satellite radio-collars to determine the amount of open-water use in the fall of each year.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Improving Estimates of Abundance and Distribution of Avian Species during Peak Spring and Fall Migration Pathways through Near Shore Areas of the Eastern Chukchi Sea

BOEM Information Need(s) to be Addressed: Information gained from this research will be used in ESA Section 7 Consultations and NEPA reviews for lease sales, EPs, DPPs and other reviews for post-sale and post-exploration decision making and mitigation in the Chukchi Sea Planning Area. In particular, this work will contribute significantly to cumulative impact assessments on marine birds of concern that will be affected by proposed onshore and offshore lease sales throughout their breeding, molting, staging, and wintering habitats in Alaska. Further, results of this work may be evaluated for use to develop mitigation measures and stipulations designed to protect migratory birds, a DOI trust resource.

Total Cost: TBD **Period of Performance:** FY 2013-2014

Description:

Background: Barrier islands, lagoons, bays, and offshore leads along the Alaskan coast of the Eastern Chukchi Sea (ECS) have been identified as important breeding, feeding, staging, and molting areas for large numbers of water birds. Near shore areas of the ECS are important staging sites for several species of waterfowl and loons during migration to and from breeding areas in arctic Alaska and Canada. Waterfowl and loons acquire critical pre-breeding and pre-wintering fat reserves in the ECS with some species using the ECS during periods of flightless molt. Among the species known to use the ECS, Spectacled Eiders (*Somateria fischeri*) are listed as threatened under the U.S. Endangered Species Act, and Yellow-billed Loons (*Gavia adamsii*) are designated as a candidate species. Steller's Eiders (*Polysticta stelleri*), also listed as threatened under the U.S. Endangered Species Act might also migrate through the ECS en route to southern molting and wintering areas. Pacific Brant is a species important to both subsistence users in Alaska and fall hunters throughout the Pacific Flyway. Pacific Brant are listed as a U.S. Fish and Wildlife Service-Migratory Bird Program focal priority species and are currently managed under a "restrictive" harvest regime due to low population size.

Recent satellite telemetry data from marked sea ducks and loons suggest that most birds used areas within 60 km of the northwest coast of Alaska from May through October, with peak use coinciding with spring and fall migration. However, marked birds also used areas as far as 110 km from the coast, within Lease Sale 193. Current understanding of the abundance and distribution of birds using near shore areas of the ECS is based on limited satellite telemetry data, and land and vessel based observations. Additional information is needed to better characterize the abundance and distribution of birds that use the ECS, especially in near shore areas.

In late summer and fall, up to 49% of the world population of Pacific Brant occurs in Kasegaluk Lagoon and directly proximate to leases sold in the Chukchi Sea Planning Area. Habitats and birds using this critical staging area could be impacted by human activities from onshore and nearshore facilities associated with offshore lease sales and by contaminants resulting from potential oil spills.

Objectives: The overall objective of this study is to estimate the abundance and distribution of avian species in near and off-shore areas of the ECS during peak spring and fall migration. Specifically it will:

- Document Pacific Brant spatial distribution, abundance, and timing of use in Kasegaluk Lagoon, landward of the Chukchi Sea Planning Area.
- Document Spectacled Eiders, Yellow-billed Loons, and Steller's Eiders spatial distribution, abundance, and timing of use within the offshore areas between Cape Lisburne and Barrow.

Methods: Aerial surveys will be conducted in spring and fall 2012 to coincide with ongoing Spectacled Eider, Red-throated Loon (*Gavia stellata*), and Yellow-billed Loon satellite telemetry studies. Within each season, surveys will be conducted over a period of 14 to 20 days. Survey areas and transects will be modified daily using near real time satellite telemetry data to optimize flight time. Surveys will be conducted within 110 km of the ECS coast of Alaska between Cape Lisburne and Barrow. The biweekly census will also include geese in following accepted methodologies.

Surveys will be conducted using established methods by 2 observers from a twin-engine, high-wing aircraft like an Aero-Commander model 690. Transects will be followed using on-board GPS and a laptop computer. Species identification and estimates of abundance will be aided by digital photography using a camera capable of producing high quality images (> 12 megapixel) with continuous shutter and image stabilization. The camera will also interface with the on-board laptop computer to georeference images and to check image quality in real time. Visual species identification, estimated abundance, and GPS locations will also be logged on the on-board laptop.

Resulting digital photographs will be used to identify species and count individuals using Adobe Photoshop CS-4 and ArcGIS 9.x. When possible, the sex and age of individual birds will also be identified. Data will be analyzed following accepted methods.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Ecology of Beluga Whales in the Eastern-Chukchi, Western-Beaufort Seas

BOEM Information Need(s) to be Addressed: The beluga whale is protected under the Marine Mammal Protection Act (MMPA) and is important for subsistence use by Native Alaskans along the Chukchi Sea coastline. Subsistence use by Natives is also protected under the MMPA and cannot be compromised by other activities such as oil and gas development. This study will provide information on habitat use and selection by beluga whales in the eastern-Chukchi and western-Beaufort Seas, a region currently under intense interest for development. Satellite tracking data provides valuable information about distribution and movements of belugas. Data for assessing prey and habitat use are also needed. Understanding habitat (e.g., bathymetry, ice cover, specific geographic locations) and prey use by belugas will be instrumental in evaluating and mitigating potential impacts on subsistence within lease areas. Information from this study will be used for NEPA documentation.

