OSRI

Annual Report FY 2018

Laboratory testing of oil, dispersants, and biodegradation.

Picture from Taylor Gofstein

Contents

Message from the Executive Director

We spent a good portion of FY18 looking back at the Oil Spill Recovery Institute's accomplishments across the previous twenty years. We reached out to colleagues to hear their reflections about the impact of our organization. Investments made by OSRI have significantly improved the ability to detect oil in the marine environment, including in areas with ice, and have generated tools able to more efficiently recover oil from the marine environment. Our work has enabled technologies to go from concept to commercially available in the span of a few years. We learn about existing needs from industry and academic partners and help address them by funding scientific research and technology development. In the past twenty years of research and partnership, OSRI has extended over $14.5 million in funding support to 173 projects (and counting!). Many of these projects resulted in publications made available to broader audiences (over 100 such publications), and we have invested in creating the next generation of experts by supporting over 20 Master's and PhD degree candidates who have conducted research related to our mission. Indeed, some of the budding scientists we have funded over the years have developed into the oil spill experts that, as time passes, are replacing a cohort of experts who are retiring.

I invite you to learn about our accomplishments over the past twenty years by watching a video we created at: http://bit.ly/20yearsofOSRI. Equally as interesting are some of the projects we funded for the first time in FY18. We supported a group of scientists studying the effects of low doses of oil exposure on Arctic cod, a keystone fish species in the Arctic marine ecosystem. We also funded a team to analyze aerial surveys from the Chukchi Sea to estimate the distribution and abundance of polar bears, as well as some of their prey species, including ringed seals and bearded seals, leading to better estimates of polar bear populations and a better understanding of their habitat quality. In the social sciences arena, we supported a contract to develop clear safety guidelines to support decision-making by spill responders and resource users concerned about food safety after a marine oil spill. And for those whose interest is piqued by pyrotechnics, we are working to improve the capabilities of herder burner systems that may be deployed in-situ during oil spills.

It is thanks to our many advisors who have deep and rich knowledge of the state of oil spill response, ecotoxicology, ecosystem function, and technology development and deployment that OSRI advances the cutting edge of research to improve our nation's ability to respond to oil spills. To that end, we are extremely grateful for the many years of service provided to our Scientific and Technical Committee by Dr. Terry Whitledge, Professor Emeritus of the University of Alaska Fairbanks and Dr. CJ Beegle-Krause, Senior Research Scientist at SINTEF. Both Dr. Whitledge and Dr. Beegle-Krause will rotate off the committee after having served the maximum term limits.

In service to our mission,

Executive Director
Oil Spill Recovery Institute

Advisory Board members

Programs of the Oil Spill Recovery Institute (OSRI) are determined by a 16-member Advisory Board composed of: (1) three Federal representatives from the Departments of Commerce, Interior and Transportation appointed by the Secretaries of the respective departments; (2) three State of Alaska representatives from the Departments of Environmental Conservation, Fish and Game, and Natural Resources appointed by the Commissioners of the respective departments; (3) two representatives each from the fishing industry, Alaska Native community (one of whom is a resident of Prince William Sound), oil and gas industry, all of whom are appointed by the Governor of Alaska; (4) two at-large representatives from communities impacted by the Exxon Valdez oil spill and who are appointed by the remaining Advisory Board members; and (5) one non-voting representative from the Institute of Marine Science at the University of Alaska Fairbanks and one non-voting representative from the Prince William Sound Science Center (PWSSC). The OSRI Advisory Board meets twice each year to set policies, adopt annual work plans and review the implementation of OSRI programs. The Board's structure includes four committees - Executive, Scientific and Technical, Financial and Work Plan - each of which meet as needed throughout the year. Annual work plans are adopted by the Advisory Board in the early fall and determine continuing projects and new project solicitations to be issued in the coming year.

Federal Representatives

Doug Helton, Chair
Operations Coordinator
Office of Response and Restoration - National Oceanic & Atmospheric Administration
Seattle, Washington
Years of Service: 2012 - present

Phillip Johnson
Department of Interior
Anchorage, Alaska
Years of Service: 2013 - present

Captain Darran McLenon
Captain, U.S. Coast Guard, 17th District
Juneau, Alaska
Years of Service: 2017 - present

State Representatives

Gabriel Wolken
Geologist
Alaska Dept. of Natural Resources
Fairbanks, Alaska
Years of Service: 2017 - present

Jeanette Alas
Habitat Biologist
Alaska Dept. of Fish & Game
Anchorage, Alaska
Years of Service: 2013 - present

Rick Bernhardt
Prevention & Emergency Response Program
Alaska Dept. of Environmental Conservation
Anchorage, Alaska
Years of Service: 2013 - present

Fishing Industry Representative

William Lindow
Cordova, Alaska
Years of Service: 2006 - present

Andrew Craig
Cordova, Alaska
Years of Service: 2013 – present

Alaska Native Representatives

Angela Totemoff
Eagle River, Alaska
Years of Service: 2011 - present

Glenn Ujioka
Cordova, Alaska
Years of Service: 1997-2013, 2016 - present

Oil & Gas Industry Representatives

Andres Morales
Operations Director –SERVS
Alyeska Pipeline Service Company
Valdez, AK
Years of Service: 2011 - present

Bark Lloyd
General Manager
Alaska Clean Seas
Anchorage, AK
Years of Service: 2016 - present

At-Large Representatives

Joe Banta
Anchorage, Alaska
Years of Service: 2006 - present

Susan Saupe
Homer, Alaska
Years of Service: 2003 - present

Non-Voting Representatives

Charles P. Meacham
Deputy Commissioner Alaska Dept. of Fish and Game, retired
Prince William Sound Science Center Board of Directors,
Gig Harbor, Washington
Years of Service: 2006 - present

Brenda Konar
Director of the Institute of Marine Science
University of Alaska Fairbanks
Years of Service: 2017-present

Scientific and Technical Committee

This committee provides advice to the OSRI Advisory Board, OSRI Research Program Manager and OSRI Director on the conduct and support of research, projects, and studies related to Arctic and sub-Arctic oil spills and their effects. It includes specialists in matters relating to oil spill containment and cleanup technology, Arctic and sub-Arctic marine environment, and the living resources and socioeconomics of Prince William Sound and its adjacent waters.

