FY12 INVITATION
PROPOSAL SUMMARY PAGE

Project Title: PWS Herring Research and Monitoring: Intensive surveys of juvenile herring

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

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

Study Location: Prince William Sound, AK

Abstract: Hydroacoustic surveys of juvenile herring nursery areas in Prince William Sound have been conducted during fall and late-winter for the last several years. The number of locations surveyed have varied from 5-9, including the 4 Sound Ecosystem Assessment (SEA) bays. However, each seasonal effort has conducted only a single night survey in each of these locations. Thorne (2010) examined seasonal changes from fall 2006 to spring 2009. He showed that apparent overwinter mortality of age 0 herring appeared to be greatest in Simpson Bay and least in Whale Bay. However, the differences in seasonal abundance could be attributed to mortality, emigration, or changes in ambient light. We propose to address these uncertainties with an intensive fall and late winter/spring intensive survey. The fall series will start mid-October 2014 and extend to the first week of December. The late winter/spring series will begin the 3rd week of February 2015, and extend into the 2nd week of April. We propose to conduct the surveys in two bays sufficiently adjacent to cover each bay each night, such as Simpson Bay, Port Gravina, Windy Bay or St. Mathews Bay. In addition to the hydroacoustic surveys, we propose a single night of direct capture effort in each location for each of the survey weeks (See Bishop, this proposal). The survey design will follow the historic zig zag transects run by Thorne since 1993 in order to remain consistent with that sampling design and to put the long term fall and spring surveys into context.

Estimated Budget:
EVOSTC Funding Requested:

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

FY 12	FY 13	FY 14	FY 15	FY 16
$50,100	$0	$76,300	$6,800	$0

Non-EVOSTC Funds to be used:
(breakdown by fiscal year)

Date: May 24, 2010

(NOT TO EXCEED ONE PAGE)

PROJECT PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

Hydroacoustic surveys of juvenile herring nursery areas in Prince William Sound have been conducted during fall and late-winter for the last several years. The objectives of this effort have been to improve understanding of habitat utilization by juvenile herring, especially age 0, and to help identify candidate sites that could be potentially used for supplementation efforts. The surveys have also been a focus for other studies on juvenile herring energetics, disease and predation. The number of locations surveyed have varied from 5-9, including the 4 Sound Ecosystem Assessment (SEA) bays. However, each seasonal effort has conducted only a single night survey in each of these locations. Thorne (2010) examined seasonal changes from fall 2006 to spring 2009. He showed that apparent overwinter mortality of age 0 herring appeared to be greatest in Simpson Bay and least in Whale Bay. However, he also pointed out that the differences over winter could also be the result of emigration. Not only might age 0 herring move among bays during the winter, but movement into and out of bays may be progressive during a season. It is possible the overwintering component of age 0 may not be fully recruited into a bay at the time a single fall survey, or may have began spring movement out of bays prior to any given late-winter survey. Another potential source of variability could be the stage of the moon. Ambient light is known to affect fish distributions. On many occasions, age 0 concentrations were readily identified by their distinct distribution: a diffuse layer near surface, near shore and near the heads of bay. On other occasions, this distinctive distribution was absent even though age 0 herring were present. The change might have been the result of different ambient light regimes.

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 Objectives. This project addresses Program Objective #3: *Address assumptions in the current measurements.* It will put current single season measurements of juvenile herring into a temporal context to address estimates of mortality and immigration/emigration.
The objectives of this study are:

1. to improve the accuracy of both annual and seasonal comparisons from single-night surveys by intensively sampling throughout a fall and spring season

2. estimate the level of immigration and emigration of age 0 herring between bays

B. Procedural and Scientific Methods

We propose to address these uncertainties with an intensive fall and late winter/spring intensive survey. The fall series will start mid-October 2014 and extend to the first week of December. The late winter/spring series will begin the 3rd week of February 2015, and extend into the 2nd week of April. We propose to conduct the surveys in two bays sufficiently adjacent to cover each bay each night, such as Simpson Bay, Port Gravina, Windy Bay or St. Mathews Bay. We will conduct four surveys per season spaced at 2 week intervals. Each of the two bays will be surveys in three consecutive nights. Such a design will address daily, weekly and monthly variability, including moon phase. In addition to the hydroacoustic surveys, we propose a single night of direct capture effort in each location for each of the survey weeks (See Bishop, this proposal). The survey design will follow the historic zig zag transects run by Thorne since 1993 in order to remain consistent with that sampling design and to put the long term fall and spring surveys into context. Such information is especially critical if hydroacoustic surveys are needed to provide an index of future age 0 herring abundance.

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

For each project objective listed above (II.A.), specify when critical project tasks will be completed. Project reviewers will use this information in conjunction with annual project reports

to assess whether projects are meeting their objectives and are suitable for continued funding. Please format your information like the following example.

Objective 1: to improve the accuracy of both annual and seasonal comparisons from single-night surveys by intensively sampling throughout a fall and spring season. *This will be met by July 2015.*
Objective 2: estimate the level of immigration and emigration of age 0 herring between bays. *This will be met by August 2015.*

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

FY12 3rd Quarter

May	Conduct annual PI meeting

FY13 1st Quarter (October 1, 12 to December 31, 12)

FY13 2nd Quarter

January	Annual Marine Science Symposium

FY13 3rd Quarter

May	Conduct annual PI meeting
June	Submit FY14 work plan for review

FY13 4th Quarter

August	Submit annual report

FY14 1st Quarter (October 1, 13 to December 31, 13)

October	Begin acoustic intensive study

FY14 2nd Quarter

January	Annual Marine Science Symposium
Winter	EVOS sponsored workshop with Herring and Long-term monitoring programs
Winter	Continue with intensive study

FY14 3rd Quarter

May	Conduct annual PI meeting
May	Complete intensive study

FY14 4th Quarter
July Data analysis
August Submit annual report

FY15 1st Quarter (October 1, 14 to December 31, 14)

FY15 2nd Quarter
January Annual Marine Science Symposium

FY15 3rd Quarter
May Conduct annual PI meeting

FY15 4th Quarter
August Submit annual report

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

FY16 2nd Quarter
January Annual Marine Science Symposium

FY16 3rd Quarter
May Conduct annual PI meeting

FY16 4th Quarter
August Submit annual report

References Cited

Thorne, R. E. 2010. Trends in Adult and Juvenile Herring Distribution and Abundance in Prince William Sound. Prince William Sound Science Center, Cordova, AK.

PWS Herring Research and Monitoring: Juvenile Herring Abundance Index
PRINCE WILLIAM SOUND SCIENCE CENTER

Personnel
This intensive survey project will take only take place in FY14. Three months' salary is requested in FY14 to conduct the surveys and ½ months' salary in FY15 to complete analysis. Dr. Buckhorn will 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.
Two months' salary is requested in FY14 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 FY14 for Dr. Thorne. He will provide technical consulting and support.

Travel
No travel is requested in this proposal (covered in other hydroacoustic budgets).

Contractual
For FY14 and FY15 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 FY14 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
In FY12 funds are requested to purchase ECHOVIEW hydroacoustic post-processing software. The specific module necessary for fish school analysis has 4 pre-requisite modules in order to work. ECHOVIEW is a much more powerful program than we are currently using and will allow us to integrate fish abundances with bird activity (FY10 project) and will also integrate with the DIDSON data collection for the non-lethal data collection experiment.

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