

**EVOSTC FY17-FY21 INVITATION FOR PROPOSALS  
FY19 CONTINUING PROJECT PROPOSAL SUMMARY PAGE**

*Proposals requesting FY19 funding are due to [shihway.wang@alaska.gov](mailto:shihway.wang@alaska.gov) and [elise.hsieh@alaska.gov](mailto:elise.hsieh@alaska.gov) by August 17, 2018. Please note that the information in your proposal and budget form will be used for funding review. Late proposals, revisions or corrections may not be accepted.*

**Program Number and Title**

19170111-B - PWS Herring Research & Monitoring: Annual Herring Migration Cycle

**Primary Investigator(s) and Affiliation(s)**

Mary Anne Bishop, Ph.D., Prince William Sound Science Center, Cordova, Alaska

**Date Proposal Submitted**

August 17 2018

**Program Abstract**

This project is a component of the Herring Research and Monitoring (HRM) program. The goal of the HRM program is to: Improve predictive models of herring stocks through observations and research. Within Prince William Sound (PWS), adult Pacific herring (*Clupea pallasii*) movements between spawning, summer feeding, and overwintering areas are not well understood. Addressing this knowledge gap will improve our ability to assess biomass trends and recovery of this ecologically important species.

In 2013, we documented post-spawn migration of herring from Port Gravina to the PWS entrances by acoustic tagging adult herring and collecting data from the Ocean Tracking Network acoustic arrays, which are located in the major entrances and passages connecting PWS with the Gulf of Alaska (GoA). However, the 2013 study could not establish if herring were seasonally leaving PWS and migrating into the GoA. With funding from EVOS in FY16, we improved our ability to detect movements between PWS and the GoA by deploying additional acoustic receivers at the Ocean Tracking Network arrays. The primary goal of this 2017-2021 project is to clarify the annual migration cycle of PWS adult herring by leveraging this expanded acoustic infrastructure. The specific objectives of this project are to 1) document location, timing, and direction of Pacific herring seasonal migrations between PWS and the GoA; 2) relate large-scale movements to year class and body condition of tagged individuals; and 3) determine seasonal residency time within PWS, at the entrances to PWS, and in the GoA. During spring 2017 we tagged 124 herring in northeast PWS at Port Gravina and detected 59 herring at entrances to the GoA. Nine fish were detected returning to the spawning grounds the following winter/spring. In April 2018, we tagged 202 herring at Port Gravina and at Hawkins Island (Canoe Pass). For FY19 we will tag a total of 210 herring on the spawning grounds.

<b>EVOSTC Funding Requested* (must include 9% GA)</b>					
<b>FY17</b>	<b>FY18</b>	<b>FY19</b>	<b>FY20</b>	<b>FY21</b>	<b>TOTAL</b>
<b>Auth: \$381,900</b>	<b>Auth: \$379,500</b>	<b>\$275,800</b>	<b>\$205,200</b>	<b>0</b>	<b>\$1,246,400</b>

<b>Non-EVOSTC Funds to be used, please include source and amount per source:</b>					
<b>FY17</b>	<b>FY18</b>	<b>FY19</b>	<b>FY20</b>	<b>FY21</b>	<b>TOTAL</b>
<b>\$15,000</b>	<b>\$15,000</b>	<b>\$15,000</b>	<b>\$15,000</b>		<b>\$60,000</b>

*\*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.*

## 1. EXECUTIVE SUMMARY

Provide a summary of the program including key hypotheses and overall goals, as submitted in your original proposal. Please include a summary and highlights from your FY18 work: preliminary results with figures and tables. If there are no preliminary results to present, please explain why (i.e., lab analysis is still in progress). List any publications that have been submitted and/or accepted since you submitted your last proposal and other products in *Section 7. FY17 Annual Reports* will be included with this proposal for review.

Conservation concerns about the Pacific herring population in Prince William Sound (PWS) make it increasingly important to document migration patterns to inform our understanding of PWS adult herring survival. Little is understood about adult Pacific herring annual migration movements between spawning, summer feeding, and overwintering areas within and between PWS and the Gulf of Alaska (GoA). Elsewhere, it is common for large herring populations to migrate from nearshore spawning areas to coastal shelf areas for summer feeding habitat (Hay and McCarter 1997, Hay et al. 2008). Corten (2002) suggested that observed herring migration patterns are not innate but are a learned behavior that initially happens when the recruiting year class follows older herring. In his review of migration in Atlantic herring (*C. harengus*), Corten observed that herring migration patterns tend to be stable over years, despite environmental variation. In PWS, Brown et al. (2002) compiled local and traditional knowledge on adult herring movements. In that study, some fishers reported herring moving into PWS through Montague Strait prior to the fall bait fishery while others reported herring moving into PWS in spring through Hinchinbrook Entrance, Montague Strait and the southwest passages of Erlington and LaTouche. These observations suggest that PWS herring are regularly migrating in and out of PWS and onto the shelf.