Terry Whitledge, Ph.D., Committee Chair, University of Alaska Fairbanks
Sarah Allan, Ph.D. National Atmospheric & Oceanic Administration
Chris Hall Alaska Clean Seas
Brenda Konar, Ph.D. University of Alaska Fairbanks
CJ Beegle-Krause, Ph.D. SINTEF
Todd O'Hara, D.V.M. Ph.D. University of Alaska Fairbanks
Anthony Parkin BP Exploration (Alaska), Inc.
Gary Shigenaka, National Atmospheric & Oceanic Administration
Stacy Studebaker Former teacher
Dick Thorne, Ph.D. Prince William Sound Science Center (retired)
Patrick Tomco, Ph.D. University of Alaska Anchorage

Practicing with the new open water barge in Prince William Sound. A new series of barges were introduced to Prince William Sound in 2018. These barges use new boom and skimmer designs to improve response speed and efficiency.

Mission and Goals

The mission of the Oil Spill Recovery Institute (OSRI) is to support research, education, and demonstration projects that improve understanding and response to oil spills in the Arctic and sub-Arctic marine environments.

In February 2015 the OSRI Board adopted the following goals to guide OSRI work into the future:

UNDERSTAND
Attain an interdisciplinary understanding of Arctic and sub-Arctic marine environments as it pertains to: the baseline; the source, fate, and effects of spilled oil; and the recovery of those environments following a spill.
• Evaluate short and long-term effects
• Identify chemical, biological, and physical impacts and consequences
• Emphasize the nearshore region
• Identify the impacts of oil spill response options
• Evaluate impacts from oil spills on the economy, life-style and well-being of people, and the resiliency of communities and resource users
• Achieve long-term coastal and ocean observing capabilities

RESPOND
Enhance the ability of oil spill response and mitigation capabilities in Arctic and sub-Arctic marine environments.
• Identify and evaluate new prevention and response technologies
• Fill knowledge gaps on behavior of spilled oil

INFORM
Share information and educate the public on the issues of oil spill prevention, response, and impacts.
• Publish scientific and technical results in the 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

PARTNER
Partner with other organizations to take advantage of shared funding, facilities, knowledge, and experience.
• Coordinate with other efforts related to OSRI's mission
• Expand OSRI's involvement in Arctic research through partnership opportunities

Background

The Oil Spill Recovery Institute (OSRI) was authorized in 1990 by the United States Congress to "*identify and develop the best available techniques, equipment, and materials for dealing with oil spills in the Arctic and sub-Arctic marine environments*"; and, also to "*determine, document, assess and understand the long range effects of the EXXON VALDEZ oil spill on the natural resources of Prince William Sound. . . and the environment, the economy and the lifestyle and wellbeing of the people who are dependent on them* (Title V, Section 5001, Oil Pollution Act of 1990, OPA90)." In 1996, the act was amended to expand the area of emphasis from the Exxon Valdez oil spill region to the Arctic and sub-Arctic marine environments. A 2005 amendment extends OSRI programs to continue until one year after the completion of oil exploration and development efforts in Alaska.

OPA90 identifies the Prince William Sound Science and Technology Institute (known as the Prince William Sound Science Center, or PWSSC) in Cordova, Alaska, as administrator and home for OSRI. Between 1992 and 1995, Congress appropriated $500,000 for OSRI. Since 1996, when amendments instituted a funding mechanism for OSRI, the program has received annual interest earnings from a $22.5 million portion of the National Oil Spill Liability Trust Fund. In 2013, that principal was adjusted to $35.3 million.

OPA90 also set up an Advisory Board to determine policies of and programs supported by OSRI. This includes oversight of the development of strategic plans, research plans, and annual work plans. The Advisory Board includes three federal, three state, two oil and gas industry, two fishing industry, two native community, and two at-large representatives. Additionally, there are non-voting members from the Institute of Marine Science/University of Alaska Fairbanks, and the Prince William Sound Science Center. The Board's structure includes four committees - Executive, Scientific and Technical, Financial, and Work Plan - each of which meet as needed throughout the year. Annual work plans are adopted by the Advisory Board in the early fall and determine continuing projects and new project solicitations to be issued in the coming year.

OSRI's first strategic plan for oil pollution research and development (1995) focused on the risks and costs of oil spills. OSRI adopted an objective to improve predictive capabilities. This also addressed the assessment of costs, a key element in identifying the best oil spill prevention and response technologies. The mission and goal statements of the strategic plan were reviewed and modified in 2002, 2008, and 2015. Each review led to the development of a five-year Science Plan.

