

Exxon Valdez Oil Spill Trustee Council



DRAFT FY17 – FY21 Work Plan for
Restoration, Research and Monitoring Projects:

Fiscal Year 2020

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Exxon Valdez Oil Spill Trustee Council
4230 University Drive, Suite 220
Anchorage, AK 99508-4650
Tel: 907-278-8012 Fax: 907-276-7178
www.evostc.state.ak.us

EVOSTC Restoration, Research and Monitoring Projects

Draft FY20 Work Plan

Prepared by:

Exxon Valdez Oil Spill Trustee Council

DOUG VINCENT-LANG
Commissioner
Alaska Dept. of Fish and Game

KEVIN CLARKSON
Attorney General
Alaska Department of Law

JASON BRUNE
Commissioner
Alaska Dept. of Environmental Conservation

JIM BALSIGER
Director, Alaska Region
National Marine Fisheries Service

DAVID E. SCHMID
Regional Forester
Forest Service, Alaska Region
US Department of Agriculture

STEPHEN WACKOWSKI
Senior Advisor to the Secretary for Alaskan Affairs
Office of the Secretary
US Department of the Interior

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PLEASE COMMENT

You can help the Trustee Council by reviewing this draft work plan and letting us know your priorities for the Fiscal Year. You can comment by:

Mail: 4230 University Drive, Suite 220
Anchorage, AK 99508-4650
Attn: Draft Fiscal Year 2020 Work Plan

Telephone: 907-278-8012
1-800-478-7745
Collect calls will be accepted from fishers and boaters who call through the marine operator.

Fax: 907-276-7178

E-mail: dfg.evos.restoration@alaska.gov

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FY20 Proposal Funding Recommendations

The funding described in this document is for EVOSTC Restoration, Research, and Monitoring Projects and for Habitat Enhancement Projects. Please note that the funding amounts in this document are approximate and rounded up to the nearest hundred dollars. The Work Plan is a working document and may be revised as needed throughout the fiscal year. Please contact the EVOSTC office if you would like exact funding amounts.

| Page | Project Number | Principal Investigator | Project Title | FY20 Requested | FY20 Funding Amount Recommended | | | | |
|------|----------------|------------------------------------|--|----------------|---------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | | | | | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
| 7 | 20200100 | EVOSTC Admin | EVOSTC Annual Budget | \$2,350,600 | Not Applicable | Not Applicable | Not Reviewed | Not Applicable | \$2,350,600 |
| 10 | 20120111 | Pegau | PWS Herring Program - see Herring Research Program Projects table below | \$1,986,800 | \$1,817,200 ^a | \$1,817,200 ^a | Not Reviewed | \$1,817,200 ^a | \$1,817,200 ^a |
| 81 | 20120114 | Lindeberg | Long-Term Monitoring Program – see LTM Gulf Watch Alaska table below | \$2,793,000 | \$2,778,400 ^b | \$2,778,400 ^b | Not Reviewed | \$2,778,400 ^b | \$2,778,400 ^b |
| 171 | 20120113 | Janzen | Data Management for Programs and Projects | \$290,100* | \$290,100* | \$290,100* | Not Reviewed | \$290,100* | \$290,100* |
| 181 | 20110853 | Kuletz, Kaler, Irons | Pigeon Guillemot Restoration Project | \$69,500 | \$69,500 | \$69,500 | Not Reviewed | \$69,500 | \$69,500 |
| 190 | 20200126 | Walker | Nearshore Fish Community Assemblages | \$162,700 | \$0 | \$0 | Not Reviewed | \$0 | Not Applicable Withdrawn |
| 197 | 20200127 | Hetrick, Campbell, Baird, Evans | Ocean Acidification Sampling | \$34,300 | \$34,300 | \$34,300 | Not Reviewed | \$34,300 | \$34,300 |
| 199 | 20200128 | Hollmen, Maniscalco, Romano, Osnas | Marbled & Kittlitz's Murrelet, Pigeon Guillemot Status and Trends Update in Resurrection Bay | \$160,700 | \$0 | \$0 | \$0 | \$0 | \$0 ^c |
| 206 | 20200129 | Corcoran, Lyons | Kodiak Marbled Murrelet Nesting Ecology and Population Trends | \$249,900 | \$0 | \$0 | Not Applicable Withdrawn | Not Applicable Withdrawn | Not Applicable Withdrawn |
| 216 | 20200130 | Labunski | Status and Recovery of Kittlitz's and Marbled Murrelet in Kachemak Bay | \$117,900 | \$0 | \$0 | \$0 | \$0 | \$0 ^c |
| 221 | 20200131 | Reimer | Alaska SeaLife Center Facilities Project | \$4,296,800 | Not Applicable | Not Applicable | Not Applicable Withdrawn | Not Applicable Withdrawn | Not Applicable Withdrawn |

*actual funding amount is dependent on Trustee Council funding decisions for FY20 projects (9.11.19). ^aRecommends a Do Not Fund for project 20170111-D. ^bRecommends a Fund Reduced for project 20120114-M. ^cRecommends a fund contingent upon the integration of proposals 20200128 and 20200130 and addressing external and agency reviewers', and Science Panel's concerns and comments as determined by the Science Director, in coordination with Trustees. Fiscal year start for this project is FY21.

| | | | | | | | | | |
|--|----------|-----------|--|--------------|----------------|----------------|--------------------------|--------------------------|--------------------------|
| 224 | 20180117 | Bornemann | Kenai Watershed Forum Stream Watch Program | \$102,900 | Not Applicable | Not Applicable | \$102,900 | \$102,900 | Not Applicable Withdrawn |
| 227 | 20180119 | Miranda | ADNR/DPOR Outreach Project | \$49,100 | Not Applicable | Not Applicable | \$49,100 | \$49,100 | \$49,100 |
| 230 | 20190124 | Klein | PWS Instream Flow Protection | \$84,800 | Not Applicable | Not Applicable | Not Reviewed | Defer to TC | Not Applicable Withdrawn |
| 232 | 20200132 | Coleman | Protecting Freshwater Resources from New Infestations of Elodea spp. | \$1,007,100 | Not Applicable | Not Applicable | Not Reviewed | Defer to TC | Not Applicable Withdrawn |
| 234 | 20200133 | Graham | Elodea Emergency Response | \$436,000 | Not Applicable | Not Applicable | Not Reviewed | Defer to TC | Not Applicable Withdrawn |
| 236 | 20200134 | Miranda | Parks Habitat Restoration and Protection – Diamond Creek, Izaak Walton, Slikok Creek | \$3,106,500 | Not Applicable | Not Applicable | Not Applicable Withdrawn | Not Applicable Withdrawn | Not Applicable Withdrawn |
| 238 | 20200135 | Miranda | Eagle Rock Facility Improvements | \$6,419,000 | Not Applicable | Not Applicable | Not Reviewed | Defer to TC | \$6,419,000 |
| TOTAL REQUESTED, RECOMMENDED & APPROVED | | | | \$23,717,700 | \$4,989,500 | \$4,989,500 | \$152,000 | \$5,141,500 | \$13,808,200 |

Herring Research and Monitoring Program Projects

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***The total for these projects can be found under 20120111-Pegau on the page one chart**

| Page | Project Number | Principal Investigator | Project Title | FY20 Requested | FY20 Approved | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|------|----------------|------------------------|---|----------------|---------------|---------------|---------------------|--------------|--------------------|-----------------|
| 17 | 20120111-A | Pegau | Herring Program-Coordination & Logistics, Postdoctoral Researcher | \$270,200 | \$270,200 | Fund | Fund | Not Reviewed | Fund | \$270,200 |
| 25 | 20120111-B | Bishop | Herring Program - Annual Herring Migration Cycle | \$434,200 | \$434,200 | Fund | Fund | Not Reviewed | Fund | \$434,200 |
| 31 | 20170111-C | Branch | Herring Program - Modeling and stock assessment | \$303,300 | \$303,300 | Fund | Fund | Not Reviewed | Fund | \$303,300 |
| 40 | 20170111-D | Gorman | Herring Program - Reproductive Maturity among Age Cohorts | \$169,600 | \$0 | Do Not Fund | Do Not Fund | Not Reviewed | Do Not Fund | \$0 |
| 51 | 20120111-E | Hershberger | Herring Program – Herring Disease Program II | \$243,300 | \$243,300 | Fund | Fund | Not Reviewed | Fund | \$243,300 |
| 57 | 20170111-F | Haught | Herring Program – ASL Study & Aerial Milt Surveys | \$166,300 | \$166,300 | Fund | Fund | Not Reviewed | Fund | \$166,300 |
| 66 | 20120111-G | Rand | Herring Program - Adult Pacific Herring Acoustic Surveys | \$77,300 | \$77,300 | Fund | Fund | Not Reviewed | Fund | \$77,300 |
| 73 | 20170115 | Whitehead | Lingering Oil – Immunological Compromise of Fish | \$322,700 | \$322,700 | Fund | Fund | Not Reviewed | Fund | \$322,700 |

Long-Term Monitoring (LTM Gulf Watch Alaska) Program Projects

The funding described in this document is for EVOSTC Restoration, Research, and Monitoring Projects and for Habitat Enhancement Projects. Please note that the funding amounts in this document are approximate and rounded up to the nearest hundred dollars. The Work Plan is a working document and may be revised as needed throughout the fiscal year. Please contact the EVOSTC office if you would like exact funding amounts.

****The total for these projects can be found under 20120114-Lindeberg on the page one chart***

| Page | Project Number | Principal Investigator | Project Title | FY20 Requested | FY20 Approved | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|------|----------------|------------------------|---|----------------|---------------|---------------|---------------------|--------------|--------------------|-----------------|
| 85 | 20120114-A | Lindeberg | LTM Program - Science Coordination and Synthesis, and Postdoctoral Researcher | \$216,100 | \$216,100 | Fund | Fund | Not Reviewed | Fund | Fund |
| 85 | 20120114-B | Hoffman | LTM Program -Administration | \$384,600 | \$384,600 | Fund | Fund | Not Reviewed | Fund | Fund |
| 94 | 20120114-C | Arimitsu & Piatt | LTM Program - Forage Fish Distribution, Abundance, and Body Condition | \$295,300 | \$295,300 | Fund | Fund | Not Reviewed | Fund | Fund |
| 102 | 20120114-D | Batten | LTM Program - Continuous Plankton Recorders | \$83,600 | \$83,600 | Fund | Fund | Not Reviewed | Fund | Fund |
| 106 | 20120114-E | Bishop | LTM Program - Seabird Abundance in Fall and Winter | \$124,800 | \$124,800 | Fund | Fund | Not Reviewed | Fund | Fund |
| 112 | 20120114-G | Campbell | LTM Program - Oceanographic Conditions in PWS | \$233,300 | \$233,300 | Fund | Fund | Not Reviewed | Fund | Fund |
| 118 | 20120114-H | Coletti | LTM Program - Nearshore ecosystems the Gulf of AK | \$426,100 | \$426,100 | Fund | Fund | Not Reviewed | Fund | Fund |
| 126 | 20120114-I | Danielson | LTM Program - GAK1 Monitoring | \$125,600 | \$125,600 | Fund | Fund | Not Reviewed | Fund | Fund |
| 130 | 20120114-J | Holderied & Baird | LTM Program - Oceanographic Monitoring in Cook Inlet/Kachemak Bay | \$135,700 | \$135,700 | Fund | Fund | Not Reviewed | Fund | Fund |
| 136 | 20120114-L | Hopcroft | LTM Program - Seward Line Monitoring | \$143,000 | \$143,000 | Fund | Fund | Not Reviewed | Fund | Fund |
| 142 | 20120114-M | Kuletz & Kaler | LTM Program - PWS Marine Bird Surveys | \$248,000 | \$233,400 | Fund Reduced | Fund Reduced | Not Reviewed | Fund Reduced | Fund Reduced |
| 149 | 20120114-N | Matkin | LTM Program -Long-term killer whale monitoring | \$140,300 | \$140,300 | Fund | Fund | Not Reviewed | Fund | Fund |

| Page | Project Number | Principal Investigator | Project Title | FY20 Requested | FY20 Approved | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|------|----------------|------------------------|---|----------------|---------------|---------------|---------------------|--------------|--------------------|-----------------|
| 154 | 20120114-O | Moran & Straley | LTM Program - Humpback Whale Predation on Herring | \$184,400 | \$184,400 | Fund | Fund | Not Reviewed | Fund | Fund |
| 162 | 20200114-P | Lindeberg & Heintz | LTM Program – Lingering Oil Component Project | \$52,200 | \$52,200 | Fund | Fund | Not Reviewed | Fund | Fund |

EVOSTC Annual Budget Description

Project Number: 20200100

Project Title: EVOSTC Annual Budget

Primary Investigator(s): Elise Hsieh, EVOSTC Executive Director
Linda Kilbourne, EVOSTC Administrative Manager

PI Affiliation: EVOSTC **Project Manager:** ADFG

EVOSTC Funding Requested:

| |
|-------------|
| FY20 |
| \$2,350,600 |

Abstract:

The budget structure is designed to provide a clearly identifiable allocation of the funds supporting Trustee Council activities. The program components are:

- Administration Management
- Data Management
- Science Program
- Public Advisory Committee (PAC)
- Habitat Program
- Trustee Agency Project Management
- Trustee Agency Funding
- Alaska Resources Library & Information Services (ARLIS)

The budget estimates detailed within those specified program components are projected based upon prior year actual expenditures and include the application of estimated merit step increases, as well as payroll benefits increases. Detailed 12-month budget component items cover necessary day-to-day operational costs of the *Exxon Valdez* Oil Spill Restoration Office and administrative costs associated with overseeing current Trustee Council program objectives.

[A seabird ecologist was added to the Science Panel in February 2020.](#)

FY20 Funding Recommendations (February 2020):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|--------------------------------|--------------------------------|----------------------|--------------------------------|----------------------|
| Not Applicable | Not Applicable | Fund | Not Applicable | Fund |

FY20 Funding Recommendations (October 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|--------------|--------------------|-----------------|
| Not Applicable | Not Applicable | Not Reviewed | Not Applicable | Fund |

PAC Comments – FY20

Date: February 2020

[No comments.](#)

Trustee Council Comments – FY20**Date: February 2020**

The Trustee Council meeting was held on Friday 28 February 2020 and funding recommendations are included in the table above. Any specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

PAC Comments – FY20**Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Trustee Council Comments – FY20**Date: October 2019**

The Trustee Council meeting was held on Friday 11 October 2019 and funding recommendations are included in the table above. Any specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Herring Research and Monitoring Program Project Descriptions

Project Number: 20120111

Project Title: Herring Research and Monitoring Program

Primary Investigator(s): W. Scott Pegau

PI Affiliation: PWSSC

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$8,240,600

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------------------|----------------------|--------------------|----------------------------|----------------------------|
| Auth: \$1,252,900 | Auth: \$1,578,800 | Auth: \$1,996,900* | \$1,986,800*, ^a | \$1,425,100*, ^a |

Requests include 9% GA.

*ADNR requires a bond posted (\$2.6K for FY19) and annual fees for land use permits for underwater acoustic arrays (\$2.7K annual for FY19-21; see FY19 Bishop, pg. 24). Includes additional ship-time support request for acoustic surveys (\$10.3K for FY19-21; see FY19 Rand, pg. 64). Includes project 19170115, which will be part of the HRM program starting in FY19.^aIncludes additional year of tagging effort and analysis (\$401.8K for FY20-21; see Bishop, pg. 24). Includes administrative review of reporting documents (\$13K for FY20; see Pegau pg. 16).

Funding From Non-EVOSTC Sources FY 17-21: \$894,700

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|-----------|-----------|-----------|
| \$157,200 | \$159,700 | \$203,200 | \$225,200 | \$149,400 |

Total Past EVOSTC Funding Authorized (FY12-19): \$11,156,900

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$16,873,500

Total Non-EVOSTC Funding (FY12-21): \$1,049,400

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/23/19.*

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 eight 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; Genomic Mechanisms Underlying Lack of Recovery; 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 and examine potential long-term impacts of oil exposure. The modeling project and the postdoctoral fellows are the primary integrating efforts that use data and information from all the projects and the Gulf Watch Alaska and Data Management programs, though there is a high level of coordination and integrations between all projects. The primary beneficiaries of our efforts are expected to be Alaska Department of Fish and Game, Prince William Sound herring fishermen, and, through publications, the larger scientific community.

Dr. Pegau serves as the program lead to ensure the proper coordination within the program, with other *Exxon Valdez* Oil Spill Trustee Council (EVOSTC)-funded programs, and as a point person for communications with the EVOSTC. An independent scientific oversight group exists that provides feedback on the program.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund* | Fund* | Not Reviewed | Fund* | Fund* |

**Indicates this review group recommends a Do Not Fund decision for HRM Project #20170111-D Gorman.*

Science Panel Comments – FY20

Date: September 2019

The productivity of this program is quite high and the Panel commends the PIs for this. The Science Panel also appreciates the inclusion of postdocs, as well as undergraduate and graduate students, on herring techniques ranging from molecular, disease, to population approaches. For future proposals, please separate out peer-reviewed publications from agency and data reports and include subheading of published, in prep, in review if necessary. We would also like to see more interpretation and discussion of data and figures presented in the proposals; this is included in some of the proposals such as in project 20170111-B. The Panel is not looking for new or additional analyses in the proposals. We are looking for context and some interpretation to allow us to evaluate the proposal.

PI Response (10.2.19): Thank you for the guidance.

The Science Panel had some concern that survey efforts, though laudable, might miss significant amounts of herring in PWS. Herring are notorious for shifting spawning locations by tens or hundreds of kilometers over time. A discussion with herring program lead Pegau indicated that extra efforts have been taken through opportunistic and other sampling to explore the possibility that herring occur in significant quantities in other portions of PWS. Pegau noted that aerial surveys are quite extensive, much larger than the acoustic surveys. For example, ADFG flies over Kayak Island, but this area is not included in the PWS management area. It would be helpful if these non-Program efforts could be briefly described in future proposals and annual reports to provide context. It seems that the herring spawning at Kayak Island should be considered part of the PWS herring metapopulation.

PI Response (10.2.19): We will ensure more description of the survey effort is in the annual report.

Science Director Comments – FY20

Date: September 2019

Overall, the program is completing tasks on time. Synthesis efforts are well underway in preparation for the Science Synthesis Workshop in February 2020. The program is requesting additional funding for two existing projects (see project A and B for details). I concur with the Science Panel's comments.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|-------|--------------------|-----------------|
| Fund* | Fund* | Fund* | Fund* | Fund* |

**Indicates this review group recommends a Fund Contingent for HRM Project #19170111-D Gorman. Review group revised recommendation to Fund for Project #19170111-D.*

Science Panel Comments – FY19

Date: September 2018

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.

Science Coordinator Comments – FY19

Date: September 2018

Revisions to the proposal forms were made to address the Science Panel's suggestions in the FY18 Work Plan. All proposals now include hypotheses, highlights and figures reflecting progress made during FY18. Program is on track except for uploading disease prevalence data to the workspace, but otherwise making excellent progress. The program is requesting an additional \$20K to the original FY17-21 proposal annually for unexpected costs of permits and bonds that have arisen for FY19-21 (19120111-B Bishop) and ship time to continue acoustic surveys (19120111-G Rand). Starting in FY19, project 19170115 will be part of the HRM program to facilitate collaboration with the HRM Program and as per discussions with the HRM program and PI of project 19170115; this proposal is revised to include the budget for project 19170115.

PAC Comments – FY19

Date: September 2018

The PAC noted that the Science Programs have produced unique and very important long-term data sets. The PAC also commented on the thoroughness of how proposal information was presented, it was well organized and clear.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|-------|--------------------|-----------------|
| Fund* | Fund* | Fund* | Fund* | Fund* |

**Indicates this review group recommends a Fund Contingent for Project #18170111-D Gorman. Update (11.21.17) Review group revised recommendation to Fund for Project #18170111-D Gorman.*

Science Panel Comments – FY18

Date: September 2017

Overall, the Panel is pleased with the Program's progress. The Panel strongly recommends that all proposals include hypotheses, highlights and figures reflecting progress made during the previous year(s), as did PIs for two of the proposals (18120111-C Branch and 18120111-E Hershberger/Purcell). The LTM proposal provide good examples of what the Panel is looking for, as they nicely addressed our previous request for this information. They also included a list of publications and datasets uploaded during the previous year, which we endorse and recommend that all proposals now include. This information is very helpful to determine whether changes are warranted in study plans for the upcoming year. Toward this end, improvements to the proposal forms will help. The Panel supports Scott's request to hire Maya Groner for the Post-doc position.

PI Response (10/11/2017)

As the program lead I will review the proposals to ensure they have the hypotheses, goals, and highlights as requested.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments. I will revise the proposal forms to address the Panel's recommendations.

PAC Comments – FY18

Date: September 2017

There are no program specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------|---------------|---------------------|-----|--------------------|-----------------|
| May 2016 | Fund Reduced | Fund Reduced | N/A | N/A | N/A |

| | | | | | |
|-----------|------|------|------|------|------|
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |
|-----------|------|------|------|------|------|

Science Panel Comments – FY17

Date: September 2016

This is a complex proposal with many integrated parts. A key strength of the proposal is the required collaboration and cooperation of PI's from very different disciplines. This cohesion was an initial requirement for the herring program and Dr. Pegau has met this challenge successfully. There were, however, many questions and comments following the initial proposals presented earlier this year. The Panel appreciated the responses of Dr. Pegau and the PI's within the revised Herring Program. Most questions or comments requested clarification or more information and were not necessarily intended to point out shortcomings or errors. In this regard, the Panel was pleased and generally satisfied with the responses that we considered to be constructive and informative.

There was one aspect of the revised proposal that elicited some concerns: the brevity of scientific context and rationale for the herring program, as a whole. We acknowledge that this is a demanding request: it is difficult enough to provide such context for individual proposals, let alone a collection of proposals such as the integrated herring program. Nevertheless, the Panel would like to have seen more attention provided to explaining how the composite set of proposals addressed basic scientific issues. The two general hypotheses listed in the opening pages of the Herring program (i) bottom-up forcing and (ii) age-specific migration are fine, but there are many other fundamental questions in the literature that are germane to the projects in the herring program. For example, within the initial overview of the herring proposals, there is scant reference to the potential impacts of climate change, as a factor that could affect herring or the research efforts directed at herring. We note, however that this specific issue is mentioned specifically in two projects. The Panel was somewhat reassured, however, when we heard directly from Dr. Pegau during a telephone conversation when he indicated that he shares some of this perspective but is constrained by time and assistance. There is some promise that the additional of a post-doc position may provide some assistance in this regard.

Date: May 2016

The Science Panel noted some possible inconsistency between the lists of hypothesis in the 'Program proposal summary' (Appendix A) and similar text from Appendix C. Appendix A presents text explaining the roles of a future post-doc position.

Appendix A states: "... the post-doc position will be directed to test the hypothesis: "Herring recruitment is driven by bottom up forcing and the total population level is determined by disease and predation."

Appendix C (HRM Coordination) repeats this hypothesis and adds two more: "Three hypotheses have arisen over the past seven years that guide our current efforts. Individual projects have additional hypotheses that they will address.

These three hypotheses are copied below (in Italic font):

H1: Herring populations exists in two states, high and low biomass, and the transition between states is rapid. This hypothesis comes from the EVOS supported modeling effort of Dale Keifer (EVOS project 070810) prior to the formation of the integrated programs. H2: Herring recruitment is driven by bottom up forcing and the total population level is determined by disease and predation. A

postdoctoral research position is proposed to allow a focused effort on using historical data to test this hypothesis. H3: Larger herring migrate out of PWS during the summer, while smaller ones remain in PWS.

The Panel was surprised by the inclusion of the specific hypotheses: H1 and H3. Also, we do not necessarily agree that these are three important hypotheses that have ‘arisen over the last 7 years’. We note that there have been no publications of accessible reports to explain the origins of any of these hypotheses. This text is not well presented and is superfluous to the main thrust of most of the individual proposals. We recommend major editing and appropriate modification of related study plans.

Under the project called “HRM Coordination” there is general text referring to a post-doc position that reads as follows (in *Italic font*) with sentences numbered.

(1) The focus of the postdoctoral research will be to examine connections between herring recruitment and condition with the physical and biological environmental conditions. (2) We will be seeking proposals for the postdoctoral position in which the specifics of the approach will be described. (3). The intent is to address the hypothesis: Herring recruitment is driven by bottom up forcing and the total population level is determined by disease and predation. (4) The postdoctoral position is proposed to as a method that allows a focused effort on using historical data to test this hypothesis. (5) Testing this hypothesis is expected to inform the population modeling effort in a manner that improves the predictive capacity of the modeling. (6) The improved model would then lead to resource managers having a better understanding of potential changes in the population.

Revision of Items 3-5 is strongly advised. Items 3-5 present a specific hypothesis that has already been examined in a number of papers for different herring populations. This comment does not mean to imply that the hypotheses are incorrect, or inappropriate, but it does unnecessarily restrict the scope of the postdoctoral position. It may be simpler and more productive to limit the ‘focus’ to examining connections between herring recruitment and condition with the physical and biological environmental conditions. The Panel also points out that a UAF doctoral student, Fletcher Sewall, located at NOAA’s Ted Stevens Marine Research Institute with Ron Heintz, is examining potential relationships between PWS herring recruitment and environmental and ecological factors. Sewall’s results may help jump start efforts by the post-doc and there may be possibilities of collaboration. Finally, the recruitment process for the post-doc described on page 31 was confusing but was explained by PI Pegau more clearly over the phone. The text should be clarified.

The Panel reflected on the scope of the herring proposals and whether there might have been other types of approaches. One example was raised during the phone call with Scott Pegau during which it was suggested that a review of the 2015 Incardona et al. paper may be helpful to consider whether low levels of lingering oil might have chronic impacts on recruitment. The Panel was surprised by the categorical rejection of this suggestion and that such experimental approaches may not have merit. We do not concur.

The Panel also reflected on the types and scope of synthesis work that might be conducted by the post-doc, and others, during the next 5 years. The Panel noted that there were a number of potential process-based connections that might be examined – such as connections between disease and predation. Further, there are potentially relevant data on other factors that might affect herring

that are not considered in either the herring or LTM programs, such as juvenile salmon competition and impacts on herring growth of condition, or pinniped predation, etc.

**Incardona, J., M. G. Carls, L. Holland, T. L. Linbo, D. H. Baldwin, M. S. Myers, K. A. Peck-Miller, M. Tagal, S. D. Rice, N. L. Scholz. 2015. Very low embryonic crude oil exposures cause lasting cardiac defects in herring and salmon. Scientific Reports, 5:13499*

Science Coordinator Comments – FY17

Date: September 2016

I concur with the Science Panel's comments. I appreciate the Team Lead and individual PI's careful attention to the Panel's May comments and feel that the applicable changes made to the Program will benefit both the Herring and Long-Term Monitoring Programs.