We propose to utilize acoustic telemetry to investigate seasonal movement patterns of Pacific herring. Post-spawn feeding, winter movements, and subsequent spawning migrations will be examined by tagging herring on PWS spawning grounds during spring and monitoring their movement patterns with moored acoustic arrays positioned at the entrances to PWS, the spawning grounds, and at other select locations in PWS. The use of acoustic telemetry will allow us to look at movement patterns on a variety of temporal and spatial scales, filling in significant gaps in our current knowledge of adult herring migration.

*2017-2021 Key hypotheses and overall goals: Annual Herring Migration Cycle*

The overall program goal of the Herring Research and Monitoring program is the continued development and testing of an updated age-structured assessment (ASA) model in collaboration with ADF&G. To address this goal, our tagging study will gather data to clarify the annual migration cycle of PWS adult herring. From 2017-2021 we will use acoustic telemetry to examine movement patterns on a variety of temporal and spatial scales, filling in significant gaps in our current knowledge of herring migration.

Our study will address the following hypotheses:

**H<sub>1</sub>:** Pacific herring populations in PWS make seasonal, post-spawn feeding migrations through major entrances and passages to the GoA.

- a) Fish with poor body condition are less likely to migrate.
- b) New recruits to the spawning population are less likely to migrate than older herring.

**H<sub>2</sub>:** The PWS herring population is composed of migrant and resident individuals.

- a) Resident individuals remain within the confines of PWS.
- b) Resident herring are associated with specific spawning grounds.
- c) Migrant individuals exit PWS by mid-June and return to the Sound in either fall or spring.

**H<sub>3</sub>** Survival is related to age and body condition.

**H<sub>4</sub>:** Fine-scale spatial use patterns are associated with individual biological characteristics and vary seasonally.

## Background and FY 2018 Update

Our project builds on the previous EVOS Herring Research & Management (HRM) 14120111-B, a pilot project of the Principal Investigator M.A. Bishop and collaborator J. Eiler (NOAA). Our pilot project developed handling and tagging methods during 2012 designed to minimize physical injuries and stress to wild Pacific herring (Eiler and Bishop 2016). Subsequently, the February 2013 installation of the Ocean Tracking Network's six acoustic receiver arrays across the entrances to the GoA provided the first opportunity to detect movements from the spawning grounds to the GoA entrances. In April 2013, we tagged and released 69 adult herring from the Port Gravina spawning area. Tags had an expected life of 263 days. Post-release we detected 93% of the tagged herring (64 of 69 individuals) either at Port Gravina and/or the Ocean Tracking Network arrays (Eiler and Bishop 2016, Bishop and Eiler 2018). With funding from EVOS in FY 2016 (Project 16160111-S), during February 2017 we deployed additional receivers at the Ocean Tracking Network arrays in a configuration that will allow us to determine what direction tagged herring travel after detection at the Ocean Tracking Network arrays (i.e., back into PWS or out towards the GoA; Bishop 2018).

Field work for this project began in April 2017 when 124 herring were acoustic-tagged on their spawning grounds in Port Gravina. Subsequently, 59 herring were detected at the Ocean Tracking Network arrays located at the entrances to GoA. We tested our hypothesis that fish in poor body condition would be less likely to migrate to the entrances. Logistic regression was used to determine if the probability of moving from Port Gravina to GoA entrances was associated with individual herring characteristics (weight [g], standard length [mm], condition, and sex) or release cohort. Fulton's Condition factor ( $k = \text{weight} \cdot \text{length}^{-3}$ ) was used as a measure of body condition. We constructed a series of univariate models and compared each model to a reduced single mean model using likelihood ratio tests (Wilks 1937). There was strong evidence that the probability of moving was related to weight, length, and sex, while there was little evidence that condition, or release cohort were associated with movement probability (Table 1).

Table 1. Likelihood ratio test results examining probability of 2017 tagged herring moving from Port Gravina to the entrances at the Gulf of Alaska.

