



2019 Work Plan Oil Spill Recovery Institute

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Prince William Sound Oil Spill Recovery Institute

2019 Work Plan

I. Purpose and organization of this document

This document describes the Oil Spill Recovery Institute (OSRI) 2019 Work Plan in the context of the overall Research Plan approved by the OSRI Board in October 2015 for fiscal years 2016 through 2020. The Research Plan should be referenced for detailed descriptions of the OSRI Program, the planning process and supporting documents. The annual reports and previous work plans should be referenced for more information regarding previously funded projects. The 2019 Work Plan provides descriptions of projects proposed for funding in the 2019 fiscal year beginning October 1, 2019 and a brief description of projects funded in previous years that have funding continuing into fiscal year 2019 (FY19). The OSRI Science Plan and previous OSRI Work Plans can be found on the internet at: www.pws-osri.org.

II. OSRI Strategic Goals and FY19 Work Plan New Projects

The Advisory Board of OSRI and the Executive Committee of the Board of Directors for the Prince William Sound Science Center (PWSSC) conducted a strategic planning session in 2014. The purpose of the planning session was to evaluate the past, the present, and plan for the future of OSRI. During that planning session the mission of OSRI was identified to be: **Support research, education, and demonstration projects that improve understanding and response to oil spills in the Arctic and sub-Arctic marine environments.** Four goals were identified as part of the strategic plan: Understand, Respond, Inform, and Partner (see OSRI Science Plan). The fiscal year 2019 Work Plan has been placed in the context of these four goals.

A. Goal #1 Understand:

Attain an interdisciplinary understanding of Arctic and sub-Arctic marine environments as it pertains to: baseline conditions; the sources, fate, and effects of spilled oil; and the recovery of those environments following a spill.

This goal addresses the OSRI mandate to “determine, document, assess, and understand the long-range effects of Arctic or subarctic oil spills”. The objectives listed in the science plan are to:

- Evaluate short and long-term effects.
- Identify chemical, biological, and physical impacts and consequences.
- Identify impacts of oil spill response options.
- Evaluate impacts from oil spills on the economy, lifestyle and well-being of people, and resiliency of communities and resource users.
- Achieve long-term coastal and ocean observing capabilities.

This work plan describes projects totaling \$295K for projects related to Goal #1. OSRI has elected to support a portfolio of initiatives, including:

- (1) Supporting the operation of SNOTEL meteorological stations in partnership with the Alaska Ocean Observing System (AOOS).
- (2) Oil degradation agent effectiveness.
- (3) Continuing partnership with NPRB for biological research.
- (4) Arctic cod sensitivity to oil and impacts on growth

a. SNOTEL stations (OSRI cost: \$10K)

One objective of the research plan is to achieve long-term coastal and ocean observing capabilities. AOOS and OSRI have had a long-standing partnership in developing, testing, and maintaining the Prince William Sound Ocean Observing System. There are two primary goals of the Prince William Sound Observing System. The first is to combine long-term monitoring with short-term hypothesis-driven process studies to understand mechanisms underlying the regional ecosystem dynamics. Understanding the circulation and the patterns of water exchange will provide a solid scientific foundation for addressing fisheries and ecosystem management needs related to long-term oceanic and climatic variability. The second goal is to provide information to the major user groups in Prince William Sound (PWS) including the coastal communities, oil and gas transportation industry (tanker traffic and oil spill response), air taxis, commercial fishermen, recreational and commercial boaters, and Coast Guard search and rescue operations.

Understanding the circulation of Prince William Sound requires accurate measurements of wind fields and precipitation. Snowmelt runoff and rainfall creates a freshwater layer that sets up aspects of the surface circulation. By understanding the basic meteorological conditions, including precipitation, we hope to improve our ability to model the hydrology of Prince William Sound, improve our understanding of the forces driving seasonal changes in circulation, and provide oil spill response organizations with necessary data.

Snowpack Telemetry (SNOTEL) meteorological stations, set up in partnership with the Natural Resources Conservation Service (NRCS) and the Alaska Ocean Observing System (AOOS), measure precipitation from snow and rain throughout the year and are needed to establish the freshwater budget. Since the summer of 2005, six SNOTEL stations have been deployed at sea level in PWS, and two stations at alpine elevations. Each station in PWS measures temperature, wind speed and direction, precipitation, and solar radiation. With several years of data now available, we are able to test, more

quantitatively, our understanding of freshwater input into PWS. The weather measurements are also important for oil spill trajectory modeling.

