Prince William Sound

Oil Spill Recovery Institute

OSRI Science Plan

Adopted February 2005

I. Institutional Function

A. Establishing Legislation

The Oil Pollution Act of 1990 (OPA 90) established the Prince William Sound Oil Spill Recovery Institute (OSRI) in Cordova, Alaska. The OSRI is administrated through the Prince William Sound Science and Technology Institute (aka Prince William Sound Science Center: PWSSC). As legislated OSRI functions to conduct research and carry out educational and demonstration projects designed to 1) identify and develop the best available techniques, equipment, and materials for dealing with oil spills in the Arctic and Subarctic marine environment; and 2) complement Federal and State damage assessment efforts and determine, document, assess, and understand the long range effects of Arctic or Subarctic oil spills on the natural resources of Prince William Sound and its adjacent waters, and the environment, the economy, and the lifestyle and well-being of the people who are dependent on them, except that the Institute shall not conduct studies or make recommendations on any matter which is not directly related to Arctic or Subarctic oil spills or the effects thereof.

B. Mission Statement

The mission of the OSRI is to better understand the effects of oil pollution on Arctic and sub-Arctic marine environments, and to seek new techniques and technologies that may prevent, mitigate, monitor or recover oil spills in Arctic and sub-Arctic marine environments through:

* Research
* Education
* Demonstration and/or application

II. Purpose of this Document

The OSRI Advisory Board will benefit from a long term plan to guide the annual workplan development process and to provide a contextual framework for specific projects and partnership commitments. OSRI partnerships will benefit from an understanding of how components of the OSRI Program are related to fulfill the missions and goals mandated by the founding legislation. This document is intended to provide guidance with regard to program components and annual budget allotments, summarized on Table 1, and does not commit the OSRI Board or staff to support or fund any of the projects described herein.

III. Program Introduction

A. Background

In 1995, OSRI published an Oil Pollution Research and Technology Plan for the Arctic and Sub-Arctic (www.pws-osri.org/publications/rdplan.html) that provides a review and the guidance for developing and managing the OSRI program. The 1995 plan used existing oil pollution research programs as a guide, particularly the National Oil Pollution Research and Technology Plan, published by the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR). This plan describes the scope of oil pollution prevention and response R&D, and OSRI's geographic focus on Alaska's oil transport system. In 1997, OSRI held a workshop to update Arctic and Sub-Arctic oil pollution issues for the Advisory Board. At this workshop R&D efforts conducted after the Exxon Valdez Oil Spill (EVOS) were reviewed and the revised national plan for oil pollution research and technology was presented (www.uscg.mil/hq/g-m/nmc/gendoc/coop/coop.htm). Based on this workshop, the OSRI Advisory Board endorsed three program areas of applied technology, predictive ecology and public education and outreach. In 2002, the OSRI Advisory Board solicited a program assessment by the National Academies' Polar Research Board (PRB). In response to the PRB report, published in early 2003, the OSRI Advisory Board deleted the three program areas, revised its Strategic Plan and adopted four goals for OSRI programs: understand, respond, inform, and partner. The following strategic plan specifically addresses these four goals.

B. Grant Authority

Under Title V, Section 5006 of OPA90, Congress authorized OSRI $23 million over 10 years from the TransAlaska Pipeline System (TAPS) Fund. In FY97, after other pending TAPS claims were settled, Congress appropriated $22.4 million of the remaining funds to be held by the U.S. Treasury with the annual interest awarded to OSRI for implementation of the R&D program for the Arctic and Sub-Arctic (Coast Guard Reauthorization Act of 1996). In FY02, Congress extended OSRI through the year 2012, and efforts are underway to extend OSRI through the life of the TransAlaska pipeline.

C. R&D Grant Policies and Procedures

OSRI initially adopted an R&D grant program based on policies and procedures used by the National Science Foundation (NSF), NOAA's National Undersea Research Program and the EVOS Trustee Council. The basic document that governs the OSRI program is the Grant Policy Manual (GPM). The GPM provides guidance on the various provisions of program management. All OSRI staff, committee members, and Advisory Board members will follow the guidelines contained in the GPM when processing and managing OSRI grants. The OSRI GPM and other OSRI documents and forms, including application packages, are available on the OSRI web site at www.pws-osri.org, or by request.

D. Roles and Responsibilities

The staff structure of OSRI is related to the PWSSC as shown in Fig. 1.

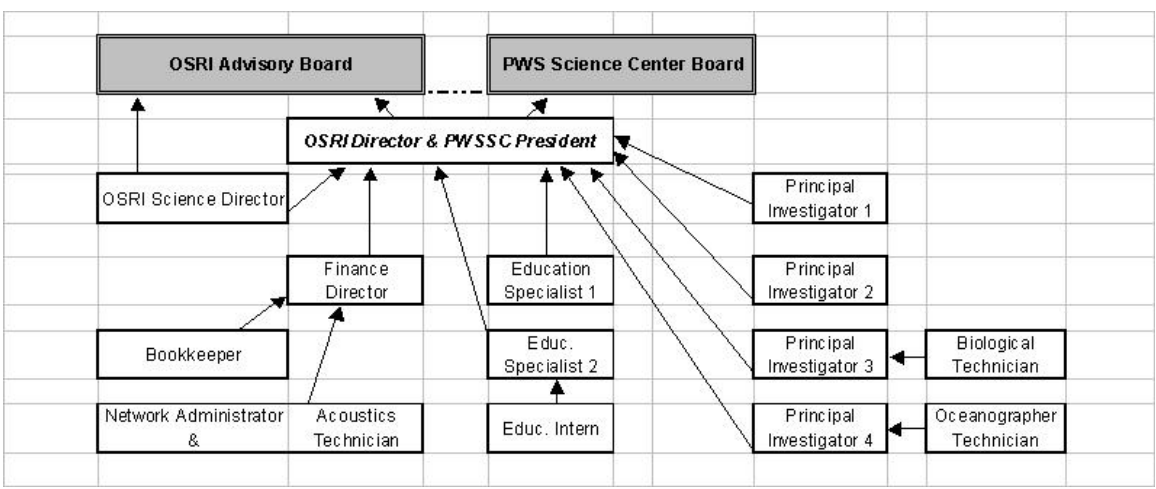


Figure 1. OSRI and PWSSC staff chart and relationship between the organizations

The following roles and responsibilities are suggested:

1. **Advisory Board** – Set strategic direction, review program toward accomplishing strategic goals, promote OSRI program results and

products to the oil spill and marine science communities, define duties of OSRI director and other staff, appoint and evaluate director and other OSRI staff, establish subcommittees, approve bylaws, set broad annual scientific priorities, approve annual program plan and large grant awards, seek operational coordination with the Prince William Sound Science Center and its Board of Directors, resolve complaints and financial award issues, act to fill vacancies on the Board, ensure fiduciary responsibilities are met, and assist OSRI Director and Science Director with partnerships.

2. **Executive Director** – Assists the OSRI Science Director with administrative support to implement OSRI programs, promotes OSRI programs through outreach efforts (e.g. web page, annual report, meetings, etc.), and communicates with the Advisory Board on a regular basis concerning administrative and fiduciary issues.
3. **Research Program Manager (previously titled "Science Director")** – Provides leadership in planning research programs, prepares annual work plans in consultation with the Work Plan Committee and the Advisory Board, works with OSRI Executive Director on fiduciary issues, and implements the work plan as approved by the Advisory Board. Coordinates proposal reviews, works with the Science and Technology Committee on proposal selections and recommendations to the Advisory Board, and ensures compliance with all policies and procedures of the Grant Policy Manual.
4. **Science and Technology Committee** – Provides advice and recommendations to the Science Director and to the Advisory Board regarding the selection and support of research projects related to Arctic or sub-Arctic oil spills. Acts as the proposal selection panel using review comments and recommendations submitted by independent (not related to either OSRI or PWSSC) technical peer reviewers. Provides recommendations to the Advisory Board on program plans, proposal and fellowship awards.

5. **Clerical Staff** - provide administrative support to the Research Program Manager and Director to carry out the OSRI Program.

E. Application and Award Process

OSRI staff, STC and Advisory Board members will follow the guidelines and procedures detailed in the Grants Policy Manual (GPM). The OSRI GPM and the annual OSRI program descriptions are available on the OSRI web site at www.pws-osri.org, or by request from the Science Director. The GPM was last revised in 2001 and will be updated during the 2005 fiscal year.

IV. OSRI Strategic Goals

The Advisory Board of OSRI and the Executive Committee of the Board of Directors for the PWSSC conducted a strategic planning session on November 25-26, 2002. The purpose of the planning session was to evaluate the past, the present, and develop strategies for the future of OSRI and the PWSSC through 2012. Strategic planning was defined as devising a strategy that contributes most effectively and consistently toward the mission and goals, and uses the plan to implement the strategies. Four goals were identified as part of the strategic plan: Understand, Respond, Inform, and Partner (Appendix A). The OSRI Science Plan has been placed in the context of these four goals and are described in the remainder of this document.

Goal #1 Understand

Attain a four-dimensional interdisciplinary understanding of Prince William Sound to enable detection and prediction of spill-related impacts and subsequent recovery.

1. Objectives:

a. Design nowcast observations, and hindcast-forecast modeling systems, demonstrate its utility, and seek long-term operational funding.
b. Conduct environmental research to understand the variability of natural systems and how a disturbance can affect these systems.
c. Profile potential oil spill and response impacts on the economy, life-style and well being of communities and resource users in Prince William Sound.