OSRI solicited its first proposals for grant projects in late 1997. Since 1998, OSRI has awarded approximately nine hundred thousand dollars a year to support a wide range of projects. The projects awarded funds in any given year are outlined in the annual work plan, which is based on the five-year Science Plan. The Science Plan is organized around four strategic goals: Understand, Respond, Inform, and Partner. The types of projects OSRI funds to fulfill each strategic goal are described in the annual report.

Practicing towing a current buster system in Prince William Sound.

Programs

STRATEGIC GOAL: UNDERSTAND

These projects are designed to help attain an interdisciplinary understanding of Arctic and sub-Arctic marine environments as it pertains to: the source, fate, and effects of spilled oil; and the recovery of those environments following a spill. In the past, much of the work was focused on modeling and observations in Prince William Sound in partnership with the Alaska Ocean Observing System. In recent years more of the effort has been focused on understanding response option impacts to recovery. To achieve this objective, we need to collect observations of the physical and biological environments and integrate them with biological and physical models.

MAINTENANCE OF SNOTEL METEOROLOGICAL STATIONS

Snowpack Telemetry (SNOTEL) stations, set up in partnership with the Natural Resources Conservation Service (NRCS), measure wind speed and direction, air temperature, air pressure, and precipitation from snow and rain throughout the year (https://www.wcc.nrcs.usda.gov/snow/). They are fully-automated, land-based stations that are set up in remote locations. Eight stations are operated in Prince William Sound in collaboration with the Alaska Ocean Observing System (AOOS). Data from these stations are expected to improve the hydrological model needed to understand ocean circulation and to verify meteorological models run for Prince William Sound.

Beginning in FY13 OSRI reduced its contribution to the array as it transitioned from a research and development project to an operational system. AOOS now provides most of the operational costs with some OSRI support for system upgrades.

This is a continuing program with to $2,278 awarded in FY18 to Micro-Specialties.

EVALUATING THE EFFECTS OF OIL SPILL EATER II ON OIL SPILL DEGRADATION IN ALASKAN MARINE ENVIRONMENTS

The Alaskan Arctic and sub-Arctic marine environments are subject to growing risks of crude oil and marine fuel spills due to increased ship traffic and the potential for offshore oil and gas development. It is important for oil spill preparedness planning to be based upon a sound scientific understanding of the efficacy of spill response products and their potential environmental impacts to marine ecology. Yet, the fate and effects of several products on the Environmental Protection Agency's National Contingency Plan (NCP) product schedule have not been evaluated thoroughly for Alaskan waters. Chemical dispersants are receiving increased research attention, but there has not yet been a thorough scientific evaluation of the heavily marketed bioremediation product, Oil Spill Eater II (OSEII) in any marine environment, including in Alaska. OSEII's formulation is not publicly known, but it reportedly contains mineral nutrients, amylase and protease enzymes, molasses as a carbon source, and an oleophilic surfactant. Although OSEII is listed on the NCP Schedule as an enzymatic additive, the enzymes it reportedly contains (protease and amylase) are not capable of directly catalyzing petroleum biodegradation. OSEII's diverse ingredients suggest multiple other possible modes of action, such as chemical dispersion, biostimulation through nutrient addition and/or through additions of labile carbon sources. Rigorous scientific

examination of the effectiveness and mode(s) of action of OSEII for biodegrading and detoxifying oil, as well as its impacts on microbial ecology of marine ecosystems, is warranted in order to ensure that this product is effective, properly classified on the NCP Schedule, and that its potential effects are understood prior to field application.

The aims of this proposed project are to 1) evaluate the effectiveness of OSEII 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 effects of OSEII on crude oil and diesel biodegradation and detoxification will be determined using laboratory incubation studies with freshly collected seawater containing indigenous microorganisms from the Arctic (open water and under-ice) and sub-Arctic (open water) marine environments in Alaska. The potential for OSEII to act as a dispersant will also be investigated using EPA dispersant effectiveness test methods. Additional treatments will isolate and examine the roles of nutrients, molasses, and enzyme additives in petroleum degradation. The effects of OSEII on indigenous microbial communities, including oil-degraders and degradation genes, will be examined using advanced molecular methods (16S rRNA sequencing, metatranscriptomics, qPCR). This team has experience investigating oil biodegradation in Arctic waters, assessing the fate and effects of oil spill response chemicals (e.g., Corexit 9500A), and in applying advanced molecular microbiological tools to these questions. The proposed work aligns with OSRI's mission to support scientific evaluations of the potential effectiveness and impacts of oil spill response methods, including additives on the U.S. EPA NCP Schedule. Results will be communicated through conference presentations, peer-reviewed scientific publications, and through direct communications with OSRI, the Alaska Department of Environmental Conservation, and other agencies and stakeholders.

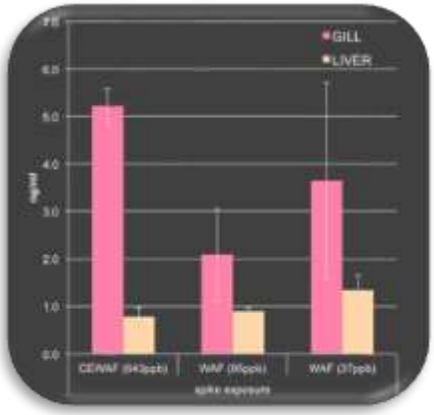
This is the third year of a three-year project led by Dr. Mary Beth Leigh of the University of Alaska Fairbanks with $110,572 in funding provided in FY18.