Model	d.f.	$\chi^2$	p-value
move ~ Weight	1	8.55	0.003
move ~ Sex	1	7.10	0.007
move ~ Standard Length	1	5.96	0.015
move ~ Release cohort	9	10.12	0.341
move ~ Condition	1	0.64	0.422
Move ~ Weight*Sex	1	0.630	0.427

Of the 59 herring detected at the arrays located at the entrances to GoA, 32 herring were recorded at one array (Hinchinbrook Entrance  $n = 28$ ; Montague Strait  $n = 4$ ), while 27 herring were detected at 2 to 4 arrays (Fig 1A). Of the 19 herring recorded at the Southwest Passage arrays, 17 fish were recorded at Elrington Passage, 5 fish at Prince of Wales, and 4 fish at LaTouche Passage. No herring were detected at the Bainbridge Passage.

From October 2017 until our February 2018 data upload, Montague Strait was the only Ocean Tracking Network array with detections. However, examining the most recent detections for 59 herring that went to the GoA, 17 occurred at the outermost arrays (Hinchinbrook Entrance  $n = 10$ , Montague Strait  $n = 6$ , Southwest Passages,  $n = 1$ ), suggesting that some tagged herring may not have yet returned from the GoA by February. Our next data upload should help answer if this is the case. Interestingly, 8 of the 59 herring that moved to the GoA entrances were detected returning to Gravina after October 2017, including two herring detected monthly from November 2017 through April 2018. At the Hawkins Island arrays, two herring tagged in April 2017 were detected during April or May 2018 (Fig. 1B)

