

**FY12 INVITATION
PROPOSAL SUMMARY PAGE**

Project Title: PWS Herring Research and Monitoring: Expanded Adult Herring Surveys

Project Period: October 1, 2011 – September 30, 2016

Primary Investigator(s): Michele Buckhorn, PhD; Richard Thorne, PhD; Prince William Sound Science Center, Cordova, AK

Study Location: Prince William Sound, AK

Abstract: Prince William Sound herring stock biomass estimates from hydroacoustic surveys provide a direct measure of the stock abundance and are also a primary input into the age-structured assessment (ASA) model that is the forecasting tool used for management. Prior to 2001, the hydroacoustic surveys were conducted exclusively by the Prince William Sound Science Center (PWSSC). Since 2001, the effort has been shared between PWSSC and the Cordova office of Alaska Department of Fish and Game (ADF&G). While the ADF&G considers the hydroacoustic surveys to be critical (Steve Moffitt, personal communication) the lack of a commercial herring fishery in PWS since 1998 has reduced management priorities for herring. Thus the PWSSC contribution has become critically important for the long-term, especially if a future fishery appears only a remote possibility. With the level of effort available over the past several years, PWSSC and ADF&G individually have achieved herring biomass estimates with a precision of about $\pm 30\%$, which is insufficient for management purposes. However, the combined effort currently meets management requirements for precision. Current stock assessment efforts by ADF&G resource managers in PWS focus on the largest spawning aggregations. The objective of this study is to increase the current survey area of adult spawning beyond the Port Gravina and Fidalgo areas to provide a more precise estimate of spawning biomass. We propose to extend the PWSSC acoustic surveys to help identify the relative contributions of additional spawning aggregations over temporal and spatial scales. This will help establish more accurate estimates of the total herring biomass in PWS and provide an alert to changes in biomass in different regions. Beginning in FY2013 and continuing until 2016, hydroacoustic surveys will be conducted in late spring (April-May) to assess adult spawning biomass. ADF&G will continue to conduct direct sampling for age/length/weight. Additional direct capture will be conducted using a midwater trawl at adult spawning sites (See Bishop proposal).

Estimated Budget:

EVOSTC Funding Requested: \$335.9

(breakdown by fiscal year and must include 9% GA)

FY 12	FY 13	FY 14	FY 15	FY 16
\$6,500	\$84,400	\$68,100	\$90,600	\$84,400

Non-EVOSTC Funds to be used:

(breakdown by fiscal year)

Date: 5/19/2011

(NOT TO EXCEED ONE PAGE)

PROJECT PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

Robust Pacific herring (*Clupea pallasii*) populations, suitable for exploitation by commercial fisheries, are typically sustained by periodic recruitment of strong year classes into the adult spawning population. However, the Prince William Sound (PWS) herring population has not had a strong recruitment class since 1989, when the *Exxon Valdez* Oil Spill (EVOS) occurred. In the EVOS settlement herring were identified as an injured resource and they remain listed as an unrecovered species by the EVOS Trustee Council (EVOSTC). Understanding why herring have not recovered in Prince William Sound requires understanding potential bottlenecks in the herring life cycle. The identification of the limiting conditions to herring recovery requires a series of focused process studies combined with monitoring of the natural conditions that affect herring survival.

Described here are projects for a program that will enhance the current monitoring efforts of the Alaska Department of Fish and Game (ADF&G), and examine aspects of particular life stages to allow better modeling of herring populations. **The long-term goal of the program is to improve predictive models of herring stocks through observations and research.** While we do not anticipate that there will be a major change in our modeling ability in the next five years, we expect that the combination of monitoring and focused process studies will provide incremental changes over the next twenty years and result in a much better understanding of herring populations by the end of the program.

