ATTACHMENT C. Annual Program Status Summary Form (Revised 11.21.19)

1. Program Number:

19120111

2. Program Title:

Herring Research and Monitoring

3. Program Lead Name(s):

W. Scott Pegau, Prince William Sound Science Center

4. Time Period Covered by the Summary:

February 1, 2019 to January 31, 2020

5. Date of Summary:

March 2020

6. Program Website (if applicable):

https://pwssc.org/herring/

7. Overview of Work Performed during the Reporting Period:

The overall goal of the Herring Research and Monitoring (HRM) program is to: **Improve predictive models of herring stocks through observations and research**. The program objectives are to:

1) Expand and test the herring stock assessment model used in Prince William Sound (PWS).
2) Provide inputs to the stock assessment model.
3) Examine the connection between herring condition or recruitment to physical and biological oceanographic factors.
4) Develop new approaches to monitoring.

a) Progress toward addressing hypotheses and achieving goals

In addressing the first objective, the Bayesian Age Structure Analysis (BASA) model was expanded to include age-1 herring surveys to determine the value of that survey in predicting the incoming age-3 herring. Furthermore, the run-time of the model has been greatly reduced from over 3.5 hours to just 15 minutes, by adopting a new and vastly more efficient Bayesian algorithm called the No-U-Turn-Sampler (NUTS), which was programmed into the modeling software packaged AD Model Builder by Cole Monnahan as part of additional efforts in the Branch lab to improve stock assessment methods. This allows a much broader array of sensitivity tests to be run on the model in a Bayesian context, and facilitates rapid evaluation of additional models to assess factors that may influence natural mortality and recruitment.

Prior to 2019, BASA consistently overestimated biomass during years with historically low biomass (2014-2018). Checks on current BASA assumptions were explored including down-weighting age composition data, an alternative model of disease, and estimating a regime shift in mean recruitment. Down-weighting the age-composition data resulted in much better fits to biomass indices and lower estimated biomass. Incorporating a shift in mean recruitment also lowered the biomass estimate, but to a lesser extent. These preliminary results may suggest a change in natural mortality is not adequately accounted for during these years. Analyses testing current model assumptions and structure are ongoing, in order to continue to improve fits and reduce estimation bias in the model.

Previous maturity assumptions within BASA imply a risk of model misspecification because of the mature vs. immature composition of the schools targeted by seine and cast net sampling and their representation of the pre- and post-spawning populations. Even though maturity data are available, it is not representative of the entire population and cannot offer an accurate estimation of the true biological maturity because sampling is largely from spawning schools. We explored different assumptions about maturity in BASA that bound the potential effects of mis-specifying maturity, including fixed fast vs. slow maturity schedules, one maturity schedule for all years vs. two different schedules split at 1997, estimating availability of immature fish (from the maturity data), assuming a fixed true biological maturity schedule of the total population (fast and slow), and estimating selectivity of seine and cast nets conditioned on the maturity data (making additional assumptions about certain samples showing high immature proportions representing the unsampled population). All of these different options had negligible impact on biomass and recruitment estimates on average but had some implications for model stability. Therefore, we have shifted the base BASA model to only estimate one period of maturity, with the value of maturity also including availability of herring to sampling. Future BASA assessments should continue to explore sensitivity to maturity assumptions using our suite of models as a starting point.

We continue to analyze the best method to include the viral hemorrhagic septicemia (VHS) antibody information. We developed a deterministic Susceptible-Exposed-Infected-Carrier (S-E-I-C) model, which will allow investigation of the role of herd immunity and pulsed, variable recruitment in disease outbreaks. Within schools, VHS outbreaks occur on the order of weeks, with mortality tapering after 3-4 weeks. Impacts of recruitment and herd immunity (i.e., a dampening of a disease epidemic due to a high number of resistant individuals in a population) will impact disease dynamics across years. The model has now been coded in R and iterations are being run exploring the impact of variable recruitment and herd immunity on short-term disease dynamics. The addition of the VHS antibody information is expected to provide the model with information needed to explain unusual mortality events.