2. Background

Alaska's Prince William Sound includes an intricate network of maritime glaciers, rain forests, offshore islands, and ocean. The Sound has about 5600 km of shoreline, is surrounded by the Chugach National Forest, and contains the most extensive system of tidewater glaciers descending from the highest coastal mountain range in North America. The Trans Alaska Pipeline terminates at Port Valdez, making the relatively undeveloped environment of the Sound highly vulnerable to oil spills, as evidenced by the 1989 Exxon Valdez spill. The OSRI and its partner organizations conduct research in Prince William Sound to enable detection and prediction of oil-spill related impacts and subsequent recovery. This mission led to the development of the Nowcast-Forecast modeling effort that consists of an atmospheric circulation model coupled to an ocean circulation model. In the event of an oil spill, NOAA scientific support staff advise the U.S. Coast Guard (USCG) on probable spill trajectories based on modeled scenarios using available data on winds and currents. This information is used to decide among various techniques for oil-spill remediation, including deployment of diversion booms to protect sensitive habitats, mechanical removal, ignition of the spill, or application of chemical dispersants. OSRI's investment in the real-time model outputs of the Nowcast-Forecast Program are intended to inform the USCG and NOAA on prevailing atmospheric and oceanic circulation patterns so that more accurate trajectories can be predicted. This approach improves the assessment of risks versus costs, a key element in identifying the best oil-spill prevention and response technologies.

An extension of the Nowcast-Forecast modeling program has potential utility in fisheries oceanography and in gaining a better understanding of the PWS ecosystem. Therefore, the modeling program is evolving to take better advantage of real-time data streams from recently deployed meteorological sensor arrays and an enhanced observational oceanography program consisting of permanent moored buoys and seasonal hydrographic transects. This evolution of the OSRI program coupled with recent national initiatives to develop an integrated ocean observing system (www.ocean.us), and the regional Alaska Ocean Observing System (www.aoos.org), is leading to the development of the Prince William Sound Observing System. The goals of the national and regional efforts include improvements of 1) the safety and efficiency of marine operations; 2) predictions of climate change; 3) national security; and 4) to more effectively protect and restore healthy coastal marine ecosystems. While some government agencies already provide some of this information to national and regional ocean observing systems like AOOS, the PWSOS can identify and work to fill observation and information gaps, and also supply tailored products to meet the needs of scientists, educators, industry, resource managers, search and rescue, and security agencies. For example, an issue relevant to OSRI is that the U.S. Coast Guard considers Prince William Sound and Port Valdez as high risks from a national security perspective. While the possibility of another accidental oil spill has been contemplated since the Exxon Valdez spill in 1989, only recently has the prospect of an intentional act of sabotage become significant. This demonstrates the need for being able to adapt existing real time data streams in unforeseen ways. This also requires that data streams are reliable and models be developed to utilize real time data.

As part of this strategy OSRI will provide only limited funding support for new infrastructure with the intent to pursue additional development through partnerships and competitive grants. However, OSRI will continue funding the key atmospheric and oceanographic components of PWSOS since no other funding sources are currently available to sustain OSRI's investment in models and instrumentation. Funding secured in 2004 by the PWSSC will allow for infrastructure expansion such as improving the consistency and data quality of the existing array of meteorological sensors, deploying solar radiation sensors and precipitation gauges in the surrounding watersheds, redeploying a stream discharge gauge on the Copper River, and developing a synoptic wave model to predict wave heights, nearshore currents, and wave-induced turbulence. Additional funding from NOAA was recently secured by the PWSSC through the Exxon Valdez Oil Spill Trustee Council to begin understanding the mechanisms and exchange rates of waters between the Gulf of Alaska and the Sound using fixed moorings at Hinchinbrook Entrance and Montague Strait, and collaborating with the GLOBEC team to develop a data assimilation model for PWS. Understanding the circulation and the patterns of water exchange will provide a solid scientific foundation for addressing not only oil spill trajectories, but also fisheries and ecosystem management needs related to long term oceanic and climatic variability.

The evolution of the OSRI Nowcast/Forecast System into PWSOS will allow better utilization of infrastructure contributed by a host of partner organizations including the Prince William Sound Regional Citizens' Advisory Council, the National Data Buoy Center, the Natural Resources Conservation Service, the University of Alaska at Fairbanks, Anchorage, and Juneau, the U.S. Forest Service, the U.S. Coast Guard, and the Exxon Valdez Oil Spill Trustee Council. The role of OSRI in the PWSOS, to fulfill the mandate of understanding the effects of oil spills on arctic and subarctic environments, will be to maintain the core components of the PWSOS (e.g. met stations, ecological observations, circulation models) until other funding sources are found (i.e. IOOS) or until 2010 whichever comes first. This effort to coordinate local resources for the common goal of leveraging funds specifically to better understand the PWS ecosystem has captured the attention of the regional AOOS. The AOOS has recently adopted the PWS effort as a pilot project for the development of a coastal ocean observing system and data management model to serve the future Alaska nodes in Southeast Alaska, Lower Cook Inlet, the Bering Sea, and the Arctic Ocean. With the assistance of AOOS, a steering committee will provide an experts forum for coordination within this consortium, and specialized sub-committees will provide technical oversight for both science and education components.

3. Existing Nowcast/Forecast and PWSOS Infrastructure

The OSRI, PWSSC, other institutions and universities, conduct research in PWS to better understand the ecosystem, and enable detection and prediction of oil-spill related impacts and subsequent recovery. The PWSOS provides observational data to models that provide output to aid in management, research, industry application, and education as shown by the flowchart in Figure 2. For the models to be accurate, and therefore of maximal reliability to user groups, they will require quality controlled data streams from multiple observational platforms.

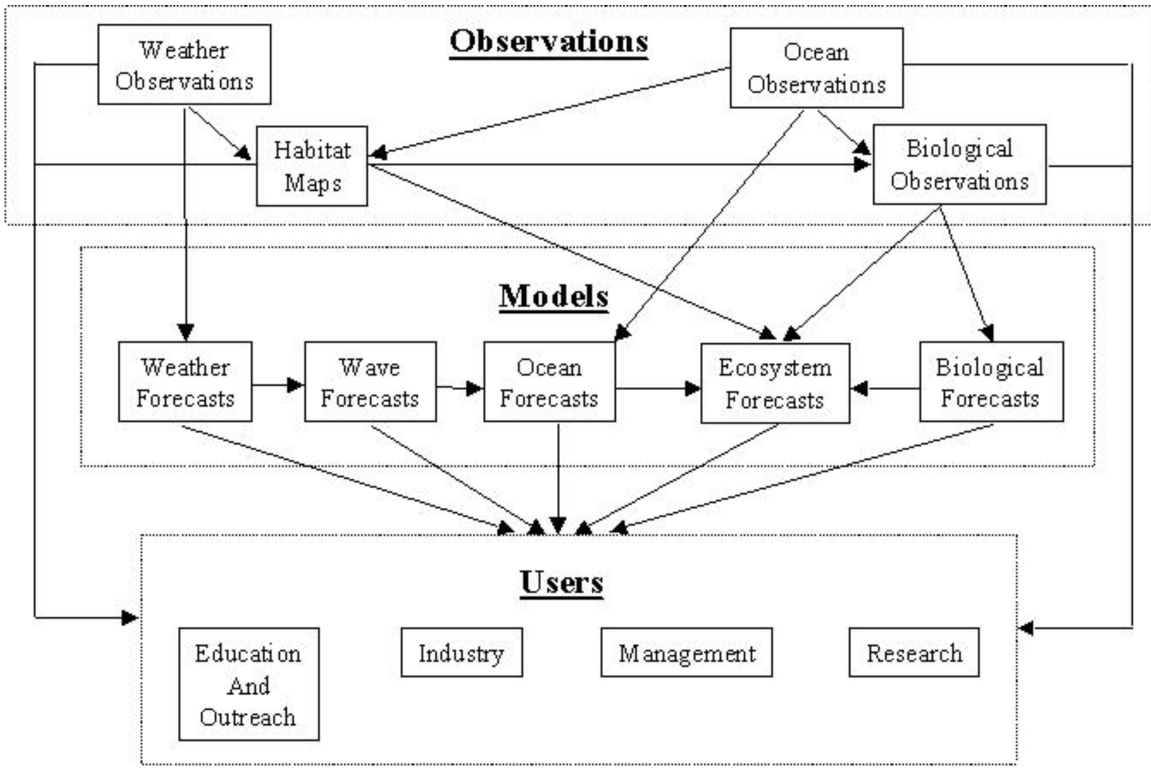


Figure 2. Key components of the PWSOS include observations, models, and users.