Total Cost: TBD **Period of Performance:** FY 2013-2018

Description:

Background: Several stocks of beluga whales use the Chukchi and Beaufort seas. The Beaufort Sea stock migrates through the area in late April and May to summering areas in the Canadian Beaufort Sea. They migrate back through the planning areas during autumn to winter in the Bering Sea. Animals from the eastern Chukchi Sea stock move into the nearshore waters adjacent to Point Lay and Wainwright along the northwest coast of Alaska. A satellite tracking study, jointly funded by the Alaska Beluga Whale Committee, the North Slope Borough and the MMS, showed that belugas from this stock used a large portion of the Alaska Beaufort Sea during the summer and migrated back south through the Chukchi Sea during autumn.

Belugas in the Beaufort and Chukchi Seas have been subject to seasonal survey effort by the MMS BWASP and recent surveys in the Chukchi Sea. Limited other research has been conducted in recent years including a study of 26 belugas that were live-captured, fitted with satellite transmitters and tracked. Transmitters lasted from less than a week to up to 16.5 months and provided a great deal of information about where belugas spent the summer, portions of the autumn, and one transmitter last long enough to provide the first information about the wintering area. Transmitters also collected information about diving behavior.

With increasing oil and gas activities in the Beaufort and Chukchi seas, there is a need to better understand distribution and movements of belugas, and prey and habitat use and selection. Analysis of summer and fall habitat use of satellite-tracked belugas from the

eastern Beaufort Sea has already occurred. A similar analysis for eastern Chukchi Sea belugas is needed.

This research project will be a broad collaboration including the Alaska Beluga Whale Committee, the North Slope Borough, Alaska Department of Fish and Game and NMML as well as ChukoTINRO and other Russian marine mammal researchers and hunters. Representatives of Alaska Native communities will participate in all aspects of the work and analysis.

Objectives:

- Evaluate prey and habitat use and selection of eastern-Chukchi and western-Beaufort Sea belugas relative to age and sex and determine winter distribution in the Bering Sea;
- Compare prey and habitat use and selection between whales from the proposed study and those from the eastern-Beaufort Sea;
- Evaluate overlap of beluga habitat use and selection with lease areas in the Beaufort and Chukchi seas.
- Evaluate potential conflicts between subsistence activities and oil and gas development along the Eastern-Chukchi Sea coastline.

Methods: Whales will be satellite tagged in cooperation with Chukchi Sea Native subsistence users at villages such as Pt. Lay. Local Natives will be involved in this study to the maximum extent possible and every attempt will be made to ensure that this study does not interfere with subsistence activities or intrude on life in the isolated coastal communities. Cruises will be conducted as necessary to assemble data on oceanographic conditions, prey and associations among belugas, sea ice and the former factors. This study will develop GIS based models to determine habitat use and selection relative to age and sex of belugas. In addition to data to be collected in this study, data will be used from belugas that were tracked with satellite transmitters in 1998, 1999, 2001, 2002, and 2007. The models will include location data, and attributes of those locations including: bathymetry, ice cover, distance from shore, prey and other oceanographic data. The models will evaluate habitat that is used relative to habitat that is available. Comparisons will be made between belugas of the eastern Chukchi Sea and eastern Beaufort Sea stocks. Aerial survey data of belugas, from the Bowhead Whale Aerial Survey Program and other surveys, will be evaluated for the potential of further understanding of inter-annual and intra-annual differences in distribution, habitat use and selection. A final report will be drafted providing BOEM with information about beluga habitat use and selection that will include evaluation and recommendations for mitigation of the potential impacts from oil and gas activities in lease areas on subsistence use of beluga whales by Natives in the Beaufort and Chukchi Seas.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Field Evaluation of an Unmanned Aircraft System (UAS) for Studying Cetacean Distribution, Density, and Habitat Use in the Arctic

BOEM Information Need(s) to be Addressed: Bowhead whales (*Balaena mysticetus*) and gray whales (*Eschrichtius robustus*) are seasonal residents of the western Beaufort Sea and the Chukchi Sea. These Arctic waters provide important feeding grounds and migration pathways for both species. Bowhead and gray whale distributions overlap spatially with lease sale areas in this region. Their occurrence in Arctic waters coincides with the timing of industrial activities related to oil and natural gas exploration, development, and extraction, which occur mostly in the "open water" season when sea ice is minimal. Both species are protected under the Marine Mammal Protection Act, and the bowhead whale is granted additional protection as an endangered species under the Endangered Species Act (ESA). Under the National Environmental Policy Act (NEPA) and the ESA, BOEM is required to evaluate if and how federal actions associated with oil and gas exploration and development may affect these species. The density, spatiotemporal distribution, and habitat use of these species in the areas concerned may play an important role in determining where and when the oil and gas industries may conduct their activities. Standard methodologies for studying these ecological questions include the use of vessel observations, passive acoustics, and aerial surveys conducted from manned aircraft. In recent years, there has been increasing interest in using Unmanned Aircraft Systems (UASs) to survey cetaceans (especially bowheads) in the outer continental shelf region of the Arctic. The performance of UASs relative to human observers in manned aircraft for detecting cetaceans, identifying individuals to species, estimating group size, identifying sensitive age classes, and estimating population density in space and time is unknown, but must be understood prior to the acceptance of the UAS platform as a substitute to manned aircraft for conducting these investigations.

Total Cost: TBD **Period of Performance:** FY 2013-2015

Description:

Background: Manned aircraft are a common platform for studying wildlife because they are relatively cost-effective for surveying large geographic areas and take advantage of humans' ability to quickly integrate sensory information on the biological and physical environment in order to detect, identify, and count species of interest. In recent years, there has been increasing interest in using UASs to study wildlife populations. In particular, UASs have been suggested as an alternate survey platform for studying the distribution and density of the Bering-Chukchi-Beaufort (BCB) stock of bowhead whales in the western Arctic, which have been investigated using manned aircraft since 1979. The primary advantage of using UASs to survey marine wildlife in the Arctic is that they eliminate the risk of sending humans far from shore in small aircraft in areas with extreme weather conditions. Furthermore, some UASs are relatively low cost, and some have relatively long flight times. Finally, it has been shown

that UASs are less likely to disturb pinnipeds, and, therefore, might invoke less of a response from cetaceans as well.