Laboratory experiments with *Ichthyophonus* combined with analysis of herring hearts collected during the program are developing our knowledge of when that pathogen may become lethal and lead to unusual mortality events. This knowledge is another step towards improving mortality within the BASA model.

We examined the maturity schedule used within the BASA as part of the synthesis effort. A maturity index is included in the age-sex-length data. Analysis of that factor and the age-structure of the samples indicated that not all age-3 fish are observed in the pre-spawning biomass and not all the fish observed are likely to spawn that year. Modeling the age-3 composition using a time-varying and a constant maturity schedule indicated that there was not a significant difference in the remainders between the two maturity schedules. Based on these results, we will be using a single maturity schedule in the future.

We fit a pair of Gaussian curves to scale growth increments for each year's growth for four year classes. We hypothesized that there would be bimodal growth patterns for fish that had a mix of maturity. Therefore, we anticipated that age-1and age-2 fish growth would be fit by a single Gaussian curve. Age-3 fish were expected to have two distinct growth patterns based on whether the fish was going to spawn (reducing growth) or not spawn. Age-4 fish would have less distinct growth differential because a smaller portion of the population being immature. Age-5 and age-6 fish would once again be fit by a single Gaussian distribution.

This preliminary analysis demonstrates some evidence for bimodal distributions in scale growth of specific cohorts of PWS herring as they mature over time. Of interest is the fact that bimodal distributions were detected for both female and male herring. There was no strong evidence that younger fish show unimodal distributions in scale growth that then diverge into bimodal distributions in older fish as bimodal distributions in scale growth were detected in several age-1 groups (1988 females, 1999 males, and 2005 males). Age-2 groups did not exhibit any evidence of bimodal distributions in the dataset. Only one age-3 group had evidence of bimodal scale growth distributions (1986 males). Several age-4 groups showed bimodal distributions for scale growth (1987 females and males, and 1991 females), as well as age-5 and age-6 groups (age-5: 1988 females and males; age-6: 1989 females, 2004 females and males, 2010 females). It would be useful to increase the sample sizes of scale growth measurements for future analysis for all age groups.

The second objective is to provide inputs to the stock assessment model. This includes the collection of age-sex-length data, aerial miles-of-milt surveys, acoustic biomass surveys, the collection of disease prevalence and antibody information. All surveys and collections were successful, and results provided in the fall to the BASA model team to estimate the 2019 biomass. There was an unusually large age-3 year class observed. Because of the recently low biomass levels the age-3 year class made up approximately 84% of the observed fish. This large recruitment event was also seen in the mile-days-milt and acoustic biomass surveys. Disease prevalence remains low, but we are analyzing the antibody data to determine if there are undetected outbreaks of VHS occurring.

The third objective is to examine the connection between herring condition or recruitment to physical and biological oceanographic factors. This was the focus of Dr. McGowan and John Trochta in the modeling group. Dr. McGowan completed the analysis of multi-decadal shifts in the distribution and timing of PWS herring spawning. This study shows there have been substantial changes in herring spawning distribution over the past 40 years, during which spawning has contracted towards southeastern areas of the Sound as the proportion of occupied spawning habitat declined from a peak of 65% in the mid-1980s to a recent low of less 9% in 2018. Herring no longer return to the primary spawning areas in PWS that were used in 1980s, and changes in spawning distributions may be contributing to, rather than resulting from, declines in population biomass. New analyses indicate that spatial shifts in spawning may have been influenced by both changes in population demographics and fishery-related effects on local spawning aggregations. Spawn timing also displayed large decadal changes that coincided with large-scale shifts in ocean temperature. Between 1980 to 2006, the median spawn date shifted earlier in the season by 25 to 30 days in eastern regions of PWS and by 15 days in western regions. Spawn timing shifted back later in the season in all regions during a seven-year cold period (2007 to 2013) and returned to the long-term mean spawn time in 2019 following anomalously warm conditions across the Northeast Pacific.

