FY14 PROGRAM PROJECT
PROPOSAL FORM

Project Title: PWS Herring Research and Monitoring: Juvenile Herring Abundance Index

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

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

Abstract: Management of the Pacific herring stock in Prince William Sound (PWS), Alaska, is based primarily on an age-structured-assessment (ASA) model. The current model, developed in 2005, incorporates both hydroacoustic estimates of the adult herring biomass and an index of the male spawning, called the "mile-days of spawn". Unfortunately, the forecast is based on measurements from the previous year and does not have a direct measure of future age 3 recruitment. Current knowledge suggests that most mortality occurs during the first winter of life, so the relative recruitment may be fixed by the end of the first year. Consequently, estimates of relative abundance of age 1 and age 2 fish should provide an index of future recruitment. An index of age 0 fish would also provide a forecast of recruitment if additional information were available on the magnitude of the first year mortality. We will conduct annual fall surveys (FY2013-2016) of 8 bays; four of which will be the Sound Ecosystem Assessment (SEA) bays (Cooney et al. 2001). This will maintain a continual database from these locations. The other 4 bays will be selected based upon the survey results of the current EVOSTC FY10 Herring Survey Project (# 10100132). Surveys will be conducted using 120 kHz split-beam hydroacoustic unit in a stratified systematic survey design (Adams et al. 2006). For this study, direct capture will be directed to size and species composition. A midwater trawl will be used to sample randomized transects within each strata.

Estimated Budget:
EVOSTC Funding Requested:

FY12	FY13	FY14	FY15	FY16	TOTAL
90,100	80,100	66,100	84,900	83,000	404,200

(Funding requested must include 9% GA)

Non-EVOSTC Funds to be used:

FY12	FY13	FY14	FY15	FY16	TOTAL
		0			

Date: 30 August 2013

I. NEED FOR THE PROJECT

A. Statement of Problem

Management of the Pacific herring stock in Prince William Sound (PWS), Alaska, is based primarily on an age-structured-assessment (ASA) model. The current model, developed in 2005, incorporates both hydroacoustic estimates of the adult herring biomass and an index of the male spawning, called the "mile-days of spawn". Evidence suggests that the current model performs adequately. Unfortunately, the forecast is based on measurements from the previous year and does not have a direct measure of future recruitment. Since herring are a relatively short-lived fish, this uncertain recruitment can be a substantial component of the forecast abundance.

Herring recruit primarily as age 3. Current knowledge suggests that most mortality occurs during the first winter of life, so the relative recruitment may be fixed by the end of the first year. Consequently, estimates of relative abundance of age 1 and age 2 fish should provide an index of future recruitment. An index of age 0 fish would also provide a forecast of recruitment if additional information were available on the magnitude of the first year mortality.

Hydroacoustic surveys of juvenile herring abundance have been conducted over the past 4 years. These surveys have been conducted in both fall and late winter. The focus has been on age 0 herring, driven by interest in the extent of the critical first overwinter mortality, and has included energetics and disease research as well as research on sources of predation mortality

B. Summary of Project to Date (if applicable)

Hydroacoustic surveys were conducted November 6- 16, 2012. Bays surveyed were the SEA bays: Simpson, Eaglek, Whale, Zaikof plus Lower Herring, Port Fidalgo, and Port Gravina. We were unable to conduct surveys in Windy Bay due to weather and delays due to mechanical failures involving the midwater trawl. Fish capture was accomplished using gillnets and castnets. Acoustic data is currently being processed and analyzed.

II. PROJECT DESIGN

A. Objectives

Project Objectives:

1. Conduct annual surveys of juvenile herring to create an index of future recruitment
2. Validate species and size composition of fish ensonified during acoustic transects (See Bishop proposal).

B. Procedural and Scientific Methods

Objective 1: Conduct annual surveys of juvenile herring to create an index of future recruitment

We will conduct annual fall surveys (FY2013-2016) of 8 bays; four of which will be the Sound Ecosystem Assessment (SEA) bays (Cooney et al. 2001). This will maintain a continual database from these locations. The other 4 bays will be selected based upon the survey results of the current EVOSTC FY10 Herring Survey Project (# 10100132).