The PWSOS currently (in 2004) consists of a broad spatial array of sensors, maintained by both government and private entities, providing meteorological, oceanographic, and tidal data in real time (Fig 3). The ocean circulation model operating from 2004 to 2007 for PWS is based on the Princeton Ocean Model (POM), operated

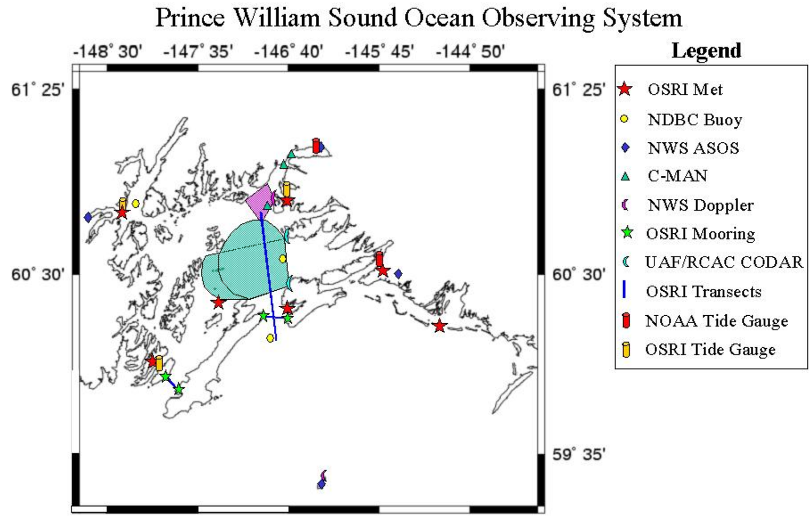


Figure 3. Instrument arrays that make up the current implementation of PWSOS. In 2004, OSRI is partnering with the PWS Regional Citizens' Advisory Council, and the University of Alaska Fairbanks to establish a land-based Coastal Ocean Dynamic Applications Radar (CODAR) system for measuring surface current velocities in the central sound basin. This high frequency radar technology provides a land-based system to transmit surface current velocities in near real-time to a variety of users, including the public, fishermen, and resource managers.

by the University of Miami Rosenstiel School of Marine and Atmospheric Sciences (RSMAS), and funded by OSRI. The PWS-POM is forced by winds, tides, heat flux, and freshwater buoyancy forcing. Tidal heights and currents are computed from tidal harmonics (amplitudes and phases) interpolated from a Northeast Pacific tide model. Wind stress is computed by the Regional Atmospheric Modeling System (RAMS), which is a mesoscale-resolving atmospheric model operated by the Alaska Experimental Forecast Facility (AEFF). Heating and cooling is given by the climatological monthly heat flux from the Comprehensive Ocean and Atmospheric Data Set (COADS). Fresh water runoff is derived from a hydrological model and is applied at the surface grid points next to the land. RAMS-driven forecasts are presently made out to 36 hrs. The limitations of the POM modeling effort are significant and include 1) validations and verifications of the POM are limited to a single-point (i.e., no spatial structure) hourly observations of wind speed and direction at NDBC buoy 46060 (mid-Sound), 2) there are few observational data from Hinchinbrook or Montague Entrances for boundary conditions, 3) there are no nested larger scale domains to provide boundary conditions, 4) there are no real time measurements of precipitation or heat flux, 5) there are no real time measurements of tides, 6) and the POM is not able to assimilate the real-time data being collected by the PWSOS.

4. Benefits of Maintaining an Ocean Observing System

a. Oil Spills

In the event of an oil spill, the U.S. Coast Guard (USCG) is designated as the Federal On Scene Coordinator (FOSC). NOAA provides scientific staff to advise the USCG on spill trajectories based on modeled scenarios from the General NOAA Oil Modeling Environment (GNOME) using any available data on winds and currents. This information is used to manage the oil spill including the deployment of diversion booms to protect sensitive habitats, aerial bombardment to ignite the spill, or to apply chemical dispersants. The real time data streams and model outputs of the PWSOS are used to inform the USCG and NOAA on prevailing atmospheric and oceanic circulation patterns so that more accurate trajectories can be predicted. This approach will improve the assessment of risks versus costs, a key element in identifying the best oil spill prevention and response technologies. Current approaches to this system of oil spill response involve one-off solutions to data acquisition and model integration. An improved approach would provide NOAA with an online data flow of model output and instrument measurements for specific locations as well as general regions.

b. Search and Rescue and National Security

Prince William Sound and the Port of Valdez are considered by the U.S. Coast Guard as high risks from a national security perspective. While the possibility of another accidental oil spill has been contemplated since the Exxon Valdez spill in 1989, only recently has the prospect of an intentional act of sabotage become significant. Accurate models of the oceanographic, atmospheric, and biological systems in Prince William

Sound are critical to the security of the sound and to search and rescue operations, therefore, the USCG would benefit from access to real-time data streams from this project. We will work with representatives from the USCG to ensure that real-time data streams for CODAR, oceanography (e.g., wave height), meteorology, and other sources are available through modeling workflows that enhance the ability of the USCG to manage oil spills, search and rescue operations, and the security of Prince William Sound.

c. Industry

PWS is home to five salmon hatcheries that release large numbers of pink (*Oncorhynchus gorbuscha*), sockeye (*Oncorhynchus nerka*), and chum (*Oncorhynchus keta*) salmon fry into PWS each year. In 1999, over 50 million adult hatchery salmon were taken from PWS, the highest number on record. Environmental monitoring information is important to the salmon hatchery industry operating in PWS. These hatcheries typically release juvenile fry stage salmon in the spring following the onset of plankton blooms. Critical elements to the survival and eventual return of adult salmon include the release of salmon fry coincident with the spring plankton blooms, a current with a velocity and direction conducive to flushing the young salmon out to sea, and a current strong enough to provide a signal to lead returning adults back to the hatcheries and natal streams. The ocean observing system products most useful to these industries are daily values of SST, salinity, current velocities, and 2 day forecasts, preferably emailed directly to each subscribed user such as the managers of the hatcheries and oyster farms. Synthesized products of value to these operations are comparisons of present values compared to historical years, i.e. in the case of the salmon hatcheries, managers need to compare present conditions to historical conditions that have known salmon returns. Salmon hatcheries are a multimillion dollar business, and most of the expense is in fish food. The longer the salmon fry are held in pens awaiting the optimal conditions for release, the more food they require. The accurate management of fry release will improve the survival of fry to the adult stage and also decrease the unpredictable variability of adult returns.

d. Ecosystem Management

The goal of the PWSOS is to combine hypothesis-driven long-term research with short-term process studies to understand mechanisms underlying long-term dynamics between the major coastal currents of the GOA, the coastal ocean, and the fauna and flora of PWS. Of particular interest is understanding predominant causes of ecological variability. The central overarching ecological hypothesis is that both the degree and source of connectivity of PWS to neighboring coastal marine systems combined with natural and anthropogenic disturbances drive dramatic variation in ecosystem processes, community structure, and population dynamics over space and time. Critical connections between PWS and other ecosystems are forged through variable water mass exchange with the GOA or from coastal freshwater runoff, implying dramatic differences in heat, salt, nutrient fluxes, stratification, planktonic propagules, and dissolved and suspended inorganic particles. This temporal and spatial variation in inputs interacts with various disturbances from ecological processes, such as predation, human activities, such as fishing, and natural events, such as earthquakes, and has important direct and indirect impacts.

5. Approach

a. Physical Science Programs

The climate at high latitudes is often extreme and is generally driven by physical forces that cause seasonal and interannual temperature variation that in turn drive regional and local winds, precipitation, and currents. Large tidal ranges that drive currents and expose vast amounts of shoreline to the twice-daily ebb and flood also influence the northern Gulf of Alaska. This physical heterogeneity in time and space explains much of the biological variability observed in fisheries, birds, and mammal populations, as well as less charismatic benthic and pelagic invertebrate and plant communities. Therefore, an understanding of this physical variability is paramount to understanding the variability of the PWS ecosystem. OSRI ,through support of the PWSOS, will continue measuring key physical variables that drive ocean currents, and provide these measurements in real time to improve model forecasts. The atmosphere and ocean models will also be upgraded to take advantage of new technologies that allow real time data assimilation. OSRI will contribute long term funding to sustain these efforts, but major upgrades in infrastructure will rely upon outside funding sources. For example, the proposed modeling effort will utilize funds from NOAA and leverage the considerable expertise of the GLOBEC program. OSRI will work with AOOS to coordinate a steering committee consisting of modelers and observationists to attend annual organizational meetings.

The principal drivers of circulation in PWS are tides, winds, heat flux, and freshwater. However, there are only three sites in PWS currently measuring precipitation, Whittier, Valdez, and Cordova. The ocean modeling effort funded by OSRI uses a runoff estimate based on climatological trends and this precludes the analysis of interannual variability of circulation as a function of freshwater input to the system. To better understand this variability we need to combine climatological trends with estimates of interannual variability of precipitation and solar radiation.

i. Oceanography: Water exchange processes

Partner: Alaska Ocean Observing System

PWS is connected to the northern GOA shelf at Hinchinbrook Entrance (HE) and Montague Strait (MS) (Fig. 4). PWS and the adjacent shelf support a wide variety of producer and consumer species, including sea birds, marine mammals, and commercially important fish stocks. Understanding the linkages between the physical and biological components of this tremendously productive ecosystem is necessary for better understanding of the physical processes that control a biological response and for effective management of marine resources. The Sound Ecosystem Assessment program (1994-1999), funded by the Exxon Valdez Oil Spill Trustee Council, identified exchange between the northern GOA and PWS as one of three physical processes that exert the most influence on the biology of phytoplankton, zooplankton, and juvenile fish within the

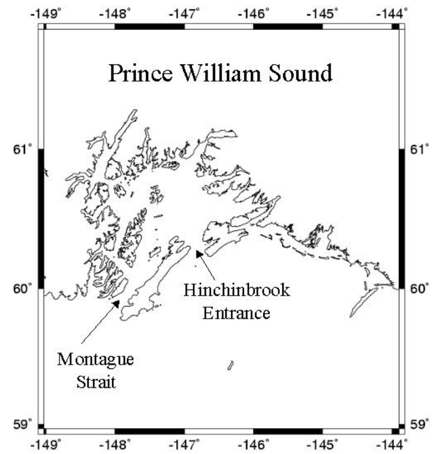


Figure 4. The locations for mooring arrays in the major entrances to PWS are shown.

