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

Proposals requesting FY19 funding are due to shiway.wang@alaska.gov and 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.

Project Number and Title

19170111-F

Surveys and age, sex, and size collection and processing

Primary Investigator(s) and Affiliation(s)

Stormy Haught, Alaska Department of Fish and Game

Date Proposal Submitted

August 17, 2018

Project Abstract

The proposed project will conduct spring aerial surveys to document Pacific herring *Clupea pallasii* milt distribution and biomass as well as the distribution and abundance of sea lions, other marine mammals, and birds associated with herring schools or spawn. This proposed project will also provide a research platform (R/V Solstice) for an adult herring acoustics survey and disease sample collection and processing. Finally, we will collect and process age, sex, and size of herring for the acoustics surveys, spawning surveys, and the PWS Herring Research and Monitoring Program disease sampling. Aerial survey and age, sex, and size data have been collected since the early 1970s and are an essential part of the age-structured model used by the Alaska Department of Fish and Game to estimate the historical and future biomass for fisheries management. Acoustics surveys have been conducted consistently since 1995 and the age-structured model is also tuned to acoustics biomass estimates. This project will help to meet the overall program goal to improve predictive models of herring stocks through observations and research by providing necessary inputs to the age-structured assessment models of the Alaska Department of Fish and Game and the *PWS Herring Research and Monitoring Program* Bayesian model.

**The abstract should provide a brief overview of the overall goals and hypotheses of the project and provide sufficient information for a summary review as this is the text that will be used in the public work plan and may be relied upon by the PAC and other parties.*

EVOSTC Funding Requested* *(must include 9% GA)*

FY17	FY18	FY19	FY20	FY21	TOTAL
Auth:$166,300	Auth:$166,300	$166,300	$166,300	$166,300	$831,500

Non-EVOSTC Funds to be used, please include source and amount per source:

FY17	FY18	FY19	FY20	FY21	TOTAL
$54,500	$54,500	$54,500	$54,500	$54,500	$272,500

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

1. PROJECT 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 since your last annual report: 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*. Prior annual reports will be appended to remind reviewers of progress in previous years.

This project will help to meet the overall goal to improve predictive models of herring stocks through observations and research by providing necessary inputs to the age-structured assessment models of Alaska Department of Fish and Game (ADF&G) and the *PWS Herring Research and Monitoring Program – Population Modeling.*

This project will continue long-term monitoring programs to 1) conduct aerial surveys to collect data associated with spring Pacific herring *Clupea pallasii* spawning events, 2) collect and process age, sex, and size (ASL) samples from prespawn and spawning aggregations of Pacific herring, and 3) provide vessel support for spring acoustics surveys, disease sampling, and collection and processing of age, sex, and size samples for target strength assessment.

Spring aerial survey data have been collected since 1972 (Funk 1994), and spring acoustics surveys have been consistently conducted since 1995 (Willette et al. 1999). ASL data are available since 1973 (Sandone 1988); however, collections of both data sets have been more extensive since the early 1980s. Herring age data were collected in 1971 and 1972 also, but only published frequency plots (no individual fish data) are available (Pirtle et al. 1973).

Aerial surveys were used to document spring herring biomass and were the primary management tool prior to the development of the first statistical catch-at-age model or age structured assessment model (ASA) in 1988 (Brady 1987, Funk and Sandone 1990). Biomass is estimated as school surface area converted to biomass from a few paired observations of aerial observers and vessel harvests (Brady 1987, Fried 1983, Funk and Sandone 1990). Surface area and biomass conversion methods are as described in Brady (1987) and Lebida and Whitmore (1985). Prior to 1988, the aerial survey program's primary objectives were to collect biomass data for an annual index, document the distribution and linear extent of milt, document herring temporal movements, and document the distribution of commercial fishing boats, fishing tender boats, and processor boats (Brady 1987). Additionally, the locations of large aggregations of Stellar sea lions (*Eumetopias jubatus*) and other marine mammals were often noted on paper maps.

Brady (1987) described how herring arrive on the spawning grounds over time and may be documented on multiple aerial surveys. Therefore, the biomass over several days of surveys cannot be summed to estimate the total or peak biomass. Consequently, peak biomass was calculated as the largest biomass observed in all areas on a single survey (Brady 1987). Additional biomass with a discrete time separation would also be added, but these conservative methods were required to estimate the peak biomass because the amount of time herring were available to observation by aerial surveys was unknown and likely variable (Funk and Sandone 1990).

Brady (1987) also detailed how the variable bathymetry of herring spawning areas in Prince William Sound has a large influence on the observer's ability to see herring schools. Herring may spawn in shallow bays (e.g., Rocky Bay, Montague Island), shallow beaches (e.g. Hells Hole beach), or deep bays (e.g., Fairmont Bay on the North Shore). The influence of bathymetry on observer efficiency suggests a biomass index will probably not be

comparable across years. Although Funk and Sandone (1990) indicated that peak biomass values may be a useful relative abundance, issues with biomass observations described by Brady (1987) and Funk and Sandone (1990) caused the department to investigate the use of an index of spawn from observations of milt.

Two indices considered for spawn documented from aerial surveys were 1) discrete miles of milt over the season and 2) the sum of miles of milt for all survey days (mile-days of milt). The advantages of milt observations compared to school biomass observations are 1) herring schools likely spawn a single time e.g., a single day, but a herring school may be observed for several days prior to, or after spawning, 2) milt is relatively easy to observe from the air and observation efficiency is generally not influenced by ocean bathymetry (Brady 1987).