Date: May 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel and Science Coordinator's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120111-A

Project Title: Herring Program – Program Coordination, Postdoctoral Researcher

Primary Investigator(s): Scott Pegau

PI Affiliation: PWSSC

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$1,072,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|------------------|------------|----------|
| Auth: \$138,400 | Auth: \$270,200 | Auth: \$302,500* | \$270,200* | \$90,700 |

*Requests include 9% GA. *Includes additional \$13K for program administrative assistance.*

Funding From Non-EVOSTC Sources FY17-21: \$261,400

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------|----------|----------|----------|----------|
| \$26,000 | \$26,600 | \$90,000 | \$90,500 | \$28,300 |

Total Past EVOSTC Funding Authorized (FY12-19): \$2,651,200

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$3,012,100

Total Non-EVOSTC Funding (FY12-21): \$373,100

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/23/19*

This proposal is to provide coordination of the Herring Research and Monitoring (HRM) program. In addition to the coordination efforts, it includes a postdoctoral researcher examining the relationships between herring diseases and environmental conditions. Furthermore, it covers the community involvement and outreach activities of the program. The goal of the project is to provide coordination within the HRM program and with the Gulf Watch Alaska (GWA) and Data Management (DM) programs. The objectives of the project are:

- 1) *Coordinate efforts among the HRM projects to achieve the program objectives, maximize shared resources, ensure timely reporting, and coordinate logistics.*
- 2) *Oversee a postdoctoral researcher.*
- 3) *Provide outreach and community involvement for the program.*

Coordination is primarily through e-mail and teleconference. The management team of GWA and the lead of DM are included in the emails to HRM PIs to ensure they are aware of our activities. We also plan joint principal investigator (PI) meetings and community involvement activities.

The postdoctoral researcher, Dr. Maya Groner, was hired at the end of year one and is focusing her research on understanding the combined impacts of environmental conditions on disease in herring population dynamics using a field collected data, experiments, and population models.

Outreach efforts are focused on providing up-to-date information on the projects and their findings. Community involvement includes regular communications with stakeholders, such as the herring

division of the Cordova District Fishermen United and Alaska Department of Fish and Game to stay aware of their findings and observations. We also are participating with GWA in listening sessions in villages within the spill affected area to seek additional local and traditional ecological knowledge.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel is pleased to see the involvement of an intern; however, we are concerned with the validity of the interpretation of the data by an inexperienced reader. For example, it was pointed out that many scales in recent years have had unusually closely spaced annuli and there was discussion whether these were true annuli or false annuli that shouldn't be considered when aging. The Panel notes that there is a Committee of Age Reading Experts (CARE) that may be able to help address such difficulties. Age readers benefit from years of experience to interpret annuli. If there is agreement about the apparent closely spaced annuli in recent warm years, would it be possible to look at archived samples to see if the same annuli patterns in past warm years?

PI Response (10.2.19): There appears to have been a misinterpretation of what was presented in the work plan. The intern imaged and measured the scales. They were not responsible for aging the fish. That is done by the ADF&G led project. The intern's aging efforts were limited to agreeing on age before imaging, as was set up in the original protocols. The image library that the intern was updating provides an easy way to look at scales from previous warm periods. One can either look at the measured growth or the images of the scales.

Thanks to the panel for the reference to the Committee of Age Reading Experts. The discussion noted in the work plan was between the different aging labs within ADF&G to see how difficult scales would be read and why each person interpreted them the way they did.

The Science Panel had considerable discussion about the quantification of spawning. The following few paragraphs attempt to capture this discussion. Evidence presented in the Branch proposal indicates that herring spawn has shifted both in time (among years) and space, both within PWS and the adjacent area of Kayak Island. Similar temporal and spatial changes have occurred recently in other regions of the eastern Pacific, such as the Strait of Georgia. Based on the new (but preliminary) spatial-temporal analyses of spawning presented in the Branch proposal (project 20120111-C) the Panel requested clarification about survey effort and if some of the explanation for recent change might be related to limitations of resources for surveys. Additional information was provided by phone by Pegau. See HRM Program 20120111 comments (above). During the phone call, however, the Panel was advised that the relatively recent occurrences of spawning on Kayak Island since about 2010 (see Figure 2 in the Haught proposal (project 20170111-F) and Figures 5-6 in the Branch proposal) are not included as part of the spawn estimates. If so, we would question the validity (or biological justification) for such an exclusion. Further, and echoing previous comments provided by the Panel, we also question the validity of the continued use of 'mile days' as quantitative units of spawn. We suggest two things. First, that the summing of spawn lengths, for two consecutive days in

the same location may serve to inflate spawn deposition for certain areas. We strongly advise that this procedure requires re-examination and explanation – but this recommendation should not be interpreted as a criticism of the aerial surveys per se. On the contrary, the Panel applauds the efforts made to locate and measure the spawning. Second, the Panel points out that a linear measure of spawn may vary significantly depending on the location where it occurred. This is self-evident: spawning on steep narrow beaches with patchy macrophytes would not be expected to have equal numbers of eggs as broad beaches with dense macrophytes. These statements are clear from diver surveys conducted in other parts of the coast, including a few years in PWS. In this regard the panel wonders if there would be merit in attempting to calibrate different spawning areas in terms of their egg-rearing capacity. Similar attempts have been made elsewhere.

PI Response (10.2.19): There appears to be a couple main points to these comments. The first is the potential for movement of the location of spawn within PWS and movement of spawn to locations outside of PWS. The second is the validity of the survey technique used.

The movement of spawn and the change in spawn timing has long been a topic of discussion among herring researchers working in PWS. Without a doubt there easily could be a shift of spawning to locations outside of PWS that are not observed. There has never been regular surveys of spawn on Kayak Island and that will need to be made clear to the modeling effort. We have tried several methods (volunteer aircraft surveys, remote camera, person on the ground, satellite imagery) to improve our understanding of spawn in that area, but we have not been able to find a reliable means to survey spawn on Kayak Island. The remoteness of the island and weather in the area limits our ability to reach those spawning areas. Regular surveys of Kayak Island are limited to some extent by the funds available; however, access to the area is a greater limitation.

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 provide a better index to abundance because they account for multiple spawning days on the same beach (Funk 1994). 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. Currently, biomass estimates derived from miles days of milt observations are weighted by district according to Willette et al. 1999. Brady, J.A. 1987. Distribution, timing, and relative biomass indices for Pacific Herring as determined by aerial surveys in Prince William Sound 1978 to 1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, Prince William Sound Data Report 87-14, Anchorage.

Funk, F. 1994. Forecast of the Pacific herring biomass in Prince William Sound, Alaska, 1993. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J94-04, Juneau.

Willette, T.M., G.S. Carpenter, K. Hyer, and J.A. Wilcock. 1999. Herring natal habitats, Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 97166), Alaska Department of Fish and Game, Division of Commercial Fisheries, Cordova, Alaska.

We will continue to work with ADF&G to review the selection on the survey technique being used. The mile-days measure obtained from the ADF&G surveys could certainly be explained in more detail, and different ways of measuring have been explored. The danger to changing this metric is that it would break the long time series of consistent estimates over time, which would require the model to treat a new approach as a separate time series from the existing time series, and this would not be useful until the new time series included at least 4-5 years of data. Direct diver surveys for eggs would be expensive to start up again since this would require training divers in the methodology required, and again would require sufficient years to be useful. Past diver surveys were very useful because they provided an absolute measure of biomass, which although it was highly uncertain compared to the aerial surveys and the hydroacoustic surveys, provided an anchor point for the stock assessment (Muradian et al. 2019).

The Panel welcomed the development of mathematical models of VHS but had concerns with the model in this proposal. One of the stated motivations related to the idea that the benefits of herd immunity might be compromised by harvesting of older fish. Yet the S-E-I-C model presented does not take account of age structure. Despite this, there are stated aims to parameterize the model and publish a paper. What would be the goals of this paper?

PI Response (10.2.19): This is a good question and requires further explanation. Age is related to immunity. The older a fish is, the more likely it is to have experienced a VHS epizootic and to have immunity. There are several ways to explicitly or implicitly incorporate age into a model. As the panel suggests, one way to incorporate age into the model structure is to explicitly model it. For every age group modeled, this will add an additional 4 equations to the model, causing a shift from a relatively simple model to a fairly complex model that can be more complicated to solve, analyze and present. Alternatively, we can make some assumptions about the composition of herd immunity in older relative to younger fish. We can assume that older fish are more likely to be in the 'C' or carrier state, while younger fish are more likely to be in the 'S' or susceptible state. Thus, when we apply a fishing pressure to the population, we can adjust target the fishing to affect mostly older fish in state 'C' (i.e., in a gill net fishery), or an even proportion of fish in all states (i.e. a purse net fishery). Young fish can be added to the model as a 'pulse' of susceptible fish each year and the proportion of susceptible fish relative to carrier fish will determine the herd immunity of a population at any time. Because this is the first VHS model we are constructing and we will need to test parameters to calibrate the model, we prefer to keep the model simple. The focus of this paper will be on communicating and demonstrating key concepts that determine VHS epidemiology: immunity, population structure (w/ regards to disease states and population size), the parameterization of the model and the justification of the S-E-I-C design (as opposed to an SIR, or SI model). It is our plan, however, that this baseline model will serve as a template for more complex models that can incorporate additional factors such as age-structure and temperature-dependence, though the exact structure of any model version will be determined by the research question being proposed. We are currently working with John Trochta and Trevor Branch

to adapt this model to have an age-structure in a later paper that is focused on how serology (i.e. immunity data) can be used to infer unobserved processes in a VHS outbreak, such as mortality or transmission.

The concerns about the modeling were mitigated by the description (page 5 of project 20120111-C) of a simulation study using an age structured model of VHS based on a slightly different epidemiological model (S-I-R). This is potentially very useful indeed and will contribute to integrating the findings from the disease study with the stock assessment modeling.

PI Response (10.2.19): The disease team and modeling team are working in close collaboration on disease models, which will include age structure and be incorporated into the stock assessment, should simulations demonstrate this would be a useful addition.

Older fish are now spawning in 2019. This means those fish have strong immunity. The panel would be interested to see if juveniles or year 1-2 fish from this older cohort are more resistant as compared to juveniles or years 1-2 from younger spawners in the past. This would suggest that there is a transfer of immunity (transcriptome or genetic) which could be addressed by the Whitehead project (20170115) and certainly could be critical information for model.

PI Response (10.2.19): Great observation; we will absolutely be tracking the VHSV antibody status of individual year classes as they get progressively older. We are as excited as you are to see these results, and we expect to have them prepared in the 2020 report. One word of caution however; there is no indication that there is any vertical transfer of VHSV antibodies from the mother to the progeny; therefore, any immunity to VHSV detected in an individual year class would have been achieved via adaptive immunity (i.e. surviving prior virus exposure).

Science Director Comments – FY20

Date: September 2019

Dr. Pegau continues to provide valuable support and coordination within the herring program and with the Gulf Watch Alaska program. Post-doctoral researcher Dr. Groner is making timely progress on her three defined projects that investigate the effects of disease on herring. In FY19, administrative review services were approved, which resulted in a noticeable increase in the quality of the reporting products submitted to Trustee Council office. The PI is requesting an additional \$14.1K to continue needed administrative services for FY20, which will include FY19 annual reports and FY21 work plans.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|-----|--------------------|-----------------|
|---------------|---------------------|-----|--------------------|-----------------|

| | | | | |
|------|------|------|------|------|
| Fund | Fund | Fund | Fund | Fund |
|------|------|------|------|------|

Science Panel Comments – FY19

Date: September 2018

We agree with the Science Coordinator that the PI and the HRM program would benefit from additional administrative assistance. We have no other project-specific comments.

PI Response (10/31/18): A new administrative assistant has been added to the coordination proposal as requested.

Science Coordinator Comments – FY19

Date: September 2018

New postdoc Dr. Groner's previous and current work will make useful contributions to the HRM program. The need for administrative assistance within the HRM program is still a concern with the Science Panel (see May 2016 FY17 comments): "On the other hand, the Panel supports strongly the need to provide additional assistance to Pegau, whose workload alone is a Herculean task." Dr. Groner is supporting the PI in the evaluation of reports and annual proposals being submitted to EVOSTC. While I greatly appreciate the PI's coordination work and effort, and welcome Dr. Groner's help with administrative work within the HRM program, I suggest additional experienced administrative assistance for the HRM program. At the PAC meeting, I was pleased to hear that the PAC understands and strongly supports the need for additional administrative assistance to improve and ensure the quality of reports and other documents that are produced by the program.

PI Response (10/31/18): A new administrative assistant has been added to the coordination proposal as requested.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel appreciates Scott's hard work and effort in the coordination of the Herring Research Monitoring Program. We were pleased to hear that PIs are compliant and rapidly uploading their data to the data portal. The panel is especially pleased to see Scott's involvement in promoting the inclusion of a postdoc in the Herring Program.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel also appreciates that Dr. Pegau's program has endured a number of changes in personnel, with some departing PI's and some new ones. Such changes can be disruptive, and the Panel heartily commends Dr. Pegau for his steady and dedicated supervision of a number of complex and varied management issues. In particular we salute the continued operational integration of the projects, especially the collaborative sharing of vessels and other forms of cooperation among PI's, both with and between the Herring and LTM programs.

The Panel appreciates the extension of the postdoc for a full three years.

Date: May 2016

The Panel strongly recommends that the Council consider the addition of funding to support a third year of the post-doc position, which the proposer currently budgets as funded for slightly more than two years. In recommending three years of funding, the Panel notes that much of the first year will be spent becoming familiar with existing programs and data. The proposal also needs to add a mentoring plan for the post-doc position. This plan could profit by including interactions between the post-doc and Hershberger, whose disease research continues to inspire new insights into causes of the lack of herring recovery in PWS.

The request for an additional \$500,000 in funding to allow for flexibility to respond to changing conditions is not supported by the Panel. If the Program would like to pursue expanded or new work, specific proposals for the expanded or new work should be submitted during the annual proposal cycle to allow for review by the Panel. On the other hand, the Panel supports strongly the need to provide additional assistance to Pegau, whose workload alone is a Herculean task.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20170111-B

Project Title: Herring Program - Annual Herring Migration Cycle

Primary Investigator(s): Mary Anne Bishop

PI Affiliation: PWSSC

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$1,744,200

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|------------------|--------------------------|------------------------|
| Auth: \$381,900 | Auth: \$379,500 | Auth: \$275,800* | \$434,200*, ^a | \$272,800 ^a |

Requests include 9% GA.

* Includes additional request for posting bond required by ADNR (\$2.6K for FY19) and annual fees for land use permits for underwater acoustic arrays (\$2.7K annual for FY19-20). ^aIncludes request for additional year of tagging and analysis (\$129K for FY20, \$272.8K for FY21).

Funding From Non-EVOSTC Sources FY17-21: \$75,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------|----------|----------|----------|----------|
| \$15,000 | \$15,000 | \$15,000 | \$15,000 | \$15,000 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,309,800

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$2,016,800

Total Non-EVOSTC Funding (FY12-21): \$490,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/23/19.*

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 (OTN) 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 movement direction and if herring were seasonally leaving PWS and migrating into the GoA. With funding from the Exxon Valdez Oil Spill Trustee Council in FY16, we improved our ability to distinguish direction of movements between PWS and the GoA by deploying additional acoustic receivers at the OTN 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 tagged 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) and to date have detected 136 at entrances to GoA. During FY19 we tagged 165 herring on the spawning grounds during April and will tag an additional 55 in fall 2019. For FY20 we will tag 210 herring on the spawning grounds in spring.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The project has definitively shown that herring move outside of PWS. This phenomenon has been hypothesized for years, but this work has provided conclusive data. The Panel appreciates the proposed additional year of tagging but was originally hoping that the additional tagged fish could be released in the same previous year. We understand, however, that tagging that many fish in one year was likely not realistic. The Panel discussed the utility of an additional 219 tagged fish in FY20 and concluded that this add-on is worthwhile as the results should strengthen project findings and conclusions.

The Science Panel would like to share a few other thoughts with the PI. First, we noted that when tagging at spawning sites the fish were ‘milting’. Does this mean that only males were tagged?

PI Response (10.2.19): Both males and females are tagged.

Second, the hypotheses are good and address key unresolved questions for herring in general. However, the Science Panel wondered if the potential results might be exactly opposite as stated. Specifically, might food-deprived adults migrate more?

PI Response (10.2.19): Currently we have migration data from the first two years of tagging. While our modeling results are preliminary, the movement probabilities and the linear constraints incorporated into the Multistate CJS model suggest that fish in good condition are more likely to move from PWS to the entrance arrays in the summer months (when fish migrate into the GOA) than fish in poor condition. If food-deprivation was a significant factor causing adults to migrate more, the opposite trend would be reflected by the model.

There is evidence that herring larvae in poor condition may be more prone to move/migrate. In either case, the results of tagging work could address this issue. Third, there is an interesting question of how and when (or what age) herring migrate away from spawning areas to offshore feeding areas and then return. The proposal mentions that it may be a learned behavior (which is supported by some scientists but not by the literature), but this remains speculative.

PI Response (10.2.19): During April 2019 tagging activities, we removed one scale for aging and were able to age 144 of the 165 fish tagged. Importantly, 3-year-old fish represented 32% of fish we were able to age. Thus, we believe the forthcoming receiver detection data will shed some light on the question at what age herring migrate. Regarding whether or not migration is a learned behavior, our proposal cites Corten's paper (2002) that suggested this might be the case, however, answering whether or not migration is learned is neither one of our project's hypotheses or objectives.

A particular difficulty with the 'learn from older fish' hypothesis is that the distributions of the age 0+ and 1+ cohorts usually are spatially disjunct from older cohorts, especially in populations or areas where herring migrate to shelf waters for summer feeding. Finally, the Science Panel asks that, when interpreting results from this project, the PI should be mindful that herring may demonstrate substantial changes in distribution, thus migratory patterns observed in one or a few years may not be static.

PI Response (10.2.19): The PI agrees with the Science Panel's statement and will take that into consideration when interpreting results.

Science Director Comments – FY20

Date: September 2019

This project provides valuable information on herring migration within and outside of PWS. In FY19, the Science Panel recommended increasing the sample sizes of tagged fish to improve the accuracy of these data and inferences. In response, the PI is requesting an additional \$129K for an additional year of tagging of 210 fish in FY20 and an additional \$272.8K for analysis in FY21. The fisheries biologist has left the project and he will be replaced with a new postdoctoral researcher in the near future. I understand from Scott Pegau that the postdoc will pick up where the biologist left off and all work will be completed as proposed. I concur with the Science Panel's comments.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel applauds the PIs work and recognizes that it has greatly advanced our understanding of herring migration within and outside of PWS. It would be nice to be able to compute SE to be comfortable with the accuracy of these data and inferences, given the relatively small sample sizes. What would it take to tag 500 fish? Is it feasible?

PI Response (10/31/18): We catch fish right before spawning (many are milting when we tag them). Because of the reduced PWS herring population and predominance of younger and smaller age classes, we have had to search long and hard to locate, catch, and tag over 200 fish during the short pre-spawning window. We would like to suggest adding a 4th year of tagging in 2020 of at least 210 fish (right now spring 2019 is scheduled to be the final year for tagging). An additional year of tagging would boost our sample size of fish that move to the entrances to approximately 500 fish. By 2020, the dominant age class would be larger, and it will be easier to find and tag larger herring.

The PI's work has wide applications. For instance, results from this project help interpret historical ADFG data. We note that, in the FY17 annual report, the PI reports that there is the ability to remotely download data but the PI was not able to access data from all of the receivers. The PI also reports that some of the receivers were tilted. Was the tilting an unexpected event? Is the download problem linked to the tilting issue? What steps will be taken to address tilt issues and loss of data from happening in the future?

PI Response (10/31/18): We consulted with various people before putting out the receivers in March 2013 and were advised that biofouling would not be an issue at the depths we were deploying. It was not until the September 2017 upload, we noted that some receivers in the Ocean Tracking Network arrays had consistent tilts of 80-90 degrees. Looking at the tilts over time, it appears that biofouling is what is causing the tilting. Depending on the tides, sometimes we can upload receivers with 90 degree tilts. However, receiver tilting appears to affect receiver detection efficiency. We have put a second receiver nearby the 18 receivers that are tilting 80-90 degrees. We are going out 2x a year instead of just once to upload data at Montague Strait and Hinchinbrook Entrance. This way we can identify and resolve problems faster and mitigate data loss.

Science Coordinator Comments – FY19

Date: September 2018

PI is making good progress; project is on track. I am pleased to see the preliminary results from FY18. Additional receivers were deployed in February 2017 to determine what direction tagged herring travel after detection (back into PWS or out towards GOA) and there are unexpected costs associated with expanding the acoustic receiving arrays (\$6.9K annually) for permits and bonds required by ADNR.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

The Panel is once again very pleased with the quality of this proposal. These results are relevant and important; the PI has answered the questions that were asked.

PI Response (10/11/2017) Thank you

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments.

PAC Comments – FY18**Date: September 2017**

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17**Date: September 2016**

This appears to be a very productive project, in terms of acquiring valuable observations about herring movements in PWS. The original proposal was both well-presented and interesting. This generated questions from the Panel – which were addressed in detail. The Panel thanks the PI for detailed and thorough response to Panel interest and concerns, which put both her work and the proposal at large into broader perspective. We also appreciate the PI adjusting sampling based on Panel comments.

Date: May 2016

The Panel was pleased by the work and rapid reporting of results in the literature. While the Panel endorsed the elements and detail of the proposal, we wondered if the work was limited by funding, or whether there were some incremental tasks that might be considered. Specifically, we wondered

if additional tag releases, from different areas and different times, might be considered. While speculative, we wondered if additional tagging might address some key hypotheses that cannot be considered within the present level of funding. For example, does the propensity to migrate out of PWS, or stay within PWS, vary with tagging (spawning) location, or perhaps fish size? Would there be merit in tagging at different times of year – and not only in the spawning season? The main comment was to suggest to the PI that additional increments to this work might be considered if such increments were cost-effective and addressed important hypotheses. Additionally, the Panel was very appreciative of the power analyses presented in the proposal, but cautions that sample sizes estimated for simulated herring in Table 1 may underestimate samples actually required for wild herring.

The Panel understands that annual migrations within PWS, while potentially interesting, are beyond the scope of the project as envisioned. However, we wonder if there may be supplementary data (e.g., herring bycatch in other fisheries) that may be useful to help cobble together a more complete picture of herring migration within and outside PWS.

A different comment on tagging reflects comments made during our call with Scott Pegau who indicated that recent genetics work showed significant differences between PWS herring and those of Kodiak. Less clear was whether there were any genetic differences found within PWS. Based on previously published work, the Panel thought that the likelihood of genetic differences among herring within PWS to be very small – but, on the other hand, if such differences were found then it would be sensible to ensure that tagging was conducted on each of any potential different stocks or sub-stocks. Perhaps a review of fish genetic research done by the Seeb's when they worked for ADFG could reveal comparisons among PWS populations that could inform this issue. The Panel would be supportive of additional project funding for increased tagging as discussed above.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120111-C

Project Title: Herring Program – Modeling and stock assessment of PWS herring

Primary Investigator(s): Trevor Branch

PI Affiliation: University of WA

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$1,161,900

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|-----------|-----------|
| Auth: \$124,300 | Auth: \$288,300 | Auth: \$297,000 | \$303,300 | \$148,900 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,136,700

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,588,900

Total Non-EVOSTC Funding (FY12-21): \$0

Abstract:

**This abstract is excerpted from the PI's Revised Proposal, dated 8/16/19, budget updated 8/16/19.*

Prince William Sound (PWS) herring collapsed shortly after the *Exxon Valdez* oil spill and has yet to recover. Here, we propose to continue the modeling component to the long-term herring monitoring project, which has as its chief goal an understanding of the current status of PWS herring, the factors affecting its lack of recovery, and an assessment of research and fishery needs into the future. Key products are the following (items 6-8 are related to the postdoctoral fellow):

1. The core product of the modeling project is the maintenance and updating of the new Bayesian age-structured assessment (BASA) model based on the ASA model used by the Alaska Department of Fish and Game (ADF&G), including annual assessment updates of PWS herring and the revision of BASA to fit to new data sources.
2. Adapting the BASA model to better model the disease component of natural mortality. Planned work includes simulation modeling of information that can be obtained from antibodies of viral hemorrhagic septicemia virus (VHSV) in herring (described by Hershberger), to examine whether such data can be used to estimate annual outbreak size, the susceptibility of different ages to VHSV, and the estimation of additional mortality due to VHSV.
3. Collation of catch, biomass, and recruitment time series from herring populations around the world to place the lack of recovery of PWS herring into context.
4. An initial exploration of factors that may be used to predict herring recruitment, including oceanography, climate, competition, and predation.
5. Management strategy evaluation to test alternative harvest control rules for managing the fishery in the future, given realistic variability in productivity over time, and the possibility that the

population has moved into a low productivity regime. Ecological, economic and social factors would be considered in the MSE.

6. Examination of physical and ecological processes linked to PWS herring spawning, spawning survival, and survival of juvenile life stages.
7. Examination of physical and ecological processes on recruitment to the PWS and Sitka Sound herring populations.
8. Identifying environmental inputs for incorporation into the BASA model to improve recruitment predictions.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel is pleased with overall project progress and appreciates the ongoing multiple lines of investigation. The panel complements the PI and postdoc on the number of publications completed and in progress. While we very much appreciate collaborative efforts with Maya Groner to include disease dynamics in the model, we have concerns with connections to the disease data. The model does not include age structure; however, age structure influences disease. There are inconsistencies in proposal A and this proposal regarding the inclusion of the disease data in the model. Please see more detailed Science Panel comments about disease modeling under herring proposal 20120111-A (postdoc).

PI Response (10.2.19): We apologize for not including sufficient information in the description of the disease model. The disease model indeed does include age structure, without which it would be almost impossible to estimate the severity of disease in each year. We are currently running simulations to determine what information could be extracted from the immunity data in terms of annual severity, additional annual mortality, and the degree to which each age group is susceptible to disease. Nothing similar has ever been included in stock assessments of other species.

The proposal indicated that the BASA model overestimated herring biomass relative to survey data. This was interpreted as model mis-specification. Investigations into this model mis-specification included placing different priors on survey coefficient of variation, allowing for autocorrelated recruitment, and fixing the sex ratio. In addition, the Science Panel wondered whether changes in natural mortality M could be an additional potential explanation worth examining.

PI Response (10.2.19): One of the projects being done by PhD student Trochta, is examining factors that may influence changes in natural mortality, and results are almost ready for inclusion in future reports.

The panel noted that milestones and tasks were changed as the postdoc position evolved. These changes seem appropriate. The analysis of spatial variability in spawning looks to be a fruitful avenue of research. The Science Panel wondered if changes in spawning distribution could be related to historical serial depletion by fisheries. ADFG fish ticket data by stat area might provide some insights

into this possibility. However, the panel appreciates that analyses of spatial distribution could be very substantial and time consuming.

PI Response (10.2.19): Dr. McGowan has examined spatial distribution of fishing, which shifted substantially over time. Further analysis of the fish ticket statistical areas data is planned, and some data issues need to be resolved at this point. Nevertheless, our initial impression is that shifts in fishing reflect shifts in the fish distribution, rather than fishing causing serial depletion, which results in shifts in spatial distribution of the fish. This is bolstered by continued large changes in spatial distribution in the absence of fishing post-collapse.

Science Director Comments – FY20

Date: September 2019

Significant progress has been made on the development of the BASA model since the start of the second five-year program in FY17. Products for FY19 include two manuscripts in prep and two in review. The primary objectives for the post-doc project have been revised to allow for a more in-depth examination of observed shifts in the location and timing of spawning in PWS over the past four decades. I agree with the Science Panel that this seems adaptive and appropriate.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel requests for future reports and proposals to please clarify that ADF&G is now using the model from this project. Timeline products: What juvenile data (ages 0-2) are now being incorporated into the model?

PI Response (10/31/18): The current BASA model was changed to start with age 0 but does not currently fit to any juvenile data. We ran a test series of model fits that included the aerial surveys of age 1+ schools in 2015 (only four data points were available), but this did not improve predictions for age-3 recruits. However, as the length of these surveys continues to grow, these and other juvenile data can be easily reincorporated into the most recent model.