Surveys will be conducted using 120 kHz split-beam hydroacoustic unit in a stratified systematic survey design (Adams et al. 2006). Bays will be stratified as MOUTH, MIDDLE, and HEAD. The areal extent of each strata will be based upon the variance of mean densities from previous surveys in order to reduce overall variance in abundance estimates (Simmonds et al. 1992, Adams et al. 2006).

Objective 2: Validate species and size composition of fish ensonified during acoustic transects (See Bishop proposal).

Historically, direct capture has been oriented to maximize age 0 captures in support of disease and energetics research. For this study, direct capture will be directed to size and species composition. Gill nets have been only been moderately effective in catching juvenile herring during previous surveys and tend to select for faster moving fishes (Thorne et al. 1983, McClatchie et al. 2000). A midwater trawl will be used to sample randomized transects within each strata (See Bishop, this proposal).

We propose to sample during fall rather than spring despite uncertainty about overwinter mortality. Previous experience suggests that the fall period provides better assessment conditions: less ice coverage and better weather. It is anticipated that the results of previous research will allow overwinter mortality to be factored into the juvenile index.

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

The study area includes all of Prince William Sound. However, most of the projects will focus on the four bays (Zaikof, Whale, Eaglek, and Simpson) that were extensively studied during the Sound Ecosystem Assessment study and PWS Herring Survey program (Figure 1). This allows the work to build upon the historical research completed in those bays. These bays also cover four different quadrants of the Sound. We anticipate a potential build out to include other bays or contraction based on the results from the synthesis. As part of the synthesis effort we will be reviewing the question "What is the appropriate sampling distribution?" as applied to the questions of juvenile herring condition and providing an index of juvenile abundance.

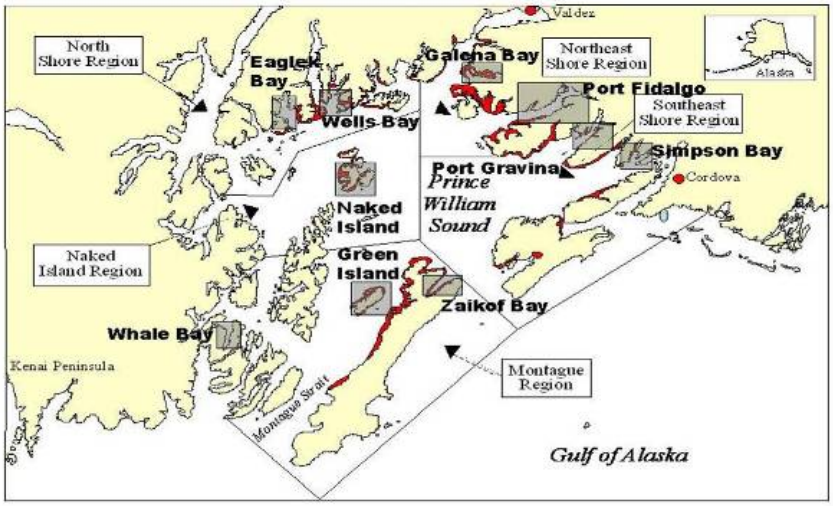

Figure 1. PWS study area, including the four SEA bays (Whale, Zaikof, Eaglek, and Simpson, as well as other bays historically important for juvenile herring.

E. Coordination and Collaboration with the Program

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

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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
Jorge Torre, PhD., Comunidad y Biodiversidad, AC, Mexico
Andrea Saenz, PhD., Comunidad y Biodiversidad, AC, Mexico

CURRICULUM VITAE

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(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:

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IV. SCHEDULE

A. Project Milestones

Objective 1: Conduct annual surveys of juvenile herring to create an index of future recruitment. *To be met by November 2013*

Objective 2: Validate species and size composition of fish ensonified during acoustic transects (See Bishop proposal). *To be met by November 2013*

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

FY14 2nd Quarter

May	Attend annual PI meeting
June	Submit FY15 work plan for review

FY14 3rd Quarter

September	Provide juvenile data for synthesis efforts.

FY14 4th Quarter

November	Conduct juvenile index survey

V. BUDGET

Budget Form (Attached)

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