

FY16 PROPOSAL SUMMARY PAGE

Continuing, Multi-Year Projects

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

Project Period: February 1, 2016 – January 31, 2017

Primary Investigator(s): Peter S. Rand, Ph.D.; Prince William Sound Science Center

Study Location: Prince William Sound, AK

Project Website (if applicable): <http://pwssc.org/research/fish/pacific-herring/>

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* (must include 9% GA):

FY12	FY13	FY14	FY15	FY16	TOTAL
\$90.1K	\$80.1K	\$66.1K	\$84.9K	\$82.9K	\$404.2K

Non-EVOSTC Funds to be used:

FY12	FY13	FY14	FY15	FY16	TOTAL

**If the amount requested here does not match the amount on the budget form, the request on the budget form will be considered to be correct.*

Date: August 14, 2015

I. EXECUTIVE SUMMARY

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.

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.

The Science Panel posed some questions during the review of the last proposal that we will attempt to answer here.

The analysis of data collected by this project has not been processed in a manner that would provide a useful index of juvenile herring population. With the transition to Dr. Rand it has been identified that getting an index is extremely important. During the transition between Dr. Buckhorn and Dr. Rand, Dr. Boswell of FIU was asked to have a technician work on processing the historic data to ensure this effort continued to move forward.

Dr. Rand is new to the conversations related to the use of a juvenile index to the population modeling effort. There are discussions between the program coordinator and ADF&G about the importance of needing a juvenile index. The age-sex-length data is consistent with the assumption in the model that in PWS the majority of herring recruit to the spawning population at age-3. This is significantly different than what is observed in Sitka and keeps the topic of determining the age of maturity near the top of conversations related to modeling efforts. The program is also using aerial surveys to provide another potential index of future recruitment and we expect to compare the aerial and acoustic indexes in the upcoming year. Conversations with the population modeling project have focused on testing the value of the index as an input in the near future.

Since we are currently only conducting a single survey a year there is not enough information to estimate survival. We are using data from the acoustic intensive project to determine if the index would have sufficient precision to estimate survival or if a change in sampling would be required to achieve that objective.

The survey design has been constant since 2012 and is expected to remain the same in 2015.

II. COORDINATION AND COLLABORATION

A. Within 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. This work is done in close collaboration with the validation project of Bishop. The vessel is shared with the condition monitoring and disease sampling as well. Sampling efforts were coordinated with the non-lethal sampling project of Boswell and Pegau.

B. With Other Council-funded Projects

N/A

C. With Trustee or Management Agencies

While intended to provide an index of the incoming year class strength, this data has not been provided to ADF&G.

III. PROJECT DESIGN – PLAN FOR FY16

A. Objectives for FY16

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.

This project will contribute to Program Objective #1: *Provide information to improve input to the age-structure-analysis (ASA) model, or test assumptions within the ASA model.*

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. Changes to Project Design

No changes have been made.

IV. SCHEDULE

A. Project Milestones for FY 16

Objective 1: Conduct annual surveys of juvenile herring to create an index of future recruitment. *Will be conducted every November FY2013-2016.*

Objective 2: Validate species and size composition of fish ensonified during acoustic transects (See Bishop proposal). *Will be conducted every November FY2013-2016.*

B. Measurable Project Tasks for FY 16

FY 16, 1st quarter (February 1, 2016 - April 31, 2016)

March Complete analysis of previous cruise data.

FY 16, 2nd quarter (May 1, 2016-July 30, 2016)

May Attend annual PI meeting

FY 16, 3rd quarter (August 1, 2016 – October 31, 2016)

FY 16, 4th quarter (November 1, 2016- January 31, 2017)

November Conduct juvenile index survey

January Annual Marine Science Symposium

Complete analysis of November cruise data

V. PROJECT PERSONNEL – CHANGES AND UPDATES

Pete Rand was hired on at PWSSC in May 2015. Part of his responsibilities at PWSSC is to oversee the Pacific herring acoustic monitoring. Over his career he has gained experience in application of acoustics in fisheries science and management, including work in the Great Lakes, reservoirs and coastal ecosystems in North Carolina, Caribbean Sea, and rivers systems in Japan, Russia and Alaska. He will work with Michele Buckhorn and Dick Thorne on reporting results from previous years, and he intends to oversee the juvenile herring surveys at PWSSC into the future.

