

PROPOSAL SIGNATURE FORM

THIS FORM MUST BE SIGNED BY THE PROPOSED PRINCIPAL INVESTIGATOR AND SUBMITTED ALONG WITH THE PROPOSAL. If the proposal has more than one investigator, this form must be signed by at least one of the investigators, and that investigator will ensure that Trustee Council requirements are followed. Proposals will not be reviewed until this signed form is received by the Trustee Council Office.

By submission of this proposal, I agree to abide by the Trustee Council’s data policy (Trustee Council Data Policy*, adopted March 17, 2008) and reporting requirements (Procedures for the Preparation and Distribution of Reports**, adopted June 27, 2007).

PROJECT TITLE: PWS herring survey: Community Involvement, Outreach, Logistics, and Synthesis, submitted under the BAA

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Signature of PI: _____ Date: _____

* www.evostc.state.ak.us/Policies/data.cfm
 ** www.evostc.state.ak.us/Policies/reporting.cfm

**FY10 INVITATION
PROPOSAL SUMMARY PAGE**

Project Title: PWS herring survey: Community Involvement, Outreach, Logistics, and Integration, submitted under the BAA

Project Period: October 1, 2009 to September 30, 2013

Primary Investigator(s): W. Scott Pegau, Prince William Sound Science Center – Oil Spill Recovery Institute

Study Location: Prince William Sound

Abstract:

This proposal contains the overview of a coordinated set of ten proposals from multiple organizations that are designed to address the Herring Surveys section of the Invitation for Proposals. It describes how individual components are being integrated to provide information needed to make informed decisions on herring restoration.

The objectives of the integrated herring survey program are:

- 1) Identify juvenile rearing bays for use in restoration planning.
- 2) Measure factors that may limit the success of herring recruitment including factors of oceanographic conditions, food availability, disease, overwinter energetics of juvenile herring, and predation.
- 3) Provide protocols and recommendations for spatial and temporal coverage of monitoring projects for potential inclusion in the core herring restoration effort.

This proposal describes the community involvement and outreach efforts, the integration of programs, sharing of logistics, and the responsibility for developing the final synthesized report.

Estimated Budget:

EVOS Funding Requested *(must include 9% GA)*

FY10	FY11	FY12	FY13	Total
343,100	385,600	354,300	97,400	1,180,400

Non-EVOS Funds to be used:

FY10	FY11	FY12	FY13	Total

PROJECT PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

The Prince William Sound herring population has not had a strong recruitment class since the *Exxon Valdez* Oil Spill (EVOS). In the EVOS settlement herring were identified as an injured resource and they remain listed as an unrecovered species by the EVOS Trustee Council. Understanding why herring have not recovered in Prince William Sound and understanding potential bottlenecks in the herring life cycle that restoration efforts could be used to bridge requires identification of the conditions limiting herring recovery. This identification of the limiting conditions will be achieved through a series of focused process studies combined with monitoring of the natural conditions that most likely affect herring survival.

What is described here are a series of projects that make up a program aimed to develop appropriate monitoring activities to help understand those factors limiting recovery. These efforts are meant to build upon the Alaska Department of Fish and Game's (ADF&G) Prince William Sound herring surveys. The focuses of the ADF&G surveys are establishing spawning biomass, mile-days of spawn, and the age-sex-weight composition of the spawning stock. Their surveys are central to our understanding of when the stock is recovering. It is however limited to the spawning stock and therefore unable to elucidate the conditions that would lead to a recovery. The proposed program addresses the collection of data needed to identify the conditions that can lead to recovery, and potentially identify bottlenecks to the recovery of Pacific herring.

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

The proposed program addresses the goals and priorities outlined in the 1994 Restoration Plan and in the FY 2010 invitation for proposals. In particular it addresses the need to "Conduct research to find out why Pacific herring are not recovering" and "Monitor recovery", listed on page 48 of the 1994 Restoration Plan. It will identify areas of important habitat and lead to the development of new tools to improve herring management. The latter will be accomplished by providing the information needed to develop, or test, biological and physical models of herring growth and recruitment rather than relying on empirical models.

In November 2006, a Herring Steering Committee was formed and tasked with developing a focused Restoration Program that identifies strategies to address recovery and restoration of herring, recognizing that activities in the program must span an ecologically relevant time frame that accounts for herring population dynamics and life history attributes. A draft Integrated Herring Restoration Program (IHRP) was completed in the fall of 2008. The main goal of the program is to determine what, if anything, can be done to successfully recover the Pacific herring in PWS from the effects of EVOS. In order to determine what steps can be taken, the program examines the factors limiting recovery of herring in PWS, identifies and evaluates potential recovery options, and recommends a course of action for achieving restoration.

Based on the recommendations of the draft IHRP and in recognition that more work is necessary to develop a full implementation of the plan, the Trustee Council seeks projects that address several topics. One of these topics is Herring Surveys. Specifically, the Trustee Council seeks

proposals to conduct surveys of bays in PWS for a better understanding of habitat utilization by juvenile herring and to identify candidate sites that could potentially be used for supplementation efforts. This proposal is in response to the solicitation for Herring Surveys.

This proposal describes an integrated herring survey program, comprising of several individual components, designed to complement existing herring surveys and inform future restoration efforts.

II. PROJECT DESIGN

A. Objectives

This program is made up of several individual projects that will have separate objectives, however all the components are being integrated to provide a program that has the following overall objectives.

- 1) Identify juvenile rearing bays for use in restoration planning.
- 2) Measure factors that may limit the success of herring recruitment including factors of oceanographic conditions, food availability, disease, overwinter energetics of juvenile herring, and predation.
- 3) Provide protocols and recommendations for spatial and temporal coverage of monitoring projects for potential inclusion into the core herring restoration effort.