Sound (Vaughn et al., 2001). An accurate description of the flow through HE is therefore necessary to investigate the relationship between circulation variability and biological variability in PWS. Observations (Muench and Schmidt, 1975; Niebauer et al., 1994; Vaughn and Gay, 2002) and numerical simulations (Bang and Mooers, 2003) show cross-channel variations in HE hydrographic and velocity fields. In spite of this spatial variability, all current meter mooring programs investigating flow through HE have, to date, been comprised of single-site moorings unable to resolve this horizontal variability. Furthermore, none of these earlier mooring programs have measured flow in the upper 20-40 m of the water column.

The proposed current meter mooring project addresses these two significant limitations to acquiring an accurate description of transport variability through the principle entrances. Three current meter moorings will be deployed across HE and MS (Fig. 5). One of the current meter moorings in each entrance will be a telemetered NDBC buoy, 46061 in HE and 46081 in MS. The other two current meter moorings in each entrance will be subsurface to avoid shipping traffic. The NDBC buoys will be instrumented with a downward looking RDI 150 KHz Workhorse Acoustic Doppler Current Profiler (ADCP), and a Seabird Microcat suspended from a cage in the buoy hull. Each subsurface mooring will have two ADCPs at ~100 m depth, one upward-looking

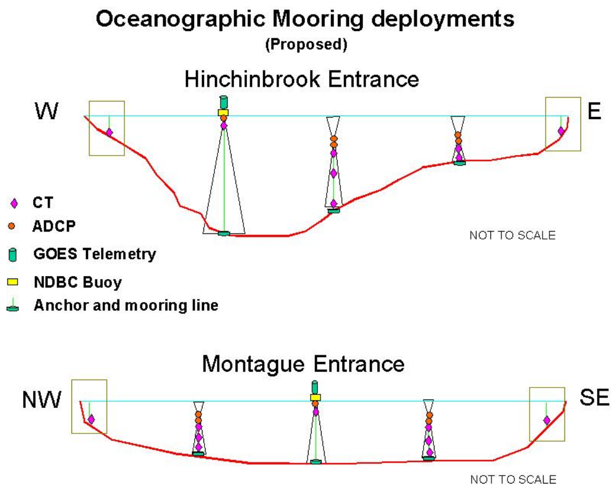


Figure 5. Each mooring array will consist of a telemetered NDBC mooring, and two instrumented subsurface moorings.

and one downward-looking. Each pair of ADCPs will consist of RDI 300 KHz Workhorses. All ADCPs will acquire hourly measurements of current speed and direction.

Yearlong time series of hourly current measurements are more than adequate to identify the principal tidal constituents of the flow through the pass. Data from the NDBC buoy mounted ADCPs will acquire high-resolution (8-m bins) observations for the water column and will acquire near-surface current measurements within ~7 m of the surface. These data will be telemetered every hour to the central computer at Stennis Mississippi for processing and web based dissemination. The subsurface mooring mounted ADCPs, deployed in upward-looking configurations, will provide high-resolution (2.25-m bins) observations in the upper 100 m of the water column and will acquire near-surface current measurements within ~7 m of the surface. The downward-looking 300 kHz ADCP will acquire measurements of lower water column currents in 2.25-m bins. Each subsurface mooring will also be instrumented with three CTD (Seabird Microcat or seacat) located at the top, middle and bottom of each string. The CTDs will sample temperature and salinity at thirty-minute intervals for the purpose of identifying periods of deepwater exchange between PWS and the northern GOA. The proposed array of two double-instrumented subsurface moorings, and a single instrumented surface mooring, will provide significantly improved horizontal and vertical resolution, and identification of cross-channel velocity variations, over the single-site moorings previously deployed in HE.

Mooring maintenance will be conducted every six months. The initial mooring deployment will occur in June 2005. During the first recovery mission in January 2006, the HE subsurface moorings will be recovered and while aboard ship, the data will be downloaded from the instruments, the instruments cleaned, and the mooring strings inspected and then re-deployed for another six months. The MS subsurface instruments will be replaced with spares. In June 2006, the HE moored instruments will be replaced with spares, and the MS moored instruments will be cleaned and then re-deployed for another six months. The sampling strategy of sequential six-month deployments is preferable to a single, yearlong deployment because the risk of data loss due to instrument failure/loss is diminished. This six-month rotation cycle will continue for a minimum of 5 years. The annual maintenance costs will be provided by OSRI.

The simplest data analyses will be time series plots of the physical field variables (velocity, transport, temperature, salinity, and winds) measured in or near HE and MS. Basic statistical measures such as record mean, variance, and monthly mean will be computed for each time series. Axes of maximum variance will be computed for currents at each bin depth for each mooring location and for winds at each wind observation location. Correlations between the time series of physical field variables will also be computed. Least squares methods will be used to extract the principal tidal constituents from the ADCP velocity data. A time series of subtidal volume transports will be calculated from the de-tided records. All subsurface mooring data will be posted on the web within one month of instrument recovery. The NDBC will process and post ADCP and CTD data from the surface buoy in real time.

ii. Coastal mountain meteorology

Partner: Natural Resources Conservation Service

OSRI will partner with Natural Resources Conservation Service (NRCS) in 2005 to establish precipitation gauges at about 500 m elevation (treeline) on Mt. Eyak and in College Fjord with deployment funding provided to the PWSSC by a grant from NOAA, and annual maintenance costs provided by OSRI. Three additional stations will be deployed in the watersheds surrounding PWS (Fig. 6) in following years with additional funding support to AOOS from NOAA. The NRCS installs, operates, and maintains an extensive, automated system to collect snowpack and related climatic data in the Western United States called SNOTEL (for SNOwpack TELemetry). The system evolved from NRCS's Congressional mandate in the mid-1930's "to measure snowpack in the mountains of the West and forecast the water supply". SNOTEL uses meteor burst communications technology to collect and communicate data in near-real-time. VHF radio signals are reflected at a steep angle off the ever present band of ionized meteorites existing from about 50 to 75 miles above the earth. The sites are generally located in remote high-mountain watersheds where access is often difficult or restricted. Sites are battery powered with solar cell recharge designed to operate unattended and without

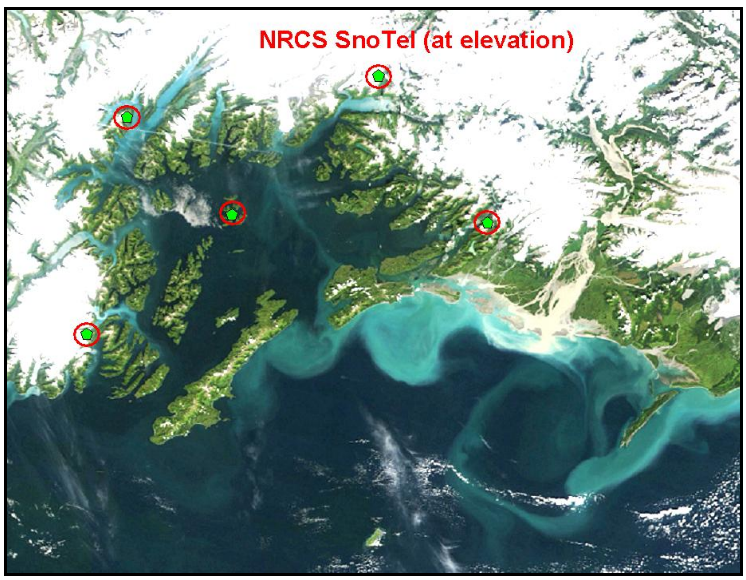


Figure 6. Locations for proposed five SNOTEL precipitation gauges at 500 m elevation.

maintenance for a year. A central computer at NRCS's National Water and Climate Center (NWCC) in Portland, Oregon controls system operations and receives the data collected by the SNOTEL network. SNOTEL sites have a pressure sensing snow pillow, storage precipitation gage, and air temperature sensor. Generally, sensor data is recorded every 15 minutes and the new generation of remote sites, master stations, and central computer facilities allows for hourly interrogation.

iii. Sea level meteorological

Partner: Natural Resources Conservation Service

The OSRI has contracted the deployment of six meteorological stations in PWS to provide real time data streams to the scientific community, oil spill responders, the USCG, and local mariners. Figure 7 shows the locations for the six stations.

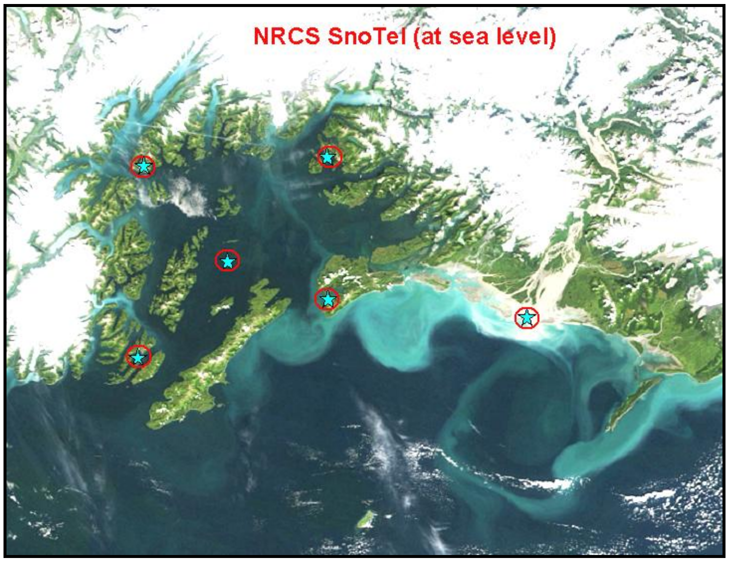


Figure 7. Locations of OSRI meteorological stations in PWS proposed for telemetry upgrade with Alaska Meteor Burst Data service.