How are these data collected and have scaling issues of juvenile to adult data been adequately addressed?

PI Response (10/31/18): When the model fits to juvenile data, these data are scaled using an estimated catchability parameter, so that the trend is captured but the absolute magnitude is scaled up and down automatically to match the adult surveys.

Can apparent increases in mortality of herring at ages 1-2 be distinguished from selectivity/catchability issues among aerial and acoustic surveys? The answers affect interpretation of the age(s) at which year class strength is determined.

PI Response (10/31/18): These are currently not incorporated into the BASA model, so the question cannot be addressed from the modeling perspective yet. It seems unlikely that changes in mortality could be estimated precisely enough from the aerial and acoustic surveys.

Regarding the antibody paper, is the PI working closely with Hershberger to get this done?

PI Response (10/31/18): We have the most up-to-date antibody data from Hershberger. Initial simulations suggested that it should be possible to estimate disease prevalence by year and age, but the actual data are much more ambiguous than the simulated data we tested. We are developing a more advanced age-structured simulation model to test how much information can be obtained from the noisier actual antibody data. We are in discussion with Hershberger on how best to proceed, but it looks like we may only be able to estimate annual disease prevalence rather than prevalence by both year and age

Different factors affect herring at different stages which is being incorporated into the ASA model. We find this valid and useful and are excited to see this published. In the FY18 work plan, the Science Panel suggested the PI to consider the development of a similar model for Sitka herring, which would be valuable as a contrast. We still believe this is an important exercise and it likely will be informative for PWS herring and valuable globally. As Sitka Sound is outside of the spill area, we encourage the PI to seek funding to accomplish this. Collaboration with ADFG in Southeast Alaska would be ideal.

PI Response (10/31/18): A Bayesian model is being developed in ADMB for Sitka by Jane Sullivan (ADF&G), although this has substantial differences in the data used, model assumptions, and functional forms of the individual components. At the present time we are not able to develop a new model for Sitka but will continue collaborating with ADF&G about how best to coordinate efforts.

Science Coordinator Comments – FY19

Date: September 2018

PI continues to be highly productive: two manuscripts published in FY18 and another in prep. I have no project specific comments

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

The Panel is pleased to see the data presented and supports the elimination of the Ricker SRR. The Panel has some suggestions regarding the model:

The BASA is a logical extension of the preceding ASA assessment model for PWS herring and may be of use to fishery managers as a model intended to determine such quantities as the stock abundance relative to the stock size threshold for opening a fishery. Some aspects of the BASA model pose difficulties for the examination of environmental relationships. The Panel does not consider the present BASA to be an adequate operating model for purposes of Management Strategy Evaluation (MSE). EVOSTC research needs would be better met by implementing the following changes to the BASA model to aid in identifying critical population processes and environmental influences on PWS herring:

- A. Extend the time series as early a date as possible (previous assessments go back to 1925). This will greatly increase the statistical power for examining environmental influences. The present BASA model begins in 1980, reducing the length of the time series.

PI Response (10/11/2017)

It is our intent to extend the time series of the BASA model further back in time than the current ASA model used by ADF&G for stock assessments. At present, both BASA and ASA start in 1980, because this marks the start of indices of abundance for this population. In the absence of biomass indices prior to 1980, annual stock assessment estimates of recruitment and biomass will be far more uncertain and less useful in examining the influence of environmental processes. However, prior to 1980, there are data on total catch, proportion at age in catch, and length at age are available (e.g. Reid 1971). It should be noted that while much more uncertain estimates of biomass and recruitment can be obtained prior to 1980, this is not true of most of the time series of explanatory factors, many of which rely on time series of data started under the EVOSTC program, or on satellite imagery. Indeed, there are far fewer explanatory variables extending back in time beyond 1980 that could be used in the analysis, reducing the usefulness of this exercise.

- B. Allow the background natural mortality rate to vary in time and estimate it. An example methodology is provided by the Canadian herring assessments (DFO 2015). This should increase accuracy of recruitment estimates and allow additional insight into possible alternative population states. This also will examination of the influence of top-down drivers (predation) and comparison with trends in predator abundance.

PI Response (10/11/2017)

The Canadian herring assessments (DFO 2015) differ from BASA in two key ways: (1) they estimate varying natural mortality constraints by a random walk with autocorrelation, such that natural mortality cannot vary much from year to year; and (2) they do not estimate additional mortality from disease. There is considerable debate in the stock assessment literature about whether natural mortality can be estimated, since it changes with estimates of recruitment and selectivity. Indeed, in

the DFO models, there are unrealistically large changes in natural mortality over time from 0.15 to 1.2 (Figure 5, DFO 2015). Setting that technical issue aside, allowing time-varying natural mortality in BASA would remove the ability to estimate additional mortality from disease, since any signal in natural mortality would be soaked up by time-varying natural mortality. This would compromise goal 2 of the project: the inclusion of new antibody data for VHSV into BASA. It is therefore premature to alter the structure of BASA at this time.

- C. Consider constructing a similar BASA model for the Sitka fishery. To the extent that Sitka shares previously-identified large-scale environmental influences with PWS (Williams & Quinn 2000), combined models will increase statistical power. Conversely, if this pattern of correlation no longer applies in recent years, comparing models should help isolate the important differences or changes in the PWS system relative to Sitka. A long-term Sitka assessment may possibly allow the time-series gap in PWS assessments (no assessments 1957-1971) to be filled on the basis of correlated recruitment patterns.

PI Response (10/11/2017)

This would be a very interesting addition, especially if the correlations in recruitment for Sitka, Seymour Canal, and Kah-Shakes have continued beyond the 1993 end point in Williams & Quinn (2000). Indeed the herring meta-analysis (in prep.) from the 2011-2016 program examines factors that might explain recruitment in all herring populations worldwide. A new model for Sitka is beyond the scope of our proposal, and would require substantial additional work, but if additional funds are available to support this expansion, we would gladly construct another BASA-type model for Sitka.

The Panel strongly encourages addressing items A and B before the use of the BASA model for analysis of environmental influences and to take into consideration item C, even though it is not within the scope of the proposal the additional model will add to the already high quality of this project. The Panel also noted the merits of conducting sensitivity analyses to evaluate the importance of errors in assumptions or parameters, such as natural mortality, on model performance. Together with Items A and B, this would help to determine when the model is ready for MSE.

PI Response (10/11/2017)

Sensitivity tests for model parameters are an integral part of the model assessment process for BASA. For instance, Muradian et al. (2017) reran the model with natural mortality of 0.15 and 0.35 in addition to the base value of 0.25 (excluding disease mortality), and also examined retrospective runs to test for bias in recent years.

The Panel whole-heartedly supports the request to use the CPPG funding (total \$150K) toward 1.5 years of salary for another postdoc (David McGowan) to conduct synthesis work via modeling project with Trevor Branch. However, herring program needs to request an additional \$150K for the remaining 1.5 years (part of FY19 and FY20) needed to create a three-year synthesis, which would provide the minimum time needed for achieve appropriate synthesis.

PI Response (10/11/2017)

We are excited to start work with David McGowan.

References:

DFO 2015. Stock assessment and management advice for BC Pacific herring: 2015 status and 2016 forecast. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Pacific Region, Science Response 2015/038.

Williams, E. H., Quinn, T. H. 2000. Pacific herring, *Clupea pallasii*, recruitment in the Bering Sea and north-east Pacific Ocean, I: relationships among different populations. Fish. Oceanogr. 9:285-299.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-------------|----------------------|----------------------------|------------|---------------------------|------------------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The original proposal, and the revision, was very well presented. The Panel appreciates the feedback from the PI on our concerns and the removal of some aspects of the proposal as suggested by the Panel. We understand the PI's justification to retain other aspects.

Date: May 2016

This is a well-written proposal that clearly shows the linkages with most of the other projects. The proposal lists six tasks, that are listed below (in Italics), with some short comments from the Science Panel on each.

(1) maintenance and updating of the new Bayesian age-structured assessment (BASA) model based on the ASA model used by ADF&G, including annual assessment updates of PWS herring and the revision of BASA to fit to new data sources such as the age-0 aerial survey, condition data, and updated age at maturity.

The Panel wondered what was meant by ‘condition data’. Does this refer to the estimates of condition that can be derived from ASL data or does it refer to something else? Also, we assume that the updated maturity data would come from the Gorman proposal. The Panel also had some discussion on the benefits of new information on size-at-maturity and age-at-maturity or both for BASA. Regarding maturity data, we repeat that there is broad evidence of temporal and spatial structuring of herring on spawning grounds, and sometimes even in over-wintering areas. During spawning, larger, older fish tend to spawn earliest, and perhaps even at different locations than younger fish. Sampling during the spawning time can lead to bias in estimates of age composition, and may lead to errors in assumptions about age-at-maturity. Therefore, the Panel endorses the approach to provide empirical estimates of age-at-maturity with such temporal and spatial structuring in mind (also see Panel comments on Gorman proposal).

(2) Adapting the BASA model to better model the disease component of natural mortality. Specifically, this would be based on new methods for detecting antibodies of viral hemorrhagic septicemia virus (VHSV) in archival and planned future collections of herring serum.

The Panel endorses this task.

(3) Continued collection and expansion of catch, biomass, and recruitment time series from all herring populations around the world to place the lack of recovery of PWS herring into context given patterns of change in herring populations around the world.

The Panel is puzzled and perhaps ambivalent about this. This seems like a worthy task but the implications for PWS seem remote. Providing that this task is not a big-ticket item, it does not present any issues, although it is not clear why this needs to be shown as a distinct task, when it could have been conducted sub-rosa.

(4) An initial exploration of factors that may be used to predict herring recruitment, including oceanography, climate, competition, and predation.

The Panel strongly endorses this task.

(5) A management strategy evaluation to test alternative harvest control rules for managing the fishery in the future, given realistic variability in productivity over time, and the possibility that the population has moved into a low productivity regime. Ecological, economic and social factors would be considered in the MSE.

The Panel does not foresee the resumption of active herring fisheries in PWS anytime in the near future. Therefore, while this task may have eventual worth, it belongs closer to the back-burner than the front.

(6) Simulations to evaluate which data sources are the most useful in assessing future herring biomass, based on an MSE of the impact of each form of data on the accuracy of the BASA model.

We recommend caution. While it may be sensible to proceed with data evaluation, it also is essential to have a concurrent examination of the efficacy and integrity of some of the key databases used in the assessment model. In particular, the factors that might affect the time series of acoustics data have not been well explained in any document to date. Similar comments might be made about some other types of data used in the assessment model (see comments made in response to the Moffitt and Gorman proposals).

The proposal would also benefit from a discussion of how this model could be transferred to ADFG for their future use.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20170111-D DO NOT FUND

Project Title: Herring Program - Studies of Reproductive Maturity among Age Cohorts of Pacific Herring in Prince William Sound, Alaska

Primary Investigator(s): Kristen Gorman

PI Affiliation: PWSSC **Project Manager:** NOAA

EVOSTC Funding Requested FY17-21: \$850,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|-----------|-----------|
| Auth: \$170,000 | Auth: \$172,000 | Auth: \$165,100 | \$169,600 | \$173,300 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$0

| FY12-17 | FY18 | FY19 | FY20 | FY21 |
|---------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY12-19): \$507,100

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$850,000

Total Non-EVOSTC Funding (FY12-21): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/23/19*

To address the lack of recovery of Pacific herring (*Clupea pallasii*, hereafter herring) in Prince William Sound (PWS), Alaska, research by the Herring Research and Monitoring (HRM) Program has been focused on improving predictive models of PWS herring stocks through observations and research. To this end, the goal of the project described here is **to test the PWS herring Bayesian Age-Structured Assessment model's age at maturity schedule with empirical data**. The main objectives of the study originally proposed in FY17 are fourfold: 1) Assess the seasonal timing (spring, summer, fall, and winter) that allows for determination of both previously spawned and maturing female herring, and maturing male herring, based on direct measures of gonad development to assess reproductive maturation states in each age cohort of interest (ages two through five) in PWS. The proportion of immature and mature herring per age cohort of interest can then be determined using the information obtained on maturation states. 2) Assess inter-annual variability in the proportion of immature and mature herring per age cohort of interest in PWS collected at the optimal seasonal time as determined by Objective 1 using direct measures of gonad maturation. 3) Couple histological analysis of gonad maturity with annual scale growth information at the individual level, within specific age cohorts of interest, to understand if scale growth patterns reflect reproductive investment; and 4) Assess annual variation in herring age at maturity schedules before and after 1997 using Alaska Department of Fish & Game's (ADF&G's) PWS herring scale image library, which may allow for understanding maturity schedules of past cohorts. The work to be conducted in FY20 is focused on Objectives 2-4. The work on Objective 2 will involve assessing inter-annual variability in

the proportion of immature and mature PWS herring per age cohort of interest (ages 2-5) collected at the optimal seasonal time as determined by Objective 1. Methods for determining the proportion of immature and mature herring at the optimal seasonal time in FY20 will follow those employed in FY17 - FY19. The work on Objective 3 couples histology results with annual scale growth information at the individual level, within specific age cohorts of interest, to understand if scale growth patterns reflect reproductive investment. The work on Objective 4 will depend on the results of Objective 3 and will focus on evaluating the potential of the scale technique for estimating past maturity schedules using ADF&G's PWS herring scale image library. This analysis will examine the progression of bimodal distributions in scale growth as a cohort of herring passes through time. The prediction is that if scale growth is related to investment in reproduction, then the frequency of fish showing reduced scale growth should increase as a cohort of fish matures over time from age 1 through age 6. Methods for conducting the scale image library analysis have been included in this proposal.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Do Not Fund | Do Not Fund | Not Reviewed | Do Not Fund | Do Not Fund |

Science Panel Comments – FY20

Date: September 2019

The overarching goal of this project is to provide a time series of maturity schedules that would be useful to the Bayesian age-structured assessment (BASA) model. As articulated in previous comments, the Science Panel has voiced ongoing concerns about this project. Although this project has provided some useful data on herring maturity from recently samples, overall project progress has been slow. Work reported in the FY18 annual report focused on the first of four objectives, namely, assess the seasonal timing (spring, summer, fall, and winter) that allows for determination of both previously spawned and maturing female herring, and maturing male herring, based on direct measures of gonad development to assess reproductive maturation states in each age cohort of interest (ages two through five) in PWS. The annual report provides summarized data on age frequency, GSI, and a modified Hjort Index for fish collected during 2018 (only). Histology data from FY17 were received, but no analysis was presented and histology results from FY18 were not yet available. Thus, validation has not been conducted and objective 1 is not yet complete. Additionally, this project, now in its third year, does not appear to have made any progress to definitively determine whether archived scale growth measurements can be used as a proxy for reproductive status of herring. As a result, the Science Panel concludes that this project is highly unlikely to successfully complete project objectives and recommends a Do Not Fund decision.

PI Response (10.2.19): While I accept the Science Panel's recommendation to no longer fund this project, I feel it is important to provide my perspective as the PI regarding the progress that has been made.

The project was designed as a five-year study with the first two years focused on establishing the optimal sampling time (Objective 1). There were issues with being able to collect fish in the first year as the population dropped to record low levels and we were refining our sampling approach. The collection techniques were refined, and our samples were collected in 2018 allowing us to examine the optimal timing of histology. A second setback occurred in that the histology lab that we were using had a technician get injured and sample processing was delayed significantly for 2018 samples.

Despite that delay, we were able to establish that we could not use histology to look at past spawning beginning by late July and set our sampling effort to June. Using the gonad maturation state, we recognized that sampling in November could allow us to discern if a fish was likely to mature by the next year. Therefore, we feel that we were able to establish the optimal sampling time and completed Objective 1 as reported in the 2018 annual report. Despite the two setbacks, this objective was completed on the schedule we had originally proposed. Thus, the Science Panel criticism that progress has been slow is inaccurate.

The Science Panel's comment regarding progress associated with using scales is perplexing since that work was delayed by an earlier recommendation from them in the 2018 annual work plan, but is currently on the schedule we proposed in the FY19 work plan. We proposed to begin working on examining scales in FY18, and at the Science Panel's recommendations associated with the FY18 work plan we delayed that effort to focus on direct measures of maturity. The Science Panel recommended that we begin the work with scales in their comments on the FY19 work plan. We are currently halfway through that fiscal year and still expect to be able to complete the proposed work by the end of the fiscal year. In the FY19 work plan we indicated that the effort would not be completed until January 2020. Again, the Science Panel criticism that progress has been slow is inaccurate.

The project has worked hard to adapt to the recommendations of the Science Panel. Despite setbacks associated with very low herring populations and delays at the histology lab we achieved our objective on time. The comment on the lack of progress on working with scales is being made when only half of the year has been completed and our progress on the processing of the scales was delayed by the Science Panel's earlier recommendation.

I feel I have a record of success as a PI. I was able to pick up a previous project that had been led by Dr. Kline, complete the work, and publish the results. Since this project builds upon a previous pilot study funded by the EVOSTC, I believe that it has a reasonable chance of success and should be permitted to complete the work necessary to determine if it is possible to establish the maturation schedule as originally proposed.

Science Panel Response (10.7.19): We recognize that the data from this project is potentially valuable to the herring age-structured assessment model. However, after careful consideration, the Panel maintains its Do Not Fund recommendation. The cost of the project (exceeds \$500,000 to date and an additional \$350,000 for FY20 and FY21) does not appear to outweigh the value in any forthcoming data. See detailed reply below.

We appreciate the PI's response. The Science Coordinator and an individual Science Panel member investigated the PI's claims regarding the Science Panel's assessment that project progress has been slow is inaccurate. We recognize that unexpected delays occur that may be out of the PI's control.

Regarding the PI's statement that Objective 1 has been accomplished, we do not find evidence that this Objective has been completed. From the FY19 proposal, Objective 1 states to "Assess the seasonal timing (spring, summer, fall, and winter) that allows for determination of both previously spawned and maturing female herring, and maturing male herring, based on direct measures of gonad development to assess reproductive maturation states per age cohort of interest (ages two through five) in PWS." Direct measures of gonad development are based on use of (i) a gonadosomatic index, (ii) a modified "Hjort" 8-stage scale of gonad maturity and (iii) ovary histology

criteria. Analysis and summary of 2017 and 2018 histology data were not reported except to dismiss results from summer samples as non-informative. No data or analyses were provided to support the PI's conclusion that histological analyses of samples collected after July could not be used to assess the likelihood of spawning earlier in the same year except to state that no post-ovulatory follicles were present after that time. There are, however, other histological criteria that could and should have been investigated, especially examination of the thickness of the ovary wall that is reported to be thicker in previously spawned females (see Bowers & Holliday 1961 Histological changes in the gonad associated with the reproductive cycle of the herring, Marine Research). Therefore, the estimated proportions of previously spawned herring using histology data were not adequately examined or presented. The PI's claim that Objective 1 is complete is premature as we see no evidence that verifies this statement.

In the FY18 Work Plan, the Science Panel understood that the scale work was not proposed to begin until FY19. However, during the FY18 review process, the Science Panel repeatedly stated in comments to the PI (FY18 Work Plan, pages 41, 60 and 62) "...if results from Objective 3 [determine if scale growth information reflect reproductive investment] in FY19 offer no convincing evidence that scales can be used to evaluate or monitor age-specific sexual maturation of herring it is highly likely that this lack of evidence may compel the Science Panel to recommend a Do Not Fund for FY20." Subsequently, the PI acknowledged the Science Panel's expectation of preliminary analysis in the FY20 proposal (FY18 Draft Work Plan, page 60). The only statement regarding the progress on scale work in the FY20 proposal is on page 6, "As noted in the FY18 annual report, the 2017 and 2018 scale growth measurements were completed for all fish sent for histology in January 2019. These measurements began in summer 2018 and it took nearly 6 months to work through the scales archived as part of this project. The growth data analysis is currently ongoing and is expected to be reported as part of the HRM program's synthesis effort to be submitted in the late fall 2019. The scale growth measurements for fish collected in 2019 will not be included in the program's synthesis report as the data will not be available in time." To date, the PI has not provided any evidence that scales can be used to evaluate or monitor age-specific sexual maturation of herring. We look forward to reviewing the HRM program's synthesis report and wish the PI the best in her future endeavors.

Science Director – FY20

Date: September 2019

I concur with the Science Panel's comments.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|------|---------------|---------------------|-----|--------------------|-----------------|
|------|---------------|---------------------|-----|--------------------|-----------------|

| | | | | | |
|----------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| September 2018 | Fund Contingent | Fund Contingent | Fund Contingent | Fund Contingent | Fund Contingent |
| October 2018 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

For the reasons outlined below the Science Panel recommend the PI begin analysis of archived scale samples now and not wait until FY21 as stated in the proposal. The Science Panel recognizes the importance of assessing age of maturity for the ASA model; however, we are still uncertain about some aspects of this project. Specifically, we advise that the efficacy of this approach (using archived scales to evaluate past maturity) should not require many years to evaluate, especially because two past projects (Moffit 2017 and Vollenweider et al (2018) have already made some assessments of scale measurements - although the work by Moffit did not specifically address age-at-maturity. Therefore, this part of the proposal is not clear. For instance, we understand the merit in examining field-captured fish, evaluating their gonads and then linking this with scales (although we have a specific comment below related to ship-board measurements of scales). We also note that this is an extension of the work described by Vollenweider et al (2018). Results from such an extension may have merit, but would not, by itself, address the fundamental objective of an *a posteriori* evaluation of previous maturation ogives which will require detailed measurements of archived scales. If the conclusions of Vollenweider et al. (2018) are valid, then one would expect to see frequency distributions of age-specific scale annuli that deviate from normal, probably beginning at age three - as indicated by Figure 18 in Vollenweider et al (2018). Namely, a bimodal distribution may be expected, where one mode represents fish that have matured and allocate considerable energy to reproduction and the other mode represents immature fish that continue to devote most energy toward somatic growth. If there were no evidence of changes in cohort-specific annuli measurements as the cohort age passed with time (i.e., the same cohort examined in subsequent years), then there would be no basis for the assumption (or hypothesis) that past maturity ogives can be gleaned from examination of archived scales. Inter-annual changes in cohort-specific frequency distributions of scale annuli must be detectable. This is the reason why we suggest that evaluation of archived scale should begin sooner, than later.

Is there a reason why existing scale measurements cannot be used immediately to evaluate the efficacy of the scale approach to estimating past maturity? For instance, Moffit advises that over 7,000 scales from the archived collection were digitized and measured. Can these data be used to evaluate the potential of scale measurements for estimation of the age of maturity?

PI Response (10/12/18): The SP directive to begin work on ADF&G's scale library in FY19 is important feedback to this project, and I agree that an analysis following the thinking provided by the SP (i.e., cohort specific bimodal distributions) may be useful. A task has been added to the FY19 deliverables to examine if cohort-specific bimodal growth patterns can be discerned from imaged scales as part of the existing ADF&G PWS herring scale library. Further, the proposal has been edited to include details of this analysis, which are reported in the Changes to Project Design and Objectives section.

We also suggest that the PI seriously consider the potential for macroscopic analysis of gonad histology (see Bucholtz, R.H., Tomkiewicz, J. & Dalskov, J. (2008) *Manual to determine gonadal maturity of herring (Clupea harengus L.)*. DTU Aqua-report 197-08, Charlottenlund: National Institute of Aquatic. Resources. 45 pektronisk_samlet.pdf.). This report, cited in the final EVOSTC report by

Vollenweider et al (2018), is not mentioned in this proposal. Is there a reason why macroscopic evaluation is not used - especially at time of the year when evidence of maturation would be clear to the naked eye?

PI Response (10/12/18): Macroscopic analysis of gonad histology was planned from the outset of this project and is following Bucholtz et al. (2008). This paper has been the focus of several conversations with the histology group doing the sample prep and veterinary pathology readings over the last 6 months. This paper has been added as an important citation in the proposal.

As an aside, the Panel also cautions that measurements of fresh scales at sea might not be directly comparable to scales that are preserved in acetate. If both measurements were to be used, then some control tests (i.e., comparisons of measurements of fresh-mounted scales and acetate imprints) would be warranted.

PI Response (10/12/18): We follow the ADF&G protocols for collecting, mounting, and measuring scales. We only make scale measurements in the lab once they are preserved in the same manner used by ADF&G. I apologize if the text is confusing about what is measured in the field. I think the confusion is a result of my describing a marine scale to take fish weight measurements right after describing the scale analysis. I modified the proposal text to make it clearer how the marine scale is being used.

We share the Science Coordinator's concern of waiting until fall to ship all the samples. Rather, samples should be shipped as they are collected as stated in the original proposal. The process and associated costs should have been investigated and included in the original proposal.

PI Response (10/12/18): Every effort going forward will be made to ship samples for histology as soon as possible. The proposal has been modified to reflect this approach for future field collections.

Our concerns are sufficiently grave that we would like to see a revised proposal that addresses our concerns by Friday 12 October. We feel this is an important step, because at present we are not convinced that the proposal can achieve its stated goals. So while we do think that evaluation of age at maturity is an important effort that could significantly alter the ASA model output, we need more convincing that the data collected in this proposal will adequately answer those questions before being able to fully support funding.

PI Response (10/12/18): Details have been added to the proposal to address the Science Panels concerns outlined in the review of the FY19 renewal proposal. I hope the Science Panel will find those changes acceptable. There has been significant progress made on this project in the last year and it would be great to keep this positive momentum going.

Science Coordinator Comments – FY19

Date: September 2018

The Science Panel had reservations at the start of this project and continues to have concerns for FY19 as noted in past Work Plans. I appreciate the figures presented in the preliminary results section, but there is no discussion to go along with the figures so the reviewer has to interpret the figures. Discussion could include, for example, comparison of Figures 1, 3 and 5 to answer the question: is the age frequency distribution of herring in PWS different between spring, winter and fall?

PI Response 9.6.18

My apologies for the lack of a discussion, but the template instructions ask for preliminary results with figures and tables and does not specifically mention including a discussion of preliminary results. I would suggest that if this is a requirement for the project renewal application that it be specifically noted in the instructions. Confusion over what is required by the template forms is the same issue that caused a lot of heartburn with my renewal proposal last year (FY18) in that specific methods were asked for by the Science Panel, when the renewal template never specifically asked for methodology, mainly I think, because the methods were described in full in the original proposals and the renewal proposals were meant to be more streamlined. It would be helpful for the renewal templates to ask for the complete information that is requested for by the Science Panel for review of proposals.

Figures 2, 4, and 6 show “Relationships between size and GSI” for herring caught during the three seasons but only data points are plotted. The relationship isn’t shown. I suggest running a regression and plotting it on the figure with an r^2 value to show the strength of the relationship or re-labeling those Figures to “Size and GSI data for...”. And state that analysis of the relationship between size and GSI data will occur in FY18 (or FY19) and reported in the FY19 annual report.

PI Response 9.6.18

I agree the text should not read “relationship” if no regression line is plotted. One important note is that for many of the plots presented in Figs 2, 4, and 6, some have only 1 or 2 data points. I see that I included age class 1 in Fig. 6 to demonstrate that no age 1 fish were collected in spring 2018, and therefore there are no data points at all. It is difficult to run a regression with any confidence with few data points in some of these cases. Thus, for now, I have revised the text to read, as suggested, “Size and GSI data”, etc, and have made a note about the fact that analysis will be completed for the FY18 annual report.

Also, the story from Figures 2, 4, and 6 would be more powerful if the x-axis starts right before the length of the fish captured, that way any relationship between length and GSI can be more clearly seen. For example, the standard lengths could start at 100 mm (with the exception of a possible outlier for Age-2 in Figure 6).