Discrete miles of milt do not account for multiple spawning events in the same area, so are unlikely to be a good index of total abundance in areas with multiple days of spawning on the same beach (Brady 1987). Mile-days of milt probably provide a better index to abundance because they account for multiple spawning days on the same beach but may be biased if the number of surveys varies significantly across years (Funk 1994). Additionally, although bathymetry probably will not influence observation of milt, it is likely one factor that will influence the biomass of spawning fish for each linear mile of milt observed. Willette et al. (1999) collected paired spawn deposition survey estimates from dive surveys and aerial survey estimates of miles of milt; the short tons (dive survey) per mile of milt (aerial survey) were much larger on Montague Island beaches when compared to short tons per mile of milt in northern or northeastern PWS beaches. Montague Island shoreline typically has large shallow, subtidal areas with complex kelp structure while the northern and northwestern beaches tend to have a steeper gradient to deep waters and less complex kelp structure. Funk (1994) used the discrete miles of milt index in his ASA model rather than the mile-days of milt index because there were fewer surveys flown in the early years (1970s). However, subsequent runs of the ASA model have excluded the earlier years and use of the mile-days of mile index.

In 2008 the department began using a tablet computer and a geographic information system (GIS) application to collect aerial survey data (Bochenek 2010). Since 2008, additional effort has been employed in documenting numbers and locations of predators such as Stellar sea lions, humpback whales (*Megaptera novaeangliae*), killer whales *Orcinus orca*, Dall's porpoises (*Phocoenoides dalli*), and bird aggregations (mostly gulls) associated with herring schools or spawn. These changes were driven by growing interest in the distribution and abundance of herring predators and the increased data capacity of scalable digital maps.

ASL data from Pacific herring have been collected from commercial fisheries and fishery independent research projects since the early 1970s. The department currently has an archive containing approximately 210,000 scales paired with size and sex data (most of the archive has been collected since 1979). Summaries of many of these data have been published (e.g., Sandone 1987, Funk and Sandone 1990, Willette et al. 1999). Processing methods are similar those described by Baker et al. (1991); however, electronic fish measuring boards have been used to enter sample summary data and individual fish data (standard length in mm, whole body weight in grams, and sex) at the time of processing since 1989. Gonad weights have been collected from prespawning fish (both sexes) in most years since 1994 (n = 8,500).

Scales are used to estimate age for PWS herring collections. They are much easier to collect and prepare for examination than otoliths. Chi-square tests of age compositions from paired otoliths and scales collected off the British Columbia coast could not refute the null hypothesis that they were from the same population (Chilton and Stocker 1987). Interpretation of age from otoliths indicated that there were older fish than interpreted from scales; however, few fish older than age 10 are found in PWS, so fish interpreted at age 9 and older are

combined into an age category 9+. Age validation and tests of paired age structures have not been completed for PWS herring.

Aerial survey, acoustics estimates, and ASL data sets are essential parts of the current ASA model that ADF&G uses to estimate historical biomass and project pre-fishery biomass a year ahead for management (e.g., Hulson et al. 2008). Additionally, mile-days of milt and ASL data are part of the Bayesian formulation of the ASA model (Muridan 2015). Scales collected from this archive were used in an EVOS funded project titled "PWS Herring Program - Scales as growth history records".

2018 Preliminary Results

In 2018 we conducted 12 aerial surveys (39.5 hours of flight time) from March 24th – April 19th (figure 1). The number of aerial surveys was down from previous years (figure 2) due to poor spring weather conditions. Surveyors observed 3.24 miles-days of active spawn milt (does not include milt observations classified as "drift" or "dissipating") in 2018, a historical low for this program (figure 3). Spatial and temporal distribution of spawning events has been increasingly limited in recent years (figures 4 and 5). This trend continued in 2018 with observed spawning events limited to Port Gravina and Canoe Pass areas (figure 6). As in recent years, additional observations of milt were made in the Kayak Island area (5.81 mile-days of milt in 2018, figure 1), but observations from this area have not historically been included in the PWS mile-days of milt index.

2018 herring collections for ASL, disease, maturity, and tagging studies were made using purse seine and the R/V Solstice, as well as cast netting in active spawn from a skiff. Collections involved 3 cruises on the R/V solstice (April 6- April 9, April 9-April 13, and April 17-April 18) for a total of 10 vessel days in 2018. Purse seine samples were collected at Hells Hole in Port Gravina (April 11), Rocky Bay on Montague island (April 13) and Cedar bay near canoe pass on Hawkins Island (April 12). Cast net samples of actively spawning fish were collected at Hells Hole (April 7) and Canoe Pass (April 17). ASL samples are in process and expected to be completed mid-September 2018. Age compositions from recent years have shown high proportions of 3-year old fish (see figure 6, 2017 age composition for example) and declining weight and length at age for most age classes (figures 7 and 8). Once complete, 2018 samples will be added to historical data to compare age composition and size.