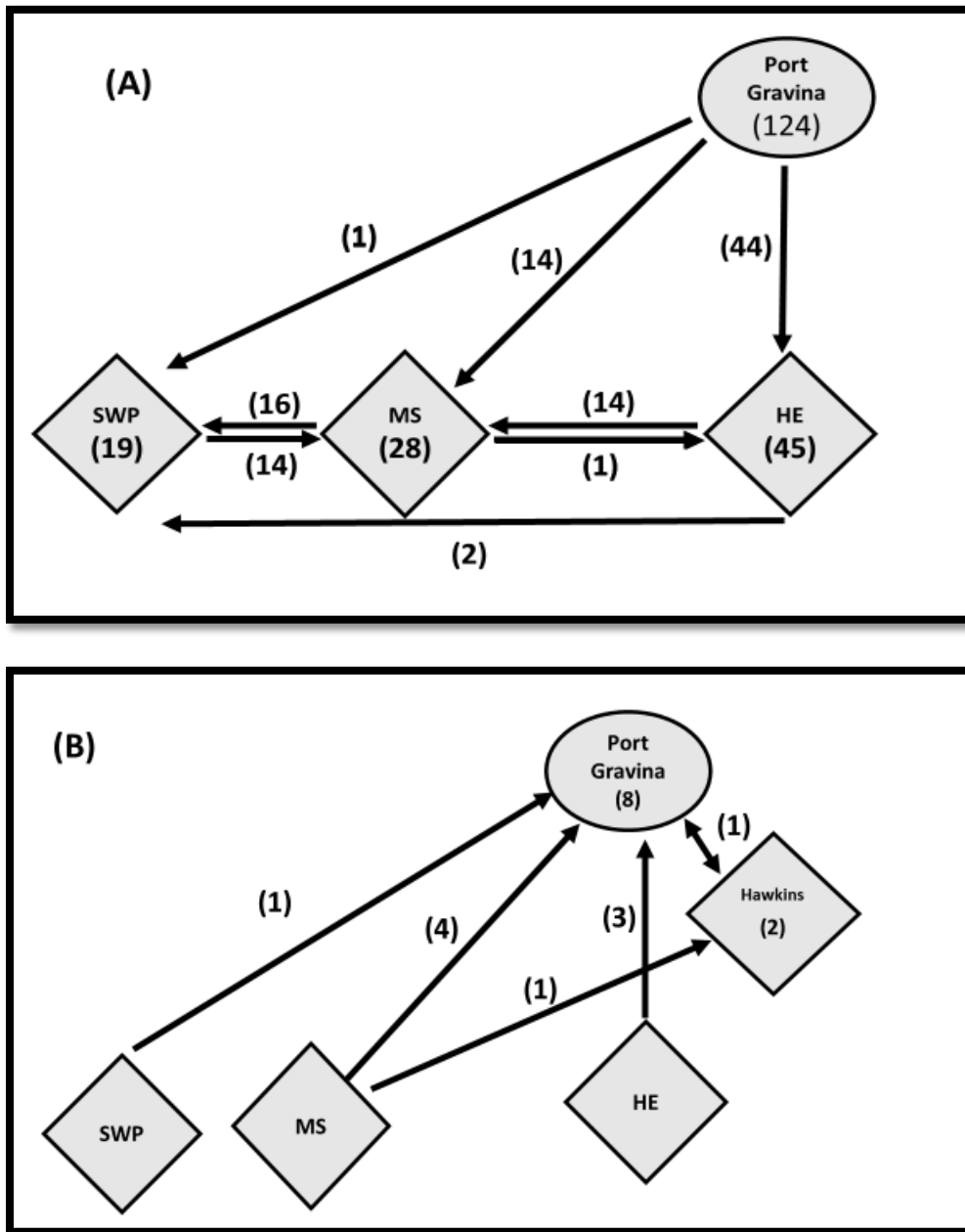


Fig 1 . Schematic showing movements by Pacific Herring tagged in April 2017: (A) from their spawning grounds at Port Gravina to the Ocean Tracking Network arrays, April 2017 through early February 2018; and (B) from the Ocean Tracking Network arrays (as determined from February 2018 data upload) to Port Gravina array and receivers in Orca Bay at Hawkins Island (November 2017 through April 2018). HE = Hinchinbrook Entrance, MS = Montague Strait, and SWP = Southwest Passages.

In April 2018, we tagged 202 herring at the only two areas where spawning was known to occur in 2018: Port Gravina (8-9 April) and Orca Bay, along the western shoreline of Hawkins Island, (11-13 April; Table 1). During our 2017 tagging efforts, the dominant herring age class was relatively small, and we had difficulties finding and jigging larger (>200 mm) herring. Therefore, for 2018 we purchased 60 of the 8 mm diameter, 2 g (air weight), Vemco V-8 acoustic tags (est. tag life 246 d) in addition to 150 of the larger (9 mm diameter) and heavier (4.7 g) Vemco V-9 tags (est. tag life 755 d). For the V-8 tags, our target tagging size were herring  $\leq 200$  mm SL and <100 g mass.

Table 1. Number of herring acoustic-tagged by month, year, location, and sex.

Month/Year	Location	Male	Female	Unk
April 2017	Port Gravina	59	62	3
April 2018	Port Gravina	39	39	5
April 2018	Orca Bay - w. Hawkins Id	67	52	0

*Array Maintenance, Receiver Tilting and Additional Receivers Deployed*

We uploaded data and conducted annual maintenance on the Ocean Tracking Network array receivers in February 2018. In April 2018, we retrieved data from and redeployed the acoustic array in Port Gravina. One acoustic release did not function, and subsequent efforts to grapple the VR2W receiver and acoustic release were not successful. We also placed three receivers in Orca Bay along the shoreline of Hawkins Island (Fig. 2). The three receivers in Orca Bay were retrieved in mid-June 2018, in anticipation of the seine fleet fishing this area. These receivers will be redeployed in fall 2018.

During the September 2017 upload, we noted that some receivers in the Ocean Tracking Network arrays had consistent tilts of 80-90 degrees. We believe that the tilts may be due to biofouling. Receiver tilting appeared to affect receiver detection efficiency at both sites (see our FY17 Annual Report). We worked closely with the Ocean Tracking Network and identified 18 receivers with large tilts for potential replacement. In April 2018, prior to our tagging activities, we added VR2AR replacement receivers at Montague Strait (n = 6) and at Hinchinbrook Entrance (n = 12). These VR2AR's are on loan from the Ocean Tracking Network, and we have agreed to try later this summer to grapple and retrieve the 18 tilting VR4 receivers.

In spring 2017, we were able to recover and refurbish 9 VR3 receivers at Port Gravina. These receivers had been deployed in 2008 as part of the Pacific Ocean Shelf Tracking (POST) project. Three of the 9 receivers were placed along the Montague Strait array to either supplement tilting receivers or replace models that must be popped up to download (e.g., VR2AR's). For the remaining receivers, we identified deployment sites that will provide insight on migration corridors in northern Montague Strait and southern Knight Island Passage. In addition, we identified areas around southern Port Gravina and Glacier Island for VR2AR receivers that we believe will provide information on fish that may not be leaving PWS. Due to permit delays, we did not receive permission from the state to deploy any of these receivers until early May 2018. Since then we have deployed 7 of 9 VR3 receivers and 2 VR2AR receivers. We plan to deploy the remaining two refurbished VR3 receivers in Knight Island Passage in August 2018.