PI response 9.6.18

I agree with the comment, and I’ve gone ahead and fixed the axes in Figs. 2 and 4. The “outlier” in Fig. 6 will make it difficult to change the axis much. However, the key point to the axes in these graphs is that they were on purpose made to be all the same so that you can compare across the age classes and see the shifts in size. So in this sense, the axes have to relative to the entire variability across all ages classes and therefore may compress some of the data.

Additionally, the dashed horizontal line in Figures 2, 4, 6 is not defined in the figure captions. A suggestion for Figures 1, 3, 5: edit the x-axis so that the age numbers are centered below the data, so it is obvious which each bar the age represents.

PI response 9.6.18

My apologies, I actually meant to include this as I had it in the FY17 annual report. The information has been added to the figures. Agreed, the axes have been updated.

I understand and appreciate reducing shipping costs by waiting to ship all histology samples after the fall field collection, but will this delay data analysis and impede progress? How much will it cost to send samples after each collection vs. shipping after the fall field collection? Was this not taken into account in the original budget?

PI response 9.6.18

It was not clear from the initial discussion with the histology lab that the samples would have to be transferred to 70% alcohol for shipping to the east coast. Because of the alcohol, they are considered hazmat and must be processed by a certified hazmat shipper. Because there is no FedEx in Cordova, the samples in 70% alcohol had to first be shipped from Cordova to Anchorage via barge, as they cannot fly without hazmat shipping papers, received by an agent in Anchorage that prepares the hazmat shipping papers and then forwards the samples via FedEx to the east coast. The entire shipping costs are just under \$1000 for the barge, hazmat insurance, paperwork done by the agent in Anchorage, and the air shipment to the east coast. Thus, by shipping these all at once, as opposed to after each collection, we save research funds. However, this shipping schedule is contrasted with somewhat of a time delay. In 2017, the shipping was delayed due to the lack of samples collected in June and September, and we waited to ship samples until after the November collection. For 2018, samples will be shipped following the September collections. I will make sure the lab understands that data are needed for the FY18 annual report due in February 2018.

The milestone/task timeline in Section 2A may need correcting. Please see the task “Draft FY17-21 Final Report”. Task is scheduled for all quarters in FY17 and FY18 but not in FY19 or FY20.

PI Response 9.6.18

Since this is referring to submitting the final report for the entire project, shouldn't it only be due at the end of the 5-year program in 2021? I have removed the X's in FY17 and FY18, with the only X being at the end of 2021.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------|----------------------|----------------------------|--------------------|---------------------------|------------------------|
| September 2017 | Fund Contingent | Fund Contingent | Fund Contingent | Fund Contingent | Fund Contingent |
| November 2017 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel appreciates the PI's work and effort during FY17 and understands that if the fish are not present, they can't be caught. The Panel whole-heartedly endorses the histology component to its full capacity. The Panel also strongly suggests recording gonad weights to determine age of maturity.

Updated Science Panel and Science Coordinator comments (11/21/2017):

The revised proposal is considerably improved, and we appreciate the effort required for this revision. The objectives are presented more clearly, and the technical approaches provide more detail. The study design is better explained and justified, and additional references were included. The revision demonstrates that the PI has a continued positive record of publishing journal articles and that the proposed work is well-coordinated with other concurrent projects in PWS. The Science Panel is pleased that the PI recognizes and acknowledges the risk associated with using scales to determine age at maturity in herring.

The Science Panel understands that the scale work is not proposed to begin until FY19, and the Panel will not expect to see preliminary results from Objective 3 in the FY19 proposal. However, we will expect to see preliminary results from Objectives 1 and 2 in the FY19 proposal. Looking into the future, if results from Objective 3 in FY19 offer no convincing evidence that scales can be used to evaluate or monitor age-specific sexual maturation of herring it is highly likely that this lack of evidence may compel the Science Panel to recommend a Do Not Fund for FY20.

The PI adequately addressed the Science Panel's concerns and comments and therefore, we have revised our recommendation of "Fund Contingent" to "Fund" for the FY18 proposal.

Please see the FY18 Work Plan comments if you are interested in reading the detailed discussion between the Panel and PI regarding various technical issues the Panel and Science Coordinator requested be resolved before any approved funding is released.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments. I greatly appreciate Panel's suggestions and the PI's responses to the Panel's concerns.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee. I appreciate the Science Panel's detailed comments and the PI's responsiveness.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

We appreciate that the PI responded thoroughly to Panel comments and felt that the responses dealt effectively with some of our concerns. The proposal, and responses to questions made in the Panel review, made good use of the international scientific literature. We recognize a dilemma faced by this PI, however, that is trying attempting to build on results of past EVOSTC-funded work (by other PI's in earlier projects), that do not yet have accessible reports.

Date: May 2016

The four objectives are:

- (1) assess the seasonal timing (spring, summer, and fall) that allows for accurate determination of both previously spawned and maturing female herring based on ovary histology to determine maturation states;
- (2) couple histology results with annual scale growth information at the individual level, within specific age cohorts, to understand if scale growth patterns reflect reproductive investment;
- (3) assess whether annual scale growth patterns can be used to infer age at maturity at the individual level across age cohorts given results from objectives 1 and 2; and
- (4) assess inter-annual variability in age at maturity based on coupled histology and scale growth over a five-year period by focused, increased sampling during the optimal seasonal period given results from objectives 1-3.

This is an ambitious project and the Panel endorses the intentions of the proposed work, but not necessarily all of the details. First, and most importantly, the Panel strongly endorses the objective of determining an 'empirical' estimate of 'age-at-maturity'. It is widely recognized that spawning herring often show spatial and temporal segregation during spawning, with larger, older fish spawning early and smaller, younger fish spawning later. This is well documented for herring and for many other spring-spawning fish species. Ignoring this, by assuming that the age structure of samples taken during spawning represents the population at large can lead to serious errors in age-structured-assessments. Therefore, to the extent that this proposal recognized that issue, the Panel is strongly supportive. To this end the Panel recommends the measurement of gonad size, and the estimation of a gonosomatic index, as the basis for estimating maturity of individuals. Collection of size data will also allow estimation of size-at-maturity, which may be important, as well.

The Panel also reiterates comments made on the age-structured model here about the likelihood that there is temporal and spatial structuring of herring with respect to size- and age-at-maturity.

Estimation of age-at-maturity should keep such temporal and spatial structuring in mind when considering sampling protocols and data analysis.

Objectives 2-4 of this proposal are concerned with herring scales and the assumption that growth increments (or some other feature of scales) can provide a meaningful estimate of the age-of-maturation of a herring. If this were possible, the Panel agrees that such a measure would be useful, providing the criteria were rigorous and repeatable. However, the Panel has several concerns. One is that this proposal makes no mention of similar work that was recently conducted, and supported by the EVOSTC, by NOAA staff. Namely, is there evidence that this approach will work? This comment applies especially to the proposed study on scales, as potential indicators of age-of-maturity, and ovarian histology objectives. Insufficient information was provided to allow the Panel to evaluate the chances for success of this portion of the proposal. It is essential that this proposal shows that the proposed work will build on existing results and knowledge. Absent some basis for this approach, the Panel is rather dubious of the chances for its success. The second concern is that there are a number of publications on herring and clupeid maturation, and criteria used for assessing maturation. The revised proposal should make it clear that the PI is aware of this work, and when appropriate, build on the existing knowledge base. Finally, the Panel does not understand why this work is proposed for five years. It should not require more than a year, or two, to evaluate the utility of scales as indicators of past maturity. The proposal should be revised accordingly.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120111-E

Project Title: Herring Program – Herring Disease Program II (HDP)

Primary Investigator(s): Paul Hershberger

PI Affiliation: USGS

Project Manager: USGS

EVOSTC Funding Requested FY17-21: \$1,157,900

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|------------------|------------------|------------|------------|
| Auth: \$197,800 | Auth: \$228,900* | Auth: \$236,700* | \$243,300* | \$251,100* |

*Requests include 9% GA. *Includes additional annual request used for processing additional herring plasma samples (\$22.5K annually FY18-21).*

Funding From Non-EVOSTC Sources FY17-21: \$321,400

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------|----------|----------|----------|----------|
| \$61,700 | \$63,600 | \$64,000 | \$65,200 | \$66,900 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,535,200

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$2,029,600

Total Non-EVOSTC Funding (FY12-21): \$405,600

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/18, budget updated 8/23/18.*

We will investigate fish health factors that may be contributing to the failed recovery of Pacific herring populations in Prince William Sound. Field samples will provide infection and disease prevalence data from Prince William Sound and Sitka Sound to inform the age structured assessment (ASA) model, serological data will indicate the prior exposure history and future susceptibility of herring to viral hemorrhagic septicemia virus (VHSV), and diet information will provide insights into the unusually high prevalence of *Ichthyophonus* that occurs in juvenile herring from Cordova Harbor. Laboratory studies will validate the newly developed plaque neutralization assay as a quantifiable measure of herd immunity against VHS, provide further understanding of disease cofactors including salinity, and investigate possible routes of transmission for *Ichthyophonus*. Information from the field and laboratory studies will be integrated into the current ASA model and inform a novel ASA-type model that is based on the immune status of herring age cohorts.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel appreciates the continued progress and willingness to adaptively manage the project to continue to produce novel results. The Panel wondered what the long-term direction of the program will be. The Panel also recognizes the integrative effort to work our understanding of disease into the model with Branch.

PI Response (10.2.19): We envision a several long-term goals for the Herring Disease Program. First, we are working towards complete validation and integration of the VHSV antibody assay into tools that can both hind-cast prior disease mortality events and forecast the potential for future disease epizootics. The hope is that we will be able to hand off a fully-vetted laboratory technique to the ADF&G pathology lab in Juneau, who will be able to work directly with ADF&G herring managers to incorporate near-real time disease metrics into their stock assessments. Second, during the next 5 years, we are interested in investigating potential interactions between pink salmon production in PWS and herring disease, as there are several diseases that cross over between the two species. Our hope is that the Herring Program will make pink salmon / herring interactions a theme and point of emphasis during the next 5-year project block (plans to discuss at the PI meeting in October 2019). Third, we are working towards understanding the basic transmission mechanisms for Ichthyophonus. It is our hope that elucidation of these processes will translate directly into tools that can forecast upcoming Ichthyophonus disease epizootics.

Science Director Comments – FY20

Date: September 2019

Funding for this project was leveraged to learn more about the pathogens of concern to Pacific herring which resulted in three papers and one book chapter that provide new insights into these pathogens. Information and knowledge gained from this project makes a significant contribution to disease research in other geographic areas and species. Efforts to investigate the possibility of zooplankton as an intermediate Ichthyophonus host have not yielded clear results. Thus, the PI will be shifting this focus to investigating the possibility of transmission through the consumption of walleye pollocks eggs. I concur with the Science Panel's comments.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel remains impressed with the level of productivity of the PI and the project. At what age are Abs first present in serum? Is there a difference between Sitka and PWS fish in this regard? In the comparison, were fish of the same age between the sites were they all just pooled? It is not clear in the figure. If younger fish are most impacted by VHSV and survivors are the ones with serum Abs, then it is an interesting question and related to the Whitehead studies on when herring mount an Ab response and if this differs between populations. Some clarifications would be appreciated. We would like to see more detail regarding this topic so we can better understand the intriguing data presented.

PI Response (10/31/18): We would like to thank the Science Panel and Science Coordinator for their constructive feedback on the proposed FY '19 work in the Herring Disease Program. We are also very excited about the VHSV antibody results from the fish health surveys in PWS and Sitka Sound. At this point, we are reluctant to overanalyze these observational data until we have more experimental data to facilitate their interpretation. Specifically, we have spent most of the summer of 2018 assessing the levels of antibodies in additional groups of wild herring and determining how these antibody levels correspond to population herd immunity against VHSV. We hope to have these results summarized for the final report of the FY'18 project. Additionally, we suspect that the antibody data presented in Figure 1 may be more meaningful when analyzed by herring year class in Dr. Branch's revised ASA model. We will be working with Dr. Branch to facilitate this integration during the fall of 2018.

Also, does warmer water enhance disease prevalence?

PI Response (10/31/18): The question of temperature and disease is rather complex, and Hershberger is currently working to address this issue in more detail by co-authoring a chapter in a Disease Ecology Textbook, describing the impacts of global climate change on disease. In short, the proximate effects of temperature are disease-specific. However, temperature can also influence host, pathogen, and plankton (intermediate host) assemblages that indirectly influence certain diseases.

Science Coordinator Comments – FY19

Date: September 2018

This novel project continues to make excellent progress and be productive: three papers have already been published in FY18 and two more are in review. I am also impressed with the level of productivity of the PI and the project.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel is pleased with the results, supports the additional funding requested, and finds the request to be reasonable and justified. Would it be beneficial (and cost-effective) for the Post-Doc (Maya Groner) to help with this project without compromising her proposed research plan? If it can be managed, the Panel feels that this involvement would benefit both the new post-doc and this project.

PI Response (10/11/2017)

Thank you. We anticipate integrating Dr. Groner's work into the HDP, as we feel Dr. Groner's contributions will be beneficial the HDP, the Herring Research and Monitoring Program, and her scientific career. We foresee no conflicts and we are eager to start working with her.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The PI adequately responded the questions the Panel raised about methodologies. The Panel fully supports the proposal by this PI. The brevity of this response should be seen as a tribute to the continued excellent work done in this project and the inter-projected cooperation and collaboration.

Date: May 2016

As in the past, the Panel reviewed the Herring Disease Program II proposal favorably overall. However, the Panel noted that some of the draft text was repetitious from previous submissions. Further, the Panel noted that not all of the previous objectives were fulfilled, especially related to

inter-population comparisons. Therefore, there are some distinct revisions that should be considered and incorporated in a final version of the proposal. The following are the points that were discussed:

Several of the Objectives were from the previous 5-year proposal and there was not a clear rationale why these were nearly identical to the previous proposal. While an extension of the earlier objectives makes sense, inadequate descriptions of previous accomplishments and application of these accomplishments will advance the knowledge of disease in PWS herring in the coming 5 years.

Pathogen-free herring have already been established to the Science Panel's knowledge. The proposal should explain how these fish will be used in studies, not how they are cultured. The Panel feels it is critical that disease free populations should be established for PWS and a Sitka or Kodiak/Cook inlet. That is, genetically distinct populations that may have differing disease susceptibilities.

The plaque neutralization assay data were already presented. The proposal should explain how these data will be employed in the coming 5 years. The past proposal indicated that there was to be a comparative study of herring populations from SE Alaska, including populations that are now established as genetically different from PWS fish. These include Sitka and Cook Inlet or Kodiak populations. Puget Sound populations may have different life histories and demographics so geographical comparisons may be less relevant than data from other Alaskan populations. At the Synthesis Symposium in Anchorage 2 years ago, a discussion of the immunity and exposure differences of populations was prominent, but this approach is not described clearly in this proposal. Taking into account the very recent discovery of the unique genetic character of PWS herring, this comparative population susceptibility to disease becomes a high priority to the Science Panel.

Further, the Panel noted that there is some interesting new technology (high throughput pathogen monitoring systems based on Fluidigm's Biomark™ technology**) that could be relevant to basic questions about the presence and persistence of diseases in Prince William Sound herring. The Panel is also aware that the PI is familiar with these technical developments. Therefore, we would be interested in learning why such an approach was not considered – or alternatively, if such an approach could be considered in a revision of the proposal.

(**<https://pag.confex.com/pag/xxiv/webprogram/Paper21716.html>)

Science Coordinator Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Date: May 2016

I concur with the Science Panel's comments. The proposal would benefit from further discussion of how the work completed by this team from 2006 to present informed the proposed work.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20170111-F

Project Title: Herring Program – Surveys and age, sex, and size collection and processing

Primary Investigator(s): Stormy Haught

PI Affiliation: ADFG

Project Manager: ADFG

EVOSTC Funding Requested FY17-21: \$831,500

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------|-----------|-----------|
| Auth: \$166,300 | Auth: \$166,300 | \$166,300 | \$166,300 | \$166,300 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$272,500

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------|----------|----------|----------|----------|
| \$54,500 | \$54,500 | \$54,500 | \$54,500 | \$54,500 |

Total Past EVOSTC Funding Authorized (FY12-19): \$558,900

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$891,500

Total Non-EVOSTC Funding (FY12-21): \$325,700

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/23/19.*

This project will continue to conduct spring aerial surveys to document Pacific herring (*Clupea pallasii*) milt distribution and linear extent of milt over time and estimate herring biomass based on the surface area of herring schools seen from the air, as well as document the distribution and abundance of sea lions, other marine mammals, and birds associated with herring schools or spawn. This project will also continue to provide a research platform (R/V Solstice) for an adult herring acoustics survey and disease sample collection and processing. Finally, this project will continue to collect and process age, sex, and size samples of herring collected by the acoustics survey, spawning surveys, and the Prince William Sound (PWS) Herring Research and Monitoring program disease sampling. Aerial surveys for documenting herring milt and herring biomass and herring sampling for age, sex, and size data have been conducted since the early 1970s and contribute essential data to the age-structured model (ASA) used by the Alaska Department of Fish and Game (ADF&G) and the Bayesian age-structured model (BASA) project supported by EVOSTC to estimate the historical and future biomass for fisheries management. 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 ADF&G and the *PWS Herring Research and Monitoring Program* Bayesian model.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20**Date: September 2019**

The Science Panel recognizes this is a monitoring project that provides important information and data to nearly all EVOSTC herring work, including the BASA model. Project goals are being completed on time. Although this project provides routine monitoring data, it nonetheless raises questions that may be worthy of investigation, perhaps as part of a program synthesis. For example, as pointed out in the Branch proposal, the PWS herring population now seems unique among many in the world for the long-term duration of low biomass or, stated differently, an apparent lack of recovery. Could this perspective be influenced a paucity of information related to spawning and distribution of herring in other areas of PWS or areas immediately adjacent – such as Kayak Island? Could there be other instances of herring spawning, perhaps in substantial quantities, that go undetected? If this were the case, could other survey methods be used? For example, synoptic larval surveys are frequently used by other agencies, especially in Atlantic waters, to monitor distribution and abundance.

PI Response (10.2.19): It is unlikely that substantial herring spawning events go undetected. The PWS area (including Kayak Island) is heavily trafficked by boat and airplane. Our first indication of spawn is often through pilot or vessel report. In addition to the herring aerial survey program, ADF&G receives regular reports from air taxis, private pilots, fishers, and subsistence users during PWS herring spawn timing. Also, Other PWS HRM program activities including acoustics, tagging, disease, and ASL surveys are running concurrent to the aerial survey program and making vessel-based observations of herring concentrations.

Many PWS commercial herring permit holders live in Cordova and the general interest in, and subsistence value of PWS herring among residents is high. Considering the amount air and vessel traffic in the sound, it is unlikely that significant spawning events, similar in magnitude to those observed in the Port Gravina and Hawkins Island areas in recent years, would go unobserved and unreported. However, we undoubtedly miss small, short-timed “spot spawning” events.

Although we do survey Kayak Island, survey coverage is less frequent than PWS proper (1-3 Kayak Island surveys per year, usually prompted by a report of spawn activity beginning). This is primarily because of it’s location and the fact that we have not historically included this area in the index. If there is strong interest for increasing the frequency of Kayak Island surveys this could be accommodated with an increase in survey budget.

The estimates generated by the aerial surveys were designed to be an index of relative abundance, comparable across the historical time series. As such, it is important to keep survey methods as consistent and repeatable as possible to retain comparability among years (also the reason we do not include Kayak Island in the current mile days of milt total...it is not included in the historical index). Although we acknowledge that other methods exist and may even produce more refined estimates of biomass, they would lack historical comparability. Unless a clear benefit was apparent, we would not support discontinuing the current program in favor of other methods.

Science Director Comments – FY20**Date: September 2019**

I concur with the Science Panel's comments.

PAC Comments – FY20**Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20**Date: October 2019**

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19**Date: September 2018**

The Science Panel appreciates the substantial effort involved in this work and the quality of this proposal. We especially want to acknowledge and express appreciation for the inclusion of retrospective data summaries, as shown in Figures 1-4. We further recognize that this work is fundamentally important for all of the herring projects. We note specifically the comment that weather impacted aerial survey efforts in 2018 (39.5 hours in 2018) and also that 2018 represented an "historical low" for the estimated mile-days of spawn. Did the adverse weather and low sampling effort contribute to the low estimate?

In view of the vital importance of this estimate of spawn we wondered if the PI had concerns about the adequacy of the survey effort. Specifically, was it limited by resources?

PI Response (10/31/18): 2018 survey efforts were limited by the unusual prevalence of poor visibility and/or high wind flight conditions. Funding, staff availability, and pilot/aircraft availability were adequate in 2018.

We also suggest that any further retrospective information about the aerial surveys, especially any data regarding the spatial coverage and temporal frequency and duration of flights could be useful for future analyses, particularly with reference to potential changes in herring distributions. Can and or should the mile-days reported be standardized by sampling effort?

PI Response (10/31/18): Temporal and spatial data exists for historical surveys and a detailed spatial analysis of survey routes could be informative. The estimates generated by the aerial surveys were designed to be an index of relative abundance, comparable across the historical time series. As such, it is important to keep survey methods as consistent as possible to retain comparability among years. Unless a clear benefit was apparent, we would not support weighting mile-days of milt estimates by survey effort.

To reiterate we strongly encourage support for adequate survey effort to verify that the observed reduced spawn extent isn't an artifact of reduced survey coverage - and to ensure that major spawning is not missed. As with some other field sampling projects in the HRM program, the Science Panel is concerned that sampling effort is adequate to make population-level inferences.

PI Response (10/31/18): Aerial surveys can only occur during Visual Flight Rules conditions as weather conditions allow. We fly when the weather allows. Estimates of mile-days of milt should be considered an index, and the surveys were designed to provide an estimate of relative abundance comparable across the historical time series. As such, changes in the method should be avoided if possible, to retain the comparability of these estimates. Linear regression, using number of surveys (x) vs. mile-days of milt (y) shows a highly significant positive relationship when applied the entire time series (1973-2018, Figure 2). High numbers of surveys were flown 1981-1992, coinciding with high estimates of mile-days of milt during the same period (Figure 1)

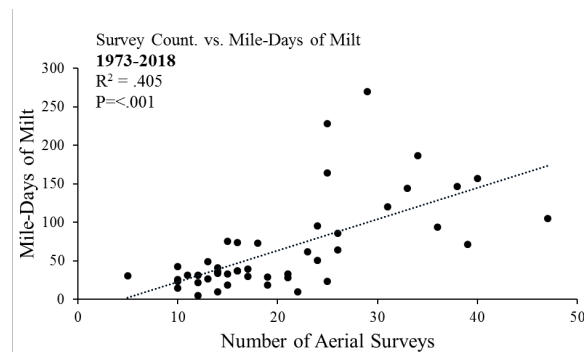


Figure 1. Number of aerial surveys vs. mile-days of milt 1973-2018

When restricted to the post-commercial fishery time-period (1993-2018, although commercial openings occurred in 1997 and 1998), the relationship is much weaker (Figure 3). The 1981-1992 time-period, when high numbers of surveys coincided with high estimates of mile-days of milt, appears to be driving the strong relationship in figure 2. The poor relationship in recent years (1993-2018) suggests that reduced estimates of spawn extent are not likely an artifact of reduced survey coverage, although, admittedly, this is a simplistic analysis.

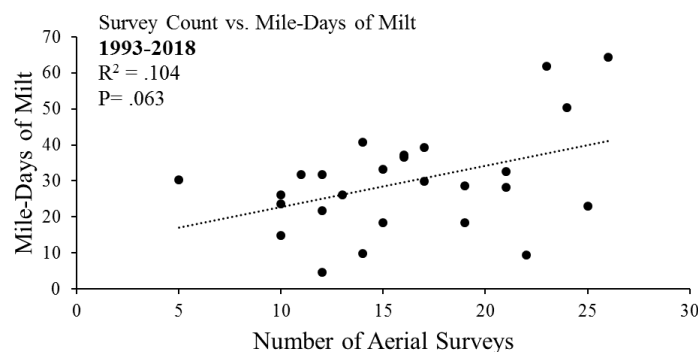


Figure 2. Number of aerial surveys vs. mile-days of milt 1993-2018

We suggest that herring body condition index be related to zooplankton data and other parameters (see Batten et al. which examined herring body condition index with phytoplankton data).

PI Response (10/31/18): We will work with other PIs in the PWS HRM program and others to determine what existing zooplankton data sets are available for analysis.

We appreciate that the PI followed our suggestion from FY18 for conducting ground-truthing aerial observations with skiff surveys and recommend this to be continued for the remainder of the project (FY19-21).

PI Response (10/31/18): We were able to ground truth 100% of observations in 2018 due to the limited spatial and temporal extent of spawning activity. Historically, mile-days of milt were not adjusted for ground truth observations. Due to the concerns of standardized survey methods and year-to-year comparability of this index we did not adjust for ground truth observations in 2018. The final estimate for 2018 mile-days of milt (4.52) would have been reduced by about .3 miles if adjusted for ground-truthing.

Science Coordinator Comments – FY19

Date: September 2018

This project provides important support and useful data for other HRM projects. Project is on task and preliminary results from FY18 are presented. PI is coauthor on a publication that is in review.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel appreciates the support this proposal provides to the entire herring program. The basic survey approach looks reasonable (based on successful work of past years) and the budget also looks reasonable.

This proposal seems to one that provides important technical services to the herring program as well as to ADF&G. The text under ‘Executive summary’ is well-presented, forthright, detailed and appreciated. This text is also very ‘Alaska-centric’ – and almost appears defensive of existing approaches and methodology. A case in point concerns the use of ‘mile-days’ as the fisheries-independent index of herring abundance. This usage should be examined, both within, and outside of the context of the assessment model. There may be valid, biological reasons why ‘mile days’ could tend to inflate estimates of escapement, depending on the circumstances. This comment should not be taken as a criticism of this proposal but applied to the entire herring program. The metric of spawning is fundamental to PWS herring and it warrants more attention – especially analyses of spatial and temporal variability, combined with herring population characteristics (size, age, etc.) As noted in last year’s work plan, similar comments can be made about the acoustic work.

The Panel feels that the entire herring program would benefit from a detailed review of the past work, including times and locations of surveys, acoustic gear used for each survey. This recommendation was also expressed in last year's work plan.

PI Response (10/11/2017)

The text is Prince William Sound centric because it explains the history of the data collection that this proposal continues. The usage various data sets within the ASA model has been examined and reported in the final report for project 16120111-Q Population modeling by Trevor Branch and in the Masters thesis of Melissa Muradian (2015). We reference the work of Willette et al. (1999) as one effort to examine the usage of mile-days-spawn. The mile-days-spawn is only considered an index of the population and not meant to be considered a direct measure of the spawning biomass. The ASA model includes historical dive surveys that the modeling project show as an anchor for the aerial survey data. In the past the logistics of conducting dive surveys were considered to make the effort too expensive to propose. With declining biomass in PWS and reduced dive surveys in Southeast Alaska there may be opportunities to develop a reasonably cost program conducted by divers trained for this type of survey. We will work to determine the feasibility and cost of conducting dive surveys in PWS. We will also continue to consider other approaches (rake or ROV surveys) to determine if a scientifically defensible survey can be conducted by alternate means.