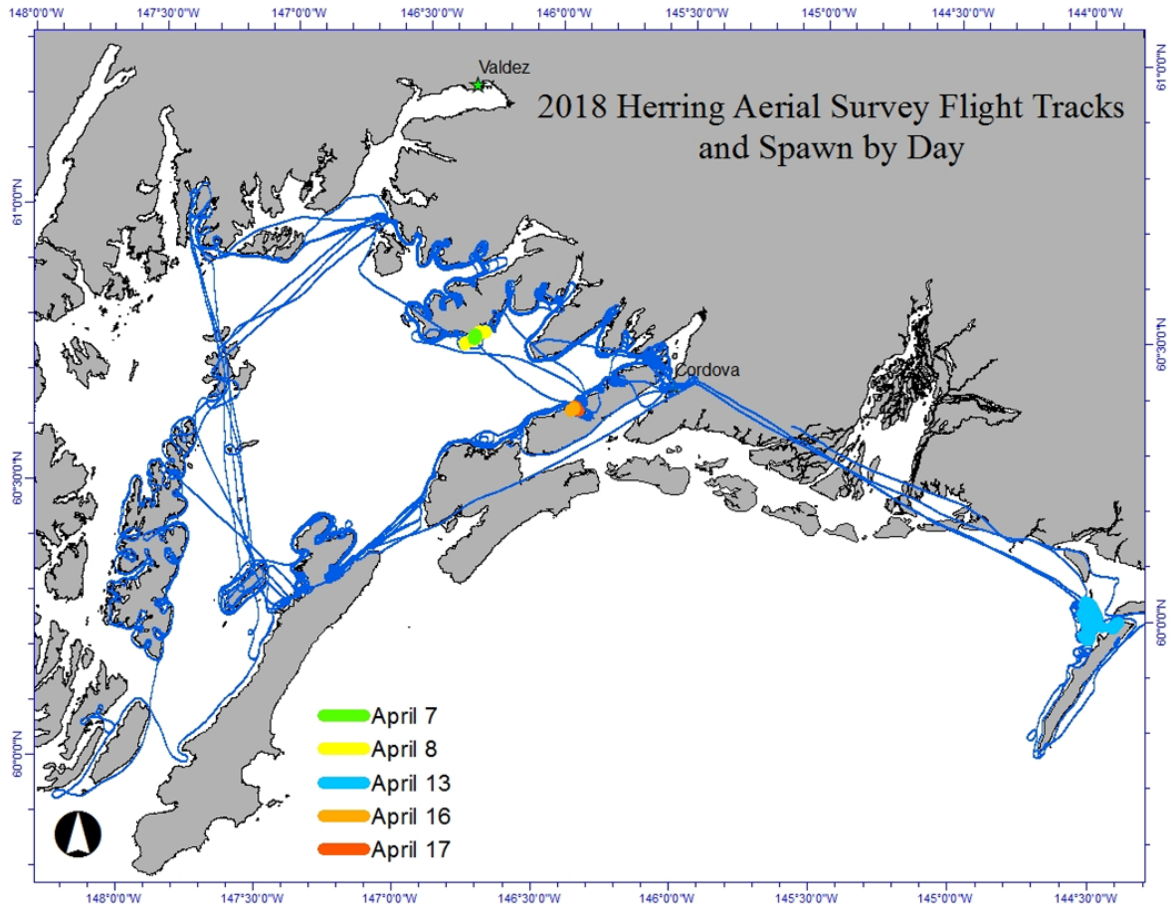

Figure 1- 2018 Aerial survey tracks (blue lines) and observed spawning events.

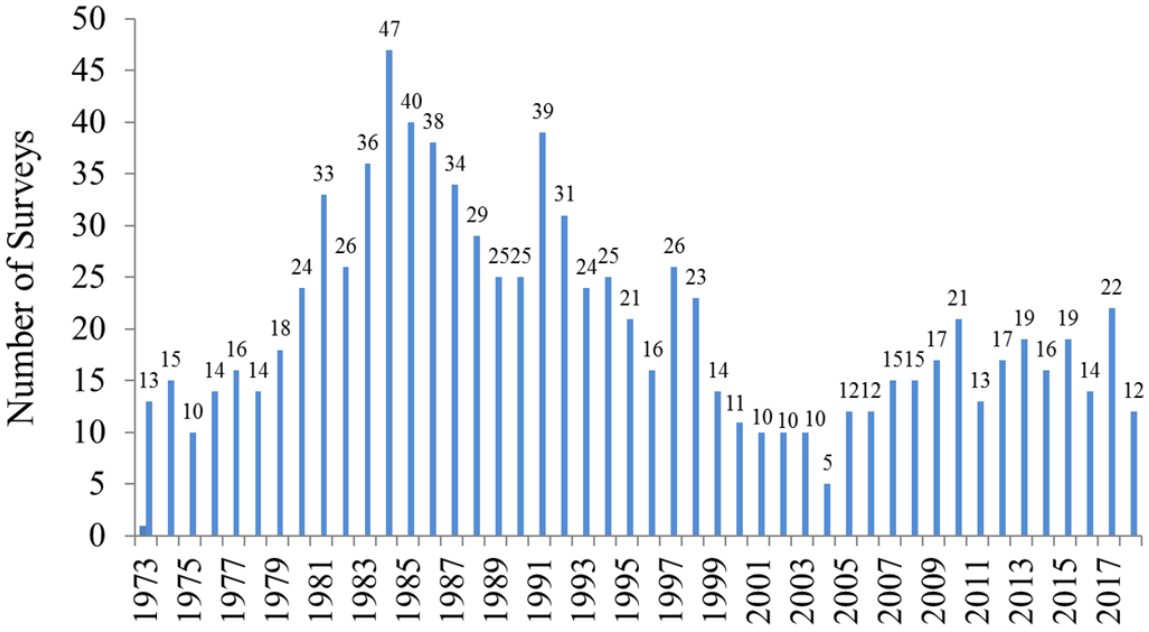

Figure 2- Number of spring PWS herring aerial surveys performed annually 1973-2018

