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

Proposals requesting FY19 funding are due to shiway.wang@alaska.gov and elise.hsieh@alaska.gov by August 25, 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

19120111 Herring Research and Monitoring

Primary Investigator(s) and Affiliation(s)

W. Scott Pegau, Prince William Sound Science Center

Date Proposal Submitted

October 3, 2018

Program Abstract

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.
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.

The program is made up of seven projects; Modeling and Stock Assessment of Prince William Sound Herring; Surveys and Age, Sex, and Size Collection and Processing; Adult Pacific Herring Acoustic Surveys; Herring Disease Program; Studies of Reproductive Maturity among Age Cohorts of Pacific Herring; Annual Herring Migration Cycle; and HRM Coordination.

Through these projects we expect to address areas of interest outlined within the HRM section of the FY17-21 invitation for proposals. The modeling project and the postdoctoral fellows are envisioned as the primary integrating efforts that use data and information from all of the projects and the Gulf Watch Alaska and Data Management programs. The primary beneficiaries of our efforts are expected to be Alaska Department of Fish and Game and Prince William Sound herring fishermen.

Dr. Pegau will serve as the program lead to ensure the proper coordination within the program, with other EVOS funded programs, and as a point person for communications with the EVOSTC. An independent scientific oversight group exists that will provide feedback on the program.

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

FY17	FY18	FY19	FY20	FY21	TOTAL
$1,252,900	$1,578,800	$1,996,900	$1,743,700	$1,152,300	$7,724,600

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

FY17	FY18	FY19	FY20	FY21	TOTAL
$157,200	$159,700	$160,700	$162,700	$149,700	$790,000

**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. 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.

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The program is made up of seven projects; Modeling and Stock Assessment of Prince William Sound Herring; Surveys and Age, Sex, and Size Collection and Processing; Adult Pacific Herring Acoustic Surveys; Herring Disease Program; Studies of Reproductive Maturity among Age Cohorts of Pacific Herring; Annual Herring Migration Cycle; and HRM Coordination.

The student working on the expansion and testing of the herring stock assessment model received a prestigious Bondermann Travel Fellowship and was spending time associated with that fellowship, which slowed work towards Objective 1. The addition of a postdoctoral fellow (Dr. David McGowan) to the modeling effort is providing additional effort to achieve Objective 1. His work examines the physical and ecological processes linked to Prince William Sound (PWS) herring spawning, egg and larval survival, and survival to recruitment to the spawning stock, and how to expand the model to account for environmental factors.

The herring age-to-maturity project continues to move forward. This summer we were able to collect 850 herring in July, in large part, due to the support of local fisherman. A social media effort was put in place to get observations of herring from the fishing fleet, which led to reports of the locations of adult and juvenile herring. We also shifted from the trawl to using jigs to catch herring, which has been more productive. We are still waiting for the histology results from fish captured in 2017.

The spring is the primary time for providing inputs to the stock assessment model. The aerial surveys indicated that the spawning biomass continues to decline, with the fewest mile-days of spawn on record detected in 2018. The processing of fish for age structure analysis is not yet completed. Samples were collected for detection of the prevalence of disease. They found that the prevalence of the three diseases being monitored remained consistent with previous years. Acoustic surveys of the herring biomass were completed. However, we are awaiting the age and weight data to allow the completion of the biomass estimate.

We added two postdoctoral researchers to the program. Dr. Maya Groner is working with Drs. Pegau and Hershberger to examine the relationship between herring diseases and environmental conditions. She is also contributing to the coordination of the HRM program. Dr. David McGowan began working with Dr. Branch and others in the HRM program to examine the physical and ecological processes linked to PWS herring spawning, egg and larval survival, and survival to recruitment to the spawning stock. These efforts address Objective 3 of the program and pull together the various projects within the HRM program and tie to the Gulf Watch Alaska (GWA) and Data Management (DM) programs. Both efforts are in the early stages and there are not results available to share at this time.

Despite the relative lack of fish in 2018, we were able to tag the number herring we desired and managed to collect samples for the maturity project. The maturity project was able to collect samples not only during the spawning period but also during the summer. The summer success is in part due to continued outreach to the fishing fleet to help identify where the fish are being observed. We also changed the method for catching herring, which has been more successful than the trawl system that we originally proposed.

