

FY14 PROGRAM PROJECT PROPOSAL FORM

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

Project Period: February 1, 2014 – January 31, 2015

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

FY12	FY13	FY14	FY15	FY16	TOTAL
6,500	84,400	68,100	90,600	84,400	334,000

(Funding requested must include 9% GA)

Non-EVOSTC Funds to be used:

FY12	FY13	FY14	FY15	FY16	TOTAL

Date: 30 August 2013

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. Summary of Project to Date (if applicable)

- a) Hydroacoustic surveys of adult herring schools were conducted March 27- April 5, 2013 and covered 629 nautical miles within Prince William Sound. Surveys were started in Port Gravina and Fidalgo, which have historically been surveyed by the previous hydroacoustic projects, then moved south and northwest to cover areas not previously covered.



Map of Prince William Sound with survey tracks for adult herring surveys.

II. PROJECT DESIGN

A. Objectives

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. CV's/RESUMES

- **Curriculum Vitae: Michele Leigh Buckhorn**

- Prince William Sound Science Center PO BOX 705, Cordova, AK
 - mbuckhorn@pwssc.org
 - (907) 424-5800 x 239 fax: (907) 424-5820

-

- **Education:**

- Ph.D. 2009 University of California, Davis, Ecology (AOE Marine Ecology)
 - Advisors: Marcel Holyoak, PhD and Peter B. Moyle, PhD
- B.A. 1999 University of California, Santa Cruz, Biology
- A.S. 1993 American River College, Math and Physical Sciences

-

-

- **Related Employment:**

- Principal Investigator. Fish Ecologist, Prince William Sound Science Center. November 2011 – present
- Postdoctoral Researcher Fish Ecologist, Prince William Sound Science Center. June 2010 – November 2011
- Postdoctoral Researcher. U.C. Davis. Department of Wildlife, Fish and Conservation Biology. 2008-2009.

-

-

- **Publications**

- *Journal Articles:*
- Thorne, R and M. L. Buckhorn. "Assessment of Adult Herring Abundance in Prince William Sound, Alaska, 1993-2012." In prep.
- Buckhorn, M.L. and R. Thorne. "Use of acoustic surveys to examine juvenile herring habitat and abundance in Prince William Sound, Alaska." In prep

-

- **Selected Presentations**

- 2011 Buckhorn, M.L. and Richard Thorne. Juvenile Herring Assessment In Prince William Sound. American Fisheries Society 141st Annual Meeting. Seattle, WA.
- 2011 Buckhorn, M.L., Richard Thorne, James Thorne. Evaluation of a Floating, Two-Vessel Towed Transducer System for Detection of Near-Surface Fishes. Poster. American Fisheries Society 141st Annual Meeting. Seattle, WA.

-

- **Recent Collaborators**

- Scott Pegau, PhD., Prince William Sound Science Center
- Richard Thorne, PhD., Prince William Sound Science Center
- A. Pete Klimley, PhD., UC Davis

-

CURRICULUM VITAE

Richard E. Thorne, Ph.D.
rthorne@pwssc.org
P.O. Box 705, Cordova, Alaska 99574
(907) 424 -5800 (work), -5820 (fax)

Employment History

Prince William Sound Science Center	Senior Scientist	2000-present
BioSonics, Inc.	Vice President	1996-1999
4027 Leary Way NW	Manager Technical Services	1991-1999
Seattle, WA 98107	Senior Scientist	1988-1999
University of Washington	Affiliate Research Professor	1991-2001
School of Fisheries	Research Professor	1981-1990 (LOA 1988-1990)
Fisheries Research Institute	Research Associate Professor	1976-1981
Seattle, WA	Senior Research Associate	1970-1976
Commercial Fisher (salmon and albacore)		1957-1968

Academic Background

Ph.D., Fisheries-1970, University of Washington, School of Fisheries
MS Degree-1968, University of Washington, Department of Oceanography
B.S. Degree-1965, University of Washington, Department of Oceanography

Selected Publications

- Thorne, R.E. and G.L. Thomas (in press). The Exxon Valdez Oil Spill and the Collapse of the Prince William Sound Herring Stock: A Reexamination of Critical Biomass Estimates, In: Alfred, J.B. and Peterson, M (eds), *Impacts of Oil Spill Disasters on Marine Fisheries in North America*, CRC Press/Taylor & Francis, Boca Raton, FL
- Thorne, R.E. and G.L. Thomas 2011. The Role of Fishery Independent Data, Chapter 12, In: Janice S. Intilli (ed) *Fisheries Management*. Nova Science Publishers, ISBN 978-1-61209-682-7.
- Frid, A., J. Burns, G.G. Baker and R.E. Thorne 2008. Predicting synergistic effects of resources and predators on foraging decisions by juvenile Steller sea lions. *Oecologia* 10.1007/s00442-008-1189-5, 12 p.
- Thorne, R.E. 2008. Walleye pollock as predator and prey in the Prince William Sound ecosystem. Pp: 289-304, In: G.H. Kruse, K. Drinkwater, J.N. Ianelli, J.S. Link, D.L. Stram, V. Wespestad and D. Woodby (eds), *Resiliency of gadid stocks to fishing and climate change*. Alaska Sea Grant, University of Alaska, Fairbanks
- Thorne, R.E. and G.L. Thomas 2008. Herring and the “Exxon Valdez” oil spill: an investigation into historical data conflicts. *ICES Journal of Marine Science* 65(1):44-50.
- Frid, A., Dill, L.M., Thorne, R. E., Blundell, G. M. 2007. Inferring prey perception of relative danger in large-scale marine systems. *Evolutionary Ecology Research*, Vol. 4.

- Churnside, J.H. and R.E. Thorne 2005. Comparison of airborne lidar measurements with 420 kHz echos-sounder measurements of zooplankton. *Applied Optics* **44**(26):5504-5511
- Thomas, G.L. and R.E. Thorne 2003. Acoustical-optical assessment of Pacific herring and their predator assemblage in Prince William Sound, Alaska. *Aquatic Living Resources* **16**:247-253.
- Thomas, G.L., J. Kirsch and R.E. Thorne 2002. Ex situ target strength measurements of Pacific herring and Pacific sand lance, *North American Journal of Fisheries Management* **22**:1136-1145.
- Thomas, G.L. and R.E. Thorne 2001. Night-time Predation by Steller Sea Lions. *Nature* **411**:1013.

Collaborations:

Gary L. Thomas,
Rosenstiel School of Marine and Atmospheric Sciences
4600 Rickenbacker Causeway
Miami, Florida 33149
gthomas@rsmas.miami.edu

IV. SCHEDULE

A. Project Milestones

Objective 1. 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.

To be met by April 2014

B. Measurable Project Tasks

Specify, by each quarter of each fiscal year, when critical project tasks (for example, sample collection, data analysis, manuscript submittal, etc.) will be completed. This information will be the basis for the quarterly project progress reports that are submitted to the Trustee Council Office. Please format your schedule like the following example.

FY14 1st Quarter

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

FY14 2nd Quarter

April	Conduct extended adult biomass cruise, collect samples for genetics
May	Attend annual PI meeting

FY14 3rd Quarter

August	Submit FY15 work plan for review
--------	----------------------------------

FY14 4th Quarter

October- December	Process and analyze data
-------------------	--------------------------

V. BUDGET

Budget Form (Attached)

Please complete the budget form for each proposed year of the project.