The stations transmit data through a VHF radio network to one of three links with the Internet. Over the last two years of operation it has become apparent that the VHF network is compromising the consistency of data transmission. Furthermore, the current contract does not provide for quality control of the data or for more than one maintenance visit per year. The RAMS model relies on the real time data stream for validation of modeled nowcasts. Without reliable access to these data the model results are skewed to those stations with the most consistent data feed, i.e. the NWS C-MAN and NDBC buoys. A grant from NOAA will allow for the conversion of these stations to NRCS

SnoTel platforms including an upgrade of precipitation and solar radiation sensors. The annual operating costs for the SnoTel telemetry and sensor upgrades are about $2500 per year per station. The annual maintenance costs for five of the six stations will be provided by OSRI for: Kokinhenik Bar, Applegate Rock, Tatitlek, Pigot Point, and Chenega Bay. The NWS has deployed a new meteorological station at the Cordova, Boat Harbor and that will replace the PWSSC building station. The Tripod Hill (Mt Eyak) station functions primarily as a VHF repeater and will be replaced with a SnoTel Station, and the Nuchek station will be maintained by the PWSRCAC for the use of spill responders.

b. Biological Science Programs

There are several annual surveys conducted in PWS by agencies and other institutions to monitor sea otters (Bodkin: EVOS, 2004), harbor seals (Hoover-Miller: EVOS, 2004), killer whales (Matkin: EVOS, 2004), and humpback whales (Matkin: EVOS, 2004). The management efforts of ADF&G contribute surveys of king crab, herring, Dungeness crab, five species of salmon, walleye pollock, sablefish, shrimp, scallops, sharks, Pacific cod, misc. skates, arrowtooth flounder, black and rougheye rockfish, and dover sole (Bechtol, pers. com.). Intertidal surveys have been conducted as part of the EVOS monitoring by Driskoll et al. (2001), Shiginaka et al. (2004), and more recently by Konar and Iken (EVOS, 2004) as part of the Census of Marine Life (http://www.coml.org/). These limited studies have contributed to our understanding of the variability of marine life over time, but we still lack a comprehensive understanding of spatial distributions and how these change over time. Better habitat maps of PWS, the life and life stages associated with them, and the physical and biological mechanisms that force variability are high priority topics for future funding, but not necessarily from OSRI.

In the next few years, OSRI will pursue a better understanding of the variability of biota in PWS and how this relates to variability of the ocean, freshwater input, mechanisms of genetic exchange between the Gulf of Alaska and the PWS, larval and spore recruitment and post-recruitment processes, and utilization of PWS habitats by different life stages of benthic and pelagic organisms. Surprisingly little is known about the PWS ecosystem even 15 years following the oil spill. For example, there are no data quantifying the spatial and temporal variability of kelp forests in PWS. High resolution bathymetry is now only available for the western Sound, and no essential fish habitat maps exist. For OSRI to continue improving the understanding of PWS and how populations vary with natural and anthropogenic perturbations, more emphasis needs to be focused on key elements of the PWS ecosystem that have not been quantified or even described. OSRI will seek funding partnerships with ADF&G, EVOS, and NPRB to continue the acoustical monitoring of fish and zooplankton, and seek collaborations with UAF and others to adopt this long term monitoring program. Similar partnerships will be sought for monitoring biota on the Copper River Delta and watershed. The PWSSC research fellowships are intended to fund short term focused investigations on biological issues relevant to the OSRI mission.

i. Ecological research

Partner: North Pacific Research Board

The OSRI will partner with the North Pacific Research Board (NPRB) to issue a joint request for proposals (RFP) in the fall of each year soliciting ecological research projects in arctic and sub-arctic climates, generally within the NPRB geographic area of interest, but with particular emphasis on the Gulf of Alaska and Prince William Sound to take advantage of the rapidly developing ocean observing system infrastructure. The observing system in PWS is focusing on real-time instrument platforms and forecast models. These models will be generating operational forecasts by 2007, and in the interim, the development of ecological applications is essential. The areas of focus are within the categories identified in the NPRB four-year general implementation plan.

The variability of marine habitats in space and time has been well documented in the pelagic, shelf, nearshore, and intertidal of Alaska's coastal seas but our understanding is limited in terms of how these habitats are utilized by different organisms at different stages of their development. We know for example that juveniles of many species utilize eelgrass beds for protection against predators but only recently have we learned the spatial extent of this habitat type. The aggregation of crabs and fishes have been documented, such as the herring schools in PWS during the winter, but little is known about the physical and biological mechanisms determining this behavior. In situ instruments are monitoring changes in the water column at numerous sites and these data will aid the development of numerical models that will generate spatially extrapolated nowcasts, and forecasts. Benthic habitat mapping is on going in the intertidal and shallow subtidal zones but for deeper waters there is no systematic program in Alaska.

ii. PWSSC plankton and nekton monitoring

Partner: Prince William Sound Science Center

Neocalanus copepods and pteropods represent the bulk of forage for planktivorous fishes (herring, walleye pollock, salmon fry, etc.) during the annual spring bloom in Prince William Sound, and therefore, have received considerable funding from OSRI in the past few years. However, there are many other biological populations in PWS at risk to oil spills and these have remained understudied. For example, another key component of the zooplankton are the larval stage juveniles of benthic and pelagic invertebrates and fishes. This is an aspect of the PWS plankton not previously studied but still of utmost importance to the local ecosystem. Many important populations in PWS have a pelagic larval stage such as Dungeness crabs, king crabs, urchins, rockfish, and herring. Many of these were fished and have been seriously depleted and now, in some cases many years after fishery closure, show few signs of recovery. A better understanding of the larval ecology of these populations and how PWS habitats provide support for different life stages is an important and little understood aspect of the PWS ecosystem. Recent mapping of PWS shorelines has shown that eelgrass beds are an important component of the shallow nearshore. The role these beds play in supporting juveniles of herring, pollock, and crabs is known to be important in other large estuaries, but little is known about the role in PWS. Similarly, the kelp forests of Montague Strait are important macro-algal populations and also habitat for juvenile rockfish and crabs. But even 15 years after the EVOS, little is known about the spatial and temporal distributions of these kelp forests and the role they provide as habitats.

iii. PWSSC Copper River Delta monitoring

Partner: Prince William Sound Science Center

Beginning in the spring of 2000, OSRI funded studies on the intertidal resources of the Copper River Delta at risk to oil spills. The primary objective of this study was to quantify through field sampling, the benthic invertebrate prey, demersal (bottom feeding) fish and crab, and avian communities and to develop the mechanistic understanding of the biological community necessary to predict how the system would respond to a major disturbance, such as an oil spill. The project has four objectives: 1) characterize the spatial abundance of macrobenthic species within the CRD and Orca Inlet regions, 2) determine and quantify factors that best serve as predictors for primary production, 3) quantify the spatial and temporal abundance of demersal and avian predators and assess the role of epibenthic predation on recruitment of intertidal macroinvertebrates, and 4) develop a cost-effective strategy and sampling design for long-term monitoring of the intertidal sedimentary habitats.

iv. Habitat mapping

Partner: TBD

A program of Shore-Zone coastal mapping in Prince William Sound (PWS) began in June 2004 and will continue based on the availability of external funding sources. Shore-Zone maps have been recognized as the highest priority product for the EVOS/GEM nearshore program following a series of community workshops, stakeholder meetings, and recommendations by nearshore scientists. The products generated by Shore-Zone provide a spatially comprehensive reference for intertidal and subtidal habitats. Aerial Video Imagery (AVI) will be collected during the lowest tides of the year and then be used as the primary data source for intertidal and shallow subtidal mapping. Video data and in situ observations will be used to generate GIS coverages of physical and biological shoreline attributes. These attributes will be validated by a rigorous field survey in the final year of the project. Shore-Zone maps in other areas are widely used by state and federal agencies for regional planning (e.g., GRS planning, eelgrass distribution maps), and development of derivative models (e.g., potential oil residence, sandlance spawning capability). Video imagery and GIS coverages will be available on the Internet.

c. Data Management

Partner: University of Alaska

Long term funding to sustain continuous data archiving and dissemination is key to the atmospheric and oceanographic components of PWSOS. This funding will initially be provided by OSRI, but the PWSOS is being designed to fully utilize the infrastructure contributed by a host of partner organizations including the regional Alaska Ocean Observing System, Prince William Sound Regional Citizens' Advisory Council, the National Data Buoy Center, the Natural Resources Conservation Service, the University of Alaska at Fairbanks, Anchorage, and Juneau, the U.S. Forest Service, the U.S. Coast Guard, and the Exxon Valdez Oil Spill Trustee Council. The AOOS Data Management Advisory Committee (DMAC) will guide the effort to develop standardized protocols under the auspices of IOOS, so that when IOOS funds become available, other funding sources can be found to maintain the data archiving servers and dissemination protocols initially developed with OSRI funding.

d. Modeling

i. Atmospheric circulation

Partner: Alaska Experimental Forecast Facility

Coastal processes are to a great extent forced by local surface wind. Alongshore wind drives surface water offshore and draws the cold, nutrient-rich deeper water to the surface. The high-resolution ocean vector wind will be derived from the Regional Atmospheric Modeling System (RAMS). RAMS is a primitive-equation finite difference model, and currently being run daily at the Alaska Experimental Forecast Facility IAEFF) at the University of Alaska Anchorage (UAA). RAMS is used as a forecast model up to 48 hours at increments of 1 hour for the Prince William Sound region.