Of 124 herring tagged in April 2017, 59 were detected leaving PWS, and 42 of those fish were detected returning to PWS by February 2018. There was no evidence that body condition or release cohort were associated with the probability of a fish moving out of PWS. Eight of the 59 fish were detected returning to Port Gravina after October 2017. The fish tags are lasting longer than expected allowing for the potential to detect fish two years after release instead of just one. However, the young age structure of the current spawning stock has caused us to switch to smaller tags for a portion of the fish. These smaller tags have a shorter lifespan. We were able to refurbish several older detectors and redeploy them in PWS to provide greater information on the movement of herring in the future.

2. 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.

	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
Expand and test model																				
Simulate inclusion of new disease info				C																
Update model disease component									X											
Analysis of survey data													X							

to ASA																			
Update on global herring meta-analysis												X							
Sample for Maturity	C	C	C		C	C	X												
Decide on timing of maturity sampling									X										
Estimate spawning biomass																			
Collect measurements during the spawn	C				C				X				X				X		
Complete sample analysis			C				X				X				X			X	
Complete model run					C				X				X				X		
Examine connection between herring and environment																			
Hire Postdoc					C														
Identify relevant data								X											
Analysis of Environmental linkage											X								
Identify environmental factors to include in model													X						
Herring movement																			
Tag herring	C				C				X										
Upload data					C				X				X						
Expand array						C													
Reporting																			
Annual reports					C				X				X				X		
Annual PI meeting				C				X				X				X			X
EVOSTC Joint Science Workshop Report												X							
FY work plan (DPD)			C				C				X				X			X	
Final Report																			X
Other																			
Website updated				C				X				X				X			X
Previous year data on workspace		C				X				X				X				X	
New Milestone																			
New task																			

B. Explanation for not completing any planned milestones and tasks

Updates of the 2017 disease prevalence data has not been uploaded to the workspace. A reminder has been sent to the PI. The data is available to the modelers and is incorporated in the annual report.

C. Justification for new milestones and tasks

The wording of the milestones and tasks have been changed slightly to help indicate how they align with the objectives of the program.

3. COORDINATION AND COLLABORATION

A. Within an EVOTC-Funded Program

Provide a list and clearly describe the functional and operational relationships with other EVOSTC-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 EVOSTC-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 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 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.

A. Within an EVOTC-Funded Program

Dr. Pegau is the program team leader and is responsible for ensuring a coordinated and focused research program that leverages other assets whenever possible. Within program coordination is primarily through e-mail and phone communications. In-person meetings of participants are expected to occur once a year for exchange of information and to encourage collaboration between projects. The next meeting is scheduled for November 2018. This meeting is expected to be held the same week, but on different days as the GWA investigator meeting to allow exchange between the groups.

Coordination between projects is also taking place through scheduling of vessels. All the investigators are required to work together to determine vessel type and number of days needed. The primary overlap we have identified is during the spring adult herring surveys. In that case the vessel will be shared by the Alaska Department of Fish and Game (ADF&G) age-sex-length sampling, acoustic survey, disease sampling, and at least the first two years of the age-at-maturity project. Because of the limited berthing available we will need to cycle the non-ADF&G projects on the vessel as appropriate.

Coordination is also achieved through the scheduling of projects to ensure results would be available for projects dependent on samples or data from another project. Information gained from the tagging project is expected to have value to age-at-maturity study in helping determine if there is a segregation by age or size class. It will also inform the work to be done by a postdoctoral researcher on identifying how herring are affected by environmental conditions. We expect that the postdoctoral researchers will facilitate further collaboration as they will need information from each of the projects to address the relationships between herring and the environmental conditions.

We will continue our collaborations with the GWA and Data Management programs. The GWA science lead and a person to be designated from the Data management team are included on the HRM email list so they are

aware of what is going on in the HRM program. Administratively, the annual work plans and reports will continue to be developed together. Our PI meetings are scheduled in a manner to encourage individuals to work with people in the other programs. We will continue to work together to design topics for analysis and development of joint scientific manuscripts and cross-program synthesis proposals. We will work with the Data Management project to ensure timely submission of data and metadata.