These objectives directly address the Herring Survey portion of the *Exxon Valdez* Oil Spill Trustee Council FY 2010 invitation for proposals.

Herring Surveys: The Council seeks proposals to conduct surveys of bays in PWS for a better understanding of habitat utilization by young herring and to identify candidate sites that could potentially be used for supplementation efforts. Of interest are young of the year herring, which are thought to school in shallow, nearshore waters, frequently at the head of bays. The Council seeks a collaborative project that may include the opportunity for community involvement in helping to locate bays where schools of juvenile herring may reside.

Surveys should collect information on oceanography, population count, disease prevalence by age class, food availability, energetic (pre/post winter) by age class, and predator abundance. Four bays (Zaikof, Whale, Eaglek, and Simpson) were extensively studied during the Sound Ecosystem Assessment study (SEA) and should be included as part of any proposed project. The highest-ranked proposals will come from teams of researchers who are specialists in each area of study and will provide a single, synthesized final report. This study is expected to last two primary years with sampling pre/post winter at a minimum. A start-up year with some field work can be proposed.

These surveys will assist in refining the “Core Data Collection” discussed in the draft IHRP. Information gathered in this initial year will help to determine a scale for core data collection that is cost effective and targets important data that is useful to the continuation of the program.

The first objective addresses the identification of sites for potential supplementation efforts. The second is to provide the requested survey information, with a focus on juveniles during the overwintering period. And the last is to provide the information needed to refine the “Core Data Collection” portion of the IHRP.

This proposal includes the community involvement, outreach, logistics, and synthesis components of the herring survey program; its specific objectives are to:

- 1) Integrate the individual projects so a single synthesized final report is developed and reduce logistical costs where possible.
- 2) Integrate community involvement into the planning and sampling programs.
- 3) Provide outreach of the lessons learned in this program to PWS residents including the effected fishing community.

B. Procedural and Scientific Methods

The objectives will be achieved through a program of integrated projects involving numerous organizations. Organizations involved in the program include: Prince William Sound Science Center, National Oceanic and Atmospheric Administration, United States Geologic Survey, Cordova District Fishermen United, Flying Fish Ltd., United States Fish and Wildlife Service, and the University of South Alabama. The following projects make up the PWS herring survey program.

- *PWS herring survey: Community Involvement, Outreach, Logistics, and Synthesis*
- *PWS herring survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys*
- *PWS herring survey: Assessment of Juvenile Herring Abundance and Habitat Utilization*
- *PWS herring survey: Plankton and Oceanic Observations in PWS*
- *PWS herring survey: Herring Disease Program*
- *PWS herring survey: Physical Oceanographic Characteristics of Nursery Habitats Influencing Growth, Over-Winter Energetics and Survival of Juvenile Pacific Herring*
- *PWS herring survey: Pacific Herring Energetic Recruitment Factors*
- *PWS herring survey: Growth and Energy Allocation in Overwintering Herring*
- *PWS herring survey: Seasonal and Interannual Trends in Seabird Predation on Juvenile Herring*
- *PWS herring survey: Top-down Regulation by Predatory Fish on Juvenile Herring*

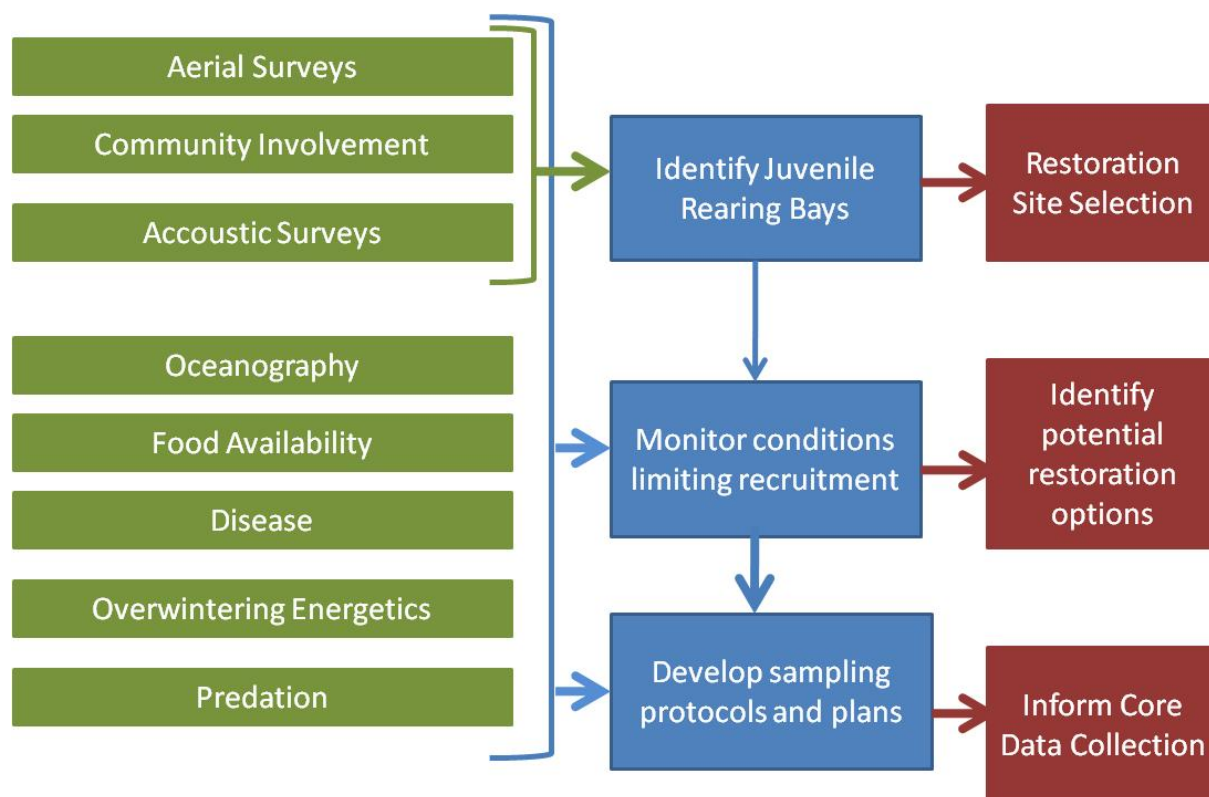


Figure 1. Linkages between elements, objectives, and needs specified in the invitation for proposals are shown. The linkages between projects are too numerous to show in this type of figure and will be developed in the text to follow.