*FY 19 Field Work*

In February 2019 we will upload data from the Ocean Tracking Network arrays at the entrances to the GoA during our annual array maintenance cruise. In April 2019 we plan to acoustic tag another 210 herring at two spawning sites. Based on spawning behavior the past three years, we assume our tag sites will include Port Gravina and Hawkins Island (around Canoe Pass). At that time we will also upload data and redeploy arrays at Port Gravina and Hawkins Island.

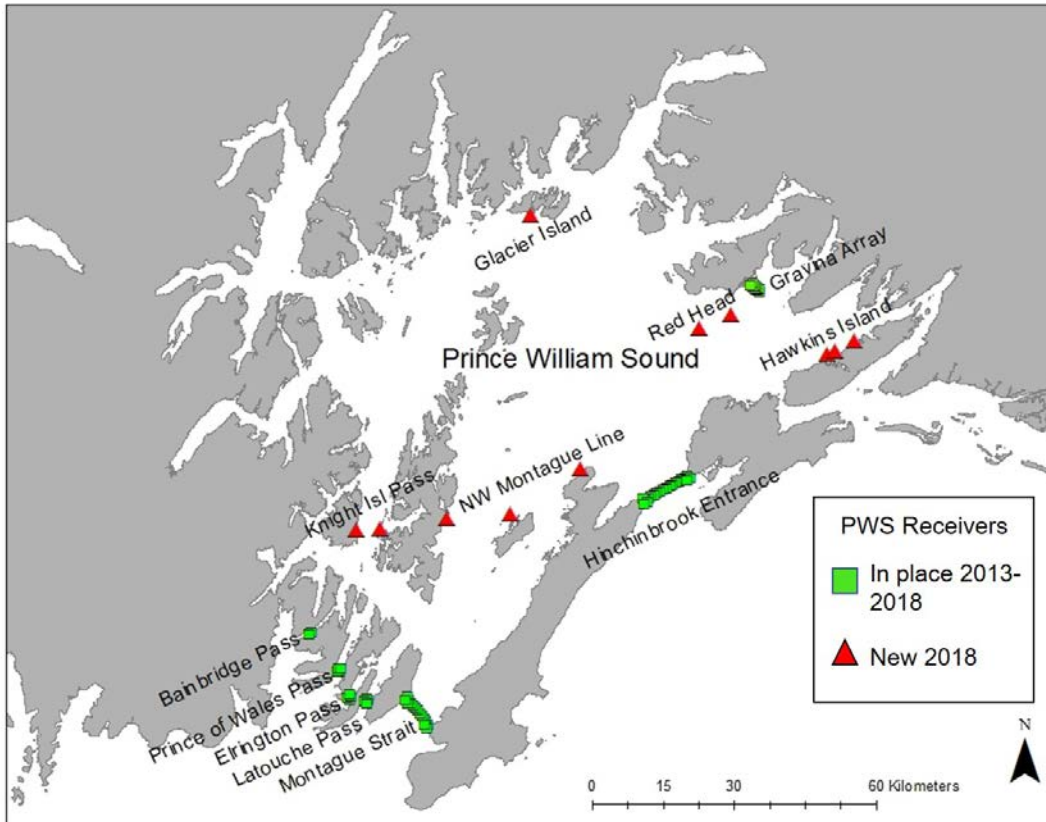


Fig. 2. Underwater acoustic arrays deployed in Prince William Sound. Green = Ocean Tracking Network arrays (entrances to PWS) and PWSSC Port Gravina array. Red = VR2AR and refurbished VR3 receivers deployed in 2018.

## PROGRAM STATUS OF SCHEDULED ACCOMPLISHMENTS

### A. Program Milestones and Tasks

Milestones are annual steps to meet overall program objectives. For each milestone listed, specify the status (completed, not completed) when each was completed and if they are on schedule, as submitted in your most current proposal.

Tasks are annual steps to meet milestones. Specify, by each quarter of each fiscal year, when critical tasks (for example, sample collection, data analysis, manuscript submittal, etc.) were and will be completed.

Please identify any substantive changes and the reason for the changes. *Reviewers will use this information in conjunction with annual program reports to assess whether the program is meeting its objectives and is suitable for continued funding.*

### B. Explanation for not completing any planned milestones and tasks

Please identify any substantive changes and the reason for the changes. If tasks were not completed as scheduled or delayed, please explain why and the anticipated completion date.