The UAS technology with the highest probability of successfully surveying cetaceans was developed for military purposes in desert environments and only recently has been applied to the natural sciences. For surveying cetaceans, the UASs' ability to encounter, detect, and identify cetaceans and quantify their abundance must be understood relative to the proven capabilities of human observers in manned aircraft. The effectiveness of UASs in surveying cetaceans has yet to be demonstrated. A small number of limited field tests have been conducted and provided initial insight into the levels of success that may be achieved using UASs. The results from these preliminary studies warrant further investigation into the use of UASs for studying cetaceans. Additional insight will be gained only through direct comparisons of UASs and the human eye in the field, with large whales (bowheads and gray whales) as the primary targets.

Objectives:

- Evaluate detection rates and ability to identify cetaceans in Arctic waters using available UAS technology.
- Compare cetacean encounter rates, detection probabilities, identification abilities, and group size estimates between a UAS and human observers during simultaneous field tests and surveys.
- Describe improvements needed in UAS technology (payloads, cameras, etc.).
- Provide recommendations for the types of monitoring or mitigation requirements that can likely be met by UASs.

Methods: The BOEM will pursue joint-funding opportunities for this project. Potential partners include NMFS-NMML, Office of Naval Research, UAF, and industry. Planning and permit application will occur during the first year. Field experiments will occur in the second year in the eastern Chukchi or western Beaufort Sea during the open water season (June – October), a season when both bowhead and gray whales have reliably been found feeding in and migrating through the region. Well-trained marine mammal observers will search from aircraft or vessels either by unaided eye or through binoculars. A UAS will operate concurrently in the same area, with a well-trained marine mammal observer on the team, viewing digital video in real-time to detect, identify, and count cetaceans visible in the video feed. The digital video footage will be saved to enable additional analyses into UAS performance later.

This study will be integrated with other ongoing BOEM studies in the region, including aerial surveys studying the distribution, density, and feeding ecology of cetaceans.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Area(s): Chukchi Sea

Title: Enclave Development: Alternative Approaches for Housing Transient Workers in Rural Alaska

BOEM Information Need(s) to be Addressed: With the construction of Prudhoe Bay oil facilities, transient industrial workers on the North Slope of Alaska were housed in enclaves separate from existing indigenous communities. Subsequent MMS/BOEM social and economic impact models are still based upon this premise of enclave housing, even though more recent economic development opportunities in places like Nuiqsut and Wainwright demonstrate a move toward less segregation. Workers are increasingly based in Alaska Native villages with temporary housing provided by Village Corporations. The situation calls for re-evaluation of assumptions of the enclave model and reanalysis of potential community impacts.

Total Cost: TBD **Period of Performance:** FY 2013-2015

Description:

Background: A defining pattern of North Slope oil production is that oil development historically has taken place in isolated industrial enclaves where most workers are out-of-region residents working in shifts. Because they have little or no direct association with proximate Alaska Native villages, this arrangement has helped to limit direct impacts on local communities. A recent analysis of the Chukchi Exploration Plan disclosed that oil companies have negotiated with the Alaska Native community of Wainwright to construct a shorebase facility for transient workers, at least during the exploration phase. This study intends to analyze available community data to assess and predict more thoroughly the potential consequences from increased community contact with industrial workers.

Nuiqsut could serve as one example from which to process data and draw analytical conclusions. In Nuiqsut, industry has replaced the enclave model with hotel accommodations at nearby Alpine for housing some transient workers. Two more large units are planned for construction, yet little analysis to assess effects on local residents has been undertaken except a Human Health Impact Analysis (HHIA). The HHIA predicted that the demographic change could result in stresses including diminished access to subsistence resources, with potential resulting changes in: a) diet and food security; b) psychosocial/gender effects, such as increased substance/alcohol abuse, violence/homicide, or accelerated assimilation; and c) occupational/community health effects, such as expanded workplace health screening and immunization protocols, STI transmission prevention strategies, and substance abuse enforcement.

The BOEM recognizes that there are distinct cultural differences between the Iñupiat Eskimo who live in the North Slope and transient industrial workers. Currently, decision documents

stipulate implementation of mitigation through education, and industry is required to enhance employee cultural sensitivity through educational presentations administered prior to deployment to the region and thereafter on an annual basis. One component of this study would be to assess if this is an effective mitigation measure that will offset potential conflicts and socio-cultural changes resulting from a rotating series of strangers embedded in the community through no personal choice of their own.

Objectives: The purpose of this study is to assess current and trend-line housing practices for transient workers throughout the North Slope of Alaska, to re-evaluate historical assumptions about enclave models of development, and to analyze potential community impacts based on fresh data and analysis in Nuiqsut and Wainwright.

Methods: This study will employ various social science methods, focusing on select communities that have historically provided housing for transient workers. The collection and analysis of data to assess short-term and longer-term effectiveness will be accomplished through the following: 1) compilation of an annotated bibliography with a special emphasis on identification of industrial housing policies in the past in Alaska; 2) ethnographic review of past development activities associated with oil and gas elsewhere to assess effects upon local indigenous populations by transient industrial workers; 3) review and assessment of premises in existing Human Health Impact Assessments and current epidemiological data for the North Slope; 4) synthesis of available social indicator data and broader discussion regarding effects of enclave development in light of local support to engage in profitable contractor services. Draft and final reports will be provided.