BERING STRAIT RESPONSE TRAINING TOOL

This project created a framework and interface for a Bering Strait Response Training Tool (BSRTT). Of key interest to OSRI is the gathering of information on marine mammal distributions within the Bering Strait region. The GIS layers have been made available for inclusion into other spill response tools, such as Arctic Environmental Response Management Application (ERMA) and through the AOOS portal. The BSRTT (http://bsrtt.defenders.org/) serves as a visual aid for Defenders' Arctic Marine Mammal Spill Response Synthesis which consists of spill response plans, gap analyses, reports and recommendations that contain an Arctic marine mammal focus from the State of Alaska and various federal land and wildlife agencies operating in Alaska.

This is a continuing project led by Karla Dutton of the Defenders of Wildlife and was completed in FY18. No new funds were provided in FY18.

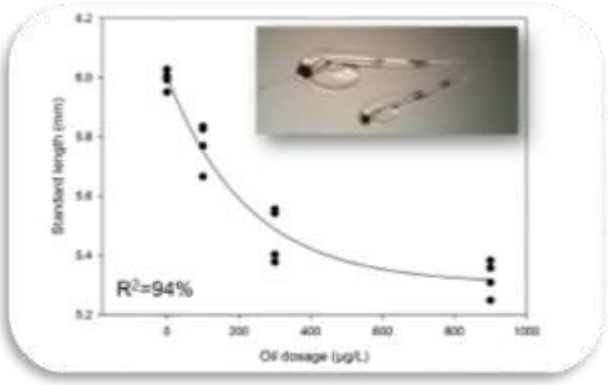
ASSESSMENT OF SUBLETHAL RESPONSES OF JUVENILE COHO SALMON TO DISPERSED OIL



Controlled exposure studies allow scientists to assess cause and effect relationships between stressors and responses of organisms. Lack of understanding of such relationships can limit the effectiveness of management and conservation decisions. Using CROSERF (Chemical Response to Oil Spills: Ecological Research Forum) protocols (adopted for the Deepwater Horizon NRDA), juvenile coho salmon (*Oncorhynchus kisutch*) were exposed to Alaskan crude oil and Corexit 9500 dispersant concentrations under acute spiked exposure regimes. To assess significant sublethal responses of exposed fishes, we conducted biomarker assays designed to measure genotoxicity, lipid composition, and cytokine levels (immune function), and then developed DNA expression and cytokine protein microarrays to assess changes in expression of genes regulating immunity. We then assessed morphometrics, standard blood chemistry, and contaminant levels in tissues for exposed and unexposed fishes. Results of these studies document how exposures to oil and/or dispersant in the field could affect sustainability of salmon, and by extension other Alaskan fish stocks of commercial, subsistence, and ecological importance.

This project was led by Dr. Dana Wetzel of the Mote Marine Laboratory and completed in FY18. This is a continuing project with no new funding provided by OSRI in FY18. This project was funded in collaboration with the North Slope Borough Wildlife Department through their Shell Baseline Studies Program (now known as the Collaborative Alaskan Arctic Studies Program).

SENSITIVITY OF ARCTIC COD EMBRYOS AND LARVAE TO OIL; DELAYED IMPACTS ON JUVENILE GROWTH AND LIPID CONDITION



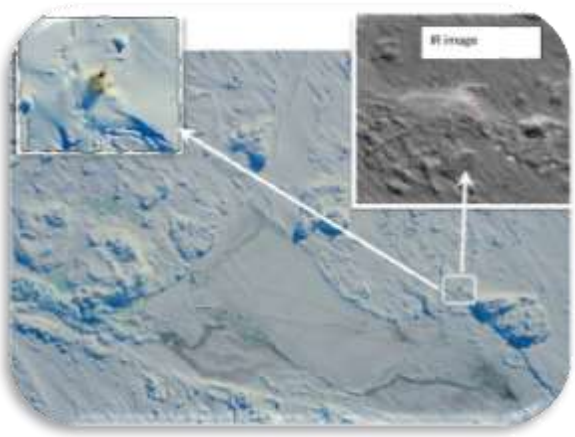
Arctic cod (*Boreogadus saida*) are important components of Arctic food webs, channeling lipid-rich energy between plankton and higher trophic levels such as marine mammals and seabirds. Arctic cod have physiology adapted for growing and storing energy in their cold-water environment, but environmental conditions that reduce growth or energy allocation (e.g., temperature, disease, toxins) will likely reduce their overwintering survival in their 1st year of life. The objective of this project is to quantify the delayed impacts of embryonic oil exposure on growth and energetic condition (lipid content) of later larval and early juvenile stages of Arctic cod. By addressing the non-lethal chronic effects of embryonic oil exposure to later life stages in Arctic cod this project will provide an ecologically meaningful measure of injury assessment for this species. Further, this project will deliver information on how low dose oil-exposure (100 µg oil/L) affects Arctic cod quality as a forage fish for higher trophic levels. This will help scientists, industry, and Arctic communities understand the delayed long-range effects of low-dose embryonic exposure to a keystone fish species and indirectly to the health of the Arctic marine ecosystem.

This is a new project led by Ben Laurel of the National Oceanic and Aeronautic Administration and Louise Copeman of Oregon State University with $24,072 provided to NOAA and $53,194 provided to OSU in FY18.

PARTNERSHIP WITH THE NORTH PACIFIC RESEARCH BOARD (NPRB)

The NPRB and OSRI both encourage research partnerships in their science plans, and both organizations have a strong interest in ocean observing, habitat, ecological and socioeconomic studies. In 2005, the two groups signed a partnership protocol to explore research priorities of mutual interest in any given year. The protocol was updated and signed by both parties again in 2018. The OSRI Science Plan committed $100,000 to this partnership in FY18. Continuation of the partnership and the level of funding committed is determined on an annual basis. We agreed to support one proposal in 2018.