The HRM program is collecting detailed information on herring and processes that affect them. GWA monitors the oceanographic conditions that drive the growth and recruitment of the herring. One of the strongest connections between programs is through the HRM postdoctoral researchers whose research efforts bridge the HRM and GWA programs. Those efforts will be looking at the impacts of biological and physical oceanographic conditions on herring populations in PWS. They will be using the detailed information on herring collected in HRM to test the impacts of bottom-up forcing, using information from the environmental drivers component, and top-down forcing using information from the pelagic component.

The HRM modeling effort includes expanding the model to include environmental drivers and predation components. This creates a connection to the environmental drivers group and the GWA Pelagic Integrated Fall/Winter Predator Prey Surveys that encompass surveys for forage fish, humpback whales, and marine birds.

B. With Other EVOSTC-funded Projects

We are working to involve Dr. Whitehead in the HRM group. He is included in our general email list and was involved in the HRM PI meeting in 2017.

C. With Trustee or Management Agencies

Alaska Department of Fish and Game is the primary trustee and management agency that the HRM program interacts with. The success of the program is highly dependent on the historical information collected by ADF&G and the expertise within the agency, so it is imperative that we work with the agency. We will continue to have an ADF&G employee (Sherri Dressel) on our scientific oversight group. ADF&G efforts are a primary project with the program to ensure the data needed to understand recovery of herring is collected. Interactions with Stormy Haught, in Cordova have provided a close connection between the program and the agency.

4. 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. 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:

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B. For the most part, we intend to continue with the originally proposed approach for addressing each of these objectives. The one change in design is to collect additional samples for disease analysis. A new technique for detecting VHS antibodies shows that previously undetected outbreaks of VHS in herring. The additional samples will be used to determine if there is age- or year- dependency to patterns of outbreaks.

One problem we encountered was difficulty in collecting the desired number of herring, outside of the spawning season, for the maturity project. We revised our sampling to focus on jigging rather than the trawl system proposed and have been more successful. We spent time testing gear from September 2017 to March 2018 in Port Gravina. For the July 2018 collection, we also used a social media campaign to help identify locations of adult herring being caught by commercial salmon fishermen. This allowed us to better target our sampling efforts.

There is limited berthing on the R/V Solstice (the primary ship for sampling during the spawn). Our original plan was to cycle different groups through. However, we have had a difficult time getting the acoustic sampling scheduled in a manner that allows a complete survey. We are requesting additional funding to support 5 days of vessel time on a separate vessel to allow the acoustic surveys to be completed (see proposal 19120111-G). A complete acoustics survey is a critical component of the age-structured model, as it is the primary current data component driving population trends and the resulting forecasts.

5. 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 changes in primary personnel of the program.

6. 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 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	$962.0	$589.4	$3,769.6	$0.0
Travel	$37.1	$47.9	$45.4	$42.5	$39.0	$211.9	$0.0
Contractual	$198.7	$221.9	$218.7	$156.1	$144.0	$939.4	$0.0
Commodities	$192.6	$160.6	$159.0	$97.7	$98.8	$708.7	$0.0
Equipment	$5.9	$0.0	$50.3	$0.0	$0.0	$56.2	$0.0
Indirect Costs (*will vary by proposer*)	$200.1	$276.5	$397.3	$341.4	$185.9	$1,401.1	$0.0
SUBTOTAL	$1,149.5	$1,448.5	$1,832.0	$1,599.7	$1,057.1	$7,086.8	N/A
General Administration (9% of subtotal)	$103.5	$130.4	$164.9	$144.0	$95.1	$637.8	
PROJECT TOTAL	$1,252.9	$1,578.8	$1,996.9	$1,743.7	$1,152.3	$7,724.7	
Other Resources (Cost Share Funds)	$157.2	$159.7	$160.7	$162.7	$149.7	$790.0	N/A