Revised Date: September 2011

ENVIRONMENTAL STUDIES PROGRAM: Alaska Annual Studies Plan FY 2012

Region: Alaska

Planning Areas: Chukchi Sea

Title: Pacific Walrus Foraging Habitat and Prey Identification from Seasonal Haulouts Along the Chukchi Sea Coastline

BOEM Information Need(s) to be Addressed: The Marine Mammal Protection Act requires mitigation of potential disturbance of walrus (*Odobenus rosmarus*). Future oil and gas activities on the OCS of the Chukchi Sea and support activities onshore have the potential to disturb resting and foraging walrus. In addition, the Pacific walrus has been proposed for listing under the Endangered Species Act.

Results of this study would be used to support NEPA analysis and potential ESA consultations in relation to geological and geophysical surveys, exploration plans and development and production plans that result from Lease Sale 193 activities in the Chukchi Sea, as well as NEPA analysis for future lease sales in the Chukchi Sea. The Chukchi Sea Lease Sale 193 area overlaps with important walrus foraging habitat. Identifying key foraging and resting areas, and predicting how these may change over time increases our ability to mitigate potential impacts to walrus from the oil and gas industry by situating offshore and onshore facilities and pipelines in areas of less importance to walrus where possible.

Total Cost: TBD **Period of Performance:** FY 2013-2017

Description:

Background: Pacific Walrus, particularly females with calves, have traditionally relied on summer sea ice as a foraging platform over the continental shelf in the Chukchi Sea. Summer sea ice in the Arctic has declined by more than 11% per decade between 1979 and 2010. Changing sea ice patterns are forcing walrus ashore along the Chukchi Sea coast in late summer and fall. Terrestrial haulouts made up of thousands of walrus have been forming between Cape Lisburne and Barrow along the Chukchi Sea coastline since 2007. Walrus foraging trips from these terrestrial haulouts may be limited in range, particularly for females accompanied by calves that have a limited ability to remain in cold water for extended periods of time. Over time, walrus may have to choose between less optimal prey items or less optimal haulout locations. This study would advance the analysis of cumulative effects of oil and gas development in conjunction with impacts of climate change to the Pacific walrus population. Results of ongoing walrus tagging studies conducted by USGS/BRD and ADF&G, and haulout studies conducted by USFWS combined with the results of this study would greatly increase our understanding of walrus foraging and habitat use in the Chukchi Sea.

Objectives: Determine whether walruses' prey selection or foraging areas change over time, either within seasons or between years, with increased use of nearshore habitats for foraging from terrestrial haulouts.

Methods: Researchers will work with local residents, ADF&G, USFWS and BRD to collect walrus feces from terrestrial haul out sites along the Chukchi Sea coastline several times throughout each haulout season. The fecal samples will be analyzed for prey taxa using a molecular approach. The researchers will generate maps of likely foraging areas in the Chukchi Sea based on known distributions of prey taxa and analyze seasonal and annual changes in prey species and foraging locations in relation to haul out locations. The proposed study will be integrated with the tagging and haulout studies mentioned in the background section to differentiate between prey ingested near the fecal collection sites and prey ingested further from them.

Revised Date: September 2011

SECTION 3.0 TOPICAL AREAS FOR FY 2014

This section presents a general forecast of significant topical issues and concerns to be addressed by studies to be proposed for FY 2013 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 within the Alaska ESP. These projects will focus on BOEM mission needs within the context of increasing offshore exploration and development and potential trends in a changing climate. Specific geographic emphases are likely to change due to potential changes in leasing or development schedules, as well as the release of the next five-year *Oil and Gas Leasing Program*.

Many of the studies proposed for FY 2012 and FY 2013 address the topical areas described below. These will be re-assessed as part of the FY 2013 planning process.

As noted in Section 1.2.1 of this document, the *Revised Program Outer Continental Shelf Oil and Gas Leasing Program 2007-2012* (USDOI, BOEMRE, 2010) pointed to a need for more environmental research in the Arctic before additional leasing occurs. It will also be important for BOEM to continue post-lease monitoring studies and other priority studies of key species and marine communities in the Beaufort and Chukchi seas. Studies of bowhead whales will continue to be a priority for the region. Many studies of other sensitive marine mammals, including cetaceans, polar bears, pinnipeds and other marine mammals are expected to continue into 2012 and beyond. Additional studies may be brought online which address fish and migratory waterfowl. Future studies will include those aimed at determining spatial and temporal habitat use patterns, habitat description and monitoring and evaluations of health over time. Studies aimed at understanding potential impacts to subsistence species and subsistence practices will continue to be important. Additional studies of the physical environment, such as current regimes and ice characteristics, will be proposed to support interpretation of data from living resource investigations and to provide a better understanding of the fate and dispersion of OCS discharges.

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 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.

The accuracy of surface wind fields, ocean currents, and information regarding the spatial and temporal variability of polynyas, leads, and landfast ice are 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 landfast ice completely blocks wind forcing of under-ice waters. Thus water moves differently under landfast ice than adjoining open or pack ice waters. It becomes very important to know locations of and seasonal changes in the distribution of landfast ice.

3.3 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 "Continuation of Arctic Nearshore Impact Monitoring in the Development Area (cANIMIDA)." The summer of 2007 was the last field season for the current cANIMIDA project. The cANIMIDA task of monitoring of Cross Island whaling has been continued. A continuation of ANIMIDA/cANIMIDA sediment chemistry monitoring, emphasizing hydrocarbon and priority metal concentrations is also proposed for FY 2012. The proposed study 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 MMS 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 need for additional monitoring will continue to be re-evaluated as oil and gas development in the Alaska Region OCS evolves.

3.4 Endangered and Protected Species

Production at the Northstar site and at 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 continued monitoring of endangered species are expected to be continued—as well as 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. The 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.