The focus of this survey program is on juvenile herring. The primary sampling periods are planned to be pre- (November) and post-winter (March). Summer surveys are also included as appropriate. The intent is to complement the ADF&G adult herring surveys by monitoring conditions that may lead to successful recruitment, and to provide the information necessary to evaluate restoration options.

How all of the projects work together to address the programmatic objectives is described below. Also described is how the specific objectives of the *Community involvement, Outreach, Logistics, and Synthesis* project are to be achieved.

Approach to achieving program objectives

Three components will be combined to address the objective of identifying juvenile rearing bays. These components include aerial surveys in the summer to identify the locations of age 0 and age 1 herring when they are found in the shallow coastal waters. This work is fully described in the proposal titled, *PWS herring surveys: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys*, submitted by Evelyn Brown (Flying Fish Ltd.). The aerial surveys provide a mechanism to cover the largest geographic area. The survey also collects distribution and density of herring predators (seabirds and marine mammals) as well as competitors (sand lance and capelin). A survey will be conducted in June of each year to examine the amount and location of age 1 herring and their associated predators and competitors. Surveys in July and

August will record the spatial extent and density of age 0 joining age 1 herring in nursery habitat and age 1 herring as well as changes in predator and competitor densities associated with the nearshore recruitment. These surveys will be coordinated with the summer field components of the acoustic and food availability surveys to provide validation of the aerial observations. The results from the surveys will identify areas to be sampled in the following years as sampling is expanded beyond the SEA bays.

Acoustic surveys of juvenile fish will be conducted in the pre- and post-winter, and summer periods. More information on the acoustic surveys is provided in the proposal titled, *PWS herring survey: Assessment of Juvenile Herring Abundance and Habitat Utilization*, submitted by Richard Thorne (PWSSC). The pre- and post-winter surveys aim to quantify juvenile fish occupancy when the fish are known to be in the pelagic environment and help guide sampling for the other components. These surveys will build upon historic surveys during these time periods to provide a better picture of the variability to improve the sampling design. This information, along with predator and food supply characteristics of the various sites, will aid our understanding of which habitats are most suitable for age 0 survival. The acoustic information also provides information on other fish that will be used by the fish predation program to be described later. The summer surveys complement the aerial surveys by examining areas deeper than the depth that can be observed from the air. A short spring survey of the adult population is proposed to ensure we have a measure of the recruitment into the adult population

A community-based sampling program is proposed to complement the aerial and acoustic surveys. We propose to work with Cordova District Fishermen United to provide ten gill net boats for surveys in the post-winter period (March), which will greatly increase the number of bays in which fish may be sampled. Since there is no active fishery for us to work with, we are proposing to contract the boats through this project to conduct the necessary sampling. In March of each year a total of ten boats will be sent to different areas of the Sound, including the four SEA bays, to sample for juvenile herring. The boats will be distributed to increase the number of bays sampled in each of the zones that include the SEA bays, and add a fifth area around Naked and Knight Islands. Each boat is expected to sample two to four bays over a two day sampling period. March was chosen as the time frame in order to match up with other sampling efforts, collect fish before we expect the plankton bloom to occur, and have a large number of potential boats available.

The boats will be outfitted with variable mesh gill nets that have been used with success by Prince William Sound Science Center and National Oceanic and Atmospheric Administration (NOAA) investigators. The nets will be designed to deploy on or near the sea floor to target juvenile herring. These fish typically congregate near the bottom during the day. At night they school up and move towards the surface. By targeting the fish on the bottom we expect to have a better chance of determining if fish are using the bay than if we tried to target schools of fish. We will also reduce the risk of collecting too many fish, which can occur if a large school encounters the net. By comparing the results from the areas sampled by both the acoustics and variable mesh nets we will achieve an indication of the effectiveness of the community involvement approach.

For the energetics studies we propose to collect up to 150 juvenile herring from each bay that is sampled. The fish will be sampled and prepared in accordance to protocols developed by the energetics studies. The ability to collect samples from a broader number of bays than the acoustic survey covers will allow us to better define if there are potential differences in habitat quality that need to be understood.

The combination of aerial, acoustic, and community-based direct capture techniques provides measures of use by juvenile herring through a number of seasons and tests a number of techniques to determine which may be most appropriate for a core data collection effort in the future. When combined with the other studies to be described below they will allow us to identify the conditions that make for good juvenile rearing habitat.

The second objective is to measure factors that may limit herring success. These include oceanographic conditions, food availability, disease, overwinter energetic of juvenile herring, and predation. Seven projects are proposed to specifically address this objective with the three proposals described so far also contributing to addressing this objective.

The monitoring of oceanographic conditions is being proposed by Shelton Gay (PWSSC) in the proposal titled, *PWS herring survey: Physical Oceanographic Characteristics of Nursery Habitats Influencing Growth, Over-Winter Energetics and Survival of Juvenile Pacific Herring*. It is proposed to install simple moorings that include a near-surface and bottom temperature-salinity (TS) recorder and several inexpensive temperature loggers between the two TS recorders. This will provide a record of temperature through the year and as a function of depth that can be used in the energetics studies to be described later. The addition of salinity provides an indication of freshwater input, which is important for the surface circulation and larval drift.