Distribution and abundance of polar bears and ice-associated seals from a U.S. – Russia multispecies instrument-based aerial survey in the Chukchi Sea



Accurate estimates of abundance are currently not available for the shared subpopulation of polar bears found in the American and Russian portions of the Chukchi Sea. The bears' primary prey species in the region, ringed and bearded seals, have also not been adequately assessed and range-wide estimates of demographic parameters for these species are not available. The proposed work uses data from spatially comprehensive, multispecies aerial surveys in the Chukchi Sea to address critical information gaps for polar bears, ringed seals, and bearded seals. In spring 2016, international collaborators successfully completed the field stage of the Chukchi and East Siberian Survey (ChESS) project, which consisted of instrument-based aerial surveys of the sea ice throughout American and Russian portions of the Chukchi Sea. Using state-of-the-art developments in sensor technology and statistical modeling capabilities, the ChESS project provides data on the distribution and abundance of polar bears and ice-dependent seals simultaneously in time and space. Custom software was used to analyze infrared image data and detect "hot spots" on the ice indicating a warm-bodied animal. High-resolution digital color images were used to identify the species detected by the thermal images. In this effort, we will estimate the distribution and abundance of polar bears, ringed seals, and bearded seals the Chukchi Sea and evaluate spatial and temporal relationships in species occurrence within a unified analytical framework. We hypothesize that these relationships will lead to improved estimates of demographic parameters, particularly for polar bears, and will provide the foundation for the first-ever habitat quality index for the species that integrates data on their primary prey.

This project is led by Dr. Peter Boveng of NOAA, Dr. Eric Regehr of the University of Washington, and Dr. Vladimir Burkanov of North Pacific Wildlife Consulting.

STRATEGIC GOAL: RESPOND

Many existing oil spill response technologies are ineffective in harsh environments at high latitudes. Projects funded under this goal aim to enhance oil spill response and mitigation capabilities in Arctic and sub-Arctic marine environments. This can be accomplished by developing or adapting equipment for oil spill response in Arctic and sub-Arctic marine environments, or by improving our understanding of the impacts of different response options.

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 On-scene Coordinators regarding food safety during pollution responses.

Project objectives 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 proposed 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.

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 improve clarity for resource users and markets.

This project is led by Sierra Fletcher of Nuka Research and Planning Group, LLC. It is a new project with $24,832 of funds committed in FY18.

ASTM SKIMMER TESTS

As new oleophilic skimmers become available it may be necessary to consider new approaches to rating the recovery capabilities of these skimmers. The current process de-rates the skimmer estimated recovery to 20% of the name plate value to approximate the expected recovery in the field. By testing new skimmers in appropriate conditions, it may be possible to demonstrate that higher recovery rates than they are currently estimated to achieve. In this work two oleophilic skimmers will be tested to examine their recovery rates.

This project is led by Chris Burns with Alaska Chadux. It is a new project with $24,988 committed in FY 18.

EXPLORATION OF AN IMPROVED INTEGRATED HERDER DELIVERY AND IGNITION SYSTEM

Recent research in in-situ burning of oil spills with herders has shown promise, but there is no single system that can apply the herders and provide an ignition. Thus, either two helicopters would be needed to apply the herders and ignite the contracted slick. The desire is to determine if a single system can be built that can deploy the herder and provide the ignition source to make the use of chemical herders more feasible. In an effort to address the need for a combined system OSRI worked with Exxon Mobil and the Bureau of Safety and Environmental Enforcement to begin a Joint Industry Program (JIP) focused on the issue. In the first phase, OSRI funded an agreed upon contractor to evaluate the state of the technology and explore the applicability of potential system designs.

This project is led by Tim Thornton of Tactical Electronics. It is a new project with $95,000 of funds committed in FY 18. This is expected to be the first phase of a multi-year JIP with industry and agency partners.

Using a heli-torch to light oil in a test basin. Picture from http://arcticresponse.wpengine.com/wp-content/uploads/2017/09/poker-flats-report-final.pdf.

STRATEGIC GOAL: INFORM

The projects described in this section are designed to share information and educate the public on the issues of oil spill prevention, response, and impacts. OSRI funds projects to educate the public at all ages, support graduate students, support workshops and symposia that allow researchers to present results, and provide direct outreach through the web.

HEADWATERS TO OCEAN

Headwaters to Ocean (H2O) is a collaborative education program developed to provoke inquiry into the natural world, to increase science and ecological literacy and to foster responsible use of natural resources. This proposal addresses the School Year Programs portion of OSRI's Work Plan. *H2O* consists of three tracks that target different sectors of society and our direct engagement track consists of programs (described below) for elementary and high school students in Cordova and other communities in coastal Alaska.

Discovery Room provides hands-on science education to students in Cordova's elementary school with the goal of inspiring life-long passion for science and increasing scientific literacy. PWSSC proposes to further refine, deliver and share lessons and materials related to OSRI's mission of understanding the effects of oil spills and recovery of Arctic and sub-Arctic marine environments. OSRI funding will support program delivery, development of marketing materials, and web-based distribution. These experiences will give students the knowledge and skills needed to understand how natural systems function and respond to climate change and other human impacts.

