

**FY16 PROPOSAL SUMMARY PAGE**  
**Continuing, Multi-Year Projects**

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

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

**Primary Investigator(s):** Peter S. Rand, Ph.D., Dick Thorne, Ph.D.; Prince William Sound Science Center, Cordova, AK

**Study Location:** Prince William Sound, AK

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

**Abstract\*:**

Prince William Sound herring stock biomass estimates from hydroacoustic surveys provide a direct measure of the stock abundance for use in 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 at adult spawning sites (See Bishop proposal).

**Estimated Budget:****EVOSTC Funding Requested\*** (must include 9% GA):

FY12	FY13	FY14	FY15	FY16	TOTAL
\$6.5K	\$84.4K	\$68.1K	\$90.6K	\$84.4K	\$334.0K

**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

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.

The current management of the Prince William Sound (PWS) herring stock by the Alaska Department of Fish and Game (ADF&G) includes information from hydroacoustic surveys. Biomass estimates from these surveys provide a direct measure of the stock abundance and are provided for 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. Over 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 can 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 5 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. 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.

The Science Panel posed a few questions during the last proposal submission that we will attempt to answer.

Questions were raised regarding the validity of the acoustic data, whether the acoustic equipment is well suited for the job, and how the acoustic data is used in the ASA models. The acoustics results are an index incorporated into both the Bayesian and ADF&G ASA models. There is an underlying assumption that the majority of the fish in the Sound are being surveyed and the work proposed here examines that assumption. We propose here to continue existing surveys to allow us to track the status of the population, but we also want to extend our survey to ensure we are not missing an important component of the population. There have been shifts in the sampling area over time as the main spawning population moved from Montague Island to Port Gravina. Similarly, there have been shifts in effort related to other observations such as the spawn surveys and sampling. When we change equipment we are comparing old and new sensors to ensure that biomass estimates remain consistent with the transition. We do the same when examining new processing algorithms. All acoustics data from adult herring surveys are stored on the herring program's workspace so reprocessing can occur if necessary.

The completion of the acoustic survey analysis requires the collaboration with ADF&G for information on the length and weight of individuals in the spawning population. There has been discussion related to survey and processing approaches. A deviation between estimates from ADF&G and PWSSC led to the discovery of an error in the areas used by ADF&G in their processing. Once that error was corrected the estimates in overlapping regions were within the error margins. Survey timing, location, and overall findings are communicated before and during the survey effort. Given the movement of the fish it is beneficial to have multiple boats trying to determine the location of major portions of the biomass and if there is potential movement of fish that may cause errors in the biomass estimates.

There is a database of historic observations on the herring program workspace. Prior to 2000 the data were not collected in a digital format so it is necessary to go to reports to determine the location and timing of spawn surveys. Transitions in effort caused by changes in spawn timing and location have been a point of discussion with the program coordinator and other investigators in the program.

While the comments seem to refer to the departure of Dr. Thorne, he has remained integrally involved in the adult herring surveys. He has been involved in all of the surveys through 2015. Dr. Buckhorn did leave the program the past year. Dr. Thorne worked with a technician from Dr. Boswell's lab in 2015 and is expected to contribute during the transition to Dr. Rand.

## **II. COORDINATION AND COLLABORATION**

### **A. Within the Program**

This project 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. The project works

closely with the validation project of Bishop to collect fish in areas outside of those sampled by ADF&G. Additional acoustic sampling throughout the Sound during spring 2015 was carried out through a contract with Florida International University in collaboration with NOAA whale surveys as part of the Gulf Watch program.

**B. With Other Council-funded Projects**

N/A

**C. With Trustee or Management Agencies**

Fish biomass estimates are provided to Steve Moffitt with ADF&G in Cordova. The project relies on weight and length data collected by ADF&G.

**III. PROJECT DESIGN – PLAN FOR FY15**

**A. Objectives for FY16**

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 accurate estimate of spawning biomass.

**B. Changes to Project Design**

N/A

**IV. SCHEDULE**

**A. Project Milestones for FY 16**

For each project objective listed, specify when critical project tasks will be completed, as submitted in your original proposal. Please identify any substantive changes and the reason for the changes. Please format your information as in the following example:

**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.

*Met by May 2016*

**B. Measurable Project Tasks for FY 16**

Specify, by each quarter of each fiscal year, when critical project tasks (for example, sample collection, data analysis, manuscript submittal, etc.) will be completed, as submitted in your original proposal. Please identify any substantive changes and the reason for the changes. Please format your schedule as in the following example:

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

*April: Survey*

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

*May 30: Annual PI meeting*

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

*August: Submit Annual Report*

*September 1: Complete Adult Survey Analysis*

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

## 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 river systems in Japan, Russia and Alaska. He will work with Dick Thorne on reporting results from this funding period, and he intends to oversee the adult herring acoustic monitoring at PWSSC into the future. Pete joined Dick and Adam Zenone (Florida International University) for one day on the spring 2015 survey in Gravina Bay to become familiarized with the current acoustic methods being applied in the Sound.

### **Peter S. Rand, Ph.D.**

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Cordova, Alaska 99574  
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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

**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**

<b>Budget Category:</b>	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	\$0.0	\$49,900.0	\$40,900.0	\$55,300.0	\$31,600.0	\$177,700.0	
Travel	\$0.0	\$3,600.0	\$3,600.0	\$3,600.0	\$3,600.0	\$14,400.0	
Contractual	\$0.0	\$2,000.0	\$3,600.0	\$3,000.0	\$24,300.0	\$32,900.0	
Commodities	\$0.0	\$4,000.0	\$0.0	\$2,000.0	\$0.0	\$6,000.0	
Equipment	\$6,000.0	\$0.0	\$0.0	\$0.0	\$0.0	\$6,000.0	
Indirect Costs ( <i>will vary by proposer</i> )	\$0	\$17,900	\$14,400	\$19,200	\$17,900	\$69,400.0	
<b>SUBTOTAL</b>	<b>\$6,000.0</b>	<b>\$77,400.0</b>	<b>\$62,500.0</b>	<b>\$83,100.0</b>	<b>\$77,400.0</b>	<b>\$306,400.0</b>	<b>\$0.0</b>
General Administration (9% of	\$540.0	\$6,966.0	\$5,625.0	\$7,479.0	\$6,966.0	\$27,576.0	
<b>PROJECT TOTAL</b>	<b>\$6,540.0</b>	<b>\$84,366.0</b>	<b>\$68,125.0</b>	<b>\$90,579.0</b>	<b>\$84,366.0</b>	<b>\$333,976.0</b>	
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 \$24,300 from Personnel to Contractual. We intend to contract with Kevin Boswell of Florida International University to provide technical support for the cruises and data processing. To do this we are moving the funds originally for a PWSSC technician (James 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.

**C. Sources of Additional Funding**

No additional funding is provided.