At a minimum the four Sound Ecosystem Assessment (SEA) study bays will be instrumented. Additional bays may be instrumented after the first year if the initial analysis indicates that it is warranted and instruments that are currently being used by other projects become available. In addition to the moorings, conductivity-temperature-depth (CTD) casts will be conducted by the food availability and bird predation projects and analyzed to better understand the oceanographic conditions in Prince William Sound.

The availability of food is to be addressed by Rob Campbell (PWSSC) in his proposal titled, *PWS herring survey: Plankton and oceanic observations in PWS*. He describes work that builds on the oceanic observations proposed by Gay and combines them with measurements of plankton concentrations. Nearly monthly zooplankton and oceanographic condition surveys are proposed. The desire is to develop a time series of properties within the SEA bays as well as other areas that may be important in changing the structure of the zooplankton population. He will be identifying the primary zooplankton species present to determine the cycles of different zooplankton species and examine differences in their concentrations spatially. When combined with the stomach analysis being proposed by Heintz (described below), it can provide an indication of the food quality as well as availability. The regular cruises also provide potential to support other programs, such as validating aerial observations.

The disease component is addressed in the proposal titled, *PWS herring survey: Herring disease program* submitted by Paul Hershberger (USGS). The disease component addresses both the herring survey and disease monitoring sections of the invitation for proposals. During each collection period juvenile herring samples will be provided from each of the bays to determine the infection and disease prevalence and intensity. Samples of adult herring will be provided in coordination with sampling by ADF&G. New screening tools will be tested to determine the disease potential within the PWS herring population. These screening tools may then modify the recommended methods for a disease component to the core data collection of the IHRP. The disease information will be combined with the other factors being measured to determine if there are differences around the Sound in disease exposure, and to help refine the environmental conditions that need to be included in a disease forecasting tool. This program will share fish collected by other components and identify if disease is potentially preventing a large recruitment event.

This program emphasizes the understanding of the overwintering energetics of young-of-the-year herring, in part because the invitation for proposals emphasizes this life stage, but more importantly because this aspect includes models established in the SEA program that can be validated and because of links to potential restoration activities. The program includes two studies aimed at establishing the overwintering energetics. They are *PWS herring survey: Pacific Herring Energetic Recruitment Factors*, submitted by Thomas Kline (PWSSC), and *PWS herring survey: Growth and energy allocation in overwintering herring*, submitted by Ron Heintz (NOAA). While there are some similarities between the projects, they are designed to be complementary and to help inform decisions on future monitoring efforts. Having two techniques will allow the determination of which is more appropriate and cost effective if energetics are proposed for inclusion into the core program of the IHRP.

The project proposed by Dr. Kline will analyze herring for their whole body energy density, whole body energy content, water content, ash weight, and nitrogen and carbon content. From these measures it is possible to estimate the protein and lipid content of the fish. These also provide the measures needed to test the overwintering energetics model developed during the SEA project. Furthermore, stable isotope analysis will be done on the samples to establish likely sources of food, such as being able to distinguish if the diet is primarily organisms that have lived their entire life in PWS, or have been imported in from the Gulf of Alaska. This study provides information on the energetics and a time integrated view of possible changes in diet. This work has close linkages to the food availability and community involvement portions of this program as well as the other energetics study.

The project proposed by Dr. Heintz will analyze fish using other chemical techniques to derive the lipid and protein portions of the fish in order to establish the energy content. They will measure the RNA to DNA ratio to determine growth rates to see how growth affects survival. With the growth rate they will examine how it is related to survival, the allocation of energy into lipids, and oceanographic conditions. They will also be examining stomach fullness and content to help identify if feeding is prevalent and identify prey species during the sampling periods. This will then help identify important species in the food availability study. The growth rate and energetics will benefit from the oceanography and food availability studies.

The combined studies will help identify if certain areas of PWS are better habitat because of growth, the likelihood of food, and the potential source of food. They provide the data necessary to test the existing overwintering models, which could then be used as a component of a herring population model based on biological and physical processes. Such models are necessary to understand how herring populations may respond to changing environmental conditions. The studies will also establish if supplemental feeding in the fall or winter could have a significant impact on herring populations.

Herring are a highly desired prey item for many fish, birds, and mammals in Prince William Sound. Understanding the conditions that may limit the recovery of herring requires an understanding of the predation pressure. There are two projects that address predation. These are *PWS herring survey: Seasonal and interannual trends in seabird predation on juvenile herring* by Mary Anne Bishop (PWSSC) and Kathy Kuletz (US Fish and Wildlife Service) and *PWS herring survey: Top-down regulation by predatory fish on juvenile herring* by Mary Anne Bishop (PWSSC) and Sean Powers (University of South Alabama). The focus on juvenile herring builds upon previous research and connects to the Invitation for Proposals focus on young of the year. These projects will help inform the restoration options by determining the role of predation on reducing the herring population, and which predators must be accounted for in developing restoration activities.

Bird surveys will be conducted in conjunction with acoustic surveys. Information from the bird surveys will be used to examine the association of piscivorous birds with schools of juvenile fish. This will allow a characterization of habitats where seabird predation is significant. This will lead to the ability to model juvenile herring consumption by the most important seabirds. This study will also be useful in identifying specific locations, or habitats, that have juvenile herring but are not frequented by birds. By defining these 'herring refugia', the study will promote protection of juvenile herring habitat without impacting birds, including species that have not yet recovered such as Marbled Murrelet and Pigeon Guillemot, that depend on juvenile where they do co-occur.

Herring predation by fish will be examined in conjunction with the acoustic surveys. The sampling of fish associated with juvenile schools, and the stomach analysis of those fish will provide an indication of the predation pressure and if prey switching occurs in the presence of other macrozooplankton. It will identify key habitats and characteristics of fish schools where predation on juvenile herring is significant. It will also help identify major juvenile herring predators, which can then be used to design predator control efforts, and in the design of other restoration efforts where predation must be minimized. It will also provide information to help develop or test ecosystem modeling efforts.