The PWS RAMS configuration consists of three nested grids: the 64-km grid covers the entire state of Alaska, the 16-km grid covers the southern Alaskan coast and northern Gulf of Alaska, and the 4-km grid covers the PWS region of interest. Graphs are available on the AEFF Weather Briefers Page (RAMS button on http://aeff.uaa.alaska.edu/wx_brief.html) in real-time as soon as the data write occurs.

The ocean wind forecast will be used as the forcing function for the ocean wave and circulation modeling as described next.

ii. Data assimilation

Partners: Jet Propulsion Laboratory and University of California Los Angeles

At the core of many ocean observing systems are the predictive capabilities of ocean circulation models, i.e., simulation models that can be used to forecast the flow of ocean currents. We propose to develop a real time data assimilation model for PWS such as the Regional Ocean Model System (ROMS). The intent is to develop a model that can utilize the data streaming from real-time ocean sensors and other model output and assimilate those data to make model corrections in real-time (Fig. 8).

The PWS ROMS model will be developed by a team at JPL and UCLA in collaboration with the current GLOBEC modeling group in the Gulf of Alaska (UAF and PMEL). This provides for an efficient use of the information and modeling expertise assembled during the GLOBEC effort. The Jet Propulsion Laboratory will develop the data assimilation component. The first and second years (of three years) will focus on developing the operational nested ROMS. Beginning in the second year, the data assimilation capability will be developed. During the second year we will also begin designing and securing funds for a coupled phytoplankton/zooplankton model. The design will also allow for coupling the ROMS with one or more future fisheries models (salmon, herring).

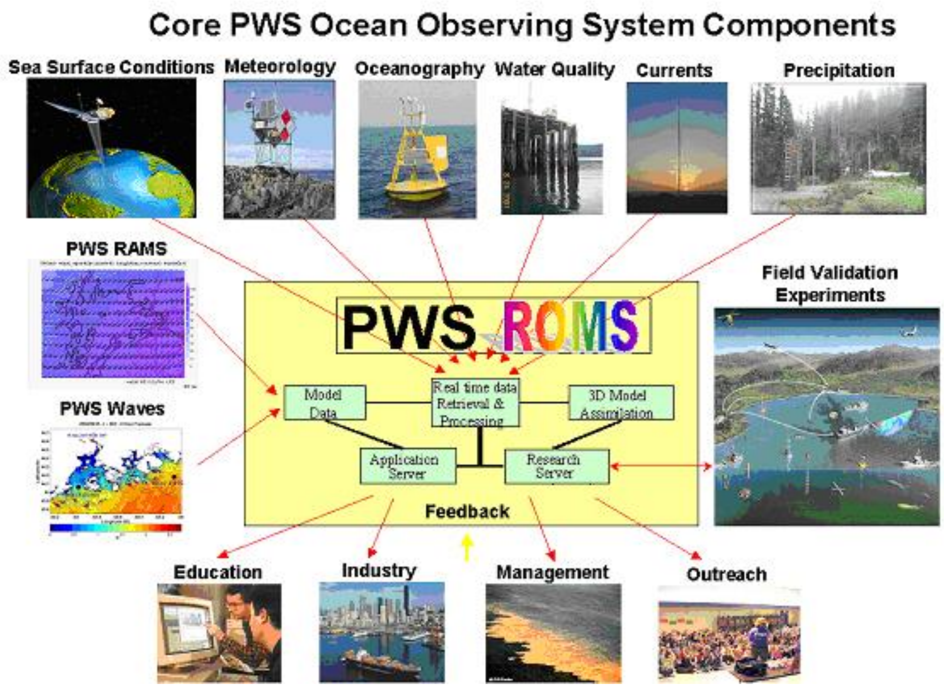
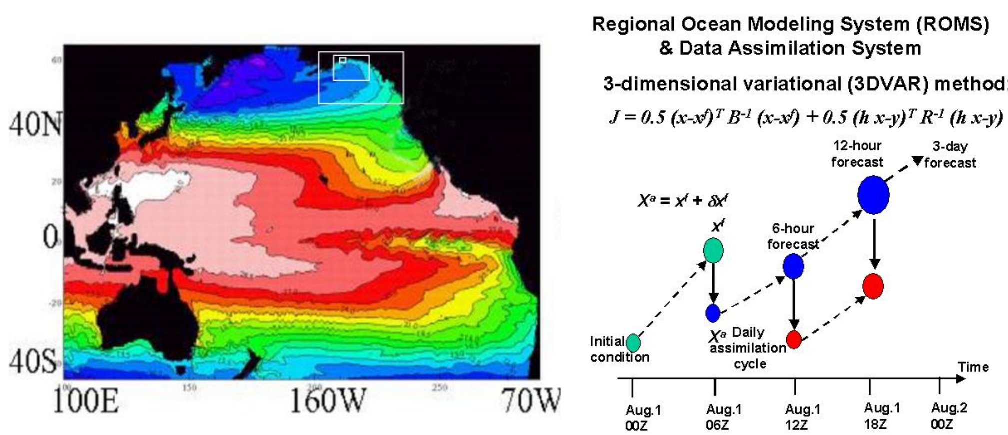


Figure 8. The proposed nested ROMS for PWS will assimilate real time data streams and output from other model (e.g. RAMS, SWAN), for more accurate forecasts useful to a broad range of users groups including industry, government, research, and the public (from Y. Chao, JPL).



A. B.

Figure 9. By integrating with the SCCOOS, the PWSOS will be in a unique position to study very large-scale signals propagating up the west coast of North America. Another feature of the ROMS is the ability to assimilate real time data streams to correct modeled predictions based on observed conditions (Figure 14B). This utility will make use of the real time instrument arrays being deployed in PWS and showcase the integrated functionality of an operational OOS (from Y. Chao, JPL).

The ocean circulation forecasts and error estimates will be based upon a nested series of the ROMS currently in use at JPL funded by the NASA oceanography program. The JPL ROMS is forced by ocean vector winds and assimilates both *in situ* and satellite observations including sea surface temperature and sea surface height. The ROMS configurations consist of a Pacific basin-scale grid at 12.5-km resolutions as well as a series of nested grids with a resolution of approximately 1-km covering PWS (Figure 9A).

ROMS is also a fully coupled physical-biogeochemical model. It solves the three-dimensional oceanic equations of momentum, temperature, salinity, and several biogeochemical tracers (e.g., nitrate, silicate, phytoplankton, and zooplankton). ROMS contains state-of-the-art parameterizations for surface boundary layer, turbulence mixing, and side boundary conditions. It also contains a three-dimensional data assimilation subsystem comprised of data quality control, data analysis, model initialization, and forecasting components (Figure 9B).

iii. Synoptic waves

Partners: Texas A&M University

Surface waves constitute an extremely energetic component of the physical oceanography affecting coastal Alaska. Waves create turbulent effects that can be orders of magnitude larger than baroclinic and barotropic currents that can overwhelm the latter to the extent that even the identity of the currents can periodically be destroyed. From a practical standpoint also, information about the wave conditions in the Alaskan coastal areas is needed for assessing the fate of oil spills and related recovery efforts and safe boat/ship operations

Because buoy and satellite altimeter measurements of waves in coastal waters suffer from spatial and/or temporal sampling limitations (Panchang et al. 1999), grid-based wave modeling (Simulating WAves in the Nearshore, SWAN) will be employed to make wave predictions for both oil spill response and marine safety applications in PWS. We will use satellite and in situ wave observations for validation of model results and satellite

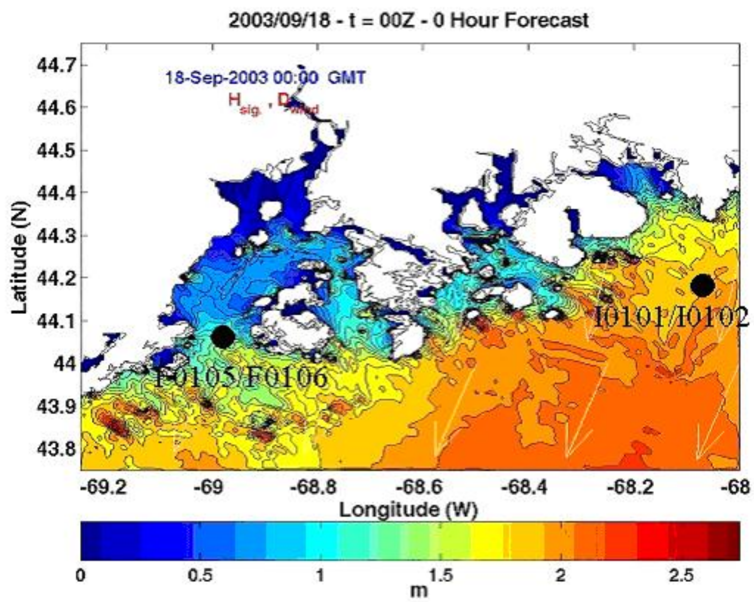


Figure 10. The SWAN wave model has been configured for Penobscot Bay as part of the Gulf of Maine Ocean Observing System (from V. Panchang, Texas A&M).

wind and wave observations for data assimilation to enhance model results. Besides traditional data assimilation schemes, we will explore techniques of artificial intelligence to incorporate satellite measurements into wave model results.