### C. Justification for new milestones and tasks

Please identify any new milestones and tasks and the reason why they have been added.

**A. Program Milestones and Tasks**

Program milestone and task progress by fiscal year and quarter, beginning February 1, 2017. Yellow highlight indicates proposed fiscal year Work Plan. Additional milestones and tasks may be added. C = completed, X = not completed or planned. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31.

Milestone/Task	FY17				FY18				FY19				FY20				FY21			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>Milestone 1: Data Collection</b>																				
Herring capture/tagging	C				C				X											
Upload data from arrays			C		C				X				X							
<b>Milestone 2: Data Processing/Mgmt</b>																				
Data summary/analysis			C	C	C	C	X	X	X	X	X	X	X	X	X	X				
Upload data workspace					C				X				X							
Metadata/data published																X				
<b>Reporting</b>																				
Annual reports					C				X				X				X			
Annual PI meeting				C			X					X				X				X
FY work plan (DPD)			C				C				X				X				X	
5-Year Final Report																	X			
Journal Publications												X					X			

**B. Explanation for not completing any planned milestones and tasks**

Not applicable

**C. Justification for new milestones and tasks**

Not applicable

**2. COORDINATION AND COLLABORATION**

**A. Within an EVOTC-Funded Program**

Provide a list and clearly describe the functional and operational relationships with other EVOTC-funded program projects. This includes any coordination that has taken or will take place and what form the coordination will take (shared field sites or researchers, research platforms, sample collection, data management, equipment purchases, etc.).

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

Indicate how your proposed program relates to, complements or includes collaborative efforts with other proposed or existing programs and projects funded by the EVOTC that are not part of a EVOTC-funded program.

**C. With Trustee or Management Agencies**

Please discuss if there are any areas which may support EVOTC trust or other agency work or which have received EVOTC trust or other agency feedback or direction, including the contact name of the agency staff. Please include specific information as to how the subject area may assist EVOTC trust or other agency work. If the proposed program requires or includes collaboration with other agencies, organizations or scientists to accomplish the work, such arrangements should be fully explained and the names of agency or organization representatives involved in the program should be provided. If your proposal is in conflict with another project, note this and explain why.

### ***Within the Herring Research and Monitoring (HRM) program***

Our study, PWS Herring Annual Migration Cycle, is a component of the larger, EVOS-sponsored Herring Research and Monitoring (HRM) program. We anticipate that we will continue to coordinate with the all the HRM projects. Our tagging work will inform the *Herring disease* studies (PI Herschberger) by establishing the migration and feeding locations of herring. This knowledge is important for identifying where and when exposure to the pathogens is occurring. This exposure information is a first step in helping to identify possible intermediate hosts for *Ichthyophonus*. From the *Herring hydroacoustic surveys* (PI Rand) we will receive data on adult school locations and will provide data to them on return timing of tagged fish. We also will investigate methods to track acoustic tag fish concurrently during hydroacoustic surveys for adults. Our project will contribute data to *Herring condition connection to environmental factors* (postdoc position) through identifying where the adult herring are at different times of year. Our project will also contribute movement and survival rate data to the project *Modeling and stock assessment* (PI Branch). For the *Herring age at reproductive maturity* (P.I. Gorman) we will share vessel space and will provide samples opportunistically. For the *Herring age, sex, and size collection* (P.I. Haught) we will receive and supply available information from Alaska Department of Fish and Game on timing and location of herring spawn. We will also be providing opportunistically seined herring from the *RV Solstice* for tagging. Finally, we will be in constant collaboration and coordination with our fearless HRM Coordinator/leader Scott Pegau, in order to improve and maintain all collaborative aspects of this project with other HRM projects. This includes attending PI meetings, making our data available in a timely matter, and completing reports in a timely matter.

### ***With Gulf Watch Alaska***

Our project will also provide information that will complement data collected by the Gulf Watch Pelagic Component's Integrated Predator-Prey Surveys. These joint surveys are being co-conducted by three existing projects:

<b><i>EVOS Gulf Watch Alaska</i></b>	
Forage fish distribution, abundance, & body condition in PWS	USGS
Humpback whale predation	NOAA/UAS
Fall and winter seabird abundance & distribution	PWSSC
PWS oceanography	PWSSC

Understanding movements by adult herring throughout the annual cycle will provide valuable information on trophic interactions between herring and piscivorous waterbirds (in particular, loons and common murre, the major avian consumers of adult herring), humpback whales, and other forage fish competitors. Additionally, the availability of oceanographic data from PWS collected at approximately monthly intervals from April-November provides an opportunity to explore how seasonal changes in herring distribution are associated with environmental drivers.