The third objective of the program is to provide protocols and sampling plans that can be used to inform the development of the Core programs outlined in the IHRP. We recognize that the cost of this sampling program is too high to be sustainable through a herring restoration program and that there are other components to the core program that are not covered under this program. We will be looking at each of the components to determine if they are necessary for implementation of a herring restoration activity, or for the understanding of why herring are not recovering. For example, if it determined that juvenile herring mortality is not strongly related to their

overwintering energetic, we would suggest dropping that sampling in a core program. However, if the energetics are limiting then continued monitoring would be recommended if winter or fall feeding approaches are planned for herring restoration.

We will also examine if there are ways to reduce costs by sampling less frequently, at less locations, or using other sources of data. Sampling less frequently may be an outcome for aspects that do not have large interannual variability. An example is sampling for whale predation every three plus years because their population is changing at a relatively steady rate. If the same is true for the bird and fish predation it may be possible to survey for one type of predator each year allowing a time series to be developed, but reducing the cost in any individual year. If a spatial coherence is observed in a project, it may be possible to reduce costs by sampling at a single location rather than at four or more. Or, maybe temperature can be monitored at the surface only and not at multiple depths. Finally, there may be other sources of data that can be used. For example, there are several sources of temperature data (NOAA buoys and tide stations, hatcheries, and some oyster farms). If additional data sources are available, the projects will need to identify them and determine if they can be used to reduce costs for future monitoring efforts.

Approach to achieving project objectives

This project is designed to cover several aspects not covered by other projects in the program. This component of the program is responsible for ensuring integration of the individual projects into a cohesive program. W. Scott Pegau will be responsible for integration of the components and the delivery of a synthesized final report. Dr. Pegau is the Research Program Manager for the Oil Spill Recovery Institute, was the Research Coordinator for the Kachemak Bay National Estuarine Research Reserve, as well as a participant in more than ten large team programs. This experience will help him integrate the components. Since he has an oceanography background rather than a fisheries one, the PWSSC will be hiring a fisheries ecologist who will work to help provide the coordination as well as participate on the acoustic surveys with Dr. Thorne. No one individual can be expected to provide the synthesized report without the expertise of the individual investigators.

Program coordination will primarily be through e-mail and phone communications. Annual meetings are planned in Cordova, tentatively in May, for all investigators to share information between themselves and with the community. These in-person meetings are vital to ensure proper communication among programs. In the final reporting year, three meetings are planned to guide the analysis and synthesis of results.

This project also includes the cost for shared logistical costs, primarily shared vessel time. This allows the project manager to help provide integration within this program and with other herring projects through maximizing vessel use. Such sharing includes using the zooplankton cruises in the summer to also provide ground truth to the aerial observations. Larger vessels will be shared by multiple projects. The boat doing acoustic surveys will also support the bird predation observations. The boat doing fish predation will also be responsible for maintaining the oceanographic observations. When possible we will work with other groups to see if sharing logistical costs or samples are feasible.

This project includes the major portion of the community involvement and outreach components. The second objective of this project is to ensure community involvement. While the research vessels to be used in this program will be local vessels, we feel that it is important to provide greater opportunity for community involvement in this program. One mechanism for that is to work with local fisherman to provide samples for the various studies and to survey different areas of the sound for the presence of juvenile herring post-winter. The details on how that is to be accomplished were described earlier under the program objective to survey for juvenile herring rearing areas. Since there isn't a fishery that would put the boats on the water when we need samples, we are proposing to contract the fishing vessels of the Cordova District Fishermen United (CDFU) in this project.

Another aspect of community involvement is the exchange of information between fishermen, community residents, and researchers. This exchange of information is the focus of the third objective of this project and will be achieved through several mechanisms. The first are annual research meetings during a time when most of the fishing fleet is here. As part of that research meeting there will be a town hall style meeting aimed at the interested public. The desire is provide updates on what is being learned and to have a dialog with the community on issues that may have been overlooked. We will investigate the feasibility of transmitting these sessions to other PWS communities through the community college or other facilities with the appropriate equipment. The PWSSC currently does this with a weekly community lecture program.

To be able to reach a broader audience than may be available for a single annual meeting we propose several other outreach approaches. The first is translating the scientific reports generated by the project into single page project profile aimed at the general public and published as part of an annual State of the Sound report by the Prince William Sound Science Center (PWSSC). Another set of materials aimed at the fishing industry to be published by CDFU. The PWSSC education group regularly develops Field Notes radio programs that are aired by KCHU, the PWS public radio station. We propose to develop three such programs each year focusing on different aspects of the program. Furthermore we are proposing to support the PWSSC community lecture series. This lecture series is held weekly through the winter and is transmitted to Valdez through the Prince William Sound Community College. We expect that a minimum of three projects each year will provide lectures on their results through this series. PWSSC education staff will also develop a program based on the research findings to deliver as part of the Spirit Camp held by the Chugach Corporation at Nuchek each summer. Additionally, the materials will be used in the Forest to the Sea, and Oceanography summer camps. These camps involve youth from around Prince William Sound and the Anchorage area.

The PWSSC education group has a very successful program with the local schools called the Discovery Room. This program involves grade-school students in hands-on research. The Discovery Room program is developing monitoring programs in which to involve students. We are proposing to develop, implement, and modify as needed a program that monitors oceanographic conditions and then relates those conditions to herring growth as determined from the ADF&G survey information and herring scale analysis.

Scientific outreach will also occur through peer-reviewed publications by individual projects and participation in appropriate scientific meetings, such as the Alaska Marine Science Symposium.