We intend to apply a basic portable system, similar to that implemented in coastal Maine, to Prince William Sound. NOAA's coarse grid simulations and wind fields for the Gulf of Alaska constitute the "basic" forcing functions. In this proposal, we plan to include a number of additional features (Panchang et al., 2004) including 1) local wind fields to be provided by the RAMS model, 2) the effects of currents and changing water levels calculated by the ROMS model, and 3) using significant wave height data and wind data derived from the Jason-1 and TOPEX satellites for validation of model results and for data assimilation to enhance model results.

e. Research Fellowships

i. PWSSC research fellowship

Partner: Prince William Sound Science Center

The intent of this OSRI fellowship is to 1) provide research staff to the PWSSC; 2) to research diverse issues relevant to the OSRI mission; and 3) to maintain the highest caliber of science possible. OSRI will fund a fellowship to conduct basic and applied research in Prince William Sound and the Gulf of Alaska utilizing the ocean observing system to meet one or more of the OSRI research focus issues. The general research focus will be defined by the OSRI Advisory Board and the Science and Technology Committee. The research area includes the Sound and the adjacent Gulf of Alaska. This position will be responsible for two main categories of work: 1) participate in the research and monitoring programs required by the OSRI grant (75%), and 2) assume a lead role in securing external funds to develop process oriented studies to further our understanding of how PWS, the Gulf of Alaska, and the surrounding watersheds (25%). The position will also be required to participate in an integrated science, education, and outreach program conducted by the education staff of the PWSSC.

ii. External research fellowship

Partner: TBD

This OSRI Research Fellowship provides a platform from which investigators from any university, agency, or private institute can conduct research at the PWSSC to better understand natural and anthropogenic variability in the ocean, benthic habitats, and watersheds of Prince William Sound. Fellows are expected to further the research themes of OSRI and are selected based on their scientific leadership, their interest and ability to participate in interdisciplinary research, and their ability and willingness to communicate the importance of OSRI's research to the public and policy makers in government. Senior Research Fellows can work independently or in collaboration with the PWSSC science staff. Research Fellows will also interact with the OSRI Science Director and the Institute's Advisory Board in developing research plans and directions for future studies. The OSRI fellowship provides salary support for 1-2 months per year for a period of three years for each Fellow, enabling them to pursue research interests related to the current theme of the Institute and to participate in Institute workshops, symposia and outreach activities. OSRI expects to appoint one new Fellow in 2005. Up to 10% of the OSRI share may be used for institutional overhead or university indirect costs.

Goal #2 Respond

Enhance the ability of oil spill responders to mitigate impacts of spills in Arctic and sub-Arctic marine environments.

1. Objectives:

a. Fill knowledge gaps on behavior of spilled oil.
b. Fill knowledge gaps on use and effectiveness of specific mitigation techniques.
c. Identify and evaluate new prevention and response technologies.

2. Background

Thousands of marine accidents occur each year in which oil or chemicals are released into the coastal environment. Spills into our coastal waters, whether accidental or intentional, can harm people and the environment and cause substantial disruption of waterways with potential widespread economic impacts. There is no single organization or facility in the U.S. with the goal of transforming scientific and technical advancements into improvements that reduce cost and improve the effectiveness of spill preparedness, response, and restoration. There is a need for more and better-coordinated investments in research, development, technology transfer, and dissemination of standard practices. Progress in these areas has great potential to improve the effectiveness of spill response.

The institutions and programs that work in these areas are in general under-funded and weakly linked. The reasons are manifold, but are neatly summarized in the following quote: “After catastrophic spills, when the acute effects of oiled beaches, polluted waterways and dying wildlife are featured in all the media, there is public outcry and political interest, accompanied by calls for action, for more research, and for better prevention and control measures. Later, as acute effects fade, but longer term and less obvious problems may continue, public interest—and with it political interest—fade…. When the next catastrophe occurs everyone wonders why no one has learned more about how to deal with the problem since the last spill…. The phenomenon of cyclical attention and lack of sustained interest and resources…[makes] it difficult to create a coherently planned…program" (NRC, 1994).

Recognizing these issues, OSRI advanced the concept of partnering with two other funding programs to leverage monies towards one annual RFP specifically aimed at developing new technologies for oil spill response in high latitude cold marine climates. OSRI is developing this partnership with the Cooperative Institute for Coastal and Estuarine Environmental Technologies (CICEET: http://ciceet.unh.edu), and the new Coastal Response Research Center (CRRC: http://www.crrc.unh.edu).

The Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) was established in 1997 as a national center for the development and innovative application of environmental technologies and methods for monitoring, managing, and preventing contamination in estuaries and coastal waters. The Institute promotes collaboration among those in academia, government, and the private sector. The Institute's unique role is to develop innovative and transferable technologies and techniques that are directly applicable to estuarine and coastal systems. Activities of CICEET also complement several other programs of the National Ocean Service (NOS), NOAA, and other federal, state, and local agencies. CICEET projects and programs are coordinated closely with the Coastal Services Center, National Centers for Coastal Ocean Science, the Office of Response and Restoration, and Sea Grant, as well as the Coastal States Organization, National Estuarine Research Reserve Association, and Estuarine Research Federation. The Institute will develop technologies and techniques that benefit other NOS and NOAA programs, federal, state, and local agencies, and academia. The Institute also will foster collaboration with the private sector to commercialize key environmental technologies. CICEET strives to get information and technology into the hands of key users and decision-makers, and build the skills necessary to use new approaches through training.

The CRRC is a partnership between the University of New Hampshire and the National Oceanic and Atmospheric Administration's (NOAA) Office of Response and Restoration. The broad goals of the CRRC are to work with NOAA's Office of Response and Restoration to conduct research, development, and technology transfer to reduce the consequences of spills and other hazards threatening coastal environments and communities. The CRRC will address national issues and focus on the research, education, and technology involved with all aspects of spills, with an overall objective of promoting effective protection and restoration of coastal areas. The primary mission of the CRRC is to establish research priorities and collaborate on and conduct research to advance the knowledge, technology, and practice of spill preparedness, response, and restoration. Additionally, the secondary missions are to compile and analyze data to establish trends in spills, spill risk, preparedness and response; transform research results into standards of practice and demonstration projects; provide reference information to improve preparedness and response capabilities; and create a learning center for spill preparedness, response and restoration to promote awareness of capabilities and realistic expectations about risks and benefits.

3. Benefits

A collaborative effort between OSRI, CICEET and the CRRC will benefit OSRI through 1) the national exposure of a well established funding program with connections to the top ranked engineering schools in the country, 2) the pooled efforts to peer review and select proposals for funding, 3) the leveraging of OSRI funds with those of CICEET and the CRRC to substantially increase the monies available for research and development of new techniques and technologies related to the recovery of cold climate oil spills.

4. Approach

a. Technology Research and Development

Partners: Coastal Response Research Center

OSRI, CICEET, and the CRRC have formed a unique partnership to develop new technologies and/or apply innovative approaches utilizing existing technologies to address oil spills in cold climate estuarine and coastal environments. Cold climate areas of interest include those subjected to severe storms, large waves, prolonged winter weather, and sea ice such as the Gulf of Alaska, Bering Sea, Chukchi Sea, Beaufort Sea, Arctic Ocean, and the Gulf of Maine. Techniques and technologies of interest include:

i. Develop and/or apply novel and cost-effective methods and technologies for preventing, recovering, reducing, or eliminating spilled contaminants.

- Hazard monitoring and early warning technologies
- Mechanical, physical, chemical, biological mechanisms and methods
- Removal of oil and toxic contaminants in and under ice

ii. Develop new sensors and technologies to detect and quantify contaminants in the environment.

- Fate and transport of released contaminants
- Fate and transport of chemicals used to treat contaminants
- Detection of oil and toxic contaminants in and under ice

iii. Develop and/or apply novel and cost-effective technologies and methods to remediate contaminated sediments and water.

- Habitat recovery and restoration
- Quantify short and long term effects of contaminants on organisms and ecosystems

The partnership will issue joint annual solicitations in the fall (starting October 2005) through the CRRC. The partnership will issue one solicitation and will involve joint marketing, joint review, but then separate funding (OSRI funds one or two projects, CICEET funds one or two, CRRC funds one or two). All parties would get credit for supporting the partnership. CRRC will develop an online database and project archive for public dissemination of projects and project results.

The project solicitation process will consist of a request for preliminary proposals in the fall of each year. Preliminary proposals will be peer reviewed by non-partnership scientists in September. The projects will be evaluated based on:

- projected outcome rather than output,
- problem solving rather than problem defining,
- technology development not description of processes,
- useful tools and products rather than interesting research,
- broadly applicable rather than site specific,

- novel and innovative rather than tried and true,
- technological advances rather than incremental steps in science,
- the environment and the economy are the endpoints rather than journal articles.