3.5 Marine Fish Migrations, Recruitment and Essential Fish Habitat

The BOEM needs information to assess and manage the potential environmental effects of offshore development on marine fish. More detailed information is needed about the biology and ecology of many marine fish species inhabiting the Alaska lease areas. The highest priority 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 NEPA analyses. 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 becoming 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 subsistence utilization. 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.

3.6 Subsistence

Residents of the North Slope coastal communities frequently express concern about cumulative impacts of offshore and onshore developments on their subsistence lifestyle. Relative to existing oil and gas operations, the villages of most pressing concern are Nuiqsut, Kaktovik and Barrow. Consideration of cumulative impacts is an increasingly important issue for BOEM in preparing NEPA documents. 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.

A significant body of research has emerged to indicate that some North Slope residents increasingly manifest serious health problems that are related to changes in diet and consumption patterns, including diabetes, botulism, iron deficiency anemia, caries, heart disease, obesity, and substance abuse. The study "Baseline Nutritional Survey: Inventory and Content Analysis of Subsistence and Market Foods as Consumed by North Slope Communities" proposed for FY 2012 would contribute to a better understanding of whether

and how incremental changes to subsistence activities on the North Slope might produce substantial impacts on the dietary behaviors and health status of identifiable Native groups.

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.

SECTION 4.0 LITERATURE CITED

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APPENDIX

Ongoing and Planned BOEM studies that address "knowledge gaps" identified by USGS

* Ongoing studies are underway but have not yet produced a final technical report; Planned studies have been approved for funding allocation, but have not yet advanced beyond the procurement stage.

Rec. #	Key Concepts	Beaufort: BOEM Ongoing/Planned Studies*	Chukchi: BOEM Ongoing/Planned Studies*
3.01	Large-scale Circulation	• Adaptation of Arctic Circulation Model (NT-08-02) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Mapping and Characterization of Recurring Polynyas and Landfast Ice in the Chukchi and Beaufort Seas (AK-09-04) • Characterization of the Circulation on the Continental Shelf Areas of the NortheasternChukchi and Western Beaufort Seas (Proposed)	• Adaptation of Arctic Circulation Model (NT-08-02) • Surface Current Circulation High Frequency (HF) Radar Mapping in the Chukchi Sea (AK-09-06) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Mapping and Characterization of Recurring Polynyas and Landfast Ice in the Chukchi and Beaufort Seas (AK-09-04) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Hanna Shoal Ecosystem Study (AK-11-03) • Characterization of the Circulation on the Continental Shelf Areas of the NortheasternChukchi and Western Beaufort Seas (Proposed)
3.02	Changing Ice Regime	• Adaptation of Arctic Circulation Model (NT-08-02) • Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07) • Mapping and Characterization of Recurring Polynyas and Landfast Ice in the Chukchi and Beaufort Seas (AK-09-04)	• Adaptation of Arctic Circulation Model (NT-08-02) • Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07) • Mapping and Characterization of Recurring Polynyas and Landfast Ice in the Chukchi and Beaufort Seas (AK-09-04) • COMIDA: Chemical and Benthos (AK-08-03) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Hanna Shoal Ecosystem Study (AK-11-03)
3.04	Monitoring of Benthos	• Recovery in a High Arctic Kelp Community (AK-08-12-02) • Epifaunal Communities in the Central Beaufort Sea (AK-08-12-07) • Population Assessment of Snow Crab, *Chionoecetes opilio*, in the Chukchi and Beaufort Seas Including Oil and Gas Lease Areas (AK-08-12-09) • ANIMIDA III: Contaminants, Sources, Bioaccumulation (AK-11-14)	• COMIDA: Chemical and Benthos (AK-08-03) • Hanna Shoal Ecosystem Study (AK-11-03) • Population Assessment of Snow Crab, *Chionoecetes opilio*, in the Chukchi and Beaufort Seas Including Oil and Gas Lease Areas (AK-08-12-09)
3.05.A	Wintering Distribution and Habitats	• Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Beaufort Sea Marine Fish Monitoring Survey in the Central Beaufort Sea (AK-10-06) • Migration and Habitat Use by Threatened Spectacled Eiders in the Eastern Chukchi Near and Offshore Environment (AK-09-03) • Population and Sources of Recruitment in Polar Bears (AK-05-02) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed) • Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed)	• Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Migration and Habitat Use by Threatened Spectacled Eiders in the Eastern Chukchi Near and Offshore Environment (AK-09-03) • Population and Sources of Recruitment in Polar Bears (AK-05-02) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed) • Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed)