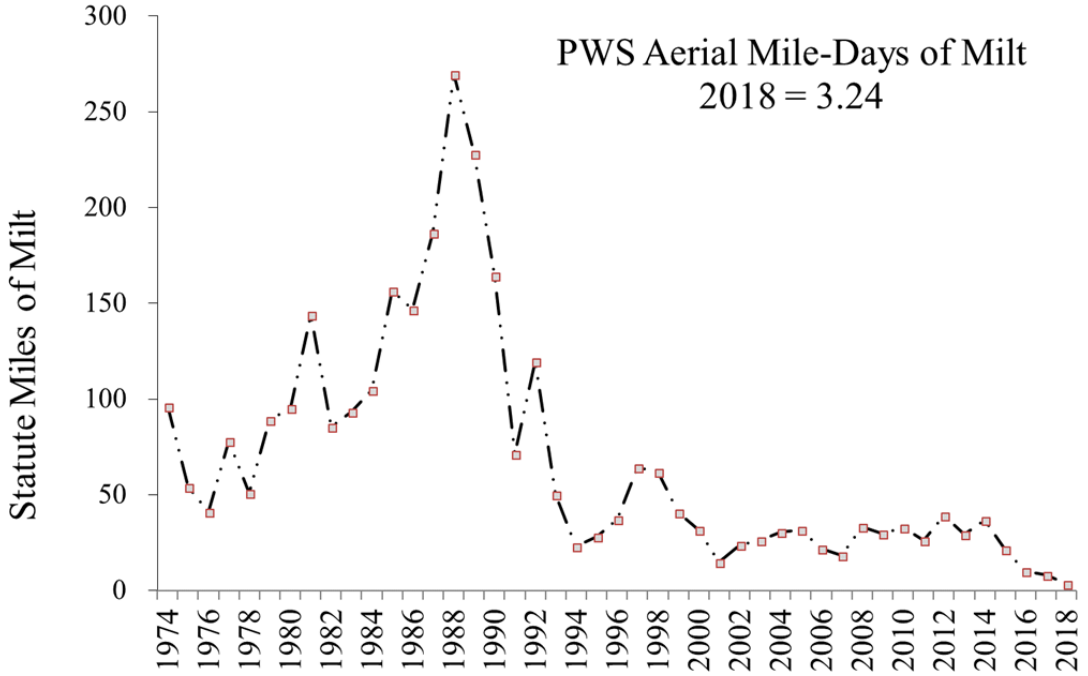

Figure 3- Mile-days of milt observed during spring PWS herring aerial surveys 1974-2018