### ***With Other Council-funded Projects***

Except for the EVOS Herring Research & Monitoring Program and the EVOS Gulf Watch Alaska program, there are no other EVOS-funded collaborations.



### ***With Trustee or Management Agencies***

Our project relies on information from ADF&G to locate adult herring schools in spring for acoustic surveys and sampling. To that extent, we work closely with Stormy Haught at the Cordova office of ADF&G. Information learned about herring migrations will be shared with ADF&G.

### ***Collaborations With Other Organizations***

This project will synergize with efforts of the Ocean Tracking Network (OTN; Fred Whoriskey, PhD. Executive Director, Dalhousie University) and with the Alaska Ocean Observing System (Molly McCammon, Executive Director). In March 2013, OTN installed two, large-scale arrays including one across the mouth of Hinchinbrook Entrance and one across Montague Strait, and four small arrays at the southwest PWS passages of Latouche, Elrington, Prince of Wales, and Bainbridge. With FY16 EVOS funding, in February 2017, the PWS Science Center (PWSSC) expanded the OTN array. Equipment is assembled and configured by PWSSC personnel in Cordova. Currently PWSSC maintains the array for OTN/AOOS on an annual basis. OTN maintains a database with detections from their worldwide network. Our data is archived in the OTN databases, as per their guidelines. In 2017, the PWSSC received funding from the Alaska Ocean Observing Network to cover the costs of annual, regular maintenance of the OTN arrays. Funding will be for five years.

## **3. PROGRAM DESIGN**

### **A. Overall Program Objectives**

Identify the overall project objectives for the program as submitted in the original proposal.

### **B. Changes to Program Design**

If the program design has changed from your original proposal, please identify any substantive changes and the reason for the changes. Include any information on problems encountered with the research or methods, if any. This may include logistic or weather challenges, budget problems, personnel issues, etc. Please also include information as to how any problem has been or will be resolved. This may also include new insights or hypotheses that develop and prompt adjustment to the program.

### **A. Objectives for FY19**

Our previous tagging efforts suggest that herring are emigrating from PWS into the GoA and then returning (Eiler and Bishop, 2016; Bishop and Eiler, 2018). As part of the Herring Research and Monitoring program, during FY19 this acoustic tagging project will contribute to the HRM program objective #2 *Provide inputs to the stock assessment model*, and objective #3 *Examine the connection between herring condition or recruitment to physical and biological oceanographic factors*.

Our acoustic-tagging project objectives for FY19 include:

- 1) Document location, timing, and direction of Pacific herring seasonal migrations between PWS and the GoA.
- 2) Relate large-scale movements to year class and body condition of tagged individuals.
- 3) Determine seasonal residency time within PWS, at the entrances to PWS, and in the GoA.

Our study will provide a better understanding of the migratory patterns of herring and the potential factors affecting herring movements, survival, and population structure. In addition to peer-reviewed publications, our project will provide valued, requested information to the fishing community, the general public, and resource managers regarding latest research results and Pacific herring ecology.

### **B. Changes to Project Design**

Not applicable

**4. PROGRAM PERSONNEL – CHANGES AND UPDATES**

If there are any staffing changes to Primary Investigators or other senior personnel please provide CVs for any new personnel and describe their role on the project.

No personnel changes are anticipated for FY19.

**5. PROGRAM BUDGET**

**A. Budget Forms (Attached)**

Provide completed budget forms.

**B. Changes from Original Proposal**

If your FY19 funding request differs from your original proposal, provide a detailed list of the changes and discuss the reason for each change.

**C. Sources of Additional Funding**

Identify non-EVOSTC funds or in-kind contributions used as cost-share for the work in this proposal. List the amount of funds, the source of funds, and the purpose for which the funds will be used. Do not include funds that are not directly and specifically related to the work being proposed in this proposal.