In October, a selection panel will convene to discuss the outcome of the first round of reviews. The preliminary proposal review is primarily a programmatic review. This review will match projects to the specific funding source (OSRI, CICEET, or CRRC) and identify projects for full proposals. An invitation for full proposals will be issued in October, and sixty days allotted for submission. In December, the full proposals will be sent to technical peer reviewers, or scientists and engineers acknowledged for their expertise. The projects will be evaluated based on:

- Qualifications of the project team,
- Quality of the proposed research,
- Expected outcome,
- Reasonable and justified project costs.

A project selection panel will convene in February to discuss and recommend projects for funding to the individual funding sources. Projects selected for OSRI funding will be presented to the Advisory Board at the February meeting. If funding is approved, projects will start on April 1.

Goal #3 Iinform

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

1. Objectives

a. Facilitate the exchange of information and ideas through education and outreach.
b. Brief the scientific community and oil spill responders on OSRI products.
c. Develop and maintain a web page that provides relevant and timely information on environmental conditions in PWS to aid oil spill responders, researchers, managers, and mariners.
d. Provide graduate and undergraduate fellowships and internships (see Goal 1).

2. Background

The Oil Spill Recovery Institute has designated a portion of its program spending for public education and outreach. Within the program is the K-12 environmental education project that supports efforts such as *Science of the Sound*. This has four core elements: "Discovery Room" is a monthly science and environmental education program for elementary students in Cordova, Alaska. "Outreach Discovery" takes a modified version of the "Discovery Room" program to isolated villages in Prince William Sound. "From the Forest to the Sea" summer camps offer residential ecology programs for 8-15 year olds. Throughout the year the "Community Education Program" offers field trips, lectures, and citizen science projects for adults and families in the region. In August of 2001 OSRI sponsored an education workshop, bringing together Alaskan education professionals to discuss ecology related issues and the need for disseminating information on oil spills. This meeting included representatives of the native communities, rural villages, and public educators. Among the topics was the Oil Spill Curriculum developed by the Oil Spill Recovery Institute following the 1989 Exxon Valdez oil spill in Prince William Sound. Educating the next generation on the susceptibility of our natural resources to manmade disasters such as oil spills is an important component in protecting those resources.

3. Benefits

Most communities in PWS are economically dependent on natural resources through fishing, hunting, mining, and logging. To ensure the socioeconomic longevity of isolated coastal communities, it is crucial that residents of PWS have a working knowledge of ecological systems and how these systems are influenced by natural and anthropogenic processes. Prince William Sound Science Center education programs reach out to many ages and communities in the local region. Programs offer imaginative exploratory learning opportunities in an area where geographic isolation places many children and families at an economic and social disadvantage. The goals of these programs are to promote inquiry into the natural world, increase science and ecological literacy, and foster stewardship for the responsible use of our natural resources.

4. Approach

a. Education and Outreach

OSRI intends to continue building upon the existing regional outreach programs. In addition, within the next year, OSRI will seek out partnering opportunities to broaden the geographic influence of the PWSSC education programs to state and national audiences and share expertise among a consortium of other education and outreach institutions. An example of a developing partnership is a new program being initiated by Tatitlek Village Council to develop a training program in natural resources designed to address the needs of rural Alaska Natives. This program includes both environmental and natural resource components to allow more meaningful Tribal involvement in fish and wildlife management, research, and monitoring activities. This initiative is being developed with the assistance of the Chugach Regional Resources Commission (CRRC), a Tribal nonprofit 501(c)(3) public charitable organization established by the seven Tribes in the Chugach Region of Alaska to collectively address natural resource and environmental issues of mutual concern. The member Tribes of CRRC includes the Tatitlek Village Indian Reorganization Act (IRA) Council, Chenega Bay IRA Council, Nanwalek IRA Council, Port Graham Village Council, Native Village of Eyak, Valdez Native Tribe, and the Qutekcak Native Tribe.

i. Prince William Sound Science Center programs

Partner: Prince William Sound Science Center

The Discovery Room and Outreach Discovery programs create the opportunity for hands-on science in both classroom and outdoor settings. The Discovery Room enhances the science curriculum for 300 Cordova students in kindergarten through sixth grade. This program alone provides 16,200 contact hours to Cordova children each year. Outreach Discovery takes Discovery Room lessons to the villages of Chenega Bay and Tatitlek. These lessons greatly enhance the limited resources these schools have available for science education. Community Programs serve adults and families in Cordova and include field trips, lectures, and seminars.

The Forest to the Sea summer camp program provides the tools and guidance for campers to understand the interdependence of all ecosystems. Hands-on education in the outdoor classroom and scientific knowledge, combined with positive experiences in the outdoors, builds a foundation for campers to grow into good environmental stewards and wise decision-makers. While immersed in their surroundings, participants learn how ecosystems are connected through interactive studies of the temperate rainforest, glacier, wetlands, and ocean.

OSRI will provide institutional sponsorship for the annual Cordova Science Festival by providing scholarships for winners of presentation categories, including posters, demonstrations, and oral presentations.

OSRI will provide institutional sponsorship for the Alaska Tsunami Bowl, the regional competition for the National Ocean Science Bowl. This program encourages high school students to excel in math and science studies by involving them in a quiz-bowl competition focused on ocean sciences.

ii. Community program development

Partner: Imaginarium

With the state budgets at an all time low, and community teachers put to the task of meeting the No-Child-Left-Behind initiative, science and particularly marine science is waning in the K-12 classroom. For 12 years, the Prince William Sound Science Center has augmented local education curriculum with hands-on science programs (see above) and, in addition to Cordova students, has delivered these programs to Tatitlek and Chenega Bay. In order to expand delivery of these classes to other remote coastal Alaska communities we are partnering with the Imaginarium, an Anchorage based education and outreach non-profit, to develop a traveling program with a general emphasis on the marine environment. We will explore ways of utilizing the real time data streams and model output from the PWSOS in the classroom.

b. Graduate Student Fellowships

The OSRI will annually solicit proposals for the Graduate Research Fellowship Program subject to available funding. Grants are available on a competitive basis to students admitted to or enrolled in a full-time doctoral or masters program at accredited colleges and universities. Fellowships may be funded for up to two years to support masters or up to three years to support doctoral level research. For more information about the Graduate Research Fellowship Program see Appendix B of this document.

c. Workshops

The OSRI Advisory Board may utilize funds to sponsor workshops, conferences or symposia on topics related to oil spills, ocean observing systems, biological monitoring, and education, and publish findings or reports generated by these meetings.

d. Web Page

Annual support is provided for upgrading and maintaining the OSRI web site.

V. Other Programs

A. Annual Report

The OSRI will contract for an Annual Report that details the programmatic activities and provides a summary financial status report. This report serves as a document of recording and evaluating the process of the OSRI program.

B. Program Coordination

This position was established in FY99 for providing programmatic leadership and oversight of the OSRI R&D program. Funding for this position is a programmatic expenditure. The amount includes salary, benefits, equipment, and travel expenses.

C. OSRI Scientific and Technology Committee Meetings

Funds are provided for meetings of the OSRI Science and Technical Committee, including selection of members and member travel. The committee advises the OSRI Board, program staff and Executive Director regarding OSRI research, projects and studies related to Arctic and subarctic oil spills and their effects.

2005-2010 OSRI Science Plan

Project		Page #	(Current) 2005	2006	2007	2008	2009	2010
			Suggested annual workplan budgets					
Understand								
Oceanography		17						
	PWSSC Research Fellowship		75	75	80	80	85	85
	Fellowship Advisor		15	15	15			
	PWSSC Technician		35	35	40	40	40	40
	Equipment		25	25	25	25	25	25
Meteorology		20						
	Weather station maintenance		40	40	40	25	25	25
	PWSSC Technician					15	15	15
Biology		23						
	e.g. NPRB Partnership			100	100	100	100	100
	PWSSC Research Fellowship		150	150	80	80	85	85
Data Management		26						
	UA		40	40	30	30	30	30
	PWSSC IT			15	15	15	15	15
Support for model development		27						
	Atmosphere		60	60	60			
	Ocean		60	60	60			
	Wave		5	5	5			
Respond								
Oil spill technology		32						
	e.g. CRRC Partnership		200	150	150	150	150	150
Inform								
Education		38						
	PWSSC programs		60	75	75	85	85	95
Graduate Students		40						
	Fellowships		100	100	100	100	100	100
Outreach								
	Board discretionary (workshops)		15	15	15	15	15	15
	Web page		5	5	5	6	6	6
Administration								
	Annual report		10	10	10	10	10	10
	Program coordination		120	120	85	85	90	90
	Meeting travel (STC, CRRC, etc)		10	15	15	15	15	15
Budget								
Subtotal annual budget			1025	1110	1005	876	891	901
Revenue	USCG Deposit	860	860	840	860	860	860	860
Indirect	PWSSC	172	172	168	172	172	172	172
Reserve	Total remaining in reserve	1576	1239	879	590	431	250	49
	Interest on reserve (5%)		62	44	29	22	12	2
Total		**2436**	**2161**	**1763**	**1479**	**1313**	**1122**	**912**

NOTE: *This budget table was compiled in late 2004; updated budgets are included in more recent Annual Work Plans.*

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Appendix A

OSRI Strategic Plan

Appendix B.

OSRI Graduate Research Fellowship Program

Appendix C Cold Climate Spill Research RFP

Appendix D

The Prince William Sound Environmental Setting