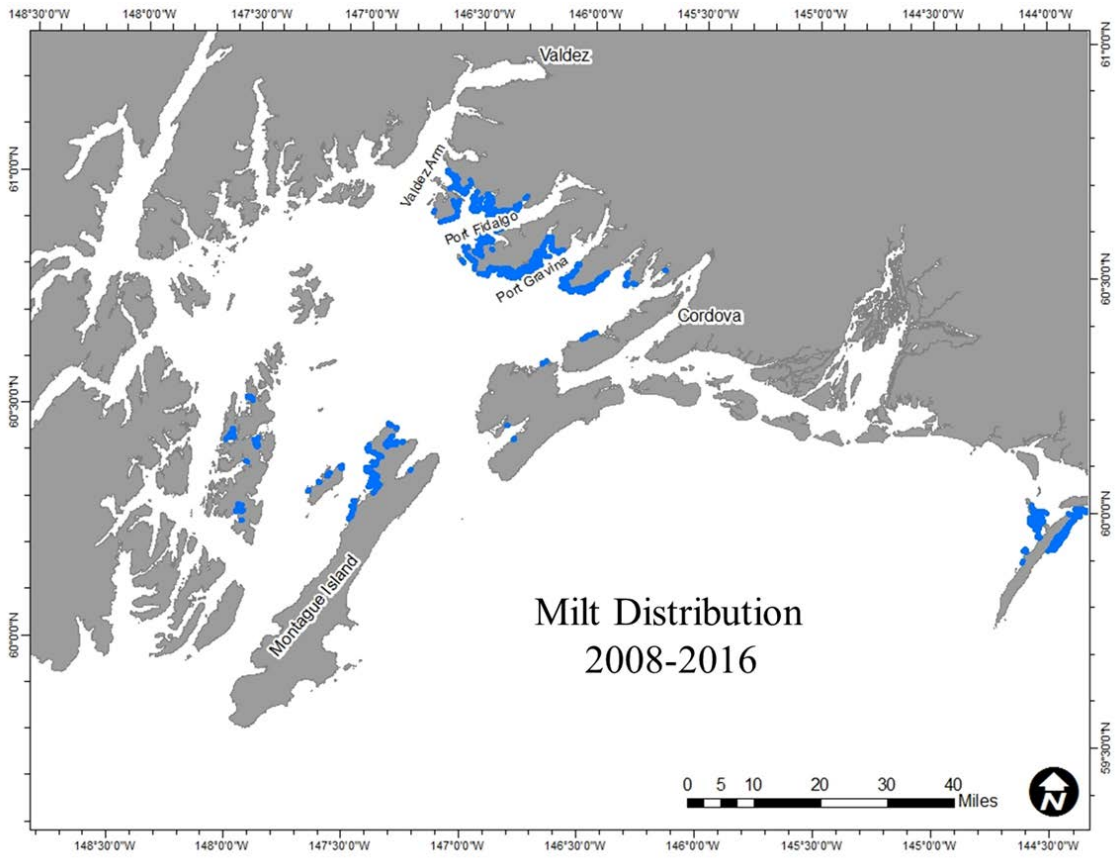

Figure 4- Locations of herring milt observations from aerial surveys 2008-2016

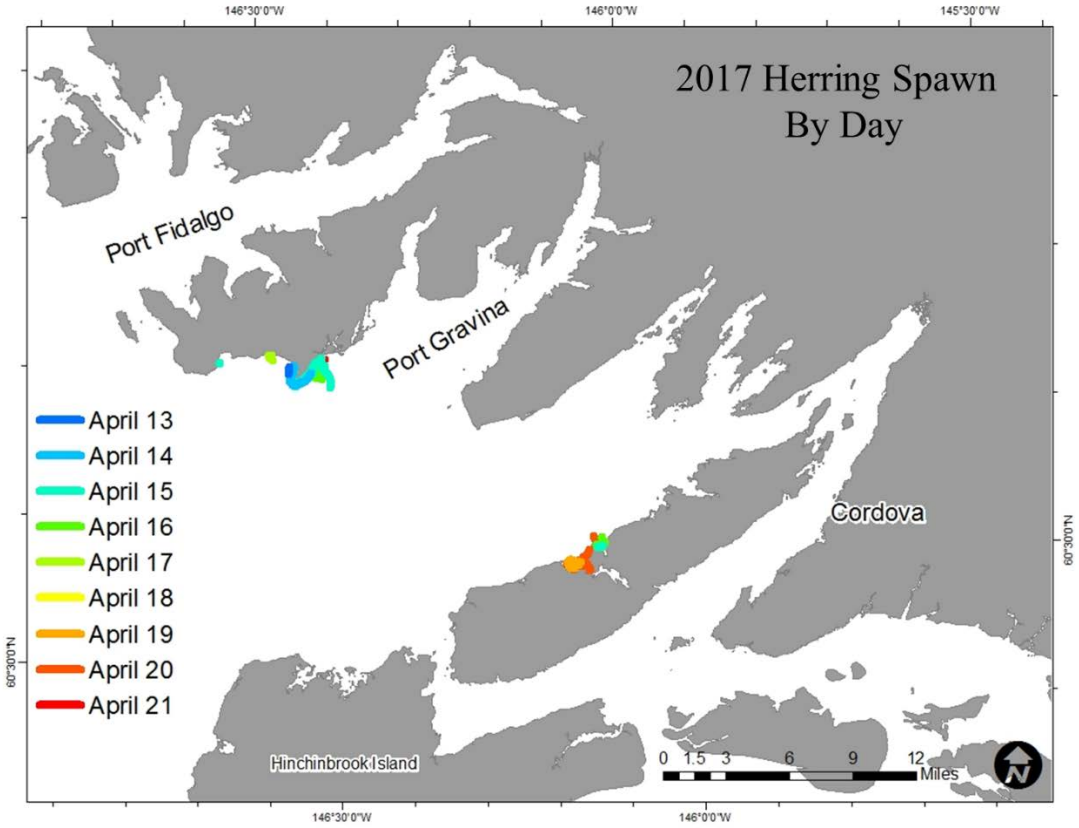

Figure 5 - Milt observed during 2017 Aerial surveys by day

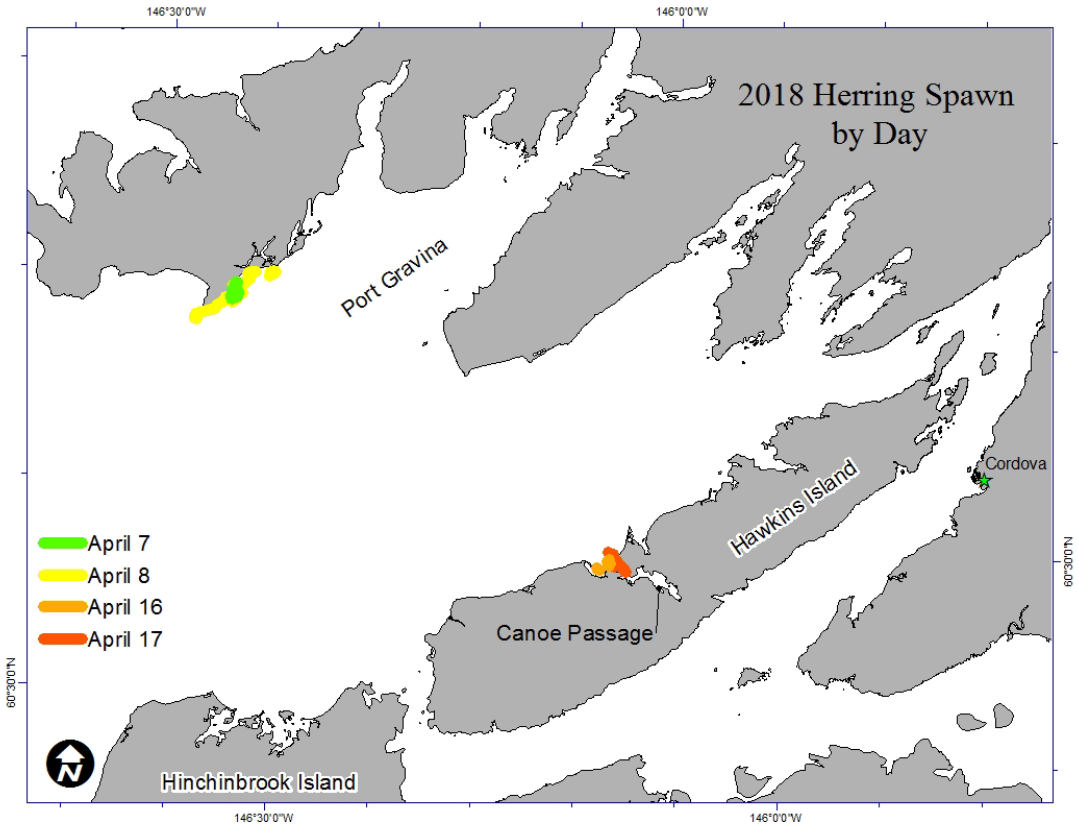

Figure 6 – Milt observed during 2018 Aerial surveys by day

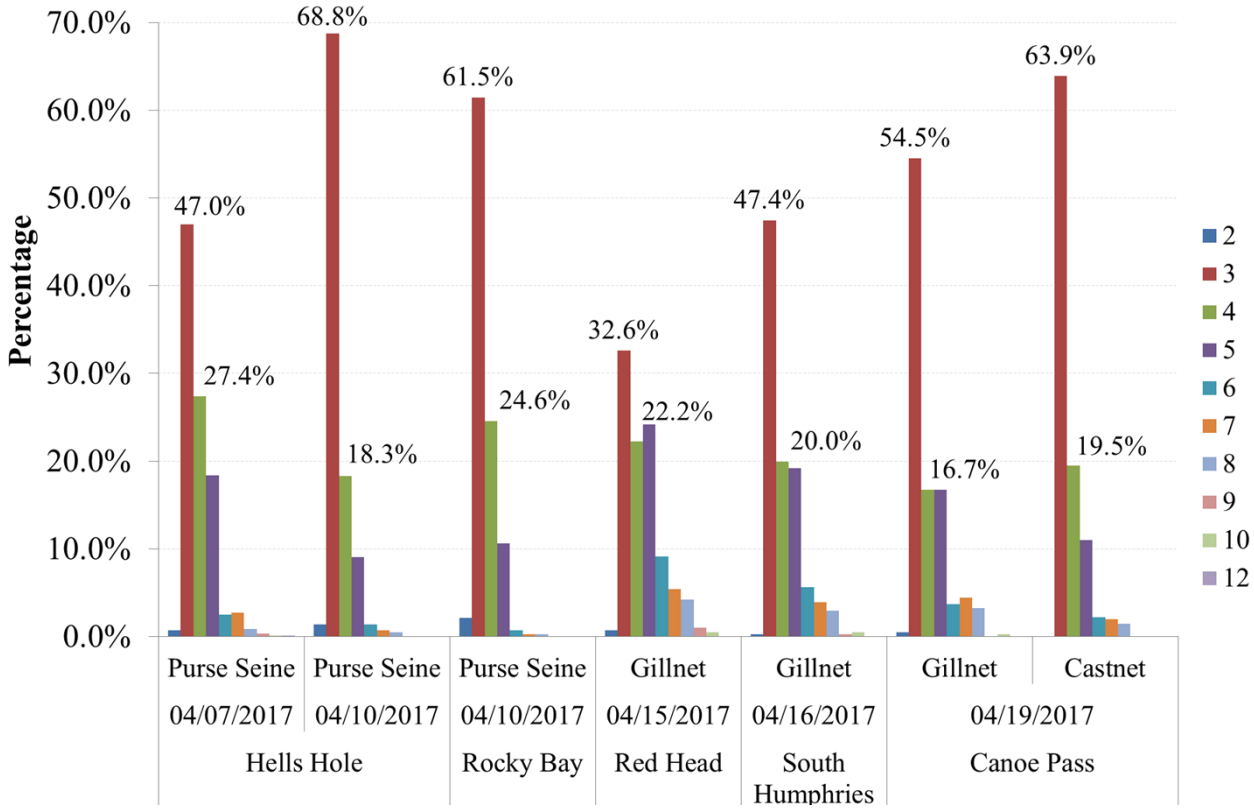

Figure 7 - Age composition of 2017 herring samples

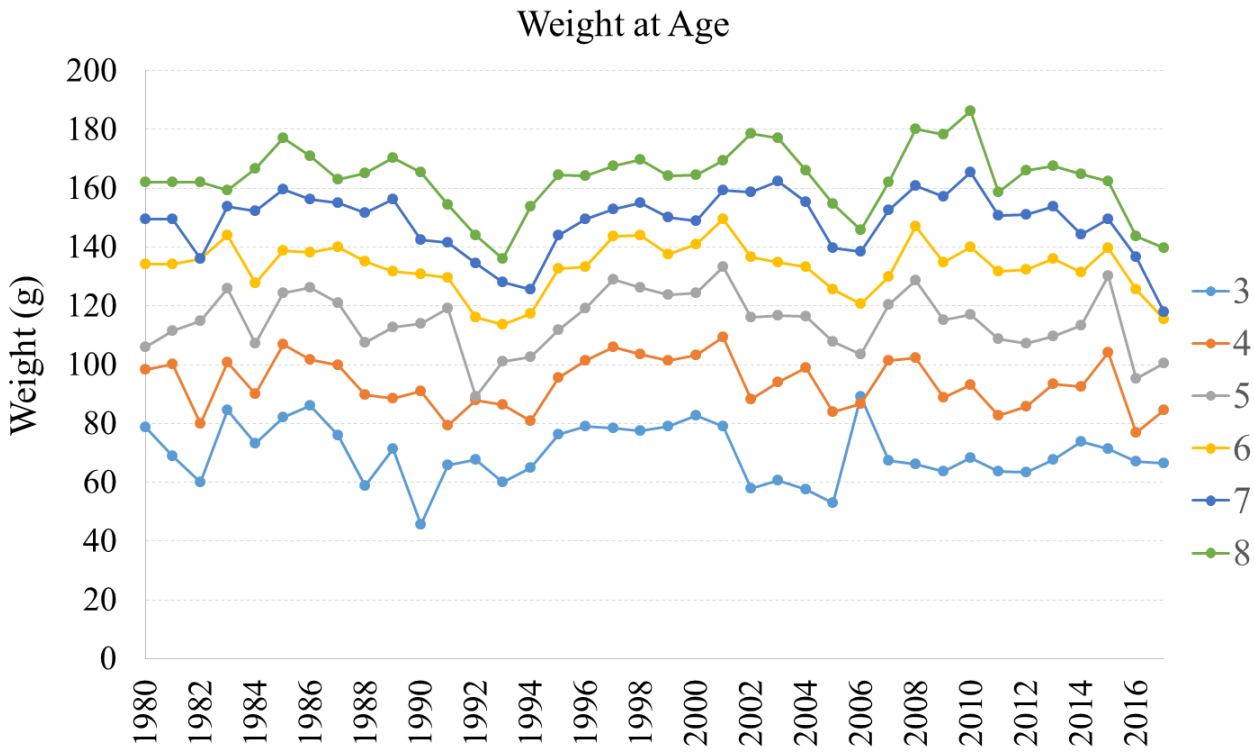

Figure 8 – Weight at age of PWS herring 1980-2017

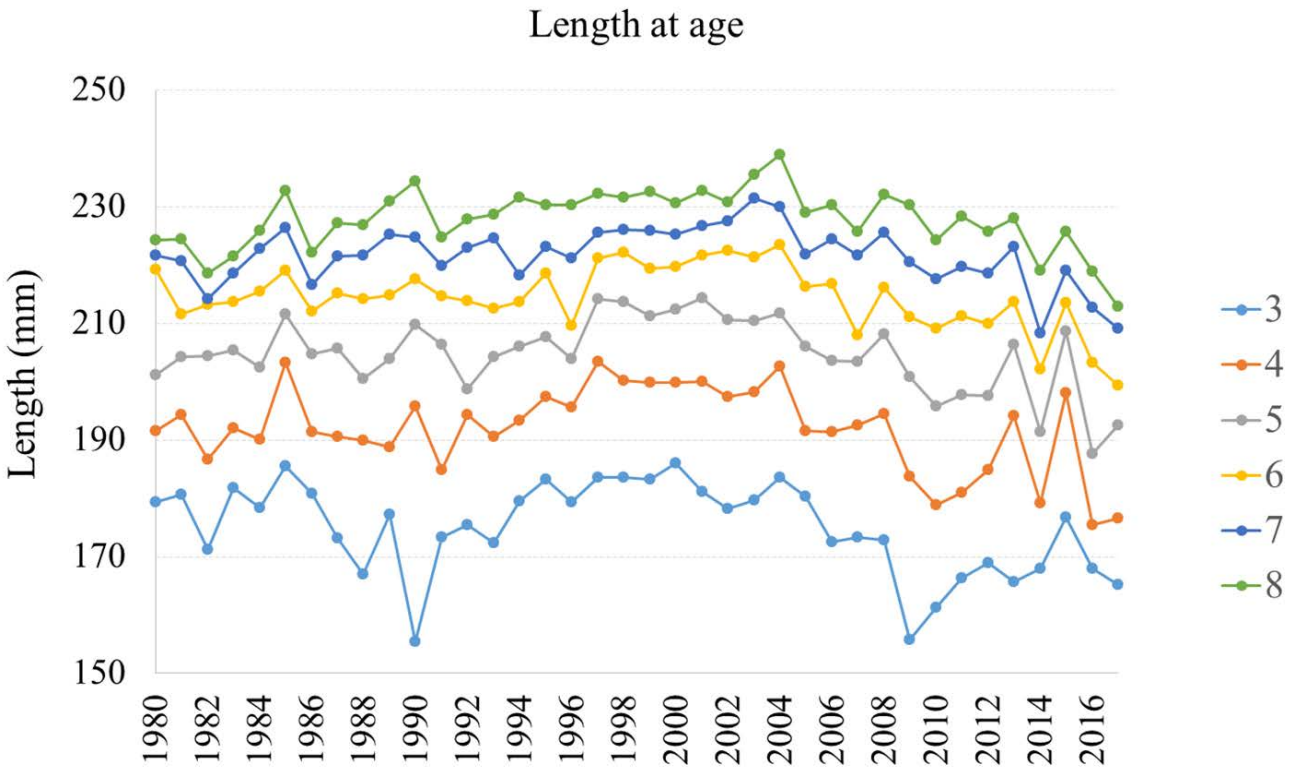

Figure 9 – Length at age of PWS herring 1980-2017

Literature cited

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2. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

A. Project Milestones and Tasks

Milestones are annual steps to meet overall project 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. Project Milestones and Tasks

Project 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.

	FY17				FY18				FY19				FY20				FY21			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Fieldwork													X	X			X	X		
Aerial surveys	C	C			C	C			X	X			X				X			
Acoustics and disease support survey	C				C				X											
Lab Analysis														X	X			X	X	
Herring ASL sample processing	C	C	C		C	C	X			X	X									
Data															X				X	