The current management of the Prince William Sound (PWS) herring stock by the Alaska Department of Fish and Game (ADF&G) depends heavily on hydroacoustic surveys. Biomass estimates from these surveys provide a direct measure of the stock abundance and are also a primary input into the age-structured assessment (ASA) model that is the primary forecasting tool. The hydroacoustic surveys were initiated in 1993 when fishers were unable to locate concentrations of herring despite a forecast for high abundance. The high forecast was based on an ASA model that relied on age-structure information alone. The hydroacoustic survey revealed that the population had collapsed. March 2011 will mark the 19th consecutive annual survey using hydroacoustic surveys. Over this time period the hydroacoustic survey has shown to be an early and accurate measure of the herring stock abundance and compares well with the recent ASA model estimates that now incorporate hydroacoustic survey information as well as an index of male spawning abundance.

Prior to 2001, the hydroacoustic surveys were conducted exclusively by the Prince William Sound Science Center (PWSSC). Since 2001, the effort has been shared between PWSSC and the Cordova office of Alaska Department of Fish and Game. Over the past 3 years, the PWSSC effort has been supported by EVOS TC. The cooperative effort has been critical since both PWSSC and ADF&G have limited resources for this effort. While ADF&G considers the hydroacoustic surveys to be critical (Steve Moffitt, personal communication) the lack of a commercial herring fishery in PWS since 1998 has reduced management priorities for herring during a time of overall limited funding for the state agency. Thus the PWSSC contribution has become critically important for the long-term, especially if a future fishery appears only a remote possibility.

With the level of effort available over the past several years, PWSSC has achieved herring biomass estimates with a precision of about $\pm 30\%$. This level of precision is insufficient

for management purposes. The level of effort available to ADF&G is similarly insufficient. However, the combined effort currently meets management requirements for precision. There is concern that some concentrations of fish are not located and surveyed under current levels, in which case the estimate is biased, a factor not incorporated into variance calculations for precision.

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

The proposed program addresses the goals and priorities outlined in the 1994 Restoration Plan (<http://www.evostc.state.ak.us/Universal/Documents/Publications/IHRP%20DRAFT%20-%20July%202010.pdf>) and in the FY 2012 invitation for proposals. In particular our program 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 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.

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 and was further refined in July of 2010. The main goal of the program is to determine what, if anything, can be done to successfully recover the Pacific herring in PWS. 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 IHRP the Trustee Council has stated in the FY12 request for proposals that they have chosen Restoration Option #2, Enhanced Monitoring, as the focus for their research interests. The program described below aims to meet the goals of this option by utilizing a combination of monitoring efforts to provide more information about the existing stock and process studies to elucidate aspects of the herring life cycle necessary to move us towards an analytical modeling approach.

II. PROJECT DESIGN

A. Objectives

Program objectives:

We have sought input for the design of the first five year proposal from scientists with ADF&G, NOAA, the current PWS herring survey program, and other institutions. Based on that input we have arrived at the following objectives for the first five-year period.

- 1) *Provide information to improve input to the age-structure-analysis (ASA) model, or test assumptions within the ASA model.* The ASA model is currently used by ADF&G for estimating herring biomass (Hulson et al. 2008). The proposed monitoring efforts are designed to address this objective by either expanding the data available for the existing ASA model or by providing information about factors that determine the size of recruitment events.

- 2) *Inform the required synthesis effort.* Proper completion of a detailed synthesis means being able to access and manipulate different sources of data and information. We are proposing projects that make data available to all researchers.
- 3) *Address assumptions in the current measurements.* Many of the existing studies are based on historical or logistical constraints. We are proposing research necessary to put the existing measurements into context spatially and temporally. This effort will allow the design of the most accurate and efficient monitoring program.
- 4) *Develop new approaches to monitoring.* With technological advances we have the potential to improve our monitoring programs so they require less effort or reduce the need to collect fish.

Because we are at the beginning of a twenty-year effort, we want to maximize the value of any data collected. The objectives listed above are designed to ensure that research and monitoring efforts within the expected twenty-year program are most effective. The programs addressing the objectives provide the information necessary to evaluate existing efforts while continuing to move towards our long-term goal.