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EDUCATIONAL BACKGROUND

Colgate University, Biology, B.A., 1987

SUNY College of Environmental Science and Forestry, Ecology, M.S., 1990

SUNY College of Environmental Science and Forestry, Ecology, Ph.D., 1994

University of British Columbia, Fisheries Science, Postdoctoral Fellow, 1995-1997

ACADEMIC/PROFESSIONAL WORK EXPERIENCE

Research Ecologist, Prince William Sound Science Center (2015-present)

Chair, IUCN Salmonid Specialist Group (2008-present)

Senior Conservation Biologist (2003-2015), Wild Salmon Center.

Assistant Professor (1997–2003), Department of Zoology, NC State University.

SELECTED REFEREED PUBLICATIONS

Rand, P.S., and M. Fukushima. 2014. Estimating the size of the spawning population and evaluating environmental controls on migration for a critically endangered Asian salmonid, Sakhalin taimen. *Global Ecology and Conservation* 2:214-225.

Rand, P.S. 2013. Current global status of taimen and the need to implement aggressive conservation measures to avoid population and species-level extinction. *Arch. Pol. Fish* 21:119-128.

Rand, P.S., M. Goslin, M.R. Gross, J.R. Irvine, X. Augerot, et al. 2012. Global Assessment of Extinction Risk to Populations of Sockeye Salmon *Oncorhynchus nerka*. *PLoS ONE* 7(4): e34065. doi:10.1371/journal.pone.0034065

Rand, P.S., B.A. Berejikian, T.N. Pearsons, and D.L.G. Noakes. 2012. Ecological interactions between wild and hatchery salmonids: an introduction to the special issue. *Environmental Biology of Fishes*. DOI 10.1007/s10641-012-9987-3

Zimmerman, C.E., **P.S. Rand**, M. Fukushima, and S.F. Zolotukhin. 2011. Reconstructing migratory and growth histories of Sakhalin taimen (*Parahucho perryi*). *Environmental Biology of Fishes* DOI 10.1007/s10641-011-9908-x

Fukushima, M., H. Shimazaki, **P.S. Rand**, and M. Kaeriyama. 2011. Reconstructing Sakhalin taimen (*Parahucho perryi*) historical distribution and indentifying causes for their local extinction. *Transactions of the American Fisheries Society* 140:1-12.

Taylor, J.C., **P.S. Rand**, and J. Jenkins. 2007. Swimming behavior of juvenile anchovies (*Anchoa* spp.) in an episodically hypoxic estuary: implications for individual energetics and trophic dynamics. *Mar. Biol.* 152(4):939-957.

Taylor, J.C., D.B. Eggleston, and **P.S. Rand**. 2006. Nassau grouper (*Epinephelus striatus*) spawning aggregations: hydroacoustic surveys and geostatistical analysis. *National Marine Fisheries Service Professional Paper Series* 5: 18-25.

Taylor, J.C., J.S. Thompson, **P.S. Rand**, and M. Fuentes. 2005. Sampling and statistical considerations for hydroacoustic surveys used in estimating abundance of forage fishes in reservoirs. *North Am. J. Fish. Mgmt.* 25: 73-85.

Rand, P.S. 2002. Modeling stomach fullness and growth potential of sockeye salmon in the Gulf of Alaska: Implications for high seas distribution and migration. *Mar. Ecol. Prog. Ser.* 234:265-280.