Quality control ASL data		C				C					X			X				X		
Quality control and editing of aerial shape files		C				C				X					X				X	
Analysis of aerial survey data			C				C				X				X				X	
Combing aerial survey shape files into historical version			C				X				X			X				X		
Upload previous FY data/metadata to workspace		C				C				X					X				X	
Distribute ASL sample summary		C					x				X									
Reporting																				

Annual reports					C				X				X				X			
Summary Report								X				X				X				X
FY work plan (DPD)			C				X				X				X					
FY17-21 Final Report																				X
Meetings & Conferences																				
Annual PI meeting				C				X				X				X				X
Publications?																				
Manuscript																				
New Milestone																				
New task																				

B. Explanation for not completing any planned milestones and tasks

Herring ASL sample processing is in progress and is expected to be completed as scheduled by mid-September, 2018. GIS work including combining 2018 aerial survey files with the historical files is expected to be completed as scheduled by mid-September, 2018.

C. Justification for new milestones and tasks

None.

3. PROJECT COORDINATION AND COLLABORATION

A. Within an EVOTC-Funded Program

Provide a list and clearly describe the functional and operational relationships with any EVOSTC-funded Program (Herring Research and Monitoring, Long-Term Research and Monitoring or Data Management Programs). 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 EVOSTC-funded Projects

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

C. With Trustee or Management Agencies

Please discuss if there are any areas which may support EVOSTC trust or other agency work or which have received EVOSTC 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 EVOSTC trust or other agency work. If the proposed project 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 project should be provided. If your proposal is in conflict with another project, note this and explain why.

A. *PWS Herring Research and Monitoring Program –Acoustics Survey*.

The proposed project will share the R/V Solstice vessel research platform with a Prince William Sound Science Center staff member to conduct the adult acoustics survey. ADF&G acoustics equipment will be shared with the Acoustics Survey project if necessary. This proposed project will also capture and process age, sex, and size samples to calculate mean target strength by time or area strata for use in

acoustics echo integration. Aerial surveys conducted by this proposed project will provide additional location information on herring aggregation for acoustics surveys.