Rec. #	Key Concepts	Beaufort: BOEM Ongoing/Planned Studies*	Chukchi: BOEM Ongoing/Planned Studies*
3.05.B	Key Forage Species	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Trophic Links: Forage Fish, Their Prey, and Ice Seals in the NortheasternChukchi Sea (AK-08-12-05) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Hanna Shoal Ecosystem Study (AK-11-03)
3.05.C	Telemetry Studies	• Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Demography and Behavior of Polar Bears Summering on Shore in Alaska (AK-09-05) • Migration and Habitat Use by Threatened Spectacled Eiders in the Eastern Chukchi Near and Offshore Environment (AK-09-03) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed) • Arctic Cod Pilot Genetics and Toxicity Study (AK-11-13a) • Arctic Cod Genetics and Toxicity Study (AK-11-13b)	• Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Demography and Behavior of Polar Bears Summering on Shore in Alaska (AK-09-05) • Pinniped Movements and Foraging: Walrus Habitat Use in the Potential Drilling Area (AK-09-01) • Pinniped Movements and Foraging: Bearded Seals (AK-07-08) • Monitoring Marine Birds of Concern in the Eastern Chukchi Nearshore Area (Loons) (AK-07-04a) • Migration and Habitat Use by Threatened Spectacled Eiders in the Eastern Chukchi Near and Offshore Environment (AK-09-03) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed) • Arctic Cod Pilot Genetics and Toxicity Study (AK-11-13a) • Arctic Cod Genetics and Toxicity Study (AK-11-13b)
3.06.A	Change in Coastal Geomorphology	• ShoreZone Mapping of the North Slope of Alaska (AK-11-07) • Shorebirds Abundance and Distribution on Delta Mudflats Along the Beaufort Sea (AK-11-10a)	• ShoreZone Mapping of the North Slope of Alaska (AK-11-07)
3.06.C	Integrate Local Traditional Knowledge	• Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Study of Sharing Networks to Assess the Vulnerabilities of Local Communities to Oil and Gas Development Impacts in Arctic Alaska (AK-05-04a) • Aggregate Effects Research & Environmental Mitigation Monitoring of Oil Operations in the Vicinity of Nuiqsut (AK-08-09) • Continuation of Impact Assessment for Cross Island Whaling Activities (AK-08-01) • Subsistence Use and Knowledge of Beaufort Salmon Populations (AK-08-12-04) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)	• Pinniped Movements and Foraging: Bearded Seals (AK-07-08) • Pinniped Movements and Foraging: Walrus Habitat Use in the Potential Drilling Area (AK-09-01) • Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Study of Sharing Networks to Assess the Vulnerabilities of Local Communities to Oil and Gas Development Impacts in Arctic Alaska (AK-05-04a) • COMIDA: Impact Monitoring for Offshore Subsistence Hunting AK-08-04) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)
3.07.A	Life History Stages of Marine Fish	• Beaufort Sea Marine Fish Monitoring Survey in the Central Beaufort Sea (AK-10-06) • Arctic Fish Ecology Catalogue (AK-07-05)	• Current and Historic Distribution and Ecology of Demersal Fishes in the Chukchi Sea Planning Area (93-48-67)
3.07.B	Identify Biological Hotspots	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Continuation of Impact Assessment for Cross Island Whaling Activities (AK-08-01) • Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea (BWASP) (AK-10-05, AK-11-06) • COMIDA: Passive Acoustic Detection and Monitoring	• Hanna Shoal Ecosystem Study (AK-11-03) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Impact Monitoring for Offshore Subsistence Hunting (AK-08-04) • Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea (AK-10-05, AK-11-06)

Rec. #	Key Concepts	Beaufort: BOEM Ongoing/Planned Studies*	Chukchi: BOEM Ongoing/Planned Studies*
		of Endangered Whales in the Arctic (AK-09-02a) • ANIMIDA III: Contaminants, Sources, Bioaccumulation (AK-11-14) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)	• COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)
3.08	Subsistence Harvests	• Aggregate Effects Research & Environmental Mitigation Monitoring of Oil Operations in the Vicinity of Nuiqsut (AK-08-09) • Study of Sharing Networks to Assess the Vulnerabilities of Local Communities to Oil and Gas Development Impacts in Arctic Alaska (AK-05-04a) • Continuation of Impact Assessment for Cross Island Whaling Activities (AK-08-01) • Subsistence Use and Knowledge of Beaufort Salmon Populations (AK-08-12-04)	• Study of Sharing Networks to Assess the Vulnerabilities of Local Communities to Oil and Gas Development Impacts in Arctic Alaska (AK-05-04a) • COMIDA: Impact Monitoring for Offshore Subsistence Hunting (AK-08-04)
4.01.A	Development of Fully Integrated Regional Climate Models	• Adaptation of Arctic Circulation Model (NT-08-02) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07)	• Adaptation of Arctic Circulation Model (NT-08-02) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07)
4.01.B	Reduce Uncertainty of Storminess Projections	• Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Mapping and Characterization of Recurring Polynyas and Landfast Ice in the Chukchi and Beaufort Seas (AK-09-04)	• COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Mapping and Characterization of Recurring Polynyas and Landfast Ice in the Chukchi and Beaufort Seas (AK-09-04)
4.01.C	Projecting Circulation Patterns	• Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Adaptation of Arctic Circulation Model (NT-08-02) • Characterization of the Circulation on the Continental Shelf Areas of the NortheasternChukchi and Western Beaufort Seas (Proposed)	• Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Adaptation of Arctic Circulation Model (NT-08-02) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Characterization of the Circulation on the Continental Shelf Areas of the NortheasternChukchi and Western Beaufort Seas (Proposed)
4.01.D	Response of Species to Changes	• ANIMIDA III: Contaminants, Sources, Bioaccumulation (AK-11-14) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Beaufort Sea Marine Fish Monitoring Survey in the Central Beaufort Sea (AK-10-06) • Epifaunal Communities in the Central Beaufort Sea (AK-08-12-07) • Population Connectivity and Larval Dispersal in Bering, Chukchi and Beaufort Sea Snow Crab Populations: Estimating Spatial Scales of Disturbance Impacts (AK-08-12-06) • Subsistence Use and Knowledge of Beaufort Salmon Populations (AK-08-12-04) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Chemical and Benthos (AK-08-03) • Current and Historic Distribution and Ecology of Demersal Fishes in the Chukchi Sea Planning Area (AK-93-48-67) • Population Connectivity and Larval Dispersal in Bering, Chukchi and Beaufort Sea Snow Crab Populations: Estimating Spatial Scales of Disturbance Impacts (AK-08-12-06) • Hanna Shoal Ecosystem Study (AK-11-03) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)