C. Data Analysis and Statistical Methods

The data collection in this portion of the program is limited to the post-winter surveys in the community involvement section. Protocols for sampling and variables to be measured during that effort will be developed with contributions from the individual projects. We anticipate wanting to know the catch-per-unit-effort, length, weight, and some level of species information.

D. Description of Study Area

The study area includes all of Prince William Sound. However, many of the projects will focus on the four bays (Zaikof, Whale, Eaglek, and Simpson) that were extensively studied during the Sound Ecosystem Assessment study. This allows the work to build upon the historical research completed in those bays. These bays also cover four different quadrants of the Sound. There will be a build out to include other bays in years two and three of this program based on the results from year 1.

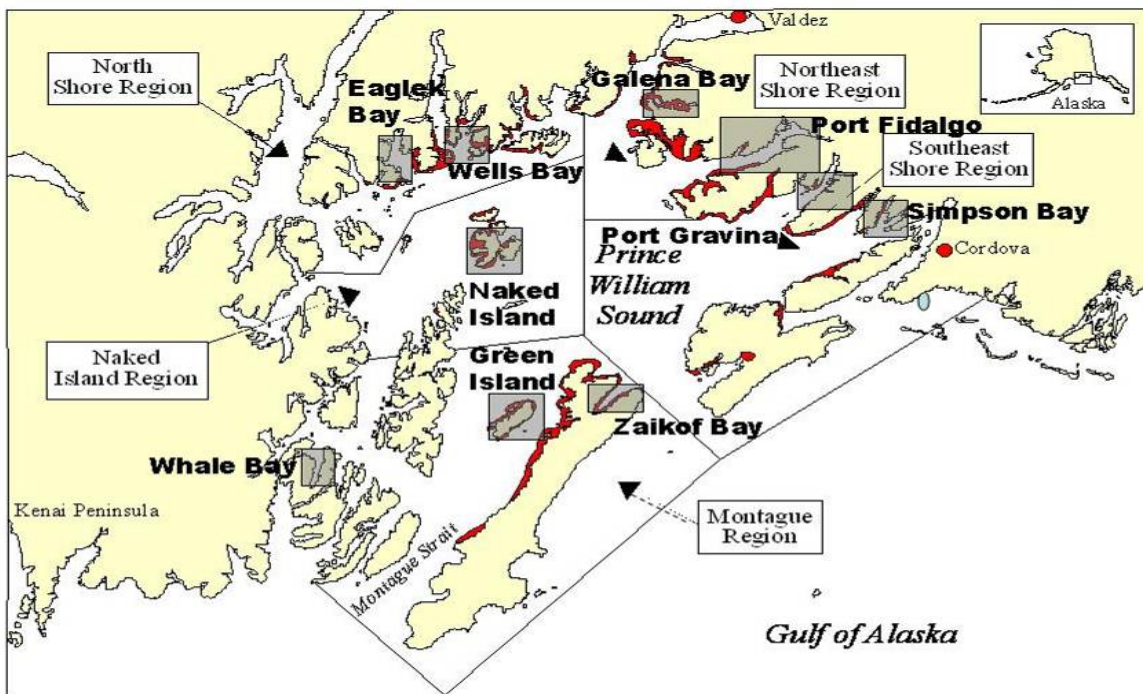


Figure 2. PWS study area, including the four SEA bays (Whale, Zaikof, Eaglek, and Simpson, as well as other bays historically important for juvenile herring).

E. Coordination and Collaboration with Other Efforts

This project is one of a set that makes up the herring survey program. The set of ten projects include:

- *PWS herring survey: Community involvement, Outreach, Logistics, and Synthesis*

- *PWS herring survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys*
- *PWS herring survey: Assessment of Juvenile Herring Abundance and Habitat Utilization*
- *PWS herring survey: Plankton and oceanic observations in PWS*
- *PWS herring survey: Herring disease program*
- *PWS herring survey: Physical Oceanographic Characteristics of Nursery Habitats Influencing Growth, Over-Winter Energetics and Survival of Juvenile Pacific Herring*
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- *PWS herring survey: Growth and energy allocation in overwintering herring*
- *PWS herring survey: Seasonal and Interannual Trends in Seabird Predation on Juvenile Herring*
- *PWS herring survey: Top-down Regulation by Predatory Fish on Juvenile Herring*

Coordination between these projects is provided in more detail in this proposal.

We are very interested in coordinating the efforts described here with other herring related projects, in particular, any projects that may help meet the objectives of this proposal. A proposal to close out the existing marine mammal project (090804) from Dr. Heintz will address our objective of providing sampling protocols and a suggested sampling program that can inform the development of the Core component of the IHRP. His proposal to study the winter consumption of juvenile herring by marine mammals is closely aligned with the objectives of this program in understanding the predation by various components.

The information collected in this program will also be used to inform feasibility studies whenever possible. For example, the food availability and energetics work will help determine if winter feeding is likely to have much affect on the success of juvenile herring.

The data collected by the various surveys is needed as inputs to test a herring life model and submodels within in the existing herring model component (ex. Project Number: 070810 Project Title: An Ecosystem Model of Prince William Sound Herring: A Management & Restoration Tool). It is through testing of components of a biologically and physically driven herring model that we can begin to understand how changing conditions may enable herring to be restored and identify restoration activities that may be successful. The data collected in this program will inform future modeling efforts and be used to test existing models.

We anticipate a proposal to look at larval dispersion will be submitted by Dr. Kline. That work can be combined with the oceanographic and food availability to help understand factors that control the very earliest life stages. A proposal by Dr. Heintz examines the movement of juvenile fish between nearshore and pelagic environments. That work would benefit from the aerial and summer acoustic surveys and can also provide verification of those observations. That program may be able to provide samples for disease or energetics studies during a period in which we anticipate limited sampling. We will look to see if shared logistics are feasible with other projects, such as the tagging project being proposed by Dr. Seitz.