PWS Herring Research and Monitoring Program – Outreach and Education.
The proposed project will assist public outreach through public presentations of methods and results.

PWS Herring Research and Monitoring Program – Herring Disease Studies
The proposed project will provide research platform vessel support (R/V Solstice) for Herring Disease Studies staff to capture and process adult herring for disease sampling as in past years. Additionally, this project will help collect scales for fish age and interpret the scales for age.

PWS Herring Research and Monitoring Program – Age at Maturity
The proposed project will assist with collection and processing of herring scales for the proposed age at maturity project.

PWS Herring Research and Monitoring Program – Population modeling
The proposed project will collect mile-days of milt, provide vessel support for the acoustics survey, and provide age, sex, and size data to update the time series of data required for the Bayesian population dynamics model.

B. *Data Management Program*
The proposed project will provide additional herring aerial survey and herring age, sex, and size data for use by other PWS Herring Program projects. Past funding and ADF&G funding has allowed us to provide aerial survey GIS data files for linear extent of spawn (1973–2015), survey routes (1997–2015), sea lion distribution and abundance (2008–2015), other marine mammals distribution and abundance (2008–2015), and bird aggregations (2008–2015).

C. *ADF&G Fisheries Management*
Aerial survey, acoustics estimates, and ASL data sets are essential parts of the current ASA model the Alaska Department of Fish and Game (ADF&G) uses to estimate the historical biomass and project pre-fishery run biomass a year ahead for management (e.g., Hulson et al. 2008). Additionally, the mile-days of milt and ASL data are part of the Bayesian formulation of the ASA model (Muridan 2015), and the scales collected from this archive were used in an EVOS funded project titled "PWS Herring Program - Scales as growth history records".

4. PROJECT DESIGN

A. Overall Project Objectives

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

B. Changes to Project Design and Objectives

If the project design and objectives have changed from your original proposal, please identify any substantive changes and the reason for the changes. Please include the revised objectives in this section. 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 project.

A. These data will be collected to meet the overall goal to improve predictive models of herring stocks through observations and research by providing necessary inputs to the age-structured assessment models of ADF&G

and the *PWS Herring Research and Monitoring Program – Population Modeling.* These data will add to data collected since 1972 (aerial surveys) and 1973 (age, sex, and size data).

Objectives of this proposed project are as follows:

1.) Conduct spring aerial surveys to collect data on survey routes, location and linear extent of herring milt, classification of herring milt, herring school biomass; distribution and abundance of sea lions, other marine mammals and bird aggregations associated with herring or herring spawn; and other relevant environmental or anthropogenic observations.

2.) Collect, process, summarize, and distribute age, sex, and size data from herring collected during acoustics surveys, spawning grounds surveys, *PWS Herring Research and Monitoring Program* disease surveys, or other relevant collections.

   a. Estimate age composition in each fishery and spawning escapements by gear type for time and area strata with sample sizes sufficient to simultaneously estimate all age proportions to within $\pm$ 5% at the 90% level of precision.

   b. Estimate mean standard length and whole body weight for each fishery and spawning escapements by gear type for time and area strata with sample sizes such that the relative error is $\pm$5% at the 95% level of precision.

   c. Estimate the mean gonad weight of prespawning fish for time and area strata with sample sizes such that the relative error is $\pm$5% at the 95% level of precision.

   d. Estimate sex composition of each fishery and spawning escapements by gear type for time and area strata with sample sizes sufficient to estimate proportions to within $\pm$5% at the 95% level of precision.

3.) Provide a vessel (R/V Solstice) as a research platform for an adult acoustics survey, disease sampling, and collection of pre-spawn and spawning Pacific herring samples. Mean length from pre-spawn samples will be used to estimate Pacific herring target strength for the acoustics work.

B. Based on previous science panel reviews, we attempted to ground-truth aerial observations of spawn extent by performing skiff surveys and visually observing egg deposition extents. This was successfully completed for all aerial observations in 2018. However, completion of ground truthing this year was likely possible due to the limited (compared to historical observations) temporal and spatial extents of herring spawning events, and their close proximity to Cordova.

5. PROJECT PERSONNEL – CHANGES AND UPDATES

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

None.

6. PROJECT BUDGET FOR FY19

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

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$54.5	$54.5	$54.5	$54.5	$54.5	$272.5	
Travel	$1.4	$1.4	$1.4	$1.4	$1.4	$6.8	
Contractual	$94.6	$94.6	$94.6	$94.6	$94.6	$473.0	
Commodities	$2.1	$2.1	$2.1	$2.1	$2.1	$10.5	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
SUBTOTAL	$152.6	$152.6	$152.6	$152.6	$152.6	$762.8	$0.0
General Administration (9% of subtotal)	$13.7	$13.7	$13.7	$13.7	$13.7	$68.7	N/A
PROJECT TOTAL	$166.3	$166.3	$166.3	$166.3	$166.3	$831.5	
Other Resources (Cost Share Funds)	$54.5	$54.5	$54.5	$54.5	$54.5	$272.5	

B. None.

C. ADF&G will provide an in-kind contribution of 2.4 months (0.17 FTE) of Fishery Biologist III time ($33.4 K) to provide overall supervision of the project, conduct boat and aerial surveys, analyze data, provide data to other program projects, and write reports. ADF&G will provide and in-kind contribution of 2.1 months (0.18 FTE) of Fishery Biologist II time ($20.7 K) to supervise FB I, FWT III, and FWT II, conduct boat and aerial survey, analyze data, provide data to other program projects, and write reports (*Objectives 1–3*).

7. FY18 PUBLICATIONS AND PRODUCTS

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

Vega, S. L., C. W. Russell, J. Botz, and S. Haught. (in review). 2017 Prince William Sound area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. XX-XX, Anchorage.