Rec. #	Key Concepts	Beaufort: BOEM Ongoing/Planned Studies*	Chukchi: BOEM Ongoing/Planned Studies*
4.01.E	Track Trajectory Climate Change	• Adaptation of Arctic Circulation Model (NT-08-02) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05)	• Adaptation of Arctic Circulation Model (NT-08-02) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Biogeochemical Assessment of the OCS Arctic Waters (AK-08-12-03) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05)
5.01	Coordinated Organization of Spill Preparedness Data	• Physical and Chemical Analysis of Crude and Refined Oils: Lab and Mesoscale Oil Weathering (Proposed)	• Physical and Chemical Analysis of Crude and Refined Oils: Lab and Mesoscale Oil Weathering (Proposed)
5.03	Updated Spill Data, Reexamination of Statistical Approaches	• Updates to the Fault Tree for Oil-Spill Occurrence Estimators (AK-11-01) • Oil Spill Occurrence Estimators for Onshore Alaska and Canada North Slope Crude and Refined Oil Spills (AK-11-02) • Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07)	• Updates to the Fault Tree for Oil-Spill Occurrence Estimators (AK-11-01) • Oil Spill Occurrence Estimators for Onshore Alaska and Canada North Slope Crude and Refined Oil Spills (AK-11-02) • Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07)
5.04	Understand Oil-in-Ice Weathering	• Physical and Chemical Analysis of Crude and Refined Oils: Lab and Mesoscale Oil Weathering (Proposed)	• Physical and Chemical Analysis of Crude and Refined Oils: Lab and Mesoscale Oil Weathering (Proposed)
5.05	Characterize Microbial Populations in Water Column	• Wading Shorebirds Habitats, Food Resources, Associated Infauna, Sediment Characteristics and Biomediation Potential of Resident Microbiota of Deltaic Mudflats (AK-11-10b)	
5.06	Improve Ocean. / Met. Data to Help Inform a Variety of Issues	• Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Characterization of the Circulation on the Continental Shelf Areas of the NortheasternChukchi and Western Beaufort Seas (Proposed)	• Hanna Shoal Ecosystem Study (AK-11-03) • Surface Current Circulation High Frequency (HF) Radar Mapping in the Chukchi Sea (AK-09-06) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05) • Characterization of the Circulation on the Continental Shelf Areas of the NortheasternChukchi and Western Beaufort Seas (Proposed)
5.15	Dispersants Effects Analysis	• Arctic Cod Pilot Genetics and Toxicity Study (AK-11-13a) • Arctic Cod Genetics and Toxicity Study (AK-11-13b)	• Arctic Cod Pilot Genetics and Toxicity Study (AK-11-13a) • Arctic Cod Genetics and Toxicity Study (AK-11-13b)
5.17	Understand Toxic and Sublethal Effects of Dispersants	• Arctic Cod Pilot Genetics and Toxicity Study (AK-11-13a) • Arctic Cod Genetics and Toxicity Study (AK-11-13b)	• Arctic Cod Pilot Genetics and Toxicity Study (AK-11-13a) • Arctic Cod Genetics and Toxicity Study (AK-11-13b)
5.22	Analyze NRDA Metrics	• Updates to the Fault Tree for Oil-Spill Occurrence Estimators (AK-11-01) • Oil Spill Occurrence Estimators for Onshore Alaska and Canada North Slope Crude and Refined Oil Spills (AK-11-02) • Workshop—Interagency Protocols for Immediate On-the-Scene Oil Spill Impact Science (AK-11-11) • Maximum Credible Blowout Occurrence and Size Estimators for the Alaska OCS (AK-11-12)	• Updates to the Fault Tree for Oil-Spill Occurrence Estimators (AK-11-01) • Oil Spill Occurrence Estimators for Onshore Alaska and Canada North Slope Crude and Refined Oil Spills (AK-11-02) • Workshop—Interagency Protocols for Immediate On-the-Scene Oil Spill Impact Science (AK-11-11) • Maximum Credible Blowout Occurrence and Size Estimators for the Alaska OCS (AK-11-12)
5.23	Joint Study Planning	• Synthesis of Arctic Research (SOAR) (AK-11-05) • Alaska Marine Science Symposium (AK-10-03) • Conference Management and Reports on BOEM Results (AK-07-06) • Joint Funding Opportunities in Existing Marine Fish Studies (AK-10-09)	• Synthesis of Arctic Research (SOAR) (AK-11-05) • Alaska Marine Science Symposium (AK-10-03) • Conference Management and Reports on BOEM Results (AK-07-06)

Rec. #	Key Concepts	Beaufort: BOEM Ongoing/Planned Studies*	Chukchi: BOEM Ongoing/Planned Studies*
5.24	Build Distributed Biological Observatory	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Synthesis of Arctic Research (SOAR) (AK-11-05) • ANIMIDA III: Contaminants, Sources, Bioaccumulation (AK-11-14) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • COMIDA: Chemical and Benthos (AK-08-03) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Hanna Shoal Ecosystem Study (AK-11-03) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)
5.26	Develop Collaboration of an Overall Science Plan	• Alaska Marine Science Symposium (AK-10-03) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Coastal Marine Institute in Alaska - 2008-2012 (AK-08-12) • Conference Management and Reports on BOEM Results (AK-07-06)	• Alaska Marine Science Symposium (AK-10-03) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Coastal Marine Institute in Alaska - 2008-2012 (AK-08-12) • Conference Management and Reports on BOEM Results (AK-07-06)
6.01	Synthesize the Literature on Effects of Anthropogenic Sound on Marine Mammals	• Synthesis of Arctic Research (SOAR) (AK-11-05)	• Synthesis of Arctic Research (SOAR) (AK-11-05)
6.06	Database of Ambient Ocean Noise	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed)	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed)
6.07.A	Distinguish Behavioral Effects of Sound	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)
6.07.B	Make Inferences about Sound Thresholds for Populations	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed) • Effects of Pile Driving Sounds on Auditory and Non-Auditory Tissues of Fish (NT-08-04)	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)
6.08	Bowhead Whale Synthesis for Anthropogenic Noise	• Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea (BWASP) (AK-10-05, AK-11-06) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and	• Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea (AK-10-05, AK-11-06) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead

Rec. #	Key Concepts	Beaufort: BOEM Ongoing/Planned Studies*	Chukchi: BOEM Ongoing/Planned Studies*
		Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Synthesis of Arctic Research (SOAR) (AK-11-05)	Whales (AK-06-01, AK-10-01) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed)
6.09	Understand Habitat Needs for Bowhead	• Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea (BWASP) (AK-10-05, AK-11-06) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Synthesis of Arctic Research (SOAR) (AK-11-05)	• Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea (AK-10-05, AK-11-06) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a) • COMIDA: Factors Affecting the Distribution & Relative Abundance of Endangered Whales: Biophysical Moorings and Climate Modeling (AK-09-02b) • Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed)
6.10	Ensure Effective Mitigation to Subsistence Hunting	• Study of Sharing Networks to Assess the Vulnerabilities of Local Communities to Oil and Gas Development Impacts in Arctic Alaska (AK-05-04a) • Continuation of Impact Assessment for Cross Island Whaling Activities (AK-08-01) • Aggregate Effects Research & Environmental Mitigation Monitoring of Oil Operations in the Vicinity of Nuiqsut (AK-08-09)	• Study of Sharing Networks to Assess the Vulnerabilities of Local Communities to Oil and Gas Development Impacts in Arctic Alaska (AK-05-04a) • COMIDA: Impact Monitoring for Offshore Subsistence Hunting (AK-08-04)
6.11	Understand Sensitivity of Beluga Whales to Icebreaking	• COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a)	• COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a)
6.12	Inventory Habitat Needs of Beluga Whale	• Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)	• Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed)
6.13	Understand Habitat Needs of Gray Whale	• Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed) • Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed)	• Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (Proposed) • Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of BOWFEST) (Proposed)
6.14	Reassess Polar Bear Distribution and Habitats	• Demography and Behavior of Polar Bears Summering on Shore in Alaska (AK-09-05) • Population and Sources of Recruitment in Polar Bears (AK-05-02)	• Demography and Behavior of Polar Bears Summering on Shore in Alaska (AK-09-05) • Population and Sources of Recruitment in Polar Bears (AK-05-02)
6.15	Quantify Habitat Requirements of Ice Seals	• Ice Seal Movements and Foraging: Village Based Satellite Tracking and Acoustic Monitoring of Ringed, Bearded, and Spotted Seals (Proposed)	• Pinniped Movements and Foraging: Bearded Seals (AK-07-08) • Trophic Links: Forage Fish, Their Prey, and Ice Seals in the Northeastern Chukchi Sea (AK-08-12-05) • Ice Seal Movements and Foraging: Village Based Satellite Tracking and Acoustic Monitoring of Ringed, Bearded, and Spotted Seals (Proposed)

Rec. #	Key Concepts	Beaufort: BOEM Ongoing/Planned Studies*	Chukchi: BOEM Ongoing/Planned Studies*
6.16	Study Vocalizations of Ice Seals	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a)	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a)
6.18	Walrus Reactions to Sound	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a)	• Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • COMIDA: Passive Acoustic Detection and Monitoring of Endangered Whales in the Arctic (AK-09-02a)
6.19	Inventory Habitat Needs of Pacific Walrus		• Pinniped Movements and Foraging: Walrus Habitat Use in the Potential Drilling Area (AK-09-01)
7.01	Improved Access to Information	• Synthesis of Arctic Research (SOAR) (AK-11-05) • Conference Management and Reports on BOEM Results (AK-07-06) • Coastal Marine Institute in Alaska - 2008-2012 (AK-08-12) • Alaska Marine Science Symposium (AK-10-03) • Alaska Environmental Database (AK-11-15)	• Synthesis of Arctic Research (SOAR) (AK-11-05) • Conference Management and Reports on BOEM Results (AK-07-06) • Coastal Marine Institute in Alaska - 2008-2012 (AK-08-12) • Alaska Marine Science Symposium (AK-10-03) • Alaska Environmental Database (AK-11-15)
7.02	Develop a Cost/Benefit Analysis of Petroleum Activities	• Testing, Improvement, and New Alaska Data for MAG-PLAN (AK-08-10)	• Testing, Improvement, and New Alaska Data for MAG-PLAN (AK-08-10)
7.03	Develop a Body of Knowledge about Cumulative Impacts	• Aggregate Effects Research & Environmental Mitigation Monitoring of Oil Operations in the Vicinity of Nuiqsut (AK-08-09) • Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Alaska Environmental Database (AK-11-15)	• Bowhead Whale Feeding Variability in the Western Alaskan Beaufort Sea: Satellite Tracking of Bowhead Whales (AK-06-01, AK-10-01) • Bowhead Whale Feeding Variability in the Western Beaufort Sea: Feeding Observations and Oceanographic Measurements and Analyses (AK-06-01, AK-10-02) • Synthesis of Arctic Research (SOAR) (AK-11-05) • Alaska Environmental Database (AK-11-15)
7.04	Incorporate Climate Change Effects Into Cumulative Analysis	• Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07) • Adaptation of Arctic Circulation Model (NT-08-02) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05)	• Evaluation of the Use of Hindcast Model Data for OSRA in a Period of Rapidly Changing Conditions (AK-10-07) • Adaptation of Arctic Circulation Model (NT-08-02) • Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study (AK-06-05)

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