B. Changes from Original Proposal

There are six modifications that have been requested in FY 19. The first is the addition of $22,500 to the Hershberger proposal (project 19120111-E) to collect and analyze addition samples for the presence of VHSV neutralizing antibodies to examine if there is an age-related component. This was a budget modification requested, and granted, in 2018. The second is the second year of funding for the postdoctoral researcher working with Trevor Branch (project 19120111-C). The addition of the postdoctoral position was requested, and granted, in 2018 with the understanding that it is a three-year position. We are making two new requests in FY 19. We are requesting $10,000 (+3,000 indirect) for ship time to be added to the acoustic survey proposal (project 19120111-G). This request is also reflected in FY 20 and 21 budgets. Another request is for $5,300 (+1,600 indirect) to cover the costs of permits and bonds required by Alaska Department of Natural Resources (ADNR) (project 19160111-B). This is an unexpected cost associated with expanding the acoustic receiving arrays. ADNR changed the permitting requirements that we have operated under in the past to require additional permit fees and a bond. With each budget change request, the general administrative costs have also been changed.

October 3, 2018 revisions

We are requesting an additional $13000 in salary in the coordination project (19120111-A) to hire Donna Aderhold to provide additional review of HRM documents being submitted to the EVOSTC. There are subsequent increases in indirect and General Administration associated with the increased salary. We have also added the budget of the lingering oil project led by Andrew Whitehead into the HRM program in years FY19-21. This change reflects an organizational shift to increase collaboration with the HRM program. It does not alter the amount requested by the project (19170115).

C. Sources of Additional Funding

Additional funding is provided by ADF&G and U.S. Geological Survey for personnel involved in the HRM program, and by the Oil Spill Recovery Institute that will provide funding to cover a portion of the HRM coordinators salary if necessary. Funding from the Alaska Ocean Observing System is being used to cover the costs of the charters to recover data from the acoustic receiving arrays.

7. FY18 PUBLICATIONS AND PRODUCTS

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

Manuscripts.

Aderhold, D. G. R., M. R. Lindeberg, K. Holderied, and W. S. Pegau, Spatial and temporal ecological variability in the northern Gulf of Alaska: What have we learned since the *Exxon Valdez* oil spill? *Deep Sea Research II.* **147**, 3-8. DOI 10.1016/j.dsr2.2017.11.015

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

Gorman, K. B., T. C. Kline, M. E. Roberts, F. F. Sewall, R. A. Heintz, and W. S. Pegau, Spatio-temporal variation in stable carbon and nitrogen isotope signatures and condition of juvenile herring (*Clupea pallasii*) in Prince William Sound, Alaska: teleconnections with the Gulf of Alaska. *Deep Sea Research II*. **147**, 116-126. DOI 10.1016/j.dsr2.2017.10.010

Harris, B.P., S.R. Webster, J.L. Gregg, P.K. Hershberger. 2018. *Ichthyophonus* in sport-caught groundfishes from southcentral Alaska. Diseases of Aquatic Organisms 128: 169-173.

Hershberger, P.K., J.L. Gregg, C. Dykstra. 2018. High-prevalence and low-intensity *Ichthyophonus* infections in Pacific Halibut (*Hippoglossus stenolepis*). Journal of Aquatic Animal Health 30:13-19.

Lowe, V.C., P.K. Hershberger, C.S. Friedman. 2018. Analytical and diagnostic performance of a qPCR assay for *Ichthyophonus* spp. compared to the tissue explant culture 'gold standard'. Diseases of Aquatic Organisms 128: 215-224.

Rand, P.S. In press. Pacific herring response to surface predators in Prince William Sound, Alaska. Marine Ecology Progress Series.

Sitkiewicz, S.E., N. Wolf, P.K. Hershberger, T.S. Smettz, S.R. Webster, B.P. Harris. *In Review*. Temporal changes in *Ichthyophonus* infection prevalence in Pacific halibut provide evidence for a stable host pathogen paradigm. Journal of Aquatic Animal Health.

Sreenivasan, A., J. Vollenweider, J. Gregg, P. Hershberger. *In Review*. Utility of Nucleic Acid Ratios and Total-Body Lipid as Indices of Energy Allocation Strategies in Larval Pacific Herring (*Clupea pallasii*). Coastal and Marine Fisheries.