Project Objective #1:

This project will address Program Objective #1 - *Provide information to improve input to the age-structure-analysis (ASA) model, or test assumptions within the ASA model.* The objective of this study is to increase the current survey area of adult spawning beyond the Port Gravina and Fidalgo areas to provide a more precise estimate of spawning biomass.

B. Procedural and Scientific Methods

Current stock assessment efforts by ADF&G resource managers in PWS focus on the largest spawning aggregations. Additional spawning aggregations exist, but are not regularly surveyed by ADF&G because of funding and personnel limitations; therefore, their relative contributions to the biomass of the PWS metapopulation remain poorly understood. The Prince William Sound Science Center (PWSSC) has also conducted acoustic biomass surveys for the past two decades. We propose to extend the PWSSC acoustic surveys to help identify the relative contributions of these additional spawning aggregations over temporal and spatial scales. This will help establish more accurate estimates of the total herring biomass in PWS and provide an alert to changes in biomass in different regions. The PWSSC survey will overlap with the ADF&G survey to provide a comparative measure between the two studies and to improve the precision of the estimate.

In this proposal for expanded adult herring surveys, we propose an effort level that will meet management needs for precision when combined with the ADF&G effort, and will also reduce current levels of uncertainty with regard to adequate geographic coverage. Beginning in FY2013 and continuing until 2016, hydroacoustic surveys will be conducted in late spring (April-May) to assess adult spawning biomass. Based on an exhaustive review of historic survey coverage, we have determined the effort required to be eight days of vessel survey for PWSSC in addition to that available to ADF&G. ADF&G will continue to conduct direct sampling for age/length/weight, primarily with a 17 FA purse seine, including concentrations located by the PWSSC effort. PWSSC effort will emphasize search for and surveys of concentrations outside

the Port Gravina/Port Fidalgo area where the herring have been concentrated during the past several years. Direct capture will be conducted using a midwater trawl at adult spawning sites (See Bishop proposal). As has been the case previously, the search effort will utilize all information available including historical records of sighting of both adults and spawn, reports of marine mammal/bird concentrations and some aerial survey effort as well as high speed vessel surveys.

C. Data Analysis and Statistical Methods

There are well-developed protocols for hydroacoustic data analysis. Basic analysis is done using echo integration techniques (Thorne 1983a,b; McLennon and Simmonds 1992). We will be using to ECHOVIEW post processing software for the echo integration and analysis. Specific analysis of schools or layers requires a bounding process to limit analysis to a specific school or layer (Fig 8). Target strength characteristics of herring as well as several other common fishes are well documented (Thorne 1983b; Traynor 1998; Thomas et al. 2002). The acoustic analysis determines the biomass density of the fish. The biomass estimates use scaling factors that are size and species specific, but are relatively insensitive to these variables (Thorne 1983b). These densities are extrapolated to the appropriate area based on the GPS information that is automatically written to the acoustic data files. Conversion of biomass to numerical values is more sensitive to species/size information. For adults and age 0 herring this information is typically available. Some assumptions are required for other species and these assumptions are dependent on the direct capture information.

D. Description of Study Area

This project will take place in the northeastern region of Prince William Sound (60.841056, -146.128239, 60.864482, -147.345965, 60.622618, -147.382919, 60.609086, -146.018257).

E. Coordination and Collaboration with Other Efforts

This proposal is part of the integrated “PWS Herring Research and Monitoring” proposal submitted by the Prince William Sound Science Center to the Exxon Valdez Oil Spill Trustee Council. It includes the collaboration and coordination described there for work within the herring research group and with the Long-Term Monitoring proposal submitted by the Alaska Ocean Observing System.

III. SCHEDULE

A. Project Milestones

Project Objective #1: to increase the current survey area of adult spawning beyond the Port Gravina and Fidalgo areas to provide a more precise estimate of spawning biomass.