**A. Budget Forms**

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL  
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM**

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	\$121.5	\$139.9	\$135.6	\$138.1	\$0.0	\$535.0	
Travel	\$1.2	\$1.2	\$1.2	\$1.2	\$0.0	\$4.6	
Contractual	\$23.6	\$46.3	\$52.9	\$5.5	\$0.0	\$128.3	
Commodities	\$118.7	\$80.5	\$5.0	\$0.1	\$0.0	\$204.3	
Equipment	\$5.9	\$0.0	\$0.0	\$0.0	\$0.0	\$5.9	
Indirect Costs (will vary by proposer)	\$79.5	\$80.3	\$58.4	\$43.4	\$0.0	\$261.7	
<b>SUBTOTAL</b>	<b>\$350.3</b>	<b>\$348.1</b>	<b>\$253.0</b>	<b>\$188.2</b>	<b>\$0.0</b>	<b>\$1,139.8</b>	<b>\$0.0</b>
General Administration (9% of subtotal)	\$31.5	\$31.3	\$22.8	\$16.9	\$0.0	\$102.6	N/A
<b>PROJECT TOTAL</b>	<b>\$381.9</b>	<b>\$379.5</b>	<b>\$275.8</b>	<b>\$205.2</b>	<b>\$0.0</b>	<b>\$1,242.3</b>	
Other Resources (Cost Share Funds)	\$15.0	\$15.0	\$15.0	\$15.0		\$60.0	

**COMMENTS:**

The PWS Science Center will provide in-kind equipment (9 VR2-W acoustic receivers and 9 acoustic releases) for an array that will be deployed around the tagging site. The value of this equipment is estimated at \$63k. This project also uses the Ocean Tracking Network, a series of acoustic arrays installed at the entrances to PWS (in place at Hinchinbrook Entrance, Montague Strait, and 4 southwestern Prince William Sound passages. The current value of these Ocean Tracking Network acoustic arrays is estimated at \$337k (not including the FY16 additions funded by EVOS). This project also piggy-backs on the annual Ocean Tracking Network maintenance cruise (funded by AOOS beginning in FY17) which includes 5d@\$3/k day.

**B. Changes from Original Proposal**

The Alaska Department of Natural Resources is now requiring that a bond be posted and that annual fees be paid for land use permits for underwater acoustic arrays. The additional cost of the bond (\$2.6k) and the annual permit fees (\$2.7k) are now included in the budget.

**C. Sources of Additional Funding**

This project uses Dalhousie University's Ocean Tracking Network, a series of acoustic arrays that are in place at Hinchinbrook Entrance, Montague Strait, and four, smaller passages in southwest PWS. The value of the Ocean Tracking Network acoustic arrays is estimated at \$337,200. This project also piggy-backs on the annual Ocean Tracking Network maintenance cruise (funded by the Alaska Ocean Observing System starting in FY 17) which includes 6d@\$3/k day. PWS Science Center will also provide in-kind equipment (9 VR2W acoustic receivers, 9 acoustic releases, and 9 floats) for an array that will be deployed at the tagging site as well as 9 VR3 refurbished receivers. The value of this equipment is estimated at \$108k.

## 6. FY18 PUBLICATIONS AND PRODUCTS

Products include publications (include *in prep* and *in review*), published and updated datasets, presentations, and outreach during FY18.

### *Peer-reviewed publications:*

Bishop, M.A. and J. H. Eiler. 2018. Migration patterns of post-spawning Pacific herring in a subarctic sound. *Deep-Sea Research Part II*. 147: 108-115. <https://doi.org/10.1016/j.dsr2.2017.04.016>

### *Publications in-prep.:*

Bishop, M.A., B. Gray, and J.H. Eiler. In prep. Inter-annual variation in migration patterns of Pacific Herring. Journal tbd.

### *Datasets:*

Bishop, M.A. 2017. Tracking seasonal movements of adult Pacific Herring in Prince William Sound, 2012-2014, EVOS Herring Program. Axiom Data Science. <https://doi.org/10.24431/rw1k1x>

<http://portal.aos.org/gulf-of-alaska.php#metadata/c1e401be-8d52-477b-a76b-acf5cd817686/project>

### *EVOS Final Reports:*

Bishop, M.A. 2018. Tracking Seasonal Movements of Adult Pacific Herring in Prince William Sound. *Exxon Valdez Oil Spill Restoration Project Final Report (Project 14120111-B)*, Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

Bishop, M.A. 2018. Annual Herring Migration Cycle: Expanding Acoustic Array Infrastructure. Exxon Valdez Oil Spill Restoration Project Final Report (Project 16160111-S), Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

### *Outreach:*

Bishop, M.A. 2018. How to tag a herring. *Delta Sound Connections*

Gray, B. 2018. Herring on the menu. *Delta Sound Connections*