Outreach Discovery program extends *Discovery Room* programming to audiences outside of Cordova, and increases the number of individuals served by Science Center education programs. Many of the students served by the *Outreach Discovery* program qualify as "underserved populations" and often have limited access to science and environmental education resources and opportunities. This request seeks to use OSRI funds to support the continued delivery of marine-themed *Outreach Discovery* programs to youth from northwest Alaska as well as enhancement of our remotely operated vehicles kits.

High School Outreach programs allow PWSSC to keep older students engaged in marine science-centric activities that promote critical thinking, problem solving and ecological literacy skills. OSRI funding will support program delivery of lessons about ocean sciences to high school students in *Outreach Discovery* and *National Ocean Sciences Bowl* programs, as well as preparation of one or more NOSB teams.

This is a continuing program with $60,000 awarded in FY18 to Lauren Bien at PWSSC. Additional funding for this project is provided by British Petroleum, ConocoPhillips, PWSSC, community contributions, and various private entities and foundations.

OSRI supported the 2018 Cordova High School National Ocean Science Bowl team, which won first place in the Alaska competition and advanced to nationals.

FELLOWSHIPS

OSRI funds are provided to support graduate student research that will enhance scientific understanding of the marine ecosystem, provide information needed by managers and decision-makers for oil spill response and recovery, and improve public awareness and understanding of marine and estuarine ecosystems. The OSRI Graduate Research Fellowship Program offers qualified master's and doctoral students the opportunity to address scientific questions of significance to Arctic and sub-Arctic regions resulting in high-quality research focused on improving oil spill response and recovery.

Silvana Gonzalez, University of Washington

Doctoral candidate
Advisor: John Horne
Cost-effective monitoring of anthropogenic impacts and environmental change in marine Arctic ecosystems

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.

This is the first year of the project with $27,016 provided in FY18.

Taylor Gofstein, University of Alaska Fairbanks

Doctoral candidate
Advisor: Mary Beth Leigh
Fate and Effects of Petroleum Contamination and Chemical Dispersants in Arctic Marine Environments

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.

This is the third year of the project with $30,000 provided in FY18.

Marc Oggier, University of Alaska Fairbanks

Doctoral candidate
Advisor: Hajo Eicken
Crude Oil Movement in Sea Ice: Development and Validation of a Parametric Model of Oil Migration

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.

This is a continuing project with no new funding provided in FY18.

Adi Barocas, University of Wyoming

Doctoral candidate
Advisor: Merav Ben-David
Combining Long-Term Data and Ecological Modeling to Assess Sensitivity of Coastal River Otters to Climate Change.

In the over-two-decades since the *Exxon Valdez* Oil Spill (*EVOS*), Alaska coastal ecosystems have shown strong signs of recovery. One of the first species to recover from *EVOS* was the North American river otter (*Lontra canadensis*). The long-term, multi-agency, studies of river otters following *EVOS* highlighted their susceptibility to environmental catastrophes, their sensitivity to climate-induced changes in fish communities, and their key role in linking aquatic and terrestrial ecosystems at the land-margin. These attributes led to the identification of river otters as a sentinel species and a 'vital sign' of Alaska coastal ecosystems.

River otters are predominantly fish predators that use terrestrial sites as latrines for social activity and intraspecific communication. Through these activities river otters play a significant role in the transfer of nutrients from sea to land. The social structure and abundance of river otters are dependent on the availability of forage and demersal fishes. A recently developed spatially-explicit, individual-based model predicts a shift in social behavior and population declines of river otters in response to reductions in forage fish abundance. Thus, long-term monitoring of river otter sociality, diet composition, and abundance in various locations along the Alaska coast provides insight into ecosystem recovery from *EVOS* and its responses to the threat of climate change.

The scientific advances in understanding river otter ecology were complemented by intensive demographic and genetic surveys, conducted in various sites of coastal Alaska. The magnitude and diversity of the research efforts over the past two decades yielded a wealth of data that is currently deposited in various formats maintained by various agencies. In order to establish valid monitoring program for river otters, a systematic inventory of the diverse types of data, and a subsequent synthetic analysis will be required.

This is a continuing project with no new funding provided in FY18.

OSRI 20th ANNIVERSARY OUTREACH

OSRI celebrated twenty years of providing funding in 2018. In order to document the work that occurred during the first twenty years, OSRI contracted to have outreach materials developed. The materials include a short film and a written report of activities. These materials are available on the OSRI website (www.pws-osri.org).

This is a new project led by Seth Walker at Curate and Brenden Schild at Ideaville. $20,000 ($5,000 Curate, and $15,000 Ideaville) was provided in FY18.

WORKSHOPS OR SPECIAL PROJECTS

These funds are to support workshops or special projects at the discretion of the OSRI Advisory Board. The following workshops and science meetings were supported in FY18.

Alaska Marine Science Symposium, $5,000. This symposium is the primary facility for disseminating research results related to Alaska's Arctic and sub-Arctic marine environments.

Alaska Forum on the Environment, $5,000. This symposium brings together speakers, panels, and participants to discuss issues related to Alaska's environment, including the impact of oil spills.

Alaska Oil Spill Technology Symposium, $7,000. This symposium was designed to allow researchers to present their findings to people in the oil spill response field. Researchers and spill responders met in Anchorage to share results and identify needs. The symposium was organized by the Alaska Department of Environmental Conservation and the University of Alaska Fairbanks.

Northern Oil and Gas Forum, $2,500. This forum brings together spill responders, researchers, and community members from Alaska and Canada to discuss issues of interest to both regions. The assistance provided supported travel for speakers.