Surveys to be met by May of each year 2013-2016

Analysis of each year's survey to be met by October of each year 2013-2016

B. Measurable Project Tasks

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

October Begin funding

FY12 2nd Quarter

January Annual Marine Science Symposium

March	Complete ordering equipment
FY12 3 rd Quarter	
May	Annual PI meeting
FY12 4 th Quarter	
August	Submit annual report
FY13 1 st Quarter (October 1, 12 to December 31, 12)	
FY13 2 nd Quarter	
January	Annual Marine Science Symposium
FY13 3 rd Quarter	
May	Conduct annual PI meeting
June	Submit FY14 work plan for review
FY13 4 th Quarter	
August	Submit annual report
September	Complete fatty acid analysis, complete scale analysis
FY14 1 st Quarter (October 1, 13 to December 31, 13)	
FY14 2 nd Quarter	
January	Annual Marine Science Symposium
Winter programs	EVOS sponsored workshop with Herring and Long-term monitoring
FY14 3 rd Quarter	
April	Conduct extended adult biomass cruise, collect samples for genetics
May	Conduct annual PI meeting
June	Submit FY15 work plan for review
FY14 4 th Quarter	
August	Submit annual report
FY15 1 st Quarter (October 1, 14 to December 31, 14)	
October	Complete adult survey analysis
FY15 2 nd Quarter	
January	Annual Marine Science Symposium
FY15 3 rd Quarter	
April	Conduct extended adult biomass cruise
May	Conduct annual PI meeting

FY15 4th Quarter

August Submit annual report

FY16 1st Quarter (October 1, 15 to December 31, 15)

October Complete adult survey analysis

FY16 2nd Quarter

January Annual Marine Science Symposium

FY16 3rd Quarter

April Conduct extended adult biomass cruise

May Conduct annual PI meeting

June Submit work plan for FY17

FY16 4th Quarter

August Submit annual report

PWS Herring Research and Monitoring: Expanded Adult Surveys
PRINCE WILLIAM SOUND SCIENCE CENTER

Personnel

All salaries for this project begin in FY13. Three months' salary is requested in each year (FY13-FY16) for Dr. Buckhorn to act as lead Principle Investigator. Dr. Buckhorn will oversee the project and coordinate with the other projects in this program. She will have primary responsibility for project design, field work, data collection, analysis and completion of final products. She will supervise the acoustics technician.

Three months' salary is requested in each year (FY13-16) for James Thorne, the acoustics technician. He will assist with data collection and is responsible for maintenance of acoustic equipment.

One-third month salary is requested in each year (FY13-16) for Dr. Thorne. He will provide technical consulting and support.

Travel

In each year travel is requested for Dr. Buckhorn for the attendance of two scientific conferences; AMSS and one of the following appropriate associations: American Fisheries Society, American Society of Ichthyologists and Herpetologists, Western Society of Naturalists.

Contractual

Each year funds are requested for Information Technology, which includes \$100/person month for network connections and costs associated with software license renewals or purchases. Funds are requested each year for printing/ mailing/ copying. The request is based on historic and anticipated usage. Funds are also requested each year for communications, which includes \$50/person month for phone, plus additional funds for long distance and fax costs.

Commodities

In each year funds are requested for office supplies (paper, pens, printers, etc.) that are typically consumed in association with the project. Additional funds are requested for miscellaneous cruise supplies (lines, nets, totes, etc.).

Equipment

Funds are requested in year one towards the purchase of a net sounder and catch monitor to monitor net depth and catch in the trawl that will be used for validation. This equipment will allow us to know where the net is sampling in relation to the acoustic data and to ensure we stay well within ADF&G permit limits. This cost is split with Bishop.

INDIRECT COSTS

The PWSSC indirect rate is estimated at 30% based on our currently negotiated rate.