An in-depth analysis has been conducted (Trochta, Branch) of the potential effects of a wide variety of factors on PWS herring recruitment and mortality. Among the many factors considered were oceanographic variables, potential competitors and predators, and river discharge. Non-zero associations with adult herring mortality were detected for the North Pacific Gyre Oscillation (NPGO), Pacific Decadal Oscillation, humpback whales, and arrowtooth flounder, but these effects weakened (i.e., bounds zero) in the most recent time period of data. Only walleye pollock and Pacific cod spawning biomass consistently reduced herring mortality (i.e., more pollock, lower mortality, higher survival, more herring). Age-1 walleye pollock, juvenile hatchery pink salmon, and a regime shift in recruitment were associated with shifts in herring recruitment, but not over the most recent time frame. Bayesian model selection techniques were used to assess if these effects improve predictions from BASA, revealing that only NPGO and walleye pollock effects on mortality provide any notable improvement in predicted mortality and recruitment. These results were presented as a talk at the Alaska Marine Science Symposium in 2020 and are being written up for publication.

Tagging efforts provide greater information about where the herring are, which allows us the opportunity to refine our understanding of the conditions the fish are experiencing. We developed an Arnason-Schwarz (AS) multistate model, a generalization of the Cormack-Jolly-Seber mark-recapture model, to estimate the probability at which PWS herring move between geographic locations while accounting for uncertainty of fish locations and mortality rates in the PWS and the Gulf of Alaska. We implemented a Bayesian version of the AS model where fish direction information recorded at the entrance arrays was incorporated into the model by using informative priors on the movement probabilities at the entrance arrays.

A logit link function was used to model movement probabilities as a function of categorical variables. Variables considered included sex, spawn state at the time of tagging (spawned, not yet spawned), standard length, weight, condition (defined as weight*length-3*1000), and tag burden (tag weight/fish weight). We combined the 2017 and 2018 data and used the median as the break point to separate the variables standard length, weight, condition, and tag-burden into two categories each.

Our analyses indicated that neither sex nor spawning state had a significant effect on movement rates; however, length, weight, and condition did have significant effects. These three variables are significantly correlated, and results were similar across the three variables. By using the median weight for the first two tag years to separate heavy and light fish, we found that during spring/summer season, heavier herring were more likely to move to the entrance arrays. Likewise, longer, heavier fish in good condition were determined to be the most likely to migrate between PWS and the Gulf of Alaska. Lighter fish, on the other hand, were more likely to return to the PWS spawning areas during the fall/winter season.

Other analyses of the tagging data included examining mortality, residency times, and migration routes. The mortality was highest in the spring. Most fish left through Hinchinbrook Entrance and returned through Montague Strait. The longest residencies were near the acoustic arrays in the Southwest passages.

Our fourth objective is to develop new approaches to monitoring the population. This year we examined the use of high-resolution satellite imagery for the detection of herring spawn. Dr. Pegau tested the use of satellite information from Planet.com for detecting herring spawn. The satellite data available through that site have ground resolution on the order of a few meters with imagery available almost daily. A limitation is that the imagery is only available on a subscription basis. There is free (or low cost) high-resolution satellite imagery available for the European Sentinel Satellite system. The coverage of that system is very limited. As with all visible wavelength satellites, the satellites are not able to detect spawn through cloud cover. The high-resolution imagery allows the detection of much smaller spawn events than the moderate resolution imaging spectroradiometer (MODIS) images that have been used in the past and allow a large area to be searched for spawn activity. There is an archive of images that could be used to search for spawn events that occur outside of the aerial spawn surveys.

We continue to conduct research into other pathogens that affect herring and are expected to be responsible for significant mortality in the population.

The program has also incorporated the lingering oil project of Dr. Whitehead (19170115). This project is examining the role of sublethal exposure to hydrocarbons on the disease susceptibility and genetics of herring. The project completed experiments that showed that embryos exposed to oil did not have a greater susceptibility to the VHS virus later in life.