The annual operating cost for the weather stations is about \$3.5K per station per year. The operating costs include regular maintenance, calibration of sensors, access to the sites, and telemetry related expenses. Funding for operation of these sites has been transitioned to AOOS. The OSRI FY19 budget includes \$10K for upgrades and repairs to the eight existing systems.

b. Impacts of oil on Arctic cod (OSRI cost: \$85K)

In the last 15 years, oil spill research at NOAA has focused on three major spill events: the 1989 Exxon Valdez spill in Prince William Sound, Alaska, the 2007 Cosco Busan spill in San Francisco Bay, and the 2010 Deepwater Horizon spill in the Gulf of Mexico. However, three key lessons were learned from these major events: 1) scientific response requires a multidisciplinary effort, 2) reactionary science can delay management response, and 3) species from different ecosystems respond very differently. Here we propose to examine the effects of an oil spill in the Alaskan Arctic by way of potential impacts on a keystone species, Arctic cod (*Boreogadus saida*) under current and future climate scenarios. Results from a 2017 pilot study indicated that Arctic cod are extremely sensitive to very low dose oil exposure, much more than other marine gadids from the Atlantic. In addition, juveniles that were exposed to oil as embryos grew significantly slower than control fish under identical environmental conditions. These findings elevated concerns of potential impact of oil on Arctic cod while raising a series of new questions as to how oil impacts survival and growth potential and what the minimum effective exposure concentrations are for this species. Moreover, with predicted elevations in Arctic sea surface temperatures, there is a need for determining how oil toxicity will be influenced by combined temperature stress in Arctic cod. This project will proactively capitalize on a new oil exposure laboratory for Arctic cod to directly address these questions and mechanistically understand both the immediate and latent effects (> 6 months post-exposure) of low dose embryonic exposure to oil.

This is the first year of a three-year research project and OSRI expects to provide \$85K of support in FY19. Expected funding in years 2 and 3 is \$120K and \$60K respectively. The project is funded in partnership with NOAA.

c. Funding partnership with the North Pacific Research Board (NPRB) (OSRI cost: \$100K)

The NPRB and OSRI have science plans that encourage research partnerships and the two organizations have been partnering to fund research of joint interest since 2006. Section 4.2.3 of NPRB's science plan directly responds to a strong recommendation of the National Research Council to seek partnerships with other entities to support joint research and funding of projects of mutual interest. Similarly, Section III.A.1 of OSRI's research plan identifies a potential partnership with NPRB to support ecological

research projects in Arctic and sub-Arctic climates. NPRB and OSRI have science and implementation plans that provide the foundation for defining research priorities of mutual interest in any given year. In 2018 OSRI and NPRB signed a new agreement that has OSRI committing to providing up to \$100K in funding for three years between 2018 and 2023.

This year OSRI will review proposals from many potential topic areas in the NPRB request for proposals that overlap with OSRI's research plan. The OSRI research plan notes that the nearshore environment is the most likely area to be impacted by an oil spill, therefore knowledge of the environment and ecology of this zone is of greatest use to OSRI. There is also increasing pressure from shipping and oil development in the Arctic and Aleutians that makes these areas of particular interest.

OSRI may contribute up to a total of \$100K in FY19 for one or more projects relevant to its research plan.

d. Toxicity of crude oil treated with herders (OSRI cost: \$100K)

In recent years, there has been substantial research conducted on the toxicity of oil and dispersant mixtures. Yet, few have looked at chemical herders that may be used to enhance burning and skimming operations. While the application volumes are expected to be extremely low, it is still important to understand the potential lethal and sublethal effects of these compounds. We will seek a proposal to examine acute and sublethal toxicity studies of treated oil and burn residues of treated oil to examine changes in toxicity due to the use of herders.

This is the first year of a three-year research project and OSRI expects to provide \$100K of support in FY19. Expected funding in years 2 and 3 is \$125K and \$75K respectively.

B. Goal #2 Respond:

Enhance oil spill response and mitigation capabilities in Arctic and sub-Arctic marine environments.

This goal addresses the OSRI mandate to “identify and develop the best available techniques, equipment, and materials for dealing with oil spills in the Arctic and subarctic marine environment.” The objectives listed in the Research Plan are to:

- Identify and evaluate new prevention and response technologies.
- Evaluate relative benefits and consequences of specific response and mitigation techniques.
- Fill knowledge gaps on behavior of spilled oil.

Projects to achieve these objectives are described below.

1. Technology research and development

This work plan describes projects totaling \$100K for projects related to Goal #2, oil spill response, OSRI is looking to fund projects in partnership with other organizations or that complement ongoing research programs.

a. Herder/burner partnership project. (OSRI cost - \$100K)

Recent advances in chemical herders that can be used to thicken slicks to provide a more efficient burn have shown a need to advance the systems used to deploy herders and apply an ignition source. OSRI is partnering with ExxonMobil and the Bureau of Safety and Environmental Enforcement to develop new tools that combine the application of herders with the helitorch system, and to develop tools appropriate for use with unmanned aircraft. Combining the herder dispensing tools on the helitorch will allow existing systems to be expanded to combine efforts rather than requiring a helicopter to apply the herder and another to ignite the slick. The use of unmanned aircraft for the same purpose is desirable to further reduce the risk to personnel and to be able to apply herders and ignition when helicopters are not available.

A total of \$100K is expected to be available to contribute to the partnership in 2019.

C. Goal #3 Inform:

Share information and educate the public on the issues of oil spill prevention, response, and impacts.

The objectives of this goal are to:

- Publish scientific and technical results in open literature
- Brief the response community on OSRI products.
- Facilitate the exchange of information and ideas through workshops and other forums.
- Educate future researchers and responders through K-12 programs, undergraduate internships, and graduate fellowships.
- Convey information to the general public through various media.
- Be a source of expertise.

The approach to reach these objectives OSRI proposes spending \$175K to fund a suite of projects related to education and outreach along with supporting workshops and conferences that provide a means to disseminate OSRI research.

1. Education

Development of future researchers, engineers, and others involved in oil spill response requires an education component that exposes students to the issues important to ecology and technology. OSRI has been a strong supporter of education programs targeting students from kindergarten to graduate school. OSRI intends to continue building upon existing regional education and outreach programs.

a. Graduate Research Fellowships (OSRI Cost: \$90K for up to three students)

Support of graduate students provides a means of focusing people at the start of their careers on oil spill related issues. OSRI funds are provided to support graduate projects that will better understand the social and economic effects of oil spills on coastal communities, provide information needed by managers and decision-makers for oil spill response and recovery, improve the technologies available to spill responders, and improve public awareness and understanding of marine and estuarine ecosystems.

Masters students may be supported for two years and doctoral students for up to four years. Applications for extensions beyond that time frame will be considered during the last year of existing funding. Students will be expected to present results to the OSRI Board at some point in their fellowship. Up to three Graduate Research Fellowship projects will be supported in FY19. We anticipate one continuing student and OSRI will release an RFP for the selection of up to two new students. Up to \$30K of support per year will be available to each fellowship. A twenty five percent match by the proposing institution is required.

Continuing fellowship: Cost-effective monitoring of anthropogenic impacts and environmental change in marine Arctic ecosystems Gonzalez, University of Washington. Detecting and understanding potential biological impacts of oil spills in the Arctic requires characterizing and understanding dynamics of fish and macrozooplankton communities. One efficient approach uses stationary active acoustics to characterize and monitor seasonally ice-covered waters of Arctic marine ecosystems. But to understand the scope of the measurements, the spatial area that is represented by acoustic point source measurements (i.e. representative range) must be quantified to ensure an effective characterization and monitoring of pelagic community dynamics.

This project will characterize spatial and temporal variability in densities and vertical distributions of fish and macrozooplankton, and quantify the representative range of temporally-indexed, acoustic measurements in the Chukchi Sea. Up to years 6 years of multifrequency acoustic data from an Acoustic Zooplankton Fish Profiler (AZFP) echosounder that is part of the Chukchi Ecosystem Observatory (CEO) located at Hanna Shoal, will be compared to acoustic data from two mobile surveys: the 2015 Arctic Marine Biodiversity Observing Network (AMBON) cruise, and the 2017 Arctic Shelf Growth, Advection, Respiration and Deposition (ASGARD) cruise. Wavelet analysis will be used to describe scales of spatial and temporal variation of animal vertical distributions and densities. Multiple methods that calculate representative ranges of means and variances will be used and compared to assess the consistency of estimated representative ranges. Results from this work will increase our ability to detect and monitor biological responses to oil spills, help design distributed monitoring networks, and, more generally, monitor environmental change in Arctic ecosystems.

OSRI will provide \$30K of support for this Ph.D. project. This is the second year of a three-year proposal.

b. K-12 Programs: (OSRI Cost: \$60K)

OSRI will continue to support the Prince William Sound Science Center's Headwaters to Ocean program in order to introduce younger students to the concepts important to understanding oil spill response and the recovery of the environment. Programs include components such as oceanographic monitoring, environmental education, and an introduction to oceanographic technologies. Beyond classroom delivery in PWS, OSRI is requesting that portions of the Discovery Room program be delivered to at least two geographic areas outside of Southcentral, or at a gathering that brings together people from those areas. OSRI desires a proposal that continues to support the existing education efforts and includes travel for delivery of materials to other communities.

This funding is for a single year to continue the Headwaters to Ocean environmental and technical education at the K-12 level. OSRI will provide \$60K in FY19. The total cost of this program is between \$130K and \$150K and is supported by a wide array of other funding sources including grants and contributions.

2. Outreach

Outreach to the public, researchers, and spill responders is important in ensuring OSRI's activities provide benefits and are peer-reviewed. Several means have been used to publicize OSRI's activities including sponsoring workshops and conferences, outreach activities of the Research Program Manager, and supporting public outreach through lecture series, radio programs, and development of printed materials.

a. Workshops and Conferences (OSRI cost: \$25K)

These funds are for workshops or special projects at the discretion of the OSRI Advisory Board. Funding is set aside for regularly scheduled conferences where OSRI funded research is presented and for supporting workshops that help OSRI achieve its mission. Workshops being considered for FY19 support include:

(1) **Alaska Marine Science Symposium.** (OSRI cost: \$5K) Each January, researchers from throughout Alaska are invited to participate in a 3-4 day conference. It is an excellent opportunity for presentation of new results and networking. OSRI will contribute \$5K to support this workshop, which will be held in late January in Anchorage.

(2) **Alaska Forum on the Environment.** (OSRI cost: \$5K) OSRI will continue its support of the Alaska Forum on the Environment, which is typically during February in Anchorage. The conference covers many issues relevant to understanding the potential impact of oil spills in Arctic and sub-Arctic marine environments. OSRI will allocate \$5K to the Alaska Forum on the Environment. A limited number of registration waivers will be available for the staff, Board, and Scientific and Technical Committee to attend the workshop.

(3) **Workshops of opportunity.** (OSRI cost: \$15K) Many important workshops occur that could provide improved products with a little additional support. The support provided here is intended to help cover the cost of running the workshop, the addition of teleconference capabilities, providing a facilitator or report editor, or other needs. OSRI will allocate a total of \$15K to support workshops that align with the OSRI mission.

D. Other Programs

1. Program coordination (OSRI cost: \$110K). The position of OSRI Research Program Manager is a programmatic expense. The total costs include salary, benefits, travel and commodities. The Research Program Manager's responsibilities include:

- Preparation of the annual work plan in consultation with the Board-appointed Work Plan Committee and in accordance with the Five-Year Science Plan adopted in 2005. Compiling information about potential projects, writing brief project descriptions and preparing project budget estimates.
- Implementing the work plan as approved by the Board. This includes drafting requests for proposals based on the Annual Work Plan priorities, and coordinating the peer review process with OSRI's Scientific and Technical Committee and with other organizations OSRI partners with for research projects.
- Coordinating with the Chair of OSRI's Scientific and Technical Committee (STC) to assure regular transfer of information between the OSRI Board and the STC. Also provide assistance, as requested by the STC Chair, in scheduling meetings.
- Meeting 2-3 times per month with the OSRI Executive Director (ED) to exchange information concerning program issues and contract awards. Work with the ED to develop a monthly program report for distribution to the OSRI Board.
- Assisting the Executive Director to ensure compliance with all policies and procedures of the OSRI Grant Policy Manual.
- Coordinating the processing of contracts for successful proposals. Monitor progress and final report deadlines for these contracts.
- Preparing bi-annual reports on OSRI grant awards and research and education programs for distribution to the OSRI Board.
- Preparing and publishing an annual report for broad distribution.
- Supervising maintenance of the OSRI website.
- Collaborating with the OSRI Executive Director to develop and maintain cooperative agreements with other organizations for research and education programs, for example with the Exxon Valdez Oil Spill Trustee Council, two Regional Citizens' Advisory Councils, the Alaska Department of Environmental Conservation, the Alaska Ocean Observing System (AOOS), the North Pacific Research Board, the UNH/NOAA Coastal Response Research Center, Bureau of Safety and Environmental Enforcement, Bureau of Ocean and Energy Management, and Joint Industry Programs.
- Periodically representing OSRI at professional meetings and workshops.

- Maintaining files and a library on oil pollution issues.
- Providing leadership in planning future research programs and work plans.
- Preparing technical reports on OSRI programs.
- Overseeing many outreach activities including presenting at workshops and conferences, maintaining the OSRI website, and publishing the OSRI annual report. Other outreach efforts are aimed to disseminate OSRI efforts through a wide array of media options, such as printed materials, radio broadcasts, and video or computer presentations.

OSRI funding will provide approximately \$86.7K personnel (6.0 months), \$10.05K travel, \$11.3K contractual, and \$1.95 K commodities for a total of \$110K.

2. OSRI Science and Technical Committee meetings (OSRI Cost: \$5K).

Funds are set aside to support the functions of the OSRI Science and Technical Committee and to support Board and STC travel-related expenses associated with OSRI partnerships such as the JIP, NPRB, etc.

E. Partnerships

The use of partnerships is a goal outlined in the OSRI strategic plan. While there is not any funding that is dedicated solely to the development or maintenance of partnership programs, there are many existing partnerships and opportunities to develop new partnerships. We continue to partner with the Alaska Ocean Observing System (AOOS) to support an ocean observing system in Prince William Sound and to validate the physical and biological models developed through efforts by OSRI and AOOS. We are examining new partnerships with AOOS as they transition into their next five-year research plan. We continue to partner with NPRB to gain knowledge on the ecology of Alaskan waters and examine issues regarding oil toxicity. We are looking to partner with organizations like the Defenders of Wildlife and the North Slope Borough Wildlife Department that also have research related to understanding the impacts of oil spills.

To achieve our objectives under the Respond goal requires partnerships. We are looking to work with industry-sponsored research programs that align with OSRI's science plan. The Arctic Technology JIP includes six different programmatic areas, four of which are closely linked with the goals outlined in the OSRI science plan. Many of their projects will be completed in this year and gaps in their efforts identified for future funding opportunities. BSEE and USCG also have important programs to follow. BSEE recently had a call for white papers that included several topics related to improving spill response in the ice environment. The USCG continues work to test technologies in the ice environment. Their work provides a relatively low cost to test some emerging technologies.

Our Inform goal related projects are also heavily dependent on partnerships, most often developed by the programs we fund. OSRI contributes a portion of the cost of the education programs outlined. These programs gain additional funding from several private, corporate, and grant contributions. The Discovery Room is also a collaborative effort with the U.S. Forest Service and the Copper River Watershed Project. OSRI contributes small amounts to the Alaska Marine Science Symposium and the Alaska Forum on the Environment. The workshop of opportunity section is designed to provide an opportunity to develop new partnerships to achieve OSRI's goals.

F. FY19 New Programs Spending Summary

Area	Project	FY19 Work Plan
Understand		
	Meteorological Stations	\$10K
	Arctic cod	\$ 85K
	NPRB Partnership	\$100K
	Toxicity of herders	\$100K
		\$295K
Respond		
	Partnership Projects	
	Herder/Burner JIP	\$100K
		\$100K
Inform		
	Graduate Fellowships	\$90K
	K-12	\$60K
	Workshops	\$25K
		\$175K
Other		
	Research Program Manager	\$110K
	STC Travel	\$5K
		\$115K
Subtotal		\$685K
Administration		
	Based on 20% of total expenditure	\$172K
Total		\$857K

III. Prior Years' Encumbered Projects Continuing in FY19

Because OSRI projects are started at the beginning of each quarter, many projects funded in previous years will continue into fiscal year 2019. The purpose of this section is to identify those projects so that the work plan aligns with the FY19 budget sheets. These projects are listed as the Prior Years' Encumbered portion of the budget. If an existing project is to get new funding in FY19 – multi-year grants – the project description exists in the previously provided section. Because the exact amount of funds that are being carried forward will not be known until sometime in October, there are no dollar amounts provided with the individual projects.

A. Goal #1 - Understand

1. Degradation additive effectiveness

In FY16 OSRI released a request for proposals to address the effectiveness of degradation agents. Several products have been proposed as additives to spilled oil to speed up the natural degradation of oil by microbes. Few have been tested in conditions expected in the Arctic or sub-Arctic. Some have not been tested by independent parties. We desire to test the efficacy of these agents prior to a spill so we can understand their potential for spill remediation and their potential effects on the environment. There is a need to understand, if the agents are enhancing degradation or dispersing the oil, what the natural response time is to the additive, and what end and intermediate products are produced.

OSRI selected to fund a proposal from Dr. Leigh of the University of Alaska Fairbanks. The work aims to 1) evaluate the effectiveness of Oil Spill Eater II on crude oil and marine diesel degradation and detoxification in Arctic and sub-Arctic seawater, 2) determine its mode(s) of action, 3) compare its efficacy to that of chemical dispersants (Corexit 9500A), and 4) to assess effects on indigenous microbial communities. The proposal outlined a three-year research project to address these objectives.

B. Goal #2 Respond:

1. Food Safety

Nuka Research and Planning Group, LLC (Nuka Research) proposes to conduct the project *Ensuring Food Safety Following an Oil Spill in Alaska*. The goal of this project is to improve the mitigation of food safety impacts resulting from a marine oil spill in Alaska through supporting the ARRT's efforts to develop policy and guidance for Onscene Coordinators regarding food safety during pollution responses.

Project objectives to achieve this goal include:

- Identify statutory and regulatory authorities, as they exist, regarding closure/opening of each of the following in the event of contamination from a marine oil spill: commercial, recreational, personal use, and subsistence resources.
- Directly engage ARRT workgroup in project via check-in calls or meetings at three key points in the development of project deliverables.
- Produce concise, thorough, and thoroughly referenced report that will serve as a direct input to the ARRT workgroup's efforts to develop a policy and guidance related to food safety in the event of a marine oil spill in Alaska.

The approach includes a review of statutes and regulations, literature, and documentation from past spills, as well as interviews with subject matter experts and knowledge-holders. Examples of policies or guidelines related to the contamination of commercial, subsistence, recreational, or personal use resources will be drawn from Alaska and elsewhere in the U.S. as well as internationally.

This project will directly serve the needs of the ARRT to further enhance preparedness of agency officials to handle food safety-related issues in a response context. In doing so, it also directly supports the Oil Spill Recovery Institute's mission to "enhance the ability of oil spill responders to mitigate impacts of spills in Arctic and sub-Arctic marine environments." Unlike many of the Institute's projects, which focus on the recovery or treatment of the slick itself, this project addresses broader impacts. Consumption of contaminated food sources or lack of access to safe food due to actual -- or perceived -- contamination are potential impacts of oil spills in Alaska. Providing clear food safety guidelines will support decision-making in the intense context of a spill response and also improve clarity for resource users and markets.

2. Skimmer Rating

The Alaska Chadux Corporation (ACC) is a nonprofit spill response company that provides coverage for fuel facilities, tank barges, tankers, and non-tank vessels across the state of Alaska. While Chadux provides coverage for a variety of operations, much of the product at risk is refined petroleum in the form of diesel and jet fuel. To remove spilled products from the marine or freshwater environment, Chadux employs several types of oil recovery devices (skimmers) that either collect an oil-water mixture (weir or suction devices) or act as an oil-water separator at the surface of the water (oleophilic devices). In recent marine responses Chadux employees have employed oleophilic skimmers to collect diesel and found the devices to be effective in a real-world environment and efficient in that they collected very little water during operation.

Chadux is proposing to test two of its skimming systems in a controlled environment to quantify the efficiency of the devices. To date, regulatory agencies such as the United States Coast Guard (USCG) and the Alaska Department of Environmental Conservation (ADEC) have not differentiated oleophilic skimming devices and weir or suction devices with regards to contingency planning standards. Chadux hopes to demonstrate that adoption of Best Available Technology (BAT) has a measurable advantage when it comes to cleaning up oil on water. Additionally, the project will allow Chadux to train its employees with oleophilic skimmers and give them the opportunity learn how to maximize their operational capabilities. Chadux also intends to open the training sessions to interested member company personnel, employees from other spill response organizations, and regulatory personnel.

C. Goal #3 Inform:

1. Graduate Research Fellowships

Continuing fellowship: Crude Oil Movement in Sea Ice: Development and Validation of a Parametric Model of Oil Migration Oggier, University of Alaska Fairbanks.

Economic interests of the oil and gas industry as well as the maritime shipping sector have increased in the Arctic over the past few decades. Despite a decline in the summer sea ice extent, Arctic waters will remain infested with sea ice for a significant part of the year in the foreseeable future. Hence, the hydrocarbon industry will need to cope with sea ice during routine operations. Understanding and predicting the fate of oil in sea ice is crucial to assess risks to ecosystems and people and to effectively respond to an oil spill in Alaskan Arctic waters.

The objective of the proposed research is three-fold:

- Development of a simple oil migration model that draws on previous work; the model is run in parallel with an oil spill laboratory experiment for parameterization and validation of predictions of onset and extent of oil percolation (depth penetration, volume of oil pervading ice matrix, expected surfacing time).
- Validation of the model based on observed oil percolation with the aid of X-ray tomography and sea-ice thin/thick optical sections.
- Evaluation of the utility of a portable X-ray tomographer to characterize the oil distribution and support prediction for operational purposes in an experiment setting representative of conditions in the field.

The following methods will be applied:

- (1) Development of the oil migration model. The model will run with simple input such as ice conditions (thickness, temperature and porosity), weather variables (temperature, HR ...) and oil parameters (volume, physical properties).

- (2a) Controlled oil spill simulation in a laboratory experiment under conditions representative of the field with continuous in-situ temperature, relative humidity measurements
- (2b) Simulation of oil percolation with daily update based on measured experimental variables
- (3) Comparison between simulation and experiment, based on (1) daily observations (ice surface, temperature) and (3) X-ray tomography data and thin-thick section.

The proposed research is significant in advancing knowledge through better prediction of oil percolation in case of an oil spill. Such understanding and the availability of a model suitable for operation prediction will help recovery efforts, e.g., in determining the most suitable time frame for the clean-up response and the choice of the method applied, and in supporting NRDA exposure evaluation.

Continuing fellowship: Fate and Effects of Petroleum Contamination and Chemical Dispersants in Arctic Marine Environments Gofstein, University of Alaska Fairbanks. This study examines how Arctic marine ecosystems may be impacted by petroleum contamination by examining the fate of petroleum contaminants and chemical dispersants, their interactions with the environment, and the factors which influence their biodegradation. This project seeks to: 1) assess the influence of the dispersant Corexit 9500 on oil biodegradation processes in Arctic seawater; 2) investigate the fate of Corexit in marine environments; 3) study the effects of chemical dispersants on microbial community structure and function and identify the organisms responsible for degrading each in the Arctic; and 4) to investigate the extent of the role that nutrients play in driving the biodegradation of hydrocarbons, including identifying any nutrients that are possible limiting factors. Incubations of seawater from the Arctic Ocean in the presence of Alaska North Slope crude oil, Corexit 9500, and both together will be performed over a 60-day time course. Degradation of both components will be measured by GC/MS for the crude oil and by LC/MS/MS for the Corexit. Microbial analyses will be performed for each treatment using 16S rRNA sequencing using an Illumina MiSeq. Nutrients (NO_2^- , NO_3^- , NH_4^+ , PO_4^{3-} and SiO_4^{4-}) will be measured flow injection analysis and total iron by atomic absorption spectroscopy. Results from this study will help enable decision makers to make an informed choice of appropriate response strategies in the event of a spill as well as increase our general understanding of petroleum biodegradation in the Arctic marine environment.