Our desire is to have this program complement the existing ADF&G surveys that are focused on adult biomass and spawning characteristics. This program focuses on juvenile herring, which are

not a major focus of ADF&G. By focusing on juveniles we hope to provide information that can be used to predict future recruitment into the spawning biomass. The disease component will also provide information needed to better understand adult mortality due to disease.

III. SCHEDULE

A. Project Milestones

Integration of the individual projects has already begun and will continue throughout the program. The integration of community involvement will be complete by March 2010. Modifications to that component may continue through the program. The outreach component will be developed by September 2010, but some materials will be modified each year.

B. Measurable Project Tasks

FY10 1st Quarter (October 1, 09 to December 31, 09)

November	Arrange logistics for the pre-winter juvenile herring survey of 5 bays including 4 SEA bays
December	Develop Field Notes radio program based on fall surveys Begin development of Discovery Room oceanography and herring program

FY10 2nd Quarter (January 1, 10 to March 31, 10)

January	Annual Marine Science Symposium
February	Provide training for the Community Involvement sampling
March	Arrange logistics for the post-winter juvenile herring survey Community Involvement sampling of juvenile herring

FY10 3rd Quarter (April 1, 10 to June 30, 10)

May	Principal Investigator update and outreach meeting Delivery of community lectures and Field Notes complete for FY10 Written outreach materials completed
July	Deliver Spirit Camp program

FY10 4th Quarter (July 1, 10 to September 30, 10)

July/August	Arrange logistics for the exploratory summer juvenile herring survey
August	Submit Annual Report

FY11 1st Quarter (October 1, 10 to December 31, 10)

October	Begin implementing oceanography and herring Discovery Room
November	Arrange logistics for the pre-winter juvenile herring survey

FY11 2nd Quarter (January 1, 11 to March 31, 11)

January	Annual Marine Science Symposium
February	Provide training for the Community Involvement sampling
March	Arrange logistics for the post-winter juvenile herring survey Community Involvement sampling of juvenile herring

FY11 3rd Quarter (April 1, 11 to June 30, 11)

May Principal Investigator update and outreach meeting
 Delivery of community lectures and Field Notes complete
 Written outreach materials completed

July Deliver Spirit Camp program

FY11 4th Quarter (July 1, 11 to September 30, 11)

July/August Arrange logistics for the exploratory summer juvenile herring survey

August Submit Annual Report

FY12 1st Quarter (October 1, 11 to December 31, 11)

October Implementing oceanography and herring Discovery Room

November Arrange logistics for the pre-winter juvenile herring survey

FY012 2nd Quarter (January 1, 12 to March 31, 12)

January Annual Marine Science Symposium

February Provide training for the Community Involvement sampling

March Arrange logistics for the post-winter juvenile herring survey
 Community Involvement sampling of juvenile herring

FY12 3rd Quarter (April 1, 12 to June 30, 12)

May Principal Investigator update and outreach meeting
 Delivery of community lectures and Field Notes complete
 Written outreach materials completed

July Deliver Spirit Camp program

FY12 4th Quarter (July 1, 12 to September 30, 12)

August Submit Project Annual Report.

FY13 1st Quarter (October 1, 11 to December 31, 11)

October First synthesis meeting of PIs

FY013 2nd Quarter (January 1, 12 to March 31, 12)

January Alaska Marine Science Symposium
 2nd PI integration meeting

FY13 3rd Quarter (April 1, 12 to June 30, 12)

March 3rd PI integration meeting

April Submit Draft Final Report

June Respond to peer review comments

FY13 4th Quarter (July 1 to September 30, 12)

July Secure final approval, acceptance of final report

September Publication of final report complete, delivered to ARLIS

BIOGRAPHICAL SKETCH

W. Scott Pegau

Oil Spill Recovery Institute
Box 705
Cordova, AK 99574
ph: 907-424-5800 x222
email: scott.pegau@gmail.com

Education:

1990 B.S., Physics, University of Alaska, Fairbanks
1996 Ph.D, Oceanography, Oregon State University

Professional Experience:

1987-1990 Research Assistant, University of Alaska, Fairbanks
1990-1996 Graduate Research Assistant, Oregon State University
1996-1997 Research Associate (Post Doc), Oregon State University
1997-1999 Faculty Research Associate, Oregon State University
1999-present Assistant Professor, Oregon State University
2002-2003 Senior Scientist, Kachemak Bay Research Reserve
2003-2007 Research Coordinator, Kachemak Bay Research Reserve
2007-present Research Program Manager, Oil Spill Recovery Institute

Research Interests:

Circulation in Prince William Sound, Cook Inlet and the Gulf of Alaska and the associated larval transport. Relationship between oceanographic conditions and fisheries. Application of remote sensing for understanding coastal processes. The development of algorithms for the inversion of reflectance to determine the inherent optical properties, their vertical structure, and application to determine taxonomic groups. Development of novel measurement applications.

I am currently involved in the ONR Radiance in a Dynamic Ocean (RaDyO) project collecting optical instruments on an AUV. I am also am working to improve technologies for responding to oil spills in arctic and subarctic waters.

Relevant Experience:

My role in the proposed work is as a program manager to assist in ensuring collaboration within the program elements. Of particular relevance to this task is my position as the Research Program Manager with OSRI, where I help design research programs, review projects, and track progress of the projects. My experience as the Research Coordinator of KBRR also provided me the opportunity to oversee a diverse team with a broad range of research interests and help develop the connections with the ADF&G and NOAA missions that applied to the Research Reserve. I participated in thirteen programs that had five or more investigators. Have been chief scientist on a cruise with multiple groups, and am helping to arrange logistics for the upcoming PWS Observing System Demonstration project.