Trochta JT, Pons M, Rudd MB, Krigbaum M, Tanz A, Hilborn R (2018) Ecosystem-based fisheries management: Perception on definitions, implementations, and aspirations. PLoS One 13:e0190467

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.

Ward EJ, Adkison M, Couture J, Dressel SC, Litzow MA, Moffitt S, Hoem Neher T, Trochta J, Brenner R (2017) Evaluating signals of oil spill impacts, climate, and species interactions in Pacific herring and Pacific salmon populations in Prince William Sound and Copper River, Alaska. PLoS One 12:e0172898

A previous publication was awarded the American Fisheries Society Publications Award for best paper of the year in Journal of Aquatic Animal Health:

"Hart, L.M., M.K. Purcell, R. Powers, A. MacKenzie, P.K. Hershberger. 2017. Optimization of a plaque neutralization test to identify the exposure history of Pacific herring to viral hemorrhagic septicemia virus (VHSV). Journal of Aquatic Animal Health 29: 74-82."

Manuscripts in prep.

Ben-Horin, T., Groner, M. L., Bidegain, G., McCallum, H., Powell, E., Hofmann, E. *in prep.* Modeling and forecasting disease dynamics in the sea. *Marine disease ecology.* Ed. Lafferty, K.

Gorman, K.B., M.E. Roberts, T.C. Kline Jr., and W.S. Pegau. Comparing calorimetric and stable isotope-derived measures of energy density among juvenile Pacific herring (*Clupea pallasii*). *In prep for Fisheries Research*.

Gorman, K.B., T.C. Kline Jr., F.F. Sewall, R.A. Heintz, and W.S. Pegau. Changes in condition and of Pacific Herring (*Clupea pallasii*) during their first overwinter period. *In prep, EVOS juvenile herring intensives project.*

Gorman, K.B., F.F. Sewall, R.A. Heintz. Winter foraging among juvenile Pacific herring in Prince William Sound, Alaska: Stable isotope ellipses and diet composition. *In prep, EVOS juvenile herring condition monitoring project.*

Shore-Maggio, A., Groner, M. L., Burge, C. A., Carnegie, R., Hershberger, P. *in prep.* Disease transmission in managed marine systems.

Trochta JT, Branch TA, Shelton AO, Hay DE (in prep) The highs and lows of herring: A meta-analysis of patterns in herring collapse and recovery. ICES Journal of Marine Science

Presentations.

Poster:

Sitkiewicz, S., P. Hershberger, N. Wolf. B. Harris. January 22-26, 2018. Poster. Effects of the parasite *Ichthyophonus* (spp.) on Pacific halibut (*Hippoglossus stenolepis*) growth and condition. Alaska Marine Science Symposium. Anchorage, AK.

Invited Seminar:

NOAA – Northwest Fisheries Science Center, Monster Seminar Jam (May 24, 2018) "The Ecology of Disease in Marine Fishes: Insights from Pacific Herring."

Outreach.

We completed updates to the website (http://pwssc.org/research/) for all of the ongoing projects within the HRM program and made significant progress in updating past projects to include more findings. We worked with the PWSSC web developers to add a search tool that allows a quick identification of on-going versus completed projects. We completed podcasts describing the herring modeling, acoustic sampling, disease research, overwintering energetics, and HRM program coordination. The podcasts can be found at http://pwssc.org/education/field-notes/ and linked within the individual project posts.

Dr. Groner participated in the listening session held at Port Graham with along with GWA researchers.

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

Gorman, K. 2018. Reproductive maturity of Pacific Herring. *Delta Sound Connections*

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

Haught, S. 2018. Aerial surveys of Pacific Herring. *Delta Sound Connections*

Hershberger, P. Forecasting disease potential in Pacific herring. *Delta Sound Connections*

Hoover, H. Herring Research and Monitoring. *Delta Sound Connections*

Rand, P.S. 2018. The dynamics of herring and predators in Prince William Sound. *Delta Sound Connections*

Datasets.

We are working with the Data Management program to ensure all data is available through the AOOS data portal.