Significant work has been focused on developing a reference genome for Pacific herring that then can be used to look for changes in herring genetics. There were delays in assembling the reference genome that has slowed our analysis of variants associated with potential changes due to exposure of herring to oil.

b) Highlights and noteworthy issues

The 2016 year class of herring that began recruiting to the spawning stock in 2019 appears to be the largest year class on record across the Gulf of Alaska. We are especially interested in what conditions led to the success of this year class and have begun working with data from the Gulf Watch Alaska (GWA) program along with information on herring stocks outside of PWS to determine what conditions result in extraordinary year classes.

c) Efforts to achieve community involvement/traditional ecological knowledge and resource management application

This past year we continued to work with Dr. Sherri Dressel of Alaska Department of Fish and Game (ADF&G) to exchange information that is of value to resource management. We also contributed a status of PWS herring to the National Oceanic and Atmospheric Administration's (NOAA's) Ecosystem Status Report for the Gulf of Alaska that is provided to the North Pacific Fishery Management Council.

We communicated with a person in the village of Tatitlek to ensure our observations could be used by subsistence fishermen in that village. The communication led to their sharing a sample of herring collected from a spawn event that we were unable to sample for age-sex-length analysis.

d) Problems and unusual developments

We had made much progress in genome assembly in Dr. Whitehead's project (19170115) last year but ran into unexpected difficulties during the long-range assembly that was using Hi-C reads to connect scaffolds into chromosomes. All the quality metrics indicated that we had made good libraries, and sequence data looked robust. But when we attempted long-range assembly this failed to produce adequate results. Hi-C data were new to us, so we figured we were doing something wrong. After much troubleshooting, the lead software engineer at Phase Genomics (which developed Hi-C) offered to help. Even he could not figure out the problem, and we made the decision to abandon the data. We went back and made some new long-range reads using Pacific Biosciences (PacBio) technology and have recruited collaborator Dr. Wes Warren to make new Hi-C libraries. We have completed the new PacBio sequencing, and Dr. Warren is in the midst of Hi-C data collection.

e) Other significant information

Dr. Pegau worked with the program principal investigators (PIs) to coordinate the submission of contributions to the synthesis report that was provided to the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) office in December 2019. The synthesis report examines five aspects of the HRM program research: the survey designs used within the HRM program, research on maturity, spawn timing, adult herring movement, and disease.

The survey design chapter describes the methods used for aerial milt surveys and methods we have tested to supplement those surveys, acoustic surveys, age-sex-size sampling, and aerial forage fish surveys. The age-sex-size samples and age-structure-analysis models are used to examine what the maturity of the fish in the pre-spawn aggregations and if fish are missing from the pre-spawn aggregations. We also examine if differential growth can be detected by using herring scales. We examine how the spawn timing and location has changed over the past four decades and what factors may have influenced the changes. Changes in spawning location appear to be related to large recruit classes. We examine movement of herring after spawn and find that larger fish are more likely to move to the Gulf of Alaska. Finally, we describe the principles governing the epizootiology of VHS virus and provide an overview of *Ichthyophonous* surveillance results.

8. Coordination/Collaboration:

A. Projects Within a Trustee Council-funded program

1. Within the Program

Coordination is primarily through email and the annual PI meeting. Work with projects includes ensuring reporting is completed promptly and assisting the coordination of sampling logistics. Dr. Pegau works with individual projects to ensure the collection of samples and as a source of information about existing data and results. This year all PI's worked together on a synthesis report that was provided to the EVOSTC office.

2. **Across Programs**

a. **Gulf Watch Alaska**

Dr. Pegau serves as the primary contact for the HRM program with the GWA program. Coordination includes having the leads to all the programs on the HRM mailing list, so everyone is aware of any information going out to the HRM PIs. He also works with the leads to address specific topics of joint interest, such as reporting. The HRM and GWA PI meetings are held together to allow for greater exchange of information. Individual projects, particularly the modeling project and the work of Dr. McGowan, are working with the GWA program to obtain the necessary time series to conduct the analysis examining the relationship between herring and other environmental factors.

b. **Data Management**

Dr. Pegau serves as the primary contact for the HRM program with the data management (DM) program. The DM program is in contact with individual projects to ensure timely submission of data.