There has been work examining the spawning characteristics, but none of it has been published yet. Dick Thorne was working on a manuscript detailing the shifts in timing and location of spawning in relation to predation pressure by whales, and we will have to follow up to determine the status of that effort. We have tried to use water temperature to help predict spawn timing for guiding survey timing. There appears to be a temperature that spawning does not occur below (~14.5C), but overwinter water temperatures have not been a consistent predictor of when spawning will begin. Spawn location, timing, and the relationship to environmental conditions are things appropriate for the analysis that David McGowan has proposed in his postdoc. The required aerial and acoustic survey information exists for that analysis.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|-----|--------------------|-----------------|
|---------------|---------------------|-----|--------------------|-----------------|

| | | | | |
|------|------|------|------|------|
| Fund | Fund | Fund | Fund | Fund |
|------|------|------|------|------|

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-------------|----------------------|----------------------------|------------|---------------------------|------------------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel raised concerns about the need for ground-truthing that the PI explained could not be completed due the lack of vessel availability. The Panel recognized this explanation but feels strongly enough about the importance of this activity that we would be supportive of a Trustee Council decision to award modest additional funds needed to complete this activity pending an appropriate proposal.

Date: May 2016

The Panel recognizes that this project provides essential information and services for all other projects on the herring program. To reiterate the list of activities, the proposed project will:

- 1) conduct spring aerial surveys to document milt distribution and biomass;
- 2) document distribution and abundance of sea lions, other marine mammals, and birds associated with herring schools or spawn;
- 3) provide a research platform (R/V Solstice) for an adult herring acoustics survey and disease sample collection and processing; and
- 4) collect and process age, sex, and size samples of herring collected by the acoustics survey, spawning surveys, and disease sampling.

While supportive of all of these tasks the Science Panel has the following comments on several topic items (underlined below).

Distribution and abundance of sea lions, other marine mammals, and birds. The Panel strongly endorses this line of inquiry and notes that evaluation of the potential impacts of pinniped predation on herring is an active area of research in other parts of the northeast Pacific. The proposers should familiarize themselves with current research.

Aerial surveys. The Panel is aware of the discrepancy between results of past aerial surveys of milt and estimates made from SCUBA diver surveys, as discussed in the paper by Hulson et al (2008). Further, as explained in the Hulson paper, there was a substantial difference between aerial survey estimates of milt and estimates based on dive surveys. In view of the importance of estimates of milt, and/or egg deposition for herring assessments, the Panel strongly recommends that some effort be made to ‘ground-truth’ the aerial surveys. Specifically, at least some of the aerial survey data should be checked by visits to the site to confirm the geographic distribution of eggs. This does not necessarily require quantitative SCUBA surveys to estimate total egg counts (as was done by Willette et al. 1999). Simpler, less expensive approaches could be considered, such as site visits on small vessels, and use of grappling hooks to look for presence/absence of eggs. Regardless, some effort must be made to calibrate the aerial survey data on milt distribution.

Ideally, this effort such an effort at ground-truthing could even provide opportunities to provide some retrospective calibration of past milt surveys. We note elsewhere (see comments on Gorman proposal) however, that an additional measurement of ‘gonad weight’ could provide very useful information related to ‘age-at maturity’. Such an addition to the routine sampling would be relatively inexpensive.

Acoustics surveys. The Panel notes the pivotal role of acoustics survey data in the assessment methodology. However, we also note that this is the only time-series data that have not been systematically examined to account for any variation attributable to varying survey designs or modification of equipment – which could include vessel types. Of course, we are aware of the 2008 paper by Thorne et al. (written as a companion paper to the Hulson paper in the same journal). However, unlike aerial survey data (from which there is a large and readily accessible data base), and also unlike the ASL (age-sex-length) databases, there is no readily accessible database on the historical acoustics data. However, there should be such a database, especially if such data are used in support of vital biomass assessments. Therefore, a recommendation from the Panel is for the development of a report on the acoustics data, as it is used, and has been used for herring assessments. Such a report should point out the strengths and limitations of such data, with emphasis on any methodological factors that might affect temporal trends in the data. Finally, to conform to normal protocols for assessments, we advise that the data, as it is used in the assessments, should be made accessible.

Hulson, P-J. F., Miller, S. E., Quinn, T. J. II, Marty, G. D., Moffitt, S. D., and Funk, F. 2008. Data conflicts in fishery models: incorporating hydroacoustic data into the Prince William Sound Pacific herring assessment model. – ICES Journal of Marine Science, 65: 25–43.

Willette, T. M., Carpenter, G. S., Hyer, K., and Wilcock, J. A. 1999. Herring natal habitats, Exxon Valdez Oil Spill Restoration Project. Final Report (Restoration Project 97166), Alaska Department of Fish and Game, Division of Commercial Fisheries, Cordova, Alaska.

Thorne, R. E., and Thomas, G. L. 2008. Herring and the “Exxon Valdez” oil spill: an investigation into historical data conflicts. ICES Journal of Marine Science, 65: 44–50.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel’s comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel’s comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Footnote: This project has gone through several titles and PIs
FY12: 12120111-F Buckhorn Juvenile Herring Abundance Index
FY13: 13120111-F Buckhorn Juvenile Herring Abundance Index
FY14: 14120111-F Buckhorn Juvenile Herring Abundance Index
FY15: 15120111-F Buckhorn Juvenile Herring Abundance Index
FY16: 16120111-F Rand Juvenile Herring Abundance Index and 16160111-T Moffit ASL Study & Aerial Milt Surveys
began
FY17: the work in 16120111-F was rolled into 16160111-T to create 17160111-F Moffit ASL Study & Aerial Milt
Surveys.
FY18: the project has a new PI, correct number is 18160111-F Haught
FY19: the project has a new PI, correct number is 19160111-F Haught
FY20: the project has a new PI, correct number is 20160111-F Haught

Project Number: 20120111-G

Project Title: Herring Program – Adult Pacific Herring Acoustic Surveys in PWS

Primary Investigator(s): Peter Rand

PI Affiliation: PWSSC

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$379,900

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------------|----------------|-----------|-----------|-----------|
| Auth: \$74,200 | Auth: \$73,800 | \$75,500* | \$77,300* | \$79,100* |

Requests include 9% GA.

**Includes request for additional \$13K annually for FY19-21 for ship-time support and associated indirect costs to conduct more thorough surveys.*

Funding From Non-EVOSTC Sources FY17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY12-19): \$557,500

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY200-21): \$713,900

Total Non-EVOSTC Funding (FY12-21): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/29/19, budget updated 8/29/19.*

We are continuing to conduct hydroacoustic surveys and calculate biomass estimates of pre-spawning biomass of Pacific herring in Prince William Sound (PWS), providing a long-term relative abundance index for the Bayesian age-structured assessment model (BASA). This work primarily addresses Objectives 1 (expanding and testing the BASA model) and 2 (providing input to the BASA model). Since 1993, the Prince William Sound Science Center (PWSSC) has been carrying out acoustic surveys as a cost-effective approach to estimate pre-spawning biomass of adult Pacific herring just prior to the spawning period. Here we propose to continue this sampling during 2020. **Our main goal for this proposed project is to produce a reliable estimate of pre-spawning biomass of the population of Pacific herring during 2020 in support of the BASA model.** As in recent years, we intend to continue to survey the two main spawning aggregation regions (Port Gravina and Fidalgo, and along the northeast coast of Montague Island). This will allow us to continue generating estimates of the pre-spawning herring biomass in PWS and provide an alert to changes in biomass in these two different regions. While our survey does not include the full extent of spawning habitat in the PWS, we assume here that surveys in these two regions account for the majority of spawning activity that occurs each spring. We feel this is a reasonable assumption given the aerial survey results that monitor herring aggregations, predators, and distribution of milt. While we have focused on these two regions in recent years, other regions may also be surveyed depending on result of aerial surveys and other indicators. We propose to carry out this assessment in spring (March-April). This project will use the Alaska Department of Fish and Game data from direct

sampling for age, sex and length in the estimates of biomass. The estimate will then be provided to the modeling project.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel had a discussion about the utility of adult acoustic surveys. It was noted that such data played an important role in resolving a data conflict previously in the BASA model. The BASA model could be used to evaluate the importance of acoustic versus aerial survey data to model results. The Science Panel also had a discussion about the Biosonics echosounder and wondered whether this is still the optimal tool for such assessments. However, the panel does not have adequate expertise in this area to answer this question.

While it is gratifying to see that this project is cognizant of the merit of expanding the areas ensonified, it is still worrisome to the panel that some portion of the herring population may now occur in areas that are not examined. We note, for instance, that NOAA is capable of conducting large (massive) scale acoustic and fishing surveys of the Bering Sea using large vessels that are capable of working in adverse weather. A fundamental question is this: is the PWS herring population diminishing in abundance (and perhaps spatial distribution) or has the population shifted its distribution to locations they are not presently observed? This comment is not meant to be critical of the PI or this specific project (although it may be useful if this issue were addressed directly in this proposal). Rather we suggest that this may be a salient question directed to the collective research community working on herring and related species in PWS.

PI Response (10.2.19): It is important to keep in mind that the acoustic survey effort is guided by results of a spatially-extensive aerial survey conducted by ADF&G each spring. We do, in fact, respond to aerial survey observations within season (i.e. presence of schools, milt, and/or herring predators) by adapting our survey effort spatially. For example, during the spring 2019 season we surveyed Canoe Pass and Double Bay, regions that have not historically been the focus of the PWS adult acoustic survey, but showed evidence of significant herring aggregations based on aerial observations. While Kayak Island is recognized as an important spawning site, surveying that site would require significantly more funding to cover ship time on a larger vessel. Expanding the survey to include this site would constitute a new survey approach that would produce a new time series. It would take many survey years for an expanded survey like this to generate insight into population dynamics across a broader survey region.

There are echosounders of higher quality in the marketplace (e.g. SIMRAD ES series), with certain advantages, including a much easier and more straightforward field calibration procedure, but it is hard to justify given the great expense of purchasing a new system. There have been some advances in fisheries acoustics, particularly the application of broadband systems. The primary advantage with these systems is the ability to discriminate species within schools based on backscatter resonance from swim bladders (e.g. Stanton et al. 2012). There are still relatively few applications of this technology, and I do not see the advantage of applying this technology to adult herring assessments in PWS given

the aggregations are composed almost entirely of Pacific herring based on results of net captures at the locations we survey. I do see how this technology might improve our ability to survey juvenile herring, as they are often found in mixed species assemblages in PWS bays based on observations from trawling in PWS bays during the HRM juvenile herring surveys conducted during 2012-2016. Determining precise size distribution and maturity status of adult individuals is critical to monitoring the population, and, at this time, I do not see how acoustic survey technologies could offer any advantage over direct net capture. I intend to track the development of this technology to determine how we might improve our assessment approach in the future.

Stanton, T.K., C.J. Sellers, and J.M. Jech. 2012. Resonance classification of mixed assemblages of fish with swimbladders using a modified commercial broadband acoustic echosounder at 1-6 kHz. Can. J. Fish. Aquat. Sci. 69:854-868.

Science Director Comments – FY20

Date: September 2019

Additional survey sites in eastern PWS based on aerial observations of milt and predators in those locations were included in FY19 which was made possible from additional funds granted by the Trustee Council for ship-time on this project. Acoustic calibration was also performed at one of these sites. This also allowed for two simultaneous surveys in both eastern and western regions of the herring spawning range and addresses the Science Panel's concerns about the adequacy of survey spatial coverage in the FY19 Work Plan. The expanded survey coverage will continue in FY20 and FY21. I concur with the Science Panel's comments.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel understands that both competition and cooperation for vessel time can occur. We further understand that results from acoustic surveys have an immediate impact on biomass assessments and other understanding of herring distribution and biology in PWS. Therefore, we have questions and concerns about the spatial and temporal consistency of herring distributions in PWS and the adequacy of the present acoustic surveys to detect change. This is not a criticism. Instead, it is a question about the adequacy of the spatial coverage of the surveys. We observe broad environmental changes that could impact herring distributions and we are concerned that potential changes in herring distributions could go undetected. Shifts in Pacific herring spawning distributions have been observed in other regions (e.g., SE AK, British Columbia). Thus, we support the request for additional funding to

continue simultaneous surveys. We would also like to know what is the extent aerial surveys can be used to inform the acoustic surveys? Does the timing of each survey allow this?

PI Response (10/31/18): Thanks for clarifying your concerns about the acoustic survey. It is important to note that each survey we conduct relies on information from the following sources:

- 1. Aerial surveys conducted by ADF&G. This helps us in terms of timing and in identifying what areas to focus on in our survey. Observations of particular interest are the presence and distribution of predators (particularly sea lions and whales). Based on my experience in recent years, we receive information from 2-3 aerial surveys just prior to and during our acoustic survey, and we have found them very helpful to help us focus our field effort.*
- 2. Some early, reconnaissance surveys by a vessel charter in the eastern sound (particularly in Fidalgo and Gravina, and along Hawkins Island, beginning in mid-March). These surveys (both visual surveys for predators and evidence of herring aggregations from ship-board sonar) provides additional information early in the season.*
- 3. During a typical vessel charter day during our survey, we run long transects during the day to observe predators and roughly map out the area that contains any herring schools (based on ship-board sonar). This is done at a higher speed (compared to our night time transects with our tow fin deployed) to enable us to cover a relatively large area and determine the rough boundaries of our survey area.*
- 4. To maximize spatial coverage over the night, we use a sawtooth transect design and adjust the length of each transect leg based on our observations leading up to the time of the survey so we can be assured we are covering a large enough area.*
- 5. In addition, we do visit some bays where herring predators were noted in the ADF&G aerial survey (outside our traditional focal areas in Gravina/Fidalgo and NE Montague Island region). To date, none of these bays have yielded evidence of herring aggregations.*

In short, I am confident that our survey coverage has been adequate to capture any changes that might be occurring in the distribution of spawning herring in PWS. Maintaining the amount of shiptime we have used in past survey years will allow us to continue this level of survey coverage into the future.

Science Coordinator Comments – FY19

Date: September 2018

PI is making good progress, has already published one manuscript in FY18. Project is on track, even ahead of schedule for some tasks. PI anticipates compressed field seasons in the future due to recent patterns of fish distribution and behavior and multiple projects competing for R/V Solstice ship time. There has been difficulty in scheduling acoustic sampling that will allow for a complete survey. Thus, PI is requesting additional funding (\$10.3K annually for FY19-21) for 5 days of separate ship time for two simultaneous surveys in both eastern and western regions of herring spawning range. 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.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19**Date: September 2018**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

The Panel agrees that the acoustic surveys provide valuable information toward achieving the goals of the herring program. As noted in last year's work plan, the Panel appreciates the progress made to date but would like to see included results from the previous years, history of assessments and maps of survey tracks.

PI Response (10/13/2017)

We thought the results from previous years was already available on the AOOS Gulf of Alaska data catalog. We are working with the Data Management program to make it available as soon as possible. The history of assessments and maps of survey tracks are available in the cruise reports and EVOS annual reports from 2000-2016. Raw data from 1993-1999 was not collected digitally and is no longer available, only the final processed biomass estimates remain. We will work with the data management program to make these available through the AOOS data catalog.

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments.

PAC Comments – FY18**Date: September 2017**

There are no project specific comments

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel particularly appreciated the assembly of the historical acoustic database. This database is one of two key databases used for annual biomass assessments. Such an accessible database supported by an accessible report is an essential component for continued biological assessments.

Therefore, we salute the progress made to date but urge the complete of the documentation of past acoustic surveys.

Date: May 2016

This proposal was well-written, and the objectives are very clearly stated: “to continue a longterm data set of biomass estimates of the spawning population of Pacific herring in Prince William Sound.” This proposal primarily addresses Objectives 1 (expanding and testing the herring ASA model) and 2 (providing input to the ASA model). Since 1993, the Prince William Sound Science Center (PWSSC) has been carrying out acoustic surveys as a cost-effective approach to estimate the biomass of adult Pacific herring just prior to the spawning period. The stated goal is to “produce a reliable estimate of adult biomass of the spawning population of Pacific herring for each year during 2017-2021 in support of the age-structured assessment (ASA) model”.

The Panel notes that this work provides essential information for the herring assessment model, and for this reason the work should continue as proposed. We also note and commend the PI for ensuring that the continuity of this work will continue as it has been conducted in the past. The Panel has several concerns and comments, however, one of which was mentioned in the response to the Moffitt proposal. That is, there is not a readily accessible database of the past acoustic surveys. Ideally there should have been annual reports showing dates and time and location of surveys, and locations where herring were, and were not, found. As much as possible these last surveys should also have commented on any issues (technical, methodological or biological) related to species identification and other factors that might have affected that validity of the data. In lieu of this and in recognition of the vital importance of these past acoustics data to the herring assessment process, the Panel recommends that a quantitative synopsis of past work be prepared, as an essential element in the assessment process. Further, the Panel appreciated that comments on target strength of herring, but also notes that there have been changes in size-at-age, and perhaps condition of PWS herring during the past several decades. Could such changes affect target strength? Perhaps there have been other changes? Therefore, we wonder how such changes in the physical and biotic environment would have affected estimates of herring biomass. Clearly there may be other concerns about acoustic work as reliable indicators of herring biomass. In view of such uncertainties, the Panel encourages the PI to take a more rigorous and critical approach to acoustic assessments. We suggest that such an approach would be, in the longer term, the most valuable information that could be provided, regardless of whether it supported, or challenged the historical time-series of acoustics data. The PI of this project, more than anyone else, is in a position to put many assumptions to the test – while still providing the necessary data that will provide a time-series input to the assessment model.

Science Coordinator Comments – FY17

Date: May 2016

I concur with the Science Panel’s comments.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20170115

Project Title: Genomic mechanisms that underlie lack of recovery of Prince William Sound herring following the 1990s collapse

Primary Investigator(s): Andrew Whitehead

PI Affiliation: UC Davis

Project Manager: USGS

EVOSTC Funding Requested FY17-21: \$1,761,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------------|----------------|-------------------------------|-------------------------|-------------------------|
| Auth:\$224,700 | Auth:\$492,800 | Auth:\$478,000* ^{\$} | \$322,700 ^{\$} | \$242,900 ^{\$} |

Requests include 9% GA. *Includes additional \$54.9K recommended by the PAC for oil dosing equipment. ^{\$}Includes additional requests for travel (\$2.6K) to the HRM Annual PI meeting for FY19-21.

Funding From Non-EVOSTC Sources FY17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY18-19): \$1,195,500

Total EVOSTC Funding Authorized (FY17-19) and Requested (FY20-21): \$1,761,000

Total Non-EVOSTC Funding (FY17-21): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/23/19.*

The long-term health of fisheries is of crucial importance for the economic health of our coastal communities and for the food security of our nation. Therefore, the causes and consequences of changes in stock abundance merit careful scientific evaluation. The causes of the collapse of the Prince William Sound (PWS) Pacific herring stock are controversial, and the reasons for the lack of recovery remain a mystery. In the research proposed here we interrogate the genome structure and genome function of PWS fish to test hypotheses about the causes and consequences of the collapse, by revealing ecological, evolutionary, and genetic mechanisms governing the demographic trajectory of PWS fish over the past ~30 years. Conspicuous events that coincided with the dramatic PWS collapse include the *Exxon Valdez* oil spill four years previous, and the widespread emergence of disease. We test hypotheses concerning the effects of oil exposure, the effects of disease challenge, and their potential interactive effects, on herring health and fitness. We will test predictions and hypotheses by reconstructing genome-wide genetic change through time (over the past 30 years) in PWS fish and compare this to population genetic change through time in two reference site populations. Furthermore, a series of laboratory-based experiments will test for population differences in their response to oil exposure in early life and subsequent resilience to pathogen exposures. Physiological measurements and patterns of genome-wide gene expression will serve to reveal similarities and differences in mechanisms of response to these stressors between PWS and reference population fish. These studies should provide novel insights into the causes and consequences of recent dramatic demographic changes in PWS fish, potentially inform novel

intervention strategies, and provide modern genomic resources for management and conservation of Pacific herring.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel offered several comments for consideration. First, findings from this project are applicable to herring in polluted environments elsewhere, as well as other forage fishes. Second, simultaneous exposure is not applicable anymore given the conditions in PWS now. Are there data in Atlantic herring where simultaneous exposure resulted in decreased immunity? If so, it may differ from sequential exposure. Third, a recent paper (by Ward et al. 2017. Evaluating signals of oils spill impacts...PLOS ONE DOI:10.1371/journal.pone.0172898) concludes that there was little overall effect of oil as an explanation for ecological change. Therefore, it seems possible that one of the outcomes of this work could be a conclusion that there was a genomic effect related to the oil spill, but it did not manifest into changes in herring abundance. That possibility notwithstanding, this work has considerable novelty and merit. It should proceed as proposed.

PI Response (10.2.19): Thank you.

Science Director Comments – FY20

Date: September 2019

This project continues to make significant progress in FY19. I appreciate the highlights from FY19 which are presented in detail. Regarding genome sequencing and assembly, is there anything that needs to be taken into consideration when using Atlantic herring long-range genome assembly for project herring long-range ordering and scaffolding (besides the unanticipated 3 months of additional computational work)? Will this affect any interpretation of data/results?

PI Response (10.2.19): Long-range scaffolding of the Atlantic herring genome will allow us to collapse our fragmented genome together. This will improve our ability to annotate the genome. Given our experience with other fish genomes, genome order is highly conserved, especially among such closely related species as Atlantic and Pacific herring. That being said, there may be some genomic rearrangements in the Pacific herring that distinguish it from the Atlantic herring. However, this will not affect any interpretations of the Pacific herring population genomics data.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19**Date: September 2018**

The Science Panel was very pleased with the project and its development and the extent to which the PI has trouble-shot various approaches and arrived a rigorous way to address questions without being able to simultaneously access samples from all populations. The reallocation of funds by the PI to purchase the oil dosing system had the unanimous support of the science panel, and we look forward to seeing further results. The PI has made rapid use of technological advances in genomic analysis leading to what we considered “great bang for the buck”. The Science Panel and Science Coordinator remained impressed with this work and the broad application these results will have to other fisheries globally. We are excited to see comparisons made with data from Puget Sound. We continue to be enthusiastic for your project and appreciate your hard work and efforts.

Science Coordinator Comments – FY19**Date: September 2018**

PI continues to make excellent progress. Milestones and tasks are on track. The first draft of a reference genome assembly for herring has been completed. Differences in the seasonal timing of spawning from each population requires oil dosing for these considerably complex experiments to be highly reproducible so accurate and robust population contrasts can be made. The results of this experiment will make valuable contributions in determining the potential of PWS herring to resist disease after exposure to oil compared to other stocks and will be an important contribution to understanding the dynamics of herring as well as the potential effects for fish stocks exposed to other oil spills globally. Noted is that there is strong support for this project from the PAC and recommendation for an additional \$50K for the cost of the oil dosing equipment. To facilitate collaboration with the HRM Program and as per discussions with the HRM program and PI this project will be part of the HRM program starting in FY19; this proposal is revised to include travel costs to the annual HRM PI meeting.

PAC Comments – FY19**Date: September 2018**

The PAC discussed the fact that the PI reprogrammed funds to purchase an oil dosing system that was not in the original project budget. It was discussed that prior similar studies would have been strengthened by use of this equipment. The PAC noted the need for high tech equipment in genetics work and recommended the additional funding of \$50K for the oil dosing system for this project.

Executive Director Comments – FY19**Date: September 2018**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel was pleased to see the integration with Paul Hershberger's disease work, linking them to see if there is a genomic change in response to these different pathogens in the PWS herring population. The Panel appreciates that goals are being achieved ahead of schedule and cost-effectively, allowing for additional samples at other locations. The Panel approves the shift of funds from future years to FY18 to get the postdoc onboard to work with the data being generated. There are many great collaborations being made. The Panel is excited to have the entire genome and transcriptome for herring mapped for other studies, including the possibility of adding more value to herring stock responses in Southeast Alaska. There might be another source of archived samples in Pacific Northwest (Doug Hay - Barkley Sound?).

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

This innovative proposal complements the Herring Research and Monitoring Program by conducting a retrospective (pre-spill to present) analysis of genome diversity and the potential impacts of oil exposure on immune deficiency, as well as an assessment of the ability of current genetic diversity to cope with ongoing disease issues. The current Herring Program is focused primarily on stock assessments and current factors affecting the lack of recovery (e.g., whale predation, disease monitoring, and recruitment issues). The Science Panel is supportive of the proposal because of the potential to answer important questions about the cause of the herring population crash as well as important genetic factors that may inhibit recovery. Notably, this project combines genome (Whitehead) and disease (Hershberger) expertise and makes use of valuable genetic samples archived by ADFG pre-spill to present. The Panel is quite enthusiastic about this new approach and opportunity to assess the evidence for mechanistic ties between oil and herring immune deficiency by bringing genomic expertise to bear on herring disease issues. The PI has an excellent track record

of productivity and expertise. A major strength of the proposal is the utilization of fish tissues samples that have been archived for almost 30 years at ADFG. This work draws upon ADFG's existing tissue collection, in combination with advanced genomic techniques, to provide a unique (and possibly unparalleled) view into the population, genetic and evolutionary history of Alaskan herring before, during and after the oiling event. This unique opportunity to utilize ADFG samples, collected and archived across decades, will facilitate a novel approach to the pressing problem of lack of herring recovery and result in valuable information regarding the PWS herring genome.

The PI builds a strong case in support of the hypothesis that oil exposure has suppressed the immune response of herring to disease thereby contributing to the crash and slowing recovery of PWS herring. The PI is uniquely positioned to address this question given that he has found strong evidence that exposure to PAHs and oil on the Atlantic and Gulf Coasts respectively has suppressed immune responses of killifish. The PI works with Paul Hershberger, who has produced internationally groundbreaking herring disease work supported by EVOSTC funding. The second tier of experiments will rear disease-naïve herring embryos from PWS and two other stocks, expose embryos to oil, and determine if there is a difference in response and in genome diversity with disease response genes. Rearing and exposure of fish will take place in the laboratory of Paul Hershberger, who has vast experience in producing disease naïve fish. This research on herring immune deficiency will be valuable in determining the potential of PWS herring to resist disease after exposure to oil compared to other stocks and will be an important contribution to understanding the dynamics of PWS herring, as well as the potential for fish stocks in general exposed to other spills elsewhere. In addition, the research is valuable regardless of the outcome (i.e., whether the link between oil and herring immune deficiency is supported mechanistically and whether or not there is a genetic diversity bottleneck effect) as the proposed work has the potential to contribute significantly to our understanding of both the causes of herring decline and the failure to recover to date – key issues to the mission of the EVOSTC.

The proposal's costs have been reviewed and are found to be appropriate for this level of technological capacity and typical for these types of advanced genomic techniques.

General Comments:

The PWS herring population collapsed several years after the spill and has not since had a sustained period of incremental growth. Scientific reports that describe potential causative linkages are matched by an approximately equal number of reports that describe alternative explanations for either the collapse, or lack of sustained recovery, or both. In short, even after several decades of research, we are still uncertain about whether there have been any long-term impacts of the spill on herring, or the herring collapse in 1993-94 and the lack of any sustained recovery. This project has the greatest potential to have a retrospective look at the past in a scientifically meaningful way.

This proposal has an unprecedented capacity to apply novel, highly technical research on Alaskan herring genomics to actually test the hypothesis that exposure to oil during the egg (or embryo) and early larval stages has led to a decrease in the genetic capacity of PWS herring to resist naturally-occurring, endemic disease organisms. This retrospective genome determination from archived genetics samples would determine if present-day PWS herring would be detectably different than their ancestors residing in PWS prior to the spill, and from other Alaskan herring populations. The proposal consists of several tests. One would be based on a time-series analyses of archived samples of herring collected and stored annually since the spill to test for change in the frequency of alleles

related to disease resistance or susceptibility in PWS versus areas that were not exposed to oil. A related test of differences in disease resistance of PWS herring from other herring would be based on laboratory experiments of reared herring from PWS and two other populations.