RESEARCH ACTIVITIES/FELLOWSHIPS/GRANTS/CONTRACTS

I have served as a principal investigator in numerous competitive grant programs from a variety of sources, including government research agencies (National Science Foundation, National Oceanic and Atmospheric Administration, National Undersea Research Program), private foundations (Gordon and Betty Moore Foundation, Disney Conservation Fund), and non-governmental organizations (National Geographic Society, Mohammed bin Zayed Species Conservation Fund, Ocean Park Conservation Fund, International Union for the Conservation of Nature, Perry Institute of Marine Science).

AWARDS/SPECIAL RECOGNITION/HONORS

Fulbright Award, Japan Program

Research Fellowship Award, Japan Society for the Promotion of Science

Robert L. Kendall Publication Award, Best Paper in Transactions of American Fisheries Society

James W. Moffett Publication Award, Most Significant Paper, US Geological Survey, Great Lakes Science Center

Hydrolab Award, International Association of Great Lakes Research

Award for Excellence in Research, New York Sea Grant Institute
 Member, Sigma Xi
 Member and Red List Authority Focal Point, IUCN Salmonid Specialist Group
 Faculty Advisor, Student Chapter of the American Fisheries Society

PROFESSIONAL AFFILIATIONS/MEMBERSHIPS

American Fisheries Society
 Society for Conservation Biology
 North Pacific Marine Science Organization

PROFESSIONAL TRIPS OUTSIDE THE UNITED STATES

I have served as chief or collaborating scientist on numerous research trips and expeditions to salmon rivers in the Russian Far East, Mongolia and Japan during 2004-2013. During this time I have also participated in numerous international workshops and conferences on fisheries science, management and conservation.

I attended and presented at a joint meeting of the North Pacific Anadromous Fish Commission and the North Pacific Marine Science Organization in Jeju, South Korea.

I frequently travel to British Columbia, Canada for research and conservation activities. I collaborate with faculty at the University of British Columbia.

I was a collaborating scientist on a research project to describe the status of Nassau grouper (*Epinephelus striatus*) in the Bahamas and Cayman Islands.

I have attended and contributed to sessions at two IUCN World Conservation Congresses (Bangkok, Thailand and Barcelona, Spain) and IUCN specialist group meetings (Abu Dhabi, United Arab Emirates, and Chester, United Kingdom).

VI. BUDGET

A. Budget Forms

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	\$16,200.0	\$49,900.0	\$40,900.0	\$55,300.0	\$28,200.0	\$190,500.0	
Travel	\$0.0	\$2,600.0	\$2,600.0	\$2,600.0	\$2,600.0	\$10,400.0	
Contractual	\$500.0	\$4,000.0	\$1,600.0	\$2,000.0	\$27,700.0	\$35,800.0	
Commodities	\$1,500.0	\$0.0	\$1,500.0	\$0.0	\$0.0	\$3,000.0	
Equipment	\$59,000.0	\$0.0	\$0.0	\$0.0	\$0.0	\$59,000.0	
Indirect Costs (will vary by proposer)	\$5,500	\$17,000	\$14,000	\$18,000	\$17,600	\$72,100.0	
SUBTOTAL	\$82,700.0	\$73,500.0	\$60,600.0	\$77,900.0	\$76,100.0	\$370,800.0	\$0.0
General Administration (9% of	\$7,443.0	\$6,615.0	\$5,454.0	\$7,011.0	\$6,849.0	\$33,372.0	
PROJECT TOTAL	\$90,143.0	\$80,115.0	\$66,054.0	\$84,911.0	\$82,949.0	\$404,172.0	
Other Resources (Cost Share Funds)	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	

B. Changes from Original Proposal

We are requesting to shift \$27,700 in funds from Personnel to Contractual. We intend to contract with Kevin Boswell of Florida International University to provide technical support for the cruise and data

processing. To do this we are moving the funds originally for a PWSSC technician (James Thorne) and Co-PI (Dick Thorne) to contractual. James no longer works at PWSSC and by contracting with FIU we gain access to the expertise of Dr. Boswell's group. Salary carried over from previous years will be used to cover Dr. Thorne's salary.

C. Sources of Additional Funding

None.