B. Projects not Within a Trustee Council-funded program

We incorporated project 19170115 (Dr. Whitehead) that examined the effects of oil on herring genetics and susceptibility to disease.

C. With Trustee or Management Agencies

Sherri Dressel of ADF&G is on the HRM scientific oversight group. Sherri, along with Stormy Haught of the Cordova office of ADF&G, are the primary contact points between the HRM program and the Trustee Agency with oversight of herring in PWS. The monitoring work of the HRM program provides the data necessary for ADF&G to monitor the Pacific herring population in PWS and determine if the population is at a fishable threshold. The exchange of information with ADF&G is important for being able to track similar research efforts ongoing at ADF&G and in the HRM program.

Drs. Groner and Hershberger have partnered with ADF&G in Sitka to assess whether temporal changes in the severity of *Ichthyophonus* infections may be responsible for recent declines in the spawning herring biomass and age structure. Data and archived samples from the past 10 years of this EVOSTC-funded project were leveraged to obtain supplemental funding from the North Pacific Research Board (# 1807: *Ichthyophonus* in Pacific Herring).

A status of PWS herring was provided to the NOAA for incorporation into their Gulf of Alaska Ecosystem Considerations report, which is reviewed by the North Pacific Fisheries Management Council.

9. Information and Data Transfer:

A. Publications Produced During the Reporting Period

1. **Peer-reviewed Publications**

Ben-Horin, T., G. Bidegain, G. de Leo, M.L. Groner, E. Hofmann, H. McCallum, and E. Powell, 2020. Modeling marine diseases. In D.C. Behringer, B.R. Stillman, and K. Lafferty, editors. *Marine Disease Ecology*. Pp. 223-251.

Bishop, M.A., J.W. Bernard. *In review.* An empirical Bayesian approach to incorporate directional information into the Arnason-Schwartz mark-recapture model. *Movement Ecology*

Cantrell, D.L., M.L. Groner, T. Ben-Horin, J. Grant, and C.W. Revie. 2020. Modeling parasite dispersal in marine ecosystems. *Trends in Parasitology*.

Gray, B., M.A. Bishop, and S.P. Powers. 2019. Structure of winter groundfish feeding guilds in Pacific herring *Clupea pallasii* and walleye pollock *Gadus chalcogrammus* nursery fjords *Journal of Fish Biology* 95:527-539. https://doi.org/10.1111/jfb.13984.

Gray, B., M.A. Bishop, and S.P. Powers. *In prep*. Winter variability in the diets of groundfish predators of Pacific Herring and Walleye Pollock in a subarctic sound. Targeted journal: *Deep-Sea Research Part II.*

Hershberger, P.K., A.H. MacKenzie, J.L. Gregg, A. Lindquist, T. Sandell, M.L. Groner, and D. Lowry. 2019. A Geographic Hot Spot of I*chthyophonus* infection in the Southern Salish Sea, USA. *Diseases of Aquatic Organisms* 136:157-162.

Monnahan, C.C., T.A. Branch, J.T. Thorson, I.J. Stewart, and C.S. Szuwalski. 2019. Overcoming long Bayesian run times in integrated fisheries stock assessments. *ICES Journal of Marine Science* 76:1477-1488.

Muradian, M.L., T.A. Branch, and A.E. Punt. 2019. A framework for assessing which sampling programs provide the best trade-off between accuracy and cost of data in stock assessments. *ICES Journal of Marine Science* 76:2102-2113.

Trochta, J.T., T.A. Branch, A.O. Shelton, and D.E. Hay. In press. The highs and lows of herring: A meta-analysis of patterns in herring collapse and recovery. *Fish and Fisheries*.