The proposal is important to EVOSTC and the State of Alaska. It addresses the most fundamental question of the herring program: what is the impact of the spill on herring and what factors are now affecting recovery? This project builds off the current herring monitoring program, and, most importantly, builds off the unique collection of archived herring collections from ADFG, the work proposed in this proposal, regardless of the results, will reflect positively on the EVOSTC. Moreover, the proposed work will likely have worldwide implications and applications for coastal marine fishes.

Specific Technical Comments:

As is often the case with such novel, groundbreaking proposals, the Panel had a number of questions that the PI should address and submit to EVOSTC before reaching a final decision on the recommendation for funding the proposal. We are confident, given the expertise and track record of the investigators, that the PIs will submit appropriate details to these comments:

1. Add technical detail on pathogen exposure experiments. The Panel had several questions that need clarification. Which pathogens will fish be exposed to? Are these from purified sources that can be used at different times of exposure? Given the population differences and pathogen responses, this is a key detail that needs to be included. Will embryos/larvae from the different populations be tested simultaneously for oil and disease exposure in the lab? If not what assurances will be made that exposure (oil as well as pathogens) conditions are identical across populations? For example, how reproducible is the oiled gravel treatment and the pathogen challenge? What steps will be taken to ensure and verify this reproducibility? What will be the age of embryos at collection? That is, 10-14 day embryos may have a different transcriptome than 5-7 day embryos because they might have been exposed to environmental stressors such as UV, desiccation and salinity changes.
2. Aim 3 needs more details on replication, exposure duration and intensity.
3. Functional annotation of genes. It would be useful to mention existing genomic resources for similar species to assure the Panel that these genes and others of potential relevance can be identified and the genome annotated.
4. Add detail on retrospective population genomics sampling. Please provide information on where fish were sampled and the age classes of collected fishes to clarify how the longitudinal time series will be interpreted. For example, age 3 fish collected in 1993 would not have been exposed to oil, but age 8 would have been. Additional information is needed to ensure that samples were representative of the population at the time of sampling and that sample numbers are sufficiently large and were preserved in such a way that genomic level data can be recovered from the samples.
5. Ignoring alleles with less than 5% frequency. While this makes sense, with N=50 individuals, this means that genotypes with fewer than 3 individuals will be discarded. Depending on the degree of polymorphism, if diverse populations have large numbers of rare genotypes, this could result in many genotypes being ignored. This is a question, especially if disease perhaps maintains

diversity via negative frequency dependent selection. It would be helpful if the PI could address this potential issue.

6. Clarify Hershberger's role and budget needs. There appears to be considerably more effort from Hershberger than indicated by the total dollar request. We assume that this is the result of "in-kind" contributions, but it would be good to document the source of those funds so that we can both be assured that they will happen and to account for any leveraging of funds. The Panel noted that this sort of in-kind contribution might be time sensitive and this is another very good reason to support funding the project in this cycle.
7. Add additional detail on the budget. Please clarify budget details for each objective to allow the reviewers and Trustees to know what the cost for each piece of the work would be and to assess what funds from other projects (both those funded by EVOSTC and others) might be being already leveraged in this proposal (see #6).

Science Coordinator Comments – FY17

Date: September 2016

This proposal comes from a highly qualified team and offers a new and novel approach. I concur with the Panel's comments and recommendations for further detail.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel and Science Coordinator's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Long-Term Monitoring (Gulf Watch Alaska) Program Project Descriptions

Project Number: 20120114

Project Title: Long-Term Research and Monitoring Program (Gulf Watch Alaska)

Primary Investigator(s): Mandy Lindeberg

PI Affiliation: NOAA

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$12,780,400

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------------------|------------------|-------------------|----------------------------|----------------------------|
| Auth:\$2,278,800 | Auth:\$2,574,900 | Auth:\$2,540,100* | \$2,792,900*, ^a | \$2,593,900*, ^a |

Requests include 9% GA.

**Funding includes additional requests in FY19 for four projects. See project proposals for more details. ^aIncludes additional funding requests for two existing projects and one proposed for FY20-21. See project proposals for more details.*

Funding From Non-EVOSTC Sources FY17-21: \$16,292,300

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-------------|-------------|-------------|-------------|-------------|
| \$3,205,100 | \$3,260,300 | \$3,027,500 | \$3,421,800 | \$3,377,600 |

Total Past EVOSTC Funding Authorized (FY12-19): \$21,220,065

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$26,606,665

Total Non-EVOSTC Funding (FY12-21): \$18,086,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/26/19.*

The Gulf Watch Alaska (GWA) program directly addresses the *Exxon Valdez* Oil Spill Trustee Council's focus area, integrated long-term monitoring of marine conditions and injured resources services. The overarching goal of GWA is to provide sound scientific data and products that inform management agencies and the public of changes in the environment and the impacts of these changes on injured resources. GWA has a consortium of 12 projects organized in the following functional groups: three monitoring components (environmental drivers, pelagic, and nearshore), a program management team, a science review panel, a science coordinating committee, and an outreach steering committee.

The program has five primary objectives: 1) sustain and build upon existing time series in the EVOS-affected regions of the Gulf of Alaska, 2) provide scientific data, data products and outreach to management agencies and a wide variety of users, 3) develop science synthesis products to assist management actions, inform the public and guide monitoring priorities for the next 15 years, 4) continue to build on collaborations between the GWA and Herring Research and Monitoring (HRM) programs, as well as other Trustee program focus areas including the data management program, lingering oil and potential cross-program publishing groups, and 5) leverage partnerships with outside agencies and groups to integrate data and expand capacity through collaborative efforts.

To date in FY19, all field sampling projects have been completed as planned and science synthesis efforts are underway among GWA components and with HRM. PIs continued to leverage GWA funding and resources to enhance collaborative efforts and the program management team has completed reporting requirements, continued development of data products, and conducted outreach activities to engage stakeholders.

Overall, there are no changes to GWA program management and outreach. We are requesting additional funding for two existing projects: 1) to continue upper trophic level surveys on the now combined Seward Line and Northern Gulf of Alaska Long-term Ecological Research oceanographic cruises, and 2) to address unanticipated increased operational costs of an agency research vessel for the nearshore ecosystem component. In addition, we are proposing a lingering oil project in FY20 as part of the recommended monitoring schedule by GWA's previous FY2012-16 lingering oil project.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel appreciates that the reports and proposals continue to be carefully prepared and well written. We note that there is good leverage and integration within projects and with the Herring Research and Monitoring program, and there is notable progress on synthesis. Projects are also meeting milestones in a timely manner. The Panel is pleased that the two admin projects have been combined as recommended. For future proposals, please separate out peer-reviewed publications from agency and data reports and include subheading of published, in prep, in review if necessary. We would also like to see more interpretation and discussion of data and figures presented in the proposals; this is included in some of the proposals such as in project D. The Panel is not looking for new or additional analyses in the proposals. We are looking for context and some interpretation to allow us to evaluate the proposal.

PI Response (9.27.19)

The Gulf Watch Alaska program is proud of its achievements and values the science panel's feedback. There is always room for improvement and in future proposals we will focus on providing more interpretation and discussion including the separation of various types of publication products accordingly.

Science Director Comments – FY20

Date: September 2019

Field sampling projects have been completed as planned for FY19. Science synthesis efforts are continuing to progress. PIs continue to leverage funding and resources to enhance collaborative efforts. Overall, there are no changes to the original proposals submitted except for two projects (see project M and project H below) and the addition of a lingering oil project proposal for FY20 (see project P below). I concur with the Science Panel's comments.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

Science Panel is pleased to see the continued increase in quality of the program and the program proposals. Science Panel was pleased with the increased emphasis by PIs on dissemination and publication of results from individual projects. The Panel encourages all PIs to bring their data together to tell a story that encompasses a bigger picture, which may be partially accomplished through the proposed synthesis papers.

PI response (10/10/18)

The GWA program management team (PMT) and principal investigators (PIs) are devoted to the success of the program and maintaining professional quality. Currently, the program and PIs are focused on data syntheses for the 3rd year (monitoring year 8) science synthesis report, which will be a series of peer reviewed papers doing just that, bringing data together to tell bigger picture stories. In the long-term, we are discussing continued cross-component analyses and synthesis projects - including various modeling efforts - that will continue into the next 5-year (FY22-26) funding cycle.

Science Coordinator Comments – FY19

Date: September 2018

The GWA program continues to be productive. I'm looking forward to the synthesis products that will be coming out of this program which will make important contributions in understanding how environmental changes have affected the GOA. I recognize that there are unforeseen circumstances (i.e., loss of previously leveraged vessel time) that have led to these project needs for FY19-21. The program is requesting an additional \$189K (includes GA) annually for four projects to replace agency-supported vessel charter costs that are no longer available, resume summer forage fish surveys and aerial survey validation in PWS, and partially fund a postdoc to support science synthesis efforts. I appreciate the process that was used to assess unfunded project needs which demonstrates that the Program Management Team and PIs are continually evaluating the GWA science program and determined to improve the projects where needed and fill knowledge gaps that exist.

PAC Comments – FY19**Date: September 2018**

The PAC noted that the Science Programs have produced unique and very important long-term data sets. The PAC also commented on the thoroughness of how proposal information was presented, it was well organized and clear.

Executive Director Comments – FY19**Date: September 2018**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

The Panel is very pleased with Mandy's role in coordinating logistics and synthesizing results. The Panel is pleased about the hiring of Rob and Donna as the Science Coordinator and Program Coordinator, respectively, and looks forward to working with them. The quality of this proposal has improved greatly compared to previous years. The Panel is encouraged to see data presented and the evaluation of past years data to determine what the projects should do in the future. This Program has published many papers, which is a positive development, and the panel is excited about the Long-Term Ecological Research funding (National Science Foundation) awarded to some of the projects. The Panel was encouraged and about Rob's plans for synthesis products including an analysis and publication(s) on biological impacts of the recent environmental changes.

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments. I also greatly appreciate the addition of point 7 in the proposal and will add it as a requirement for future proposals.

PAC Comments – FY18**Date: September 2017**

There are no program specific comments

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|--------------|--------------------|-----------------|
| Fund Reduced | Fund Reduced | Fund Reduced | Fund Reduced | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-------------|----------------------|----------------------------|--------------|---------------------------|------------------------|
| May 2016 | Fund Reduced | Fund Reduced | N/A | N/A | N/A |
| Sept 2016 | Fund Reduced | Fund Reduced | Fund Reduced | Fund Reduced | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel appreciated the thorough and organized responses to our comments. The responsiveness of the program to Panel concerns was very much appreciated. Project specific comments for each proposal are included on each proposal's individual page below.

Date: May 2016

This LTM Program includes spatially and temporally linked studies that monitor abundances of many important predator-prey systems, especially ones involving forage fishes, a key forage-fish-consuming marine mammal – humpback whales, seabirds, and an apex predator – the killer whale, all in the context of continued monitoring of historic long-term transects for physical, chemical, and biological (phytoplankton, zooplankton) parameters. This set of concurrent temporal information holds promise for understanding how ocean conditions and climate change are modifying the PWS and NGOA ecosystems. Unfortunately, the proposed program did not seem to build off of the Program's 2013 Synthesis document. There is a lack of some descriptions of previous work where needed and an absence of depth of hypotheses, comparisons and evolving discussions on the work proposed, so much of which is a continuation from past or related projects. For example, there continues to be a lack of discussion in individual project designs of previous scientific work that may be used to develop their hypotheses or that could be treated as a contrasting interactive web of species.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-A and B

Project Title: LTM Program
Program Management I – Synthesis and Coordination, Postdoctoral Researcher
Program Management II – Administration, Science Review Panel, PI Meeting Logistics, Outreach and Community Involvement

Primary Investigator(s): Mandy Lindeberg (PM I), Katrina Hoffman (PM II)

PI Affiliation: NOAA, PWSSC **Project Manager:** NOAA

PM I EVOSTC Funding Requested FY17-21: \$1,105,600

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|------------------|------------|------------|
| Auth: \$226,800 | Auth: \$227,600 | Auth: \$212,800* | \$216,100* | \$222,300* |

Requests include 9% GA.

* Changes reflect transfer of funds for GWA program coordinator position from PM I to PM II (NOAA contract to NOAA Grant) for FY19-21 (no new additional funds are being requested. See Science Coordinator comments for details). Total also includes an additional requested \$62.3K per year to partially fund a postdoc position for science synthesis efforts for FY19-21.

PM I Funding From Non-EVOSTC Sources FY17-21: \$527,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|-----------|-----------|-----------|
| \$105,400 | \$105,400 | \$105,400 | \$105,400 | \$105,400 |

PM I Total Past EVOSTC Funding Authorized (FY12-19): \$1,375,700

PM I Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,814,100

PM I Total Non-EVOSTC Funding (FY12-21): \$592,000

PM II EVOSTC Funding Requested FY17-21: \$1,728,900

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|------------------|------------|------------|
| Auth: \$277,100 | Auth: \$282,400 | Auth: \$382,500* | \$384,600* | \$402,300* |

Requests include 9% GA.

PM II Funding From Non-EVOSTC Sources FY12-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

* Changes reflect transfer of funds for GWA program coordinator position from PM I to PM II (NOAA contract to NOAA Grant) for FY19-21. No new additional funds are being requested. See Science Coordinator comments for details.

Total Past EVOSTC Funding Authorized (FY12-19): \$2,360,100

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$3,147,000

Total Non-EVOSTC Funding (FY12-21): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

The Program Management I (PM I) project provides program coordination and science synthesis of data for the Exxon Valdez Oil Spill Trustee Council's (EVOSTC's) integrated Long-term Monitoring of Marine Conditions and Injured Resources and Services program, referred to as Gulf Watch Alaska (GWA). The Program Management II (PM II) project is the administrative and outreach component of GWA. The Prince William Sound Science Center (PWSSC) serves as the fiscal agent for non-Trustee Agency recipients of GWA funds. The work plans for these two projects are combined because together they represent management of the GWA program.

The program management team (PMT, collectively PM I and PM II) oversees more than two dozen principal investigators, collaborators, and science reviewers to produce and integrate a wealth of scientific information on the northern Gulf of Alaska ecosystem and spill-affected area and share that information with others. Program coordination and science synthesis (PM I) improves linkages between monitoring efforts spanning large regional areas (from Prince William Sound to lower Cook Inlet and the Alaska Peninsula). Program coordination includes facilitating within program planning and sharing of information between principal investigators, other Trustee-funded programs, and non-Trustee organizations. High quality products and science synthesis efforts help communicate monitoring results by delivering reports, publishing data, developing scientific papers, supporting outreach, and integrating information across the entire program. Program administration, science review panel, logistics, and outreach (including website), and community involvement (PM II) complements work under the PM I project. The administrative portion of the PM II project oversees funds for non-trustee agencies, while also providing travel and logistics for GWA in-person meetings and teleconferences.

So far in FY19, the PMT has maintained all of the program administration and outreach activities noted above which included participating in a community engagement/local knowledge exchange event between GWA team members and community members in the spill-affected community of Seldovia, producing program presentations/outreach products, and continued science synthesis efforts for four cross-component manuscripts and 18 time series indicators (12 new this past year) to inform ecosystem-based fisheries management in the Gulf of Alaska. The PMT has also been actively planning the 2020 Science Synthesis Workshop with EVOSTC staff. Overall there are no changes to these projects' objectives.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Panel appreciates the Quarterly Currents and the links to media (e.g., newspaper articles) with a range of topics. The Science Panel wonders whether this effort can also benefit public outreach. For example, could this publication be modified such that all or selected parts can be included in Riley Woodford's ADFG's Wildlife News email? This may also be a good opportunity to provide a product

for communities as requested by the Science Coordinator. Science Panel concurs with the Science Coordinator's comments.

PI Response (9.27.19)

We are pleased with how well the Quarterly Currents have been received. Expanding the distribution list is a great idea and we appreciate the suggestions. We will look into these suggestions and others, keeping the EVOSTC Science Coordinator apprised of opportunities.

Science Director Comments – FY20

Date: September 2019

The Program Management Team members have developed a solid relationship over time, with each role explicitly defined and appear to provide seamless coordination and administrative support to the program. The Science Coordinator and program PIs continue to make progress on the synthesis papers; results will be presented at the Science Synthesis Workshop in February 2020. The Program Management II continue outreach efforts and I am pleased to see that another Traditional Ecological Knowledge (TEK) session(s) with spill-affected native communities will be scheduled for FY20. While these sessions have received positive feedback from the communities and researchers, it has also been noted that community members would like to receive products that report project results. In your proposal on pg 14 under Objective 4, it states that “We engage Trustee Agency managers and community members with interests in the spill area, including those who can provide a perspective on traditional ecological knowledge, to learn how data and information products can best serve them. We generate products to meet those needs and improve understanding of ecosystem processes affecting variation in spill-affected resources.” It is not clear to me in the proposal or in the Outreach products in Section 7, which products have been dispersed back to the communities where the TEK sessions have taken place. Although presentations are made to the communities, I suggest that a simple fact sheet product or something similar that reports results for distribution to the communities, including their schools. If this is already being done, please clarify.

Program Management II requests permission to transfer unused \$21K from program Science Review Panel travel to Contractual (\$15K) and Commodities (\$6K) to cover increased costs such as insurance and maintenance at PWSSC, and also hardware, software and other unanticipated expenses related to the cost of transitioning the Program Coordinator from NOAA to PWSSC which was approved in FY19 and has overall been a cost-saving measure. I support this reasonable transfer request of funds.

There is one personnel change, the postdoc hired in FY19 recently took a new position within another TC-funded project. However, he continues to contribute to the synthesis products as originally assigned. Program staff are working on filling the position and do not expect any interruptions in progress.

PI Response (9.27.19)

The Gulf Watch Alaska Management Team is pleased the science coordinator appreciates our efforts and efficiencies running a large program. We also welcome suggestions for outreach and communicating program science as resources allow. The program has created visual schematics created about the Nearshore and Pelagic components. We envision developing interpretive text for these which will allow the schematics and the processes described within them to serve as stand-alone items that can be circulated to and/or displayed within communities. We intend to round out the set with schematics describing some of the key processes monitored by the Environmental Drivers

component. We will evaluate the opportunity to create additional fact sheets of results beyond those items. However, that role may best be served by ensuring distribution of Delta Sound Connections to each of the communities in question. Across the years of the program, Delta Sound Connections provides a carefully curated assemblage of articles that explain program findings in lay terms.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel continues to be impressed with the leadership of the PMT. The long list of publications and presentations is a reflection of the effective guidance applied by the PMT. Science Panel shares the Science Coordinator's concern that the postdoc is not lead author on any of the synthesis papers and the scientific growth for the product. Synthesis is part of the GWA program as stated in the original proposal: Program Goal C-Assess monitoring data holistically in order to better understand the range of factors affecting individual species and the ecosystem. And Objective 2- Provide and document integration of monitoring results – This includes cross-program standardization of data collection, GWA science synthesis products, and publications. However, the Science Panel recognizes that this would be a good opportunity to inexpensively fund a program experienced postdoc.

The Science Panel is pleased that the graduate student will transition to a 60% postdoc in FY19 as this provides a career opportunity for him as well as synthesis opportunity. The Panel felt it was important that this is a true change in position from graduate student status and there was some concern expressed that the 40% portion of the position would remain in a "graduate student mode". It is important from a career perspective that the postdoc make independent contributions to synthesis efforts.

PI Response (10/10/18)

We appreciate the positive feedback regarding GWA PMT leadership and our attempts to continually improve the program. Regarding postdoc mentoring, we understand the importance of providing opportunities for senior authored papers and professional development for a postdoc working with GWA. The immediate supervisors of the postdoc, D. Esler (19120114-H, Nearshore) and R. Suryan (19120114-A, this project), both formally held academic positions and have experience mentoring postdocs and graduate students. We have discussed and would develop the equivalent of a postdoc individual development plan, similar to what is required at academic institutions. As a 3-year postdoc position, there is ample time for contribution as both senior and co-author on publications currently in

progress and yet to be identified, both synthesis-focused and otherwise. The student would transition to 100% postdoc following completion of degree requirements. This indeed would be a transition out of “graduate student mode” to an emphasis on career development and professional advancement.

Science Coordinator Comments – FY19

Date: September 2018

The Program Management Team continues to provide excellent leadership for the GWA program. The GWA Science Coordinator is making progress with Science Synthesis products which includes 4 manuscripts to date. PMII has been productive with outreach activities and products.

There are two requests from the PMT. The first is for the GWA Program Coordinator’s funding to be transferred to PMII (would be NOAA grant through PWSSC instead of NOAA contract) to avoid the costly overhead fees associated with the new NOAA contractor. The second is to partially fund a postdoc at \$63.2k/yr (includes GA) for FY19-21 that will be dedicated to synthesis efforts across components. Current PI time is largely devoted to collection and presentation of data within their projects, hiring a qualified postdoc who can link data streams from throughout the program would result in high value, broad-scale product in a timely manner. The postdoc candidate is well qualified; as a current PhD student in the GWA program, he is already familiar with the Program and has been highly productive. He is scheduled to complete his dissertation in 2019 so timing would work out well. The candidate is already being funded 0.40 FTE for FY19-21. What are the candidate’s current responsibilities for FY19-21? If these responsibilities are different than working on synthesis products, how will they be distributed and accomplished, or will these tasks be in addition to working on synthesis products?

PI Response 8.31.18

The graduate student’s current responsibilities in FY17-21 for a 0.40 FTE appointment with GWA is field data collection, logistics, data management, and analysis with the Nearshore component. When this candidate completes their degree in FY19 and switches to full-time, their current employer (USGS) will not have the additional 0.6 FTE funds to support their full-time employment. The nearshore PIs and GWA Science Coordinator are confident that the candidate could maintain their current 0.40 FTE GWA responsibilities while contributing an additional 0.60 FTE to GWA science synthesis in FY19-21. The GWA Science Coordinator is currently the only person devoted to science synthesis and he is committed to leading one manuscript and supporting all others to the extent possible. The addition of a postdoc would provide much needed support to the Science Coordinator and to PIs who are volunteering to lead synthesis manuscripts. We feel this is a unique opportunity to obtain support for GWA science synthesis efforts while only having to request funding for an additional 0.60 FTE - and to avoid trying to replace the graduate student’s knowledge and expertise in our program after completing their degree and moving on to full-time employment elsewhere.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

As stated above, the Panel is pleased with Mandy's leadership skills and very pleased with the proposal and organizational structure. The Panel appreciates the different management aspects of this proposal and proposal 18120114-B and suggests consolidating these two proposals into one Program management proposal. This would help to clarify how the two program management components relate to one another and to demonstrate lack of duplication.

PI Response (10/11/2017):

The Program Management Team appreciates the Science Panel's suggestion to consolidate the management proposals: 1) 18120114-A or Program Management I and 2) 18120114-B or Program Management II projects. We are willing to consolidate the program management proposals and reports; however, the budgets for PMI and PMII need to remain separate and would be reported on separately. We will work with EVOSTC staff to develop a reasonable format for consolidation and tracking.

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments. I will work with Mandy to address the Panel's suggestion.

PAC Comments – FY18**Date: September 2017**

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17**Date: September 2016**

The Science Panel was pleased with the proposal and organizational structure. The structure of the coordinating committee and science review Panel sets the mechanisms for evaluation and adaptive management of the project. We also appreciated the responsiveness to Panel requests to streamline the budget.

Date: May 2016

The Panel is encouraged and gratified by Mandy Lindeberg's acceptance and participation in the role of Science Lead and looks forward to her leadership. The Panel did express concern that the science coordinator position is intended to be filled after the start of the Program. This key position will be responsible for the design and implementation of the Program and it may take longer than anticipated to find an individual with the appropriate education and skill sets. Is there a plan in place, if the hiring process takes longer than planned or a qualified candidate is not identified? If the position is not a NOAA employee as hoped, will this impact the projected five year cost?

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-B

Project Title: LTM Program - Program management II – Administration, Science Review Panel, PI Meeting Logistics, Outreach, and Community Involvement

Primary Investigator(s): Katrina Hoffman

PI Affiliation: PWSSC

Project Manager: NOAA

SEE 19120114-A and B above for FY19-FY21

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel appreciates the PI's coordination activities. The Panel suggests combining this proposal with 18120114-A into one Program management proposal.

PI Response (10/11/2017):

See response in section above for project 18120114-A.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17**Date: September 2016**

The Panel appreciated the responsiveness to Panel requests to streamline the budget.

Date: May 2016

The administrative budget is substantial and the Program should be cautious with regard to such costs.

Science Coordinator Comments – FY17**Date: May and September 2016**

I concur with the Science Panel's comments.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-C

Project Title: LTM Program – Monitoring long-term changes in forage fish distribution, abundance, and body condition in PWS

Primary Investigator(s): Mayumi Arimitsu & John Piatt

PI Affiliation: USGS

Project Manager: USGS

EVOSTC Funding Requested FY17-21: \$1,318,900

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|------------------|------------|------------|
| Auth: \$198,800 | Auth: \$229,800 | Auth: \$292,100* | \$295,300* | \$302,800* |

Requests include 9% GA.

*Totals in FY19-21 include additional annual requests of \$70,850 per year that will be used to reinstate summer validation sampling of Herring Research and Monitoring Program aerial juvenile forage fish surveys (funding secured through PWSRCAC) and summer acoustic-trawl surveys.

Funding From Non-EVOSTC Sources FY17-21: \$1,502,400

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|-----------|-----------|-----------|
| \$256,000 | \$256,000 | \$256,000 | \$517,200 | \$217,200 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,688,300

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$2,286,400

Total Non-EVOSTC Funding (FY12-21): \$2,763,400

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

Identifying drivers of change in forage fish populations is key to understanding recovery potential for piscivorous species injured by the *Exxon Valdez* oil spill. The goals of the Gulf Watch Alaska forage fish monitoring project are to provide information on the population trends of forage species in the Gulf of Alaska (GOA) and to better understand how underlying predator-prey interactions influence recovering species and pelagic ecology within Prince William Sound (PWS) and the GOA. Sampling in FY18 indicated predator and prey abundances in PWS were low and forage species such as capelin and sand lance continued a multi-year trend of low occurrence in seabird diets in the GOA. During summer 2019 sampling we encountered spawning capelin and large energy-rich sand lance in PWS, providing the first signals that these forage fish populations may be recovering. Our continued sampling will provide insight into how forage fish populations respond to the persistence of or recovery from the recent Pacific marine heat wave.

In FY20, we will continue summer aerial survey validation in conjunction with the Herring Research and Monitoring program, summer acoustic-trawl sampling, and the fall integrated predator-prey survey in PWS. We will also conduct seabird diet sampling at Middleton Island during spring/summer (Apr-Aug). We are not proposing changes to this project for FY20.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel appreciates the Pls response to last year's comments. The panel noted that seabird diets show an increase in the relative abundance of herring in seabird diets, whereas HRM projects are not seeing an increase in herring. This is something that is worth investigating together with the HRM projects. Please include this comparison and potential interpretations of its causes in your FY19 annual report. This sort of comparison should also be included in the science synthesis paper. There are many possible explanations, but they point to the likelihood that bird diets may not provide useful proxies for fish abundance.