Publications

Some recent publications

- Montes-Hugo, M. A., K. Carder, R. J. Foy, J. Cannizzaro, E. Brown, and S. Pegau, Estimating phytoplankton biomass in coastal waters of Alaska using airborne remote sensing, *Remote Sens. Environ.* **98**, 481-493, 2005.
- Wijesekera, H. W., W. S. Pegau, and T. J. Boyd, The effect of surface waves on the irradiance distribution in the upper ocean, *Optics Express*, **23**, 9267-9264, 2005.
- Pegau, W. Scott, Inherent optical properties of the central Arctic surface waters, *J. Geophys Res.*, **107**, doi. 10.1029/2000JC000382, 2002.
- Bartlett, J. S., M. R. Abbott, R. M. Letelier, and W. S. Pegau, Analysis of a method to estimate chlorophyll-a concentration from irradiance measurements at varying depths, *J. Atmos. Ocean. Tech.*, **18**, 2063-2073, 2001.
- Whitmire, A.L., E. Boss, T.J. Cowles, and W.S. Pegau, Spectral variability of the particulate backscattering ratio, *Optics Express*, **15**, 7019-7031, 2007.

Collaborators

S. Baird (ADFG), A. H. Barnard (Wetlabs), T. Boyd (SAMS), G. C. Chang (UCSB), J. Christensen (Bigelow), E. Cokelet (PMEL), T. D. Dickey (UCSB), M. Johnson (UAF), M. Lewis (Satlantic), M. Moline (Cal Poly), C. Mordy (PMEL), C. Ohlmann (UCSB), S. Okkonen (UAF), T. Otis (ADFG), C. A. Paulson (OSU), S. Saupe (CIRCAC), G. C. Schoch (AOOS), D. Stramski (Scripps), M. Twardowski (WETLabs), H. Wijesekera (NRL), T. Whitledge (UAF), C. Walker (ADFG), M. Willette (ADFG)

BUDGET JUSTIFICATION

Personnel:

One month of salary is requested in the first three years for W. Scott Pegau to be the overall coordinator for the project. Up to an additional month of funding will be available for him through OSRI for coordination work. He will be responsible for ensuring regular meetings occur among the investigators and be the interface to the community involvement and outreach components. In the report writing year two months of salary are requested for Pegau, with up to two months available from OSRI if needed. Funds are requested for a fisheries ecologist that will be hired and shared with the acoustic survey project. That person will be responsible for providing sampling protocols and training of the community involvement portion. They will be responsible for providing any necessary data from the community involvement portion, and the lead for logistics. Finally, they will be the lead on developing synthesized reports on an annual basis. Funding is requested for four Prince William Sound Science Center Educators to develop and deliver the outreach programming described in the proposal.

Travel:

Funds are requested for two people to attend the Alaska Marine Science Symposium each year. Funds are also requested for the educators to travel to the Spirit Camp each of the first three years.

Contractual:

A contract will be established each of the first three years with Cordova District Fishermen United to provide ten boats for three days of sampling in March. They will organize locating the fishermen and ensuring they attend training to sample for this program. They will arrange to obtain and repair the nets. They will also develop and distribute outreach materials on the program to the fishing industry. Only the first \$25K of this contract is subject to PWSSC indirect costs.

Funds are requested to contract two moderate size vessels for sampling. These are expected to be about 55 feet in length and take four to six passengers. Based on the sampling needs of the various projects this seems to be the best arrangement of vessels to meet everyone's needs. Since these are anticipated to be several small contracts they are subject to the full indirect rate.

Additional funds are requested for network charges and communications expenses. Funding is requested for printing of outreach materials. Funds are requested each year for mailing and shipping expenses.

Commodities:

Funds are requested each year for office and outreach supplies including paper, software updates, etc. Funds are requested in the first year for a digital microscope to allow some of the ADF&G herring scale cards to be photographed for use in the education program examining linkages between ocean conditions and herring growth. In the second year funds are requested to purchase monitoring equipment, such as a hand-held temperature salinity meter, and temperature loggers for use in the education programs.

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 10- FY 12**

Budget Category:	Proposed FY 10	Proposed FY 11	Proposed FY 12	Proposed FY 13	TOTAL PROPOSED
Personnel	\$63.4	\$65.4	\$67.5	\$66.2	\$262.5
Travel	\$3.0	\$3.0	\$3.0	\$2.2	\$11.2
Contractual	\$187.9	\$219.8	\$197.3	\$0.9	\$605.9
Commodities	\$6.5	\$3.5	\$2.0	\$0.5	\$12.5
Equipment	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Indirect (<i>will vary by proposer</i>)	\$54.0	\$62.1	\$55.2	\$19.5	\$190.8
SUBTOTAL	\$314.8	\$353.8	\$325.0	\$89.3	\$1,082.9
General Administration (9% of subtotal)	\$28.3	\$31.8	\$29.3	\$8.0	\$97.4
PROJECT TOTAL	\$343.1	\$385.6	\$354.3	\$97.4	\$1,180.4
Other Resources (Cost Share Funds)	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0

COMMENTS: In this box, identify non-EVOS funds or in-kind contributions used as cost-share for the work in this proposal. List the amount of funds, the source of funds, and the purpose for which the funds will be used. Do not include funds that are not directly and specifically related to the work being proposed in this proposal.

FY10 - 13

**Project Title: PWS Herring Survey: Community Involvement, Outreach, Logistics, and Synthesis
Lead PI: Pegau (PWSSC)**

**FORM 4A
NON-TRUSTEE
AGENCY SUMMARY**

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 10- FY 12**

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
New Equipment Total			\$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY10

**Project Title: PWS Herring Survey: Community
Involvement, Outreach, Logistics, and Synthesis
Lead PI: Pegau (PWSSC)**

**FORM 4B
EQUIPMENT
DETAIL**