2. Reports

Pegau, W.S, and D.R. Aderhold, editors. 2020. Herring Research and Monitoring Science Synthesis. Herring Research and Monitoring Synthesis Report, (*Exxon Valdez* Oil Spill Trustee Council Program 20120111). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Pegau, W.S., J. Trochta, and S. Haught. 2019. Prince William Sound Herring. In S. Zador, E. Yasumiishi, and G.A. Whitehouse, editors. Ecosystem Status Report 2019 Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK.

3. Popular articles

Bishop, M.A. 2019. Time to spawn. *Delta Sound Connections*. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf).

Hoover, H. 2019. Herring Research and Monitoring. *Delta Sound Connections*. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf).

Gray, B. 2019. Ping! Tracking fish using passive acoustic technology. *Delta Sound Connections*. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf).

Groner, M. 2019. 'ICH-Y' Diseases in Pacific Herring. *Delta Sound Connections*. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf).

McGowan, D.W. 2019. Spatial patterns of capelin in the Gulf of Alaska. *Delta Sound Connections*. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf).

Oziolor, E.M., N.M. Reid, S. Yair, K.M. Lee, S. Guberman VerPloeg, P.C. Bruns, J.R. Shaw, A. Whitehead, and C.W. Matson. 2019. Adaptive introgression enables evolutionary rescue from extreme environmental pollution. Science 364:455-457.

Pegau, S. 2019. Changes in Forage Fish. *Delta Sound Connections*. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf).

Trochta, J.T. 2019. Herring models: why and how they are used? *Delta Sound Connections*. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf).

B. Dates and Locations of any Conference, Workshop, or Public Presentations where EVOSTC-funded Work was Presented

1. Conferences and Workshops

Arimitsu, M., M.A. Bishop, D. Cushing, S. Hatch, R. Kaler, K. Kuletz, C. Matkin, J. Moran, D. Olsen, S. Pegau, J. Piatt, A. Schaefer, and J. Straley. 2020. Changes in Marine Predator and Prey Populations in the Northern Gulf of Alaska: Gulf Watch Alaska Pelagic update 2019. (poster) Alaska Marine Science Symposium, January.

Bishop, M.A., T. Branch, K. Gorman, M. Groner, S. Haught, P. Hershberger, S. Pegau, P. Rand, J. Trochta, and A. Whitehead. 2020. PWS Herring Research and Monitoring. (poster) Alaska Marine Science Symposium, January.

Gill, T., T. Linbo, P. Hershberger, J. Incardona, and A. Whitehead. 2019. Interactions between oil exposure and immune function relevant for Pacific herring population collapse. Annual Meeting of the Society of Environmental Toxicology and Chemistry. Toronto, ON, Canada. November.

McGowan, D., and T. Branch. 2019. Large multi-decadal space and time shifts in Pacific herring spawning in the Gulf of Alaska. Oral presentation. PICES, Victoria, BC. 21-24 October

Pegau, W.S., T. Branch, D. McGowan, J. Trochta, A. Whitehead, P. Hershberger, M. Groner, P. Rand, K. Gorman, M.A. Bishop, and S. Haught. 2020. 2020. Prince William Sound Herring Research and Monitoring Program. Poster Presentation. Alaska Marine Science Symposium. Anchorage, AK, January.

Trochta, J.T., 2020. A Bayesian analysis of the utility of ecosystem information in a stock assessment. Oral presentation. Alaska Marine Science Symposium, Anchorage, AK.

2. Public presentations

Hershberger, P. 2019. "Principles of Viral Hemorrhagic Septicemia Virus." Guest Lecture in FHL 568: Ecology of Infectious Marine Disease. University of Washington, Friday Harbor Laboratories, June.

C. Data and/or Information Products Developed During the Reporting Period, if Applicable

A PWS herring contribution to the NOAA Ecosystem Status Report for the Gulf of Alaska.

Stock assessment of Prince William Sound herring for 2019.

D. Data Sets and Associated Metadata that have been Uploaded to the Program's Data Portal

A tagging log with accompanying age, sex, and length of each herring tagged along with a unique tag ID number. These data were recorded in April 2019 and have been uploaded to the Research Workspace. Detection data through May 2019 were uploaded and includes data from Ocean Tracking Network receiver through February 2019 and spawning ground receivers through May 2019. These files include detections of the unique tag ID numbers at each receiver with the accompanying time and date. Our data will be publicly available on the data portal by February 2021.