PI Response (9.27.19)

We appreciate this suggestion from the science panel and we plan to address the issue in greater detail in our FY19 annual report. There are several reasons the Middleton seabird diets do not reflect the findings of the Herring Research and Monitoring program spring spawning stock biomass trends for Prince William Sound, including the following: 1) herring are not a primary prey species as they contribute a relatively small proportion (< 3% of prey biomass across years) of seabird diets sampled at Middleton; 2) more than 75% of the herring in rhinoceros auklet chick diets between 1993-2018 were juvenile herring (i.e., a mix of age-0 and age-1, < 10 cm in length), in recent years (especially 2013 and 2017) larger size classes of herring were represented in Middleton seabird diets; and 3) tagging studies indicate that shorter foraging trips are less costly, however, when preferred species are less available offshore Middleton Island seabirds can increase foraging range to include coastal mainland areas where juvenile herring occur.

Minor question: regarding Figure 1 (page 3), on the top panel, what species do the clear bars at the top represent? This is missing from the figure legend.

PI Response (9.27.19)

The clear bars represent "other". Thank you for pointing this out, we will correct the legend in future use of this figure.

Science Director Comments – FY20

Date: September 2019

This project is on track and meeting goals as planned. No changes are proposed for FY20. This project continues to provide useful data on forage fish population trends in PWS. It will be interesting to see if capelin and sand lance abundance continues to increase from FY19 in FY20 and how these patterns correspond with climate data.

PI Response (9.27.19)

Thank you for this input. We also are very curious to see how sand lance and capelin populations respond over the next couple of years.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel recognizes the importance of annual ground-truthing of aerial surveys, and supports reinstating aerial surveys especially given that HRM has secured funding from RCAC for aerial surveys. The Science Panel wondered about the interannual spatial and temporal consistency of acoustic surveys. Shouldn't they be conducted over as broad an area as possible? It was noted that a lot of PWS has not been surveyed. Specifically how much of PWS is surveyed, including the deeper areas? Can the PIs advise whether this is important?

PI Response (10/10/18)

From our original 2012-2016 research program we concluded that a reduced and targeted set of summer acoustic transects would be an efficient way to conduct forage fish surveys over a broader area within Prince William Sound (PWS). These acoustic transects were designed with information on the distribution of forage fish in PWS, and were meant to sample high density forage fish areas important to breeding marine birds during summer in PWS. The summer surveys (conducted in 2014-2016) include 463 km of transects at 16 locations throughout the Sound. They target nearshore and relatively shallow areas because that's where the majority of forage fish biomass is concentrated in the Sound during summer. Accordingly, the shallow nearshore areas contain greater densities of marine birds than deeper offshore areas during summer as these are predators of sand lance, capelin, and juvenile herring. The Integrated Predator Prey surveys (Fall) began in the second funding cycle (FY17-21) with the purpose of better integrating the humpback whale, forage fish, and fall marine bird surveys. They were designed around three historically important humpback whale feeding areas where krill and juvenile and adult herring occur in coastal (<50m) and deeper waters (<300m) of PWS. The fall surveys include 139 km of transects in Montague Strait, Bainbridge Passage, and Port Gravina.

The Science Panel is also curious to know what the value added of this project over data already captured by herring surveys as most of the forage fish found in this project appear to be herring. Can the herring data be used to help assess forage fish abundance? The Science Panel realizes that the goals of these two projects are different, but could data and perhaps vessels be shared between this project and the HRM herring surveys?

PI Response (10/10/18)

Herring are very important prey in many areas of PWS and when populations are at high levels, they are the dominant prey item. However, herring alone does not support predator populations in PWS. Capelin, krill, and sand lance, are also important prey items. Our proposed survey work does not duplicate herring research. The Herring Research and Monitoring (HRM) program's aerial and GWA acoustic surveys of herring and forage fish are complementary as they sample different scale, habitats, and target species/size classes during the same time period. Broad-scale aerial surveys are useful for counting schools of juvenile herring and Pacific sand lance along shorelines. Finer-scale acoustic trawl surveys are better suited for capelin, juvenile walleye pollock, juvenile and adult herring, and krill. HRM acoustic surveys occur during spring and focus on herring spawning; the other important prey for predators in PWS that are noted above are not quantified by these herring-specific acoustic surveys. It would not be possible for GWA and HRM to share vessels for acoustic surveys because of differences in timing of surveys and survey objectives involving multi- vs. single-species surveys.

Science Coordinator Comments – FY19

Date: September 2018

Project is on track except for some metadata which is in progress and anticipated to be completed in fall 2018. I am encouraged to see that PIs are coauthors on a publication in review.

Questions were emailed to PI for response on 8.30.18

Are there any results besides the Middleton Island data to report for FY18?

PI Response 9.4.18

The only field work for this project that has occurred so far in FY18 is Middleton Island. The Integrated Predator-Prey (IPP) surveys in Prince William Sound will take place 11-20 September. These results will be reported in the FY18 annual report

The project requested an additional ~71K (includes GA) to resume June aerial forage fish surveys which will provide data for (1) validation for the HRM aerial surveys (which will now be funded by RCAC) and juvenile and adult herring indices for the ASA model, and (2) acoustic indices for important forage fish (capelin and sand lance) age structure and body condition during summer, species composition of zooplankton, juvenile pollock, herring for understanding food web dynamics. In regards to supporting the HRM aerial surveys, results from the first 5 yr program show that “validation efforts suggest herring and sand lance schools can be classified to species by aerial observers. Additionally, adult herring schools were always classified correctly; but smaller age-classes (i.e., age-0 and age-1) of herring could not be reliably distinguished from one another and were therefore combined as juvenile herring for our work conducted in July.” (16120114-O Final Report) and “In both this work and the previous effort, the majority of misidentified fish involved age-0 herring and sand lance.” and “Because the transformation of these age-0 fish usually occurs sometime in July, we conclude that identification errors by aerial observers would be lower in June when age-0 herring and sand lance are not visible from the air.” (HRM project 15120111-R Aerial Survey Support Final Report). So, if HRM is resuming aerial surveys in June and these aerial surveys have already been validated with acoustic surveys in 2012, 2013 and 2014, it's not apparent why these surveys need to be validated again with acoustic surveys.

PI Response 9.4.18

First just to clarify, the aerial survey validation is separate from the acoustic surveys. The aerial survey validation includes directed sampling of specific fish schools detected by the aerial observer. To do this, our team on the ground (in skiffs or a larger vessel) was directed to schools by the pilot after he had assessed the species and age of the schools. We collected fish using jigs, purse seine, cast net, or video to ground-truth the pilot's observations, which ultimately provided a measure of uncertainty in the pilot's observations.

In practice, the aerial surveys need to be ground-truthed every time they are conducted to validate species and age composition of fish observed from the aircraft – similar to targeted net sampling conducted during vessel-based hydroacoustic surveys. We validated the aerial surveys in 2014, 2015, and 2016. While the aerial surveys have been conducted in some years without ground-truthing, those surveys lack calibration and estimates of uncertainty. Furthermore, in addition to species and age composition, direct sampling of fish allows specimens to be collected for laboratory analyses (otolith analysis, stable isotope, energetics, etc.).

Acoustic surveys in deeper water compliment the aerial surveys where fish are only observed in shallow nearshore waters. Additionally, the aerial shoreline surveys take 2 weeks to complete in the plane, and a boat needs to be on the water wherever the plane happens to be working. Because the boat is slow and can't leave from Cordova every day to get to all areas of PWS, and because validation only takes a few hours out of every day, it makes the most sense to use the vessel to also conduct summer acoustic surveys while it waits for the plane. Whether we do the acoustic surveys or not the vessel costs are the same (i.e., 2 weeks of charter time), so the summer acoustic-trawl surveys would just be value-added to make the project most efficient.

Perhaps, more importantly, these data can be used to understand how prey resources influence marine bird trends during the breeding season and how prey resources affect humpback whale distribution and abundance. June survey data will aid in the understanding of how animals are responding to the blob, effects of which are still being observed in 2018. However, from the FY12-16 project final report (Appendix A), it appears that observations from Middleton Island support results from the summer forage fish surveys. Therefore, can the Middleton Island seabird breeding season diet sampling data be used as a proxy for the June forage fish surveys?

PI Response 9.4.18

Middleton Island seabird diets are a good proxy for what's happening with many forage fish in the GOA and PWS. For example, we do think that Middleton diets are representative for capelin and sand lance, however, due to low occurrence in seabird diets in most years, they are likely insufficient for tracking PWS juvenile herring populations. Furthermore, it is prudent to sample fish within PWS because these habitats are oceanographically and structurally different from Middleton, and it's possible that changes can affect one area and not the other. Directly sampling forage fish in PWS will better relate to marine bird surveys that GWA is conducting in PWS. Finally, the summer 2014-2016 acoustic-trawl surveys were important because they provided indices of other important pelagic taxa not sampled effectively with aerial surveys, such as krill, young of the year walleye pollock, and gelatinous zooplankton. The summer acoustic surveys are especially interesting because they documented the middle-trophic conditions in PWS during the marine heat wave years (2014-2016) and continuing this time series could be very valuable moving forward as we document the recovery following this major perturbation. For example, we find in Cook Inlet that common murrelets have just experienced their third year in a row (at least 2016-2018) of complete failures, which is directly

related to food availability and indicates the ecosystem has not bounced back yet. PWS was the center of distribution for the murre die-off over the winter of 2015-16, we have a very unique forage fish dataset from those years but we need more years of data to put them into context as the system recovers. For FY17-21 proposals, we prioritized continuation of the Middleton diet data collection as it provides the best and longest timeseries information on forage fish for the GOA region, however, it is not a replacement for summer forage fish sampling in PWS.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel was gratified to see a broader and stronger use of the Middleton Island monitoring data into the overall project and appreciates the sound science being conducted by the PIs. Huge improvements were made in data management, which can be attributed to the leadership of the Program.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|--------------|--------------------|-----------------|
| Fund Reduced | Fund Reduced | Fund Reduced | Fund Reduced | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|------|---------------|---------------------|-----|--------------------|-----------------|
|------|---------------|---------------------|-----|--------------------|-----------------|

| | | | | | |
|-----------|--------------|--------------|--------------|--------------|------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund Reduced | Fund Reduced | Fund Reduced | Fund Reduced | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel expressed some concern about how the data would be interpreted. The PIs recognize they cannot provide sound-wide abundance estimates because of limited spatial sampling, but do not consider the implications of their limited sampling being a biased subset of potential sampling locations (only locations with whales). Some interpretations seem potentially circular: if there are fewer predators and fewer prey is that because the prey populations have declined and predators are declining or moving elsewhere, or because predators have reduced prey populations and are foraging elsewhere? Presumably within a season the correlation might even shift from initially positive to negative as the season moves on. Care will need to be taken in the interpretation of these data and what they mean for forage fish abundance. The PIs should carefully consider exactly how and for what the data will be used.

Regarding the Middleton Island sampling, the Panel considered the relevance of this sampling both on biological and geographic considerations. It was not clear to us how the PIs would use data on presence in the diet to estimate abundance of forage fish? Presumably the bird diet is not just a strict reflection of abundance due to prey selectivity, spatial patterns in abundance of different prey species, etc. The Panel has concerns regarding the location of this work in the project and recommends the removal of the proposed effort at Middleton Island.

Date: May 2016

This project is part of a newly proposed “Integrated Predator-Prey Survey” program that seeks to integrate three proposed projects (Arimitsu, Moran, Bishop) into a single integrated survey. The survey would be conducted in the fall and would target persistent humpback whale feeding locations.

While the Panel is supportive of continued forage fish work, there are concerns regarding the actual integration of the three projects. The proposal appears to be an integration of PIs collecting data at the same time and location through a shared vessel. It was unclear from any of the three proposals how the data would actually be integrated to address the hypotheses of the Integrated Predator-Prey Survey. If the intent is not a true integration, then the project should be renamed accordingly. Also, based on the focus on known seabird and marine mammal foraging areas, the proposal should note that it does not intend to scale-up results to the level of PWS. Moreover, the Panel was unsure of how the seabird diet data from Middleton Island would be incorporated into the Survey, given its offshore GOA location, 130 km southwest of Cordova. The other projects are benefiting from data collected at the same time and location, but Middleton Island is not within any of the anticipated survey areas. The Panel acknowledges that inclusion of Middleton Island allows incorporation of a set of important seabirds not included elsewhere in the LTM Program, specifically an auklet, black-legged kittiwake, and puffins. The proposal is short on methodology. The Panel requests the proposers to expand the description of their methods as there is insufficient information for a thorough review.

Science Coordinator Comments – FY17

Date: September 2016

I concur with the Panel's comments and, like the Panel, remain concerned regarding the applicability of the proposed Middleton Island data set. I appreciate the desire to maintain an existing data set but do not believe that the data is useful to either the individual project or the overall LTM Program. A stated goal of this project is an integrated data set from simultaneous surveys of three component projects to reduce vessel cost while combining sampling efforts with spatial and temporal consistency. Middleton Island is not within any of the proposed survey areas and the data will not be collected at the same intervals as the rest of the project. I recommend removing the requested amount for this work (\$40,000 for FY17) from the funding request and removing the scope of the work for the entire five-year Program.

Date: May 2016

I concur with the Science Panel's comments. I support the individual projects that are part of the proposed "Integrated Predator-Prey Survey" but cannot determine how, if at all, the projects will actually integrate beyond sharing vessel time. The Middleton Island bird diet work appears incongruous with the other projects.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel and Science Coordinator's comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-D

Project Title: LTM Program - Continuous Plankton Recorders

Primary Investigator(s): Sonia Batten

PI Affiliation: SAHFOS

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$406,200

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------------|----------------|----------------|----------|----------|
| Auth: \$76,500 | Auth: \$78,800 | Auth: \$81,200 | \$83,600 | \$86,100 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$932,500

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|-----------|-----------|-----------|
| \$183,700 | \$183,900 | \$186,300 | \$188,300 | \$190,300 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,500,200

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,669,900

Total Non-EVOSTC Funding (FY12-21): \$1,525,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/16/19.*

The Continuous Plankton Recorder (CPR) transect samples the Alaskan shelf from lower Cook Inlet across the slope into the open Gulf of Alaska, providing a now 19-year record of taxonomically resolved, seasonal, near-surface zooplankton and large phytoplankton abundance over a wide spatial scale. Sampling takes place approximately monthly, six times per year, usually between April and September. Outputs from the project include indices of plankton abundance (e.g., large diatom abundances, estimated zooplankton biomass), seasonal cycles (phenology of key groups) and community composition (e.g., appearance of warm water species, change in dominance by some groups). Variability in any, or all, of these indices might be expected to flow-through to higher trophic levels such as herring, salmon, birds and mammals that forage across the region, some of which have been impacted by the *Exxon Valdez* oil spill. Results show that interannual variability in plankton dynamics is high and plankton responded clearly and rapidly to the warm conditions of 2014-2016, with changes evident in abundance, composition and timing. We are not proposing any major changes to this project for FY20.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20**Date: September 2019**

This project continues to do very good work. We appreciate the leveraged funding and continued collaboration with other EVOSTC projects and continues to produce important scientific publications. We again note the comparison of physical processes with herring in the GOA (2016 paper) which provides a good example of what analyses and synthesis can be achieved with these types of higher trophic data.

PI Response (9.27.19)

Thank you for your comments. We appreciate the positive feedback.

Science Director Comments – FY20**Date: September 2019**

Project goals are being met on time. This project continues to add valuable data to the existing long-term time series. I concur with the Science Panel's comments.

PI Response (9.27.19)

Thank you for your comments. We appreciate the positive feedback.

PAC Comments – FY20**Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20**Date: October 2019**

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19**Date: September 2018**

The Science Panel would like to note that the PI's 2016 Fisheries Oceanography paper is a great example on how to present synthesis of data across trophic levels. The PI presented and discussed the preliminary results well. This project continues to produce valuable data and the Science Panel appreciates that this project has a diversity of other funding sources.

Science Coordinator Comments – FY19**Date: September 2018**

PI continues to have a record of staying on track. This long-term time series continues to provide information to other projects. No other comments.

PAC Comments – FY19**Date: September 2018**

No project specific comments.

Executive Director Comments – FY19**Date: September 2018**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

The Panel has no project specific comments.

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments.

PAC Comments – FY18**Date: September 2017**

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel has no project specific comments.

Date: May 2016

The Panel notes this is a continuing time series of zooplankton information useful to a variety of other projects. The proposer (Batten) has a solid record of producing timely results, including a consistent dataset.

Science Coordinator Comments – FY17**Date: May and September 2016**

I concur with the Science Panel's comments.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-E

Project Title: LTM Program - Long-term monitoring of marine bird abundance and habitat associations during fall and winter in PWS

Primary Investigator(s): Mary Anne Bishop

PI Affiliation: PWSSC

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$557,300

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------------|----------------|------------------|------------|------------|
| Auth: \$90,100 | Auth: \$92,700 | Auth: \$121,900* | \$124,800* | \$127,900* |

Requests include 9% GA.

** Totals in FY19-21 include additional annual request of \$26,200 to conduct November & March surveys in bays of PWS.*

Funding From Non-EVOSTC Sources FY17-21: \$106,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------|----------|------|------|------|
| \$53,000 | \$53,000 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY12-19): \$685,600

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$938,300

Total Non-EVOSTC Funding (FY12-21): \$352,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

The fall-winter marine bird surveys in Prince William Sound (PWS) will continue to build upon a 12-year time series (2007-2019) of marine bird abundance and habitat associations. Surveys occur onboard research vessels conducting oceanographic, fisheries, or marine mammal surveys, thereby increasing opportunities for cross-project collaboration and reducing project costs. Our September surveys are integrated with Gulf Watch Alaska (GWA) pelagic component's forage fish assessments of prey availability (20120114-C) and humpback whale monitoring (2020114-O) with all three projects sharing logistics, timing, and location of sampling. These integrated surveys allow us to estimate forage biomass at the same locations in which marine birds and humpback whales are feeding, thereby providing comparable information on both predator density and prey availability. Our November and March surveys are in conjunction with the GWA project monitoring of oceanographic conditions in PWS (2020114-G) and enable us to extend our long-term dataset of marine bird observations within juvenile herring bays of PWS that previously relied on fishery survey vessels that are no longer funded. For all surveys we use established protocols employed by all other GWA marine bird survey efforts (Kachemak Bay/Cook Inlet, Seward Line/Gulf of Alaska, PWS summer).

Of the marine birds that overwinter in PWS nine species were initially injured by the *Exxon Valdez* oil spill, including three species that have not yet recovered or have unknown recovery status. Fall and

winter are critical periods for survival as food tends to be relatively scarce or inaccessible, day length reduced, and water temperatures colder. By monitoring marine birds during fall and winter, we will improve our predictive models of species abundance and distribution across PWS in relation to biological and physical environmental factors. Our long-term monitoring has shown that the nonbreeding season cannot be characterized as a single time period when describing marine bird distribution and suggests that multiple surveys are required to quantify wintering populations and understand changes in distribution. We are not proposing changes to this project.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

Project is making good progress in a timely manner. The Science Panel has no specific comments or questions.

PI Response (9.27.19) Thank you for your comments.

Science Director Comments – FY20

Date: September 2019

PI continues to make good progress. I appreciate the detailed summary of results from FY18 and FY19. No specific comments or questions.

PI Response (9.27.19) Thank you for your comments.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | |

Science Panel Comments – FY19

Date: September 2018

Was the same NOAA vessel leveraged by both projects during the March cruises? The Science Panel asks that the PMT and the PIs communicate with trust agencies, such as NOAA, USFWS and ADFG, to see if they could also use this vessel for any agency activities. We understand the reason for nearshore bay surveys and would like to know if using ships of opportunity is really efficient and if effort and funds should be redirected from open water to preferred nearshore habitats. Can parts of Figure 2 surveys be eliminated if they are not proving to be useful? Is it possible to leverage ship time for surveys from project 19120114-G Campbell? Specifically, there appears to be considerable overlap in spatial sampling proposed in bays in this proposal [Fig 4] with those in Campbell [Fig 1 from 19120114-G], and Campbell proposes 6 times yearly sampling.

PI Response (10/10/18)

Yes, the same National Oceanic and Atmospheric Administration (NOAA) vessel was leveraged by both humpback whale and fall/winter marine bird projects (18120114-O, Moran & Straley, and 18120114-E, Bishop) during FY17 and FY18.

We will coordinate with agencies such as NOAA, U.S. Fish and Wildlife Service, and Alaska Department of Fish and Game to see if they could also use the dedicated marine bird survey vessel for additional activities.

Our surveys cover three basic habitat types: open waters, bays, and passages. The first 10 years of our surveys onboard ships of opportunity included all three habitats. However, when the juvenile herring surveys were discontinued in 2016 there was no longer coverage in the bays because the available ships of opportunity only covered open waters and passages. By using a dedicated marine bird vessel in November and March we can once again target bays for surveys in addition to continuing our data collection in open waters and passages while in transit between bays. The within-bay transects would be fixed, thus sampling within bays would not be opportunistic. The in-transit transects are while taking the shortest route between fixed bay transects and would also be relatively consistent, reducing spatial variability of the marine bird surveys. Given the geographic extent and high variability of the PWS ecosystem, sampling open-water areas while traveling between sampling locations is valuable to understanding distribution of marine birds in PWS. For example, our past surveys have identified several areas of high marine bird densities in open waters including Montague Strait and Orca Bay. Also, our current survey design is the most efficient way to sample bays distributed throughout PWS.

Finally, we are currently in communication with Dr. Campbell (project 19120114-G, PWS oceanography) regarding vessel-sharing during November and March. Dr. Campbell's sampling events typically occur over a 3-day period, while our surveys take approximately 6 days, so there would be additional personnel costs on his end. In addition, in its current configuration the vessel (R/V New Wave) would need to be modified to accommodate a marine bird observer. Specifically, a small observing platform would need to be fabricated that would be placed on top of the cabin. We recognize that combining efforts could ultimately reduce costs by ~20%, so talks are ongoing.

Science Coordinator Comments – FY19

Date: September 2018

PI continues to make good progress and the project is on track. PI continues to be productive and has another manuscript in prep for FY18. This project provides important data for regional comparisons of marine bird densities and other GWA projects in the Environmental Drivers group. NOAA vessels were leveraged for FY17 and FY18 for this project and 18120114-O Moran & Straley to conduct winter and early spring surveys and will no longer be available for FY19 and beyond. Funding (\$24K includes GA) is requested to continue the November and March cruises to continue work as described in the original project proposal. This study has shown that marine birds aggregate in nursery bays during nonbreeding seasons which may impact juvenile herring populations, knowledge which would contribute to the HRM program. Additionally, both projects 114-O and E are proposing to continue a spring/March cruise with requested funding. Is each project requesting its own vessel? If so, is there any way to share a vessel in March to reduce costs?

PI Response 9.5.18

Yes, each project is requesting their own vessel. When identifying projects with unfunded needs, we did have a lengthy discussion about sharing vessels, as the nearshore team also requested funding for March survey in PWS (that project did not rank in top 3 to request funds). We concluded that projects 19120114-E (fall/winter seabirds) and 19120114-O (humpback whales) would not be able to share a charter vessel. March surveys for marine birds and whales have different objectives, methods, and proposed spatial coverage (Figs. 1 and 2) and, therefore, require separate survey vessels. For example, the marine bird surveys (Fig. 1) are fixed transects sampled annually using the chartered vessel as the survey platform. In contrast, the whale survey route changes annually depending on where the whale and herring aggregations are (Fig. 2), and once an aggregation is encountered, the chartered vessel that is also used as the survey platform engages in focal following of predators and prey. Timing also differs. For marine birds, surveys would be conducted in early to mid-March before spring migration. On the other hand, we attempt to time whale surveys just prior to herring spawning in late March or early April. This is often too late for winter bird work.

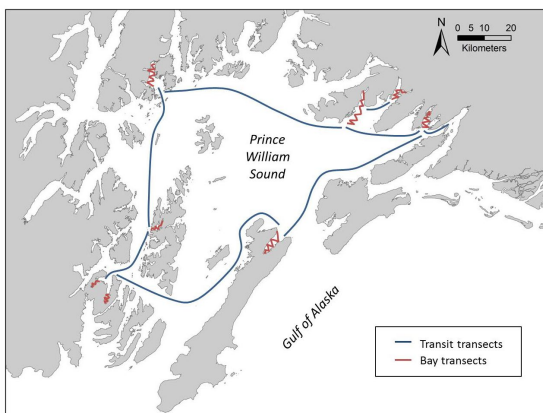


Figure 1. Proposed dedicated marine bird surveys to occur in November and March in Prince William Sound, AK. Surveys will replicate our longest time series (2007 - 2016) and most consistent data.

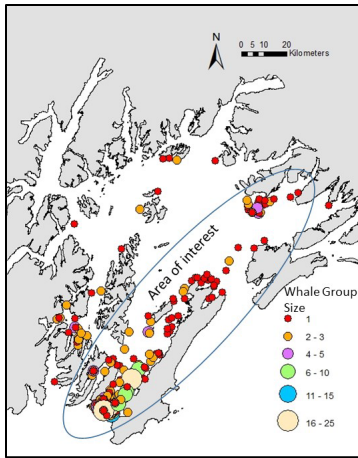


Figure 2. Area of interest for spring whale surveys in Prince William Sound, AK. Given limited vessel time, effort will focus on southern PWS an area of high whale and pre-concentrations.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

This proposal was very well presented and seems very reasonable. The Panel was pleased to see that the PI incorporated previous suggestions into the proposal. The Panel commends the PI's effort to integrate seabirds and mammals in her work on herring.

Regarding a statement on pg. 66 of this proposal: "As currently designed for FY17-21, the fall/winter marine bird project will not be working directly with the PWS Herring Research and Monitoring Program." The Panel would like clarification on what is meant here. The Panel recommends coordinating and collaborating to the extent reasonable.

PI Response (10/11/17):

Thank you for the opportunity to clarify our coordination and collaboration with the Herring Research and Monitoring (HRM) program. In past years, we have placed a marine bird observer onboard HRM project cruises. The HRM program has no scheduled cruises between September 2018 and March 2019. Thus, we are not able to collaborate directly with HRM during FY18. However, this project will share data with the HRM program and we will explore possibilities for joint publications.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18**Date: September 2017**

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17**Date: September 2016**

The Panel was pleased with the changes made by the PIs in response to Panel comments, including the methodology. Some concerns were raised about the interpretation of data given that survey tracks are specifically targeted to the presence of whales. If survey tracks are chosen because of whale foraging presence, then how useful will it be to use these data to detect associations? Almost by definition any birds in their survey will be associated with whales. The question is, how close and are they interacting? Is 150 m close enough? Too close?

Date: May 2016

The Panel noted that the proposal was difficult to review as a majority of the text was copied from the other Predator-Prey Survey proposal. It was challenging to find information within the text specific to this project. The Panel requests a revised proposal that focuses on the details of this specific project and how its data will be integrated into a wider cross-project set of analyses of interacting forage "fish", and piscivorous seabirds, and whales (humpback whales explicitly) .

Science Coordinator Comments – FY17**Date: May and September 2016**

I concur with the Science Panel's comments.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-G

Project Title: LTM Program – Monitoring of oceanographic conditions in PWS

Primary Investigator(s): Robert Campbell

PI Affiliation: PWSSC

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$1,142,300

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|-----------|-----------|
| Auth: \$218,700 | Auth: \$223,400 | Auth: \$228,300 | \$233,300 | \$238,500 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$1,425,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|-----------|-----------|-----------|
| \$300,000 | \$300,000 | \$275,000 | \$275,000 | \$275,000 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,712,000

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$2,183,800

Total Non-EVOSTC Funding (FY12-21): \$1,774,900

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

This project will continue physical and biological measurements to assess trends in the marine environment and bottom-up impacts on the marine ecosystem of Prince William Sound (PWS). Regular (~6 per year) vessel-based surveys of PWS will be conducted to maintain ongoing time series observations of physical (temperature, salinity, turbidity), biogeochemical (nitrate, phosphate, silicate, dissolved oxygen), and biological (chlorophyll-a concentration, zooplankton abundance and composition) parameters in several parts of PWS. Sampling sites include central PWS, the entrances (Hinchinbrook Entrance and Montague Strait), and four priority bays that were part of the *Exxon Valdez* Oil Spill Trustee Council-funded Sound Ecosystem Assessment project in the 1990s and the ongoing Herring Research and Monitoring project.