Copper River Delta Symposium, $2,000. Support was provided to assist with delivery of the symposium that examines the scientific work being conducted in the Copper River Delta.

OTHER

RESEARCH PROGRAM MANAGER

Funds are provided for the expense of the OSRI Research Program Manager (RPM) to track existing programs, develop new programs, develop partnerships, and outreach OSRI programs. Major activities include implementing the five-year research plan, the development of the FY19 work plan, participating in several workshops, and updating the OSRI outreach materials.

Expenses related to this position are combined with the travel expenses of the Scientific and Technical Committee described below. Total expenses for these two components was $88,387.

SCIENTIFIC AND TECHNICAL COMMITTEE

The Scientific and Technical Committee (STC) meets annually to assist in developing the annual work plan and to advise OSRI on implementation of the work plan. Funding is provided to cover the travel costs of the members of the Scientific and Technical committee.

Financials

Funds for the Oil Spill Recovery Institute were authorized by the United States Congress through the Oil Pollution Act of 1990 (OPA'90) and amending legislation. The Prince William Sound Science Center (PWSSC), a non-profit research and education institute in Cordova, Alaska, administers the OSRI programs as directed by OSRI's Advisory Board. PWSSC receives the interest earnings from a $35.3 million trust managed by the U.S. Treasury and held within the National Oil Spill Liability Trust Fund. These funds originated from the Trans-Alaska Pipeline Authority and are dedicated to finance the OSRI programs.

The following pages include the Statements of Financial Position for the Prince William Sound Science Center and the Financial Position and Statement of Activities related to the OSRI programs for the fiscal year 2018. Fiscal year 2017 data is provided for comparison.

Professional audits of PWSSC's financial records, including the OSRI program fund, are completed annually by a nationally recognized accounting firm. The fiscal year 2018 audits were completed by Altman Rogers & Co., Anchorage, Alaska. Copies of audited financial statements are available upon request to Linnea Ronnegard, Finance Director, PWSSC, P.O. Box 705, Cordova, Alaska, 99574, or email lronnegard@pwssc.org.

Summary of OSRI program expenditures for FY18 and FY17:

Program Areas	**FY18**	**FY17**
Administration	150,769	192,794
Research (Understand)	332,764	224,948
Research (Respond)	19,469	279,007
Public Education & Outreach (Inform)	165,891	138,788
Other Programs	88,387	131,769
TOTALS	757,280	967,306

PWSSC building in Cordova, Alaska.

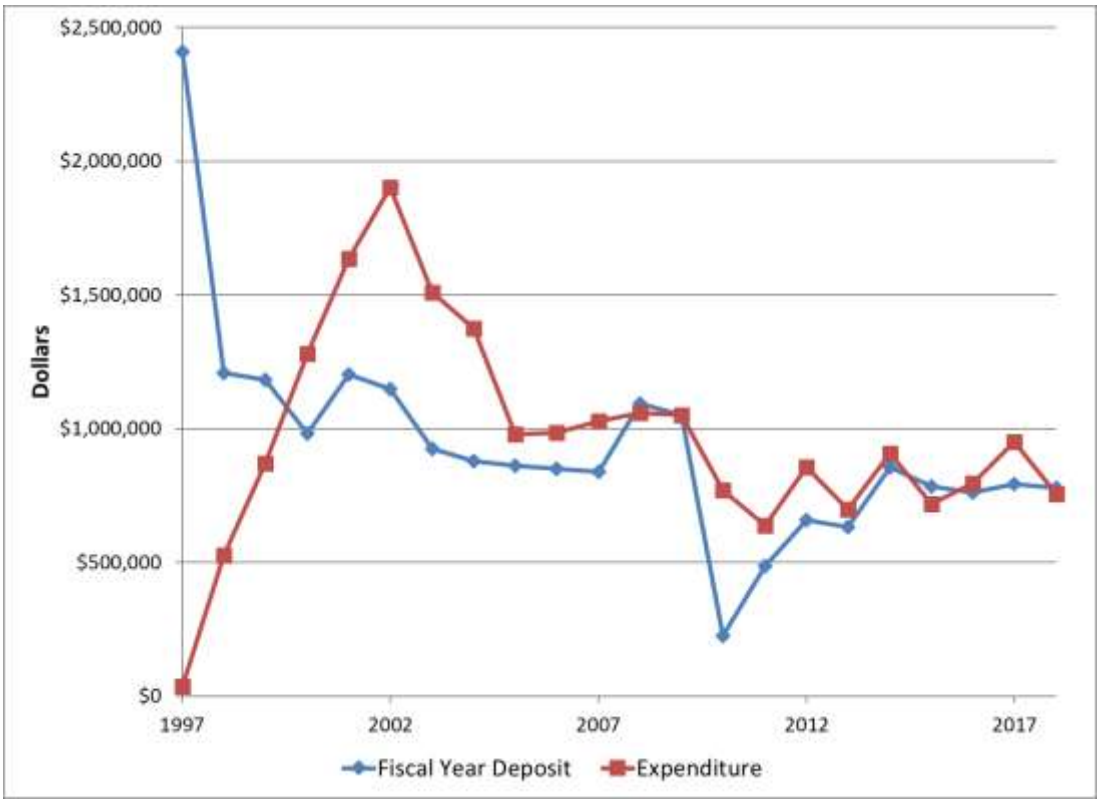
Statement of Financial Position

Including the Oil Spill Recovery Institute
Year Ended September 30, 2018
(*with comparative totals for 2017*)

	General Fund	Plant Fund	Program Fund	Totals 2018	Totals 2017
Assets:					
Cash	281,981		1,328,173	1,610,154	153,643
Receivables	193		316,772	316,996	903,430
Prepaids and other assets	66,650			66,650	69,473
Due from other funds	530,345		33,441	563,756	1,148,203
Investments			354,083	354,083	1,552,512
Property and equipment, net of accumulated depreciation		835,432		835,432	932,645
Total assets	879,170	835,432	2,032,439	3,747,041	4,759,906
Liabilities:					
Accounts payable	304,978			304,978	544,062
Line of credit					
Wages, taxes & benefits payable	118,816			118,816	92,360
Current portion of long-term debt	7,559			7,559	9,644
Deferred to revenue	4,918		57,501	62,419	141,762
Due to other funds	33,411		530,345	563,756	1,148,203
Long-term debt					7,578
Total liabilities	469,682		587,846	1,057,528	1,943,609
Net assets:					
Unrestricted	409,488	835,432	1,444,593	2,689,513	2,816,297
Total liabilities & net assets	879,170	835,432	2,032,439	3,747,041	4,759,906

Oil Spill Recovery Institute Programs
Combined Statement of Financial Position
Year Ended September 30, 2018
(*with comparative totals for 2017*)

	OSRI Totals	
	2018	2017
Assets		
Cash	1,328,173	39,028
Investments	354,083	1,552,512
Total assets	1,682,256	1,591,540
Liabilities		
Deferred revenue	22,620	
Due to other funds	169,200	53,129
Total liabilities	191,820	53,129
Net assets - unrestricted	1,490,436	1,538,411
Total liabilities and net assets	1,682,256	1,591,540



Deposits and expenditures per fiscal year since the original deposit in fiscal year 1997.

Oil Spill Recovery Institute Programs
Combined Statement of Activities

Year Ended September 30, 2018
(*with comparative totals for 2017*)

	OSRI Totals	
	2018	2017
Revenues:		
Grants and contributions - Federal	757,280	822,356
Interest		
Investment income	(47,975)	(37,110)
Other		
Total revenues	709,305	785,246
Expenses:		
Salaries and benefits	209,003	256,526
Travel	26,128	25,533
Professional services	11,515	10,103
Subcontracts and charter costs	990	
Supplies	3,442	1,559
Telephone	1,302	2,414
Network	13,805	10,237
Postage and freight	83	88
Printing, publications and copying	1,350	1,723
Utilities and rent	280	8,000
Insurance	1,202	1,244
Equipment maintenance		4,062
Other	491	1,339
Grants awarded	458,014	597,664
Total expenses before interfund facility, equipment costs, and indirect costs	727,605	920,492
Interfund facility and equipment costs	14,496	13,656
Interfund research vessel costs		
Indirect costs	14,379	10,719
Total expenses	756,480	920,492
Transfer to Plant Fund	(800)	(4,823)
Change in net assets	(47,975)	(164,444)
Net assets at beginning of year	1,538,411	1,702,855
Net assets at end of year	1,490,436	1,538,411

Publications

Barocas, A., R. Hefner, M. Ucko, J.A. Merkle, and E. Geffen. 2018. Behavioral adaptions of a large carnivore to human activity in an extremely arid landscape. *Animal Conservation.* DOI. 10.1111/acv.12414

Counihan, K.L., 2018. The physiological effects of oil, dispersant and dispersed oil on the bay mussel, Mytilus trossulus, in Arctic/Subarctic conditions. *Aquatic Toxicology,* **199**. 220-231.

Lewandoski, S.A., M.A. Bishop, and M. K. McKinzie. 2018. Evaluating Pacific cod migratory behavior and site fidelity in a fjord environment using acoustic telemetry. *Canadian Journal of Fisheries and Aquatic Sciences*. **75**. No. 11. 2084-2095

McFarlin, K.M., M.J. Perkins, J.A. Field, and M.B. Leigh. 2018. The biodegradation of crude oil and Corexit 9500 in Arctic seawater. *Frontiers in microbiology*. **9**. 1788. DOI 10.3389/fmicb.2018.01788.

Mearns, A., D. Janka, R. Campbell, S. Pegau, K. McLaughlin, M. Lindeberg, P. Eiting, and G. Shigenaka. Twenty-six years after the Exxon Valdez Oil Spill: Volunteers continue monitor long-term variability of intertidal biology in western Prince William Sound. In. *International Oil Spill Conference Proceedings*, (Vol. 2017, No. 1, pp. 2017340). International Oil Spill Conference.

Mosier, T.M., D.F. Hill, and K. V. Sharp. 2018. Update to the Global Climate Data package: analysis of empirical bias correction methods in the context of producing very high-resolution climate projections. *International Journal of Climatology*. **38**. No. 2. 825-840.

Pegau, W.S., J. Garron, L. Zabilansky, C. Bassett, J. Bello, J. Bradford, R. Carns, Z. Courville, H. Eicken, B. Elder, P. Eriksen, A. Lavery, B. Light, T. Maksym, HP Marshall, M. Oggier, D. Perovich, P. Pacwiardowski, H. Singh, D. Tang, C. Wiggins, and J. Wilkinson. 2017. Detection of oil in and under ice. In. *International Oil Spill Conference Proceedings*, (Vol. 2017, No. 1, pp. 1857-1876). International Oil Spill Conference.

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Photos from biodegradation additive project from Dr. Leigh. The top picture shows the incubation experiment in the cold room. The bottom picture shows testing for dispersion.

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