Uploaded the most recent version of the BASA model and results using 2019 data (Feb. 2019). Metadata on the workspace summarizes the data sets and how to run the model, while detailed instructions and descriptions are contained within READ_ME files and line comments within the code. The upload includes: AD Model Builder files to run model, R code to pre-process data for model & post-process model output, figures and tables of key model output (fits to data, estimates of biomass and recruitment, parameter estimates), and raw model output (read in by R code to produce figures and tables).

PWS Herring Age at Maturity dataset.

Pathogen survey data from PWS and Sitka Sound.

Data sets and associated metadata that have been uploaded to the Gulf of Alaska Data Portal include: 2019 aerial survey maps, 2008-2019 aerial herring biomass observations shapefiles, 1973-2019 aerial herring spawn observations shapefiles, 1997-2019 herring aerial survey routes shapefiles, 2008-2019 aerial survey marine bird observations shapefiles, 2008-2019 aerial survey marine mammal observations shapefiles, 2008-2019 aerial survey sea lion observations, 2014-2019 herring age-sex-length data.

Raw acoustic data from the spring 2019 survey were uploaded to the Research Workspace following the research cruise. Intermediary acoustic summary files were uploaded on 17 February 2020, and the final biomass estimate was added to the time series and made public on 17 February 2020. Preliminary biomass estimates were shared with HRM PIs during the November 2019 PI meeting.

Population genomics data collection is complete. Raw sequence read data has been uploaded for long-term archive at National Center for Biotechnology Information, as per common practice in our field. Data have not yet been publicly released – we will keep data under embargo until our analyses are complete, at which time we will provide links to the data to be posted on the Gulf of Alaska Data Portal. We have started archiving our population genomics bioinformatics analysis scripts in GitHub (https://github.com/eoziolor/phpopgen_home). When script archives are completed following our analysis, we will provide links through the Gulf of Alaska Data Portal.

10. Response to EVOSTC Review, Recommendations and Comments:

EVOSTC Science Panel Comment. We have no program specific comment except that we ask the PIs to evaluate the adequacy of their sampling design to make population-level inferences. Consider the acoustics survey, and age & length sampling.

Response. We included descriptions of the sampling design in our synthesis. We acknowledge that the surveys are designed to detect only the population that is expected to spawn each spring. In considering expanding the entire population there are a couple of major concerns. Our concerns are with the value of the increased cost associated with the a full PWS Sound and discontinuing one time series in favor of starting a second that would have a different relation to the total population.

11. Budget:

EXXON VALDEZ **OIL SPILL TRUSTEE COUNCIL**
PROGRAM 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	$515.1	$741.7	$961.4	$905.2	$662.1	$3,785.5	$2,262.7
Travel	$37.1	$47.9	$45.4	$43.4	$39.5	$213.2	$106.4
Contractual	$198.7	$221.9	$218.7	$166.7	$140.9	$946.9	$429.4
Commodities	$192.6	$160.6	$159.0	$194.9	$99.0	$806.1	$557.8
Equipment	$5.9	$0.0	$50.3	$0.0	$64.2	$120.4	$25.4
Indirect Costs (*will vary by proposer*)	$200.1	$276.5	$397.3	$357.0	$207.4	$1,438.1	$1,891.5
SUBTOTAL	$1,149.5	$1,448.5	$1,832.0	$1,667.2	$1,213.0	$7,310.2	N/A
General Administration (9% of subtotal)	$103.5	$130.4	$164.9	$150.0	$109.2	$657.9	
PROJECT TOTAL	$1,252.9	$1,578.8	$1,996.9	$1,817.2	$1,322.2	$7,968.1	
Other Resources (Cost Share Funds)	$157.2	$159.7	$203.2	$225.2	$149.4	$894.7	N/A