Additionally, an autonomous profiling mooring will be deployed in central PWS to provide high frequency (twice daily) depth-specific measurements of the surface layer that will be telemetered out in near real-time. The profiler will include measurements that complement the survey activities (temperature, salinity, oxygen, nitrate, chlorophyll-a, turbidity). An *in situ* plankton camera was recently developed for the profiler and will be used to enumerate zooplankton, large phytoplankton and other particles, with some taxonomic discrimination.

Spring and early summer observations in PWS indicate the timing of the spring bloom was near the climatological average and is continuing a trend towards lower productivity over time. Surface layer water temperatures returned to above average in 2018/2019. Plankton assemblages shifted towards

warm water taxa following the 2014-2015 marine heat wave, but cool water taxa became more common in 2018. We are not proposing any major changes to this project for FY20.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel is pleased that the plankton camera is running again on the autonomous profilers. We note this project continues to be productive. Data show the magnitude of bloom has changed but the timing has not. Do you have indications about the reasons for these findings? Might it have something to do with increased water column stability and reduced nutrient flux (freshwater input and/or upwelling)? Is there some indication about the potential influences of increased temperature, freshwater input (e.g. increased glacial melt), or photoperiod? This project, and two others, noted the switch among warm- and cold-water zooplankton. Is there evidence to indicate the mechanism to be differential local production or advection of these species from other areas? The Panel appreciates the amount and quality of the data and would like to see if data analyses can address the questions above.

PI Response (9.27.19)

I thank the science panel for their comments. The mechanisms forcing the spring bloom in Prince William Sound (PWS) are as complicated as one might expect, and the first approximation appears to be an interaction between light, stability (primarily thermal but also salinity), and wind mixing (Eslinger et al. 2001: doi 10.1046/j.1054-6006.2001.00036.x; Henson, 2007: doi 10.1357/002224007784219002). Stability is set up in ~April/May and the bloom initiates if it is not disrupted by wind mixing. The timing of the bloom will therefore depend on the timing of stability onset and wind events, while the magnitude will depend on the amount of nitrate available at the surface -- the bloom terminates after nitrate is depleted in surface waters.

We do not have a tremendously long time series of the nutrient biochemistry in PWS, but the system is largely advective, and much of the nitrate input is likely from deepwater renewal events that bring in off-shelf waters (high salinity, low oxygen and high nitrate) to the basins of PWS in summer when downwelling relaxes. That deep water is mixed up into the surface waters over the winter and is what drives the spring bloom. At depth in PWS there is a modest trend towards increased salinity over the last few decades (Campbell, 2018: doi 10.1016/j.dsr2.2017.08.014), which is presumably driven by decreased downwelling and enhanced deepwater transport. That would imply that nitrate flux might actually be increasing somewhat in the deep waters of PWS.

The Campbell (2018) study also found a shoaling of mixed layer depths in the last 40 years, which seems a likely explanation for the reduction in overall productivity, as the science panel suggests. An interesting pattern that we have observed at the profiler site since the onset of the 2013-2014 marine heat wave (MHW) is a fairly consistent negative temperature anomaly in waters immediately underlying the mixed layer. This can be seen in 2018 in the profiler temperature anomaly panel (2nd from top) of Fig. 7 of the project 20120114-G FY20 work plan. Given that deep waters of PWS are exhibiting a warming trend, the presence of a cold anomaly suggests to me that the surface mixed

layer is much thinner presently than in the climatology, which manifests as cooler anomalies at depth. In other words, the shoaling and strengthening of the mixed layer means that "deep water" (which is cooler) is found closer to the surface than previously. It follows that the total amount of near-surface nitrate available to the phytoplankton in the seasonal mixed layer will be reduced which will ultimately result in a smaller bloom.

*With regard to zooplankton species compositions, even prior to the MHW, Russ Hopcroft (Seward Line PI) and I noticed that the species we designate now as "warm species" were often present in PWS in low abundance, but comparatively rare on the shelf along his GAK line. We hypothesized that PWS may be a refugium of sorts for those species. Smaller embayments around the periphery of PWS (particularly the non-glaciated ones) can become considerably warmer in summer than central PWS or on the shelf. So the MHW may have made the environment in PWS a more amenable habitat to those species, and conversely less amenable to the canonical subarctic taxa we designate as "cool water" ones. The two year lag between the onset of the MHW and the largest anomalies is interesting, but could be due to enhanced local production or advection -- they are not mutually exclusive. It seems likely that the reality was a mix of the two - some species have always been present and did better during the MHW years (a closer look at stage compositions may be informative), while others were advected northward by the prevailing currents. At least one species, *Corycaeus anglicus*, was extremely rare prior to the MHW (not seen some years, 1-2 observations in others) but is now prevalent throughout PWS.*

The questions highlighted by the science panel are of considerable interest and are the focus of ongoing analyses that the science panel can expect to see in future reports. Our focus in the last years was fairly broad descriptive manuscripts on the hydrography and the plankton ecosystem in PWS (published in the Gulf Watch Alaska/Herring Research and Monitoring Deep-Sea Research II volume). In FY19 we have been focused on synthesis activities, a manuscript on the profiler and plankton camera (reviews received September 23, 2019 and will be accepted pending revisions), and a manuscript in preparation on the Kachemak Bay plankton ecosystem. We are looking forward to diving into more of the details in future work.

Science Director Comments – FY20

Date: September 2019

Project tasks are being completed on time. The PI continues to be productive: two manuscripts presenting project results are currently prep. Observations from this project are being leveraged by other researchers for additional related proposals. No specific comments or questions.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19**Date: September 2018**

Science Panel appreciates this time series and looks forward to seeing how the zooplankton community in Cook Inlet relates to oceanographic conditions. The Panel notes that there was a significant increase in warm water zooplankton species in 2016/2017 (Figure 5) after the blob occurred and would like to see analyses that might explain that lag response. We acknowledge that analyses are underway and encourage the PI to publish.

PI Response (10/10/18)

A region-wide comparison of the results of the Prince William Sound (PWS), Seward Line, and lower Cook Inlet projects has been identified as a good potential synthesis manuscript topic and is part of our ongoing science synthesis discussions. Analysis of a now 40 year conductivity and temperature at depth (CTD) profile database in the PWS region shows that temperatures there tend to lag those in the Gulf of Alaska (GOA; as proxied by the Pacific Decadal Oscillation index) by about 12 months (see Fig. 12 in Campbell 2018). Temperature anomalies did shift towards positive anomalies in late 2013 in PWS as they did in the GOA during the emergence of the marine heatwave. An estimate of heat flux at the mid-PWS National Data Buoy Center buoy (Buoy 46060) suggests that heat flux out of the surface ocean in PWS was low in the marine heatwave years (late 2013-2016), which has also been proposed as the mechanism for the genesis of the marine heatwave (e.g., Bond et al. 2015). We take from this that the same atmospheric phenomenon (the “ridiculously resilient ridge” as stated in Swain 2015) that drove the formation of the marine heatwave in the central GOA was also operating in PWS and led to those positive anomalies. The transport lags into PWS discussed in Campbell (2018) then led to temperature anomalies in PWS remaining elevated longer than they were in the GOA, well into 2017.

There was already some indication of a higher prevalence of warm water zooplankton species in PWS in 2013, but it is a good observation that it was not until 2015/2016 that they are almost uniformly prevalent. We would attribute that to both the lag due to transport and the lag that one can expect from a biological system responding to a physical forcing. McKinstry and Campbell (2018) discuss in detail some of the species shifts observed during the marine heatwave years (see section 4.2. Climatic shifts and zooplankton variation). Briefly, several of the “warm water” species identified in Fig. 5 of project 19120114-G’s FY19 work plan have been observed in PWS for some time; many of them fell into what our Indicator Species Analysis termed “winter taxa.” While recently comparing our observations with those by Russ Hopcroft’s along the Seward Line, we have noticed that a number of those species tend to be more prevalent in PWS and hypothesize that it might be some sort of refugium for those species. We would extend that hypothesis and suggest that those already present warm-water species were at a comparative advantage during the marine heatwave years (and cool-preferring species may have conversely been at a disadvantage), and so there was a trend to become more prevalent over time as conditions remained advantageous. So rather than there being a large shift in 2015, there was a trend towards more warm water species over time (with some noise, as one expects from plankton observations). There are other possible explanations, but this is perhaps the most plausible hypothesis given the available data. Approaching the question quantitatively would be difficult, but we will be vigilant for potential opportunities. The basic life histories of many of the

warm water diagnostic species (Mesocalanus tenuicornus, Clausocalanus anglicus, Corycaeus pacificus) are not well described in general (really, Calanus pacificus is the sole exception), much less so in Alaska, and even less is known about their vital rates. As the GWA oceanographic time series extend beyond the impact of the marine heatwave, program PIs expect to be able to say more about the lags in zooplankton populations.

Science Coordinator Comments – FY19

Date: September 2018

PI is making good progress and project is on task. I appreciate the preliminary results presented in the proposal. Good to read that PI is already collaborating with HRM postdoctoral research McGowan who just started in FY18.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel believes the PI is conducting important work that supports the goals of the EVOSTC. The Panel was happy to see that there are peer-reviewed publications in press and encourages the PI to keep publishing.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel has no project specific comments.

Date: May 2016

The Panel acknowledges the value of continued time series of physical, chemical, and biological primary production data to provide the basis for analyses of how changing environmental conditions are affecting the higher trophic level animals of the PWS and other spill-affected regions of the Northern Gulf of Alaska.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-H

Project Title: LTM Program – Nearshore Ecosystems in the Gulf of Alaska

Primary Investigator(s): Heather Coletti, Brenda Konar, Katrin Iken, Dan Esler, Thomas Dean

PI Affiliation: NPS, USGS, NOAA, Coastal Resources
Project Manager: USGS

EVOSTC Funding Requested FY17-21: \$2,118,600

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|------------|------------|
| Auth: \$401,900 | Auth: \$452,700 | Auth: \$411,400 | \$426,100* | \$426,600* |

*Requests include 9% GA. *Includes additional annual requests of \$24K for FY20-21 to support increased operating costs for the RV Alaskan Gyre.*

Funding From Non-EVOSTC Sources FY17-21: \$2,009,200

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|-----------|-----------|-----------|
| \$410,000 | \$410,000 | \$410,000 | \$389,600 | \$389,600 |

Total Past EVOSTC Funding Authorized (FY12-19): \$2,825,900

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$3,678,600

Total Non-EVOSTC Funding (FY12-21): \$3,379,200

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

Nearshore monitoring in the Gulf of Alaska (GOA) provides ongoing evaluation of status and trends of more than 200 species, including many of those injured by the 1989 *Exxon Valdez* oil spill. The monitoring design includes spatial, temporal and ecological features that support inference regarding drivers of change. Continued monitoring will lead to a better understanding of variation in the nearshore ecosystem across the GOA and a more thorough evaluation of the status of spill-injured resources. This information has been used in a number of management contexts and will be critical for anticipating and responding to ongoing and future perturbations in the region, as well as providing for global contrasts. In FY20, we propose to continue sampling in Kachemak Bay (KBAY), Katmai National Park and Preserve (KATM), Kenai Fjords National Park (KEFJ), and Western Prince William Sound (WPWS) following previously established methods. Monitoring metrics include marine invertebrates, macroalgae, birds, mammals, and physical parameters such as temperature. In addition to taxon-specific metrics, monitoring includes recognized important ecological relations such as predator-prey dynamics, measures of nearshore ecosystem productivity, and contamination. In FY18, sea star observations included some recruitment and recovery in WPWS and KEFJ but not in KBAY or KATM. In FY19, some sea star recovery also included KATM and KBAY, but numbers are still low in comparison to previous years. We expected a lag in recovery in these latter two regions as the disease seemed to move across the GOA from the east to the west following the large sea star die-off that began in 2015. We also initiated marine bird and mammal surveys and black oystercatcher

productivity monitoring as well as increased sea otter foraging data collection efforts in FY18 in KBAY that continued through FY19. We are not proposing any major changes to activities under this project for FY20; we are requesting additional funds (\$24k includes 9% GA) to support increased costs of operating the RV *Alaskan Gyre*, a critical platform for the nearshore component.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Panel would like to see more detail on the increase in operating costs. Is the additional request for \$24K for previous costs or for this year's increase in operating costs? Will this be an annual request?

PI Response (9.27.19)

The costs of operating the US Geological Survey (USGS) research vessel Alaskan Gyre are increasing through time, while the base contribution of USGS facilities money has remained static (Fig. 1). The base contribution from USGS still allows the boat to be used at a fraction of the cost of charter vessels (see estimates below); however, this does not cover as much of the total operating costs as in past years. USGS has prepared a business plan for operating and maintaining the Alaskan Gyre, which resulted in the need to increase costs to projects. These increased costs are being required of all users of the Alaskan Gyre, not just Gulf Watch Alaska projects.

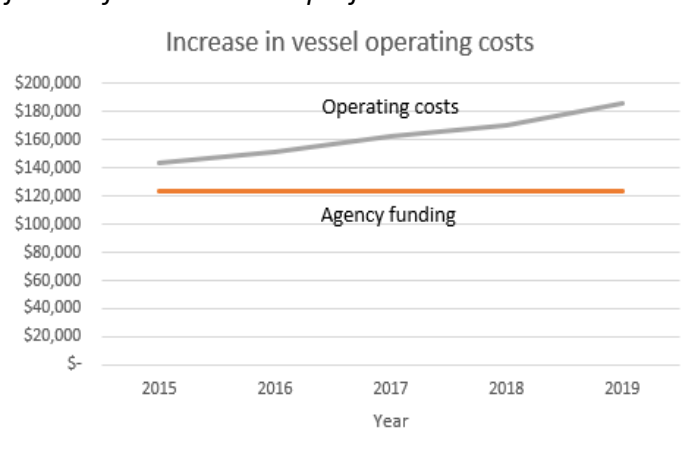


Figure 1. Annual costs of operating the USGS research vessel Alaskan Gyre relative to the agency funding allocation.

The increase in overall operating costs reflects increases in nearly all of the specific costs of running the Alaskan Gyre. However, a sizeable proportion of the increased costs are associated with a few specific items, including personnel (captain salary and benefits), maintenance (shop rates and material costs are increasing), and harbor fees. All of these costs are essential for safely and effectively operating the vessel. The budget request for FY20 is for costs anticipated in that fiscal year, not previous years' costs. We also are requesting funds for FY21, anticipating that operating costs will not go down. If additional funding is not approved, field time on the Alaskan Gyre could be reduced by as many as 19 days.

Charter boats used for nearshore sampling have ranged from \$3600 to \$5000 per day. Our request for additional funds, assuming at least 50 days of Gulf Watch Alaska use annually, is less than \$500 per day. Moreover, some of the Gulf Watch Alaska work involves trawling for forage fish and the Alaskan Gyre has been specifically outfitted to do this work.

In FY19 we requested the exploration of the relationships among species. The PIs did not address this inquiry. We note the PIs responded with an example that mussel density has increased, and *Fucus* and sea stars have declined but no other interpretations were offered or reported in the FY18 annual report. The Panel requests PIs address this and present possible mechanisms for this change. This certainly should be included in the synthesis paper(s). We appreciate the listed collaborations with a wide variety of groups.

PI Response (9.27.19)

We agree with the science panel that understanding inter-specific relationships is important and that the nearshore component is particularly well-suited for evaluating those, given the large number of species monitored across multiple trophic levels and the sampling design in which all data streams are spatially coordinated. Below we describe our efforts to date along these lines, as well as plans for additional exploration in the near future.

The Nearshore program is the lead on two of the Gulf Watch Alaska synthesis manuscripts currently in progress. One of these manuscripts is specifically focused on inter-species and community relationships and titled “Synchronous Region-wide Responses in Intertidal Community Structure to a Marine Heat Wave in the Gulf of Alaska.” This synthesis product will focus on changes in intertidal community structure at long-term monitoring sites that stretch across the Gulf of Alaska from Prince William Sound to the Katmai Peninsula over the period from 2006 through 2018, with emphasis on changes that occurred during the 2014-2016 marine heatwave. We are examining site specific changes in intertidal temperature as well as changes in percent cover of intertidal algae and invertebrates during this period. Preliminary analyses indicate that differences in community structure exist across sites; however, synchronous trends across sites in heatwave years over very large spatial scales suggest influence of large-scale oceanographic events. While mean water temperatures differ across sites and regions (i.e., Katmai generally colder), all regions exhibited anomalous warming during heatwave years indicating that the heatwave may be driving these synchronous responses of the biological community in the intertidal.

We also will be continuing to explore inter-specific relationships within the nearshore component and across components. The USGS postdoc position, recently funded by the EVOSTC, will support an early-career scientist as they work with Gulf Watch Alaska principal investigators to evaluate interspecific relationships as part of synthesis efforts.

Additional species-environmental relationships are in our FY18 Annual Report (Coletti et al. 2019), as well as in the annual NOAA Gulf of Alaska Ecosystem Status Report (Coletti et al. 2018), we identified warming water temperatures (heatwave) as a possible driver for coincident responses of several species, representing various trophic levels, across the nearshore environment in the northern Gulf of Alaska. These include both direct responses of warming surface temperatures and also indirect effects through interspecific interactions. We documented negative anomalies of rockweed in three of the four regions and sea stars across all regions coincident with warm water temperatures. We hypothesized that the decline in sea star abundance was likely due to sea star wasting disease (Konar

*et al. 2019), which was first detected in 2014 and is generally associated with warm water temperature anomalies (Eisenlord et al. 2016). We documented positive anomalies during 2015-2019 for large mussels. This is likely due, in part, to a response to the reduced predation pressure given the synoptic decline of sea stars. Continued positive anomalies of large mussels in Katmai National Park and, to a lesser degree, in Kachemak Bay coincide with continued negative anomalies of sea stars in these two regions. A decline in small mussel density (an indicator of recruitment) was also observed during the 2015-2017 period, possibly because of the decrease in *Fucus* as available settlement habitat or some reduction in primary productivity.*

We also published a paper specific to the sea star decline to document pre- and post-heatwave community structure and examined possible static drivers of those communities (Konar et al. 2019). Sea star wasting disease and then subsequent declines in sea stars resulted in a sea star assemblage that is responding to different environmental variables, and has drastically altered ecological function by the reduction of species composition and loss of large predatory sea stars. Understanding the delicate interplay of environmental variables that influence sea star assemblages could expand knowledge of the habitat preferences and tolerance ranges of important sea star species within the northern Gulf of Alaska.

*In 2016, a paper was published in *Ecosphere* (Coletti et al. 2016) highlighting the overall nearshore monitoring program while simultaneously providing examples of linkages across metrics to detect and infer causes of change. In one example specific to Kenai Fjords National Park, we documented changes in the proportion of various prey types in the sea otter diet that coincided with changes in the abundance of the mussel, *Mytilus trossulus*. This is likely a bottom-up driven interaction as mussel abundance in Kenai Fjords is very high while sea otter abundance is considered low, but stable and likely at carrying capacity for this region.*

Coletti, H. A., J. L. Bodkin, D. H. Monson, B. E. Ballachey, and T. A. Dean. 2016. Detecting and inferring cause of change in an Alaska nearshore marine ecosystem. *Ecosphere* 7(10):e01489. 10.1002/ecs2.1489.

Coletti, H., J. Bodkin, T. Dean, K. Iken, B. Konar, D. Monson, D. Esler, M. Lindeberg, R. Suryan. 2018 Intertidal Ecosystem Indicators in the Northern Gulf of Alaska in Zador, S. G., and E. M. Yasumiishi. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, AK 99301. <https://www.fisheries.noaa.gov/resource/data/2018-status-gulf-alaska-ecosystem>.

Coletti, H., D. Esler, B. Konar, K. Iken, K. Kloecker, D. Monson, B. Weitzman, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, B. Robinson, and M. Lindeberg. 2019. Gulf Watch Alaska: Nearshore Ecosystems in the Gulf of Alaska. Exxon Valdez Oil Spill Restoration Project Annual Report (Restoration Project 18120114-H), Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

Eisenlord, M. E., M. L. Groner, R. M. Yoshioka, J. Elliott, J. Maynard, S. Fradkin, M. Turner, K. Pyne, N. Rivlin, R. van Hooedonk, and C. D. Harvell. 2016. Ochre star mortality during the 2014 wasting disease epizootic: role of population size structure and temperature. *Philosophical Transactions of the Royal Society B: Biological Sciences* 371.

Konar, B., T. J. Mitchell, K. Iken, H. Coletti, T. Dean, D. Esler, M. Lindeberg, B. Pister, and B. Weitzman. 2019. Wasting disease and environmental variables drive sea star assemblages in the northern Gulf of Alaska. *Journal of Experimental Marine Biology and Ecology*. <https://doi.org/10.1016/j.jembe.2019.151209>

Science Director Comments – FY20

Date: September 2019

This project continues to contribute nearshore system data to long-term time series, some of which date back more than five decades, and many that were initiated soon after the oil spill. Information

from this project is being used in a number of management contexts including data contributions to the annual stock assessments Ecosystems Considerations Chapter to the North Pacific Fishery Management Council which informs managers on essential fish habitat and sensitive early life stages of federally managed fish species and providing data to the Bureau of Ocean Energy Management on habitats and sensitive species to support environmental analysis for the OCS Cook Inlet Lease Sale 244 NEPA.

The USGS research vessel Alaskan Gyre is one of the primary research platforms that supports Gulf Watch Alaska work, logging at least 50+ days of use annually. Funding for the Gyre has been largely cost-shared by USGS; however, operating costs have increased. Thus, this project is requesting additional annual funding of \$24K (includes GA) for FY20 and FY21 to cover increased operating expenses of the USGS research vessel Alaskan Gyre. Even with the rise in operating expenses, costs for the Gyre remain well below those of private charters and the Gyre is already specifically outfitted to meet Gulf Watch Alaska project field requirements. Without additional funds to support the increase in operating costs, the number of field days may need to be reduced resulting in decreased field activities and less data collected. I understand that situation, for clarification please identify what operating costs are specifically increasing.

PI Response (8.28.19)

All costs are increasing including personnel, maintenance, and fuel. At the same time, the base contribution of USGS facilities money has remained static. The base contribution from USGS still allows the boat to be used at a fraction of the cost of charter vessels; however, this doesn't cover as much of the total operating costs as in past years. USGS has carefully devised a business plan for operating and maintaining the Gyre, which resulted in the need to increase costs to projects.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

Science Panel is curious to know if this project interacts with the LTER program and specifically whether LTER and EVOSTC funding are responsible for different sampling locations.

PI Response (10/10/18)

With the start of a new long-term ecological research (LTER) site in the northern GOA, the nearshore component will continue to actively engage with the Environmental Drivers component as we explore linkages from the offshore to the nearshore environments. Currently, that includes a proposed synthesis

product examining the relationship between offshore and coastal temperatures. An additional proposed synthesis product includes biological responses to the marine heatwave. As for the sampling sites within the nearshore component, they were randomly selected to allow for inference across the regions of the GOA prior to the start of GWA. Kachemak Bay sites are the exception and are a continuation of historical sampling.

We recognize that there are several informative time series of individual species, but would like to see analyses to explore the relationships among species. Current analyses only report single species trends over time, which are certainly useful, but given the rich literature on species interactions in these nearshore systems (e.g., keystone effects of sea stars) it seems that assessing correlations among taxa across space and/or time would be a profitable approach that might produce hypotheses for the extent to which changes observed were the direct effect of environmental variation vs indirect effects mediated through species interactions.

PI Response (10/10/18)

We agree that assessing correlations among taxa across space and time will be a valuable contribution. For example, the nearshore component submitted a section to the NOAA GOA Ecosystem Status Report showing negative anomalies of Fucus and sea stars, with concurrent positive anomalies for large (≥ 20 mm) mussel density across the GOA. The negative anomaly for Fucus and sea stars is correlated with warm water temperatures in nearshore areas. The decline in sea star abundance was likely due to sea star wasting disease, which was first detected in 2014 and is generally associated with the warm water temperature anomalies. The positive anomalies during 2015-2017 for large mussels is possibly a response to the reduced predation pressure given the synoptic decline of sea stars. A decline in small mussel density (an indicator of recruitment) was also observed during this time period, likely because of the decrease in Fucus as available settlement habitat and possibly reduction in primary productivity. If funded, the postdoc working with GWA would conduct analyses exploring linkages within and across components.

Please provide clarification on the overarching hypotheses referred to in the text under Figure 6 in the proposal.

PI Response (10/10/18)

To clarify the overarching hypotheses referred in our FY19 EVOSTC work plan: Our overarching goal is to understand drivers of variation in the GOA nearshore ecosystem. The foundational hypotheses of the Nearshore Project include: (1) What are the spatial and temporal scales over which change in nearshore ecosystems is observed? (2) Are observed changes related to broad-scale environmental variation, local perturbations, or underlying ecological processes? (3) Does the magnitude and timing of changes in nearshore ecosystems correspond to those measured in pelagic ecosystems?

Science Coordinator Comments – FY19

Date: September 2018

Project milestones and tasks are on track. I am gratified to see the data from this project being used in several manuscripts that have been published, in review or in prep during FY18.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel appreciates the amount of data being collected on multiple nearshore sites. There is not a clear integration with oceanographic studies, but there is enough substance to make this a meaningful, stand- alone nearshore ecosystem project. The Panel is very pleased with their productivity and integration of students into the studies.

PI Response (10/11/2017):

The nearshore component greatly appreciates the Science Panel's support of our progress towards an integrated nearshore program. There have been recent discussions to use oceanographic data, initially temperature, across all components to examine linkages between offshore and nearshore systems. We anticipate that analyses of temperature data will be our first step in integrating other oceanographic processes to pelagic and coastal systems for the GWA program.

The Panel would like to see more of the synoptic surveys, what they are finding or not finding temporally and on a spatial scale. A question from the Panel for the PIs to ponder: Have egg-eating seabirds/waterfowl changed their distribution regarding location in time and space to herring spawning?

PI Response (10/11/2017):

Several PIs in the nearshore program did publish a paper in Ecosphere (<http://onlinelibrary.wiley.com/doi/10.1002/ecs2.1489/full>) that examined temporal trends in sea otter abundance, energy recovery rates, and demographics at varying spatial scales. However, based on the design of the nearshore component, an exercise examining trends across space and time could be done for a variety of species. We are meeting as a component prior to the PI meeting in November to examine data trends to date and develop product ideas for the next 1-3 years within the nearshore component. Specific to the Science Panel's question about changing seabird/waterfowl distribution, we have set aside time for cross-component bird data integration and synthesis discussions at the PI meeting in November. All parties will have data summaries to discuss and determine how we may be able to look at trends over time, and changes in distribution, and integration with data from other components, including environmental drivers.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

The PAC meeting was 28 September 2017 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel wished to draw attention of the PIs to similar recent declines in mussels in the Gulf of Maine in the Atlantic. No action is required by the PIs, but they might find parallel research on a similar problem interesting. A paper by Sorte et al. in Global Change Biology would be once place to look: Sorte, C. J. B., Davidson, V. E., Franklin, M. C., Benes, K. M., Doellman, M. M., Etter, R. J., Hannigan, R. E., Lubchenco, J. and Menge, B. A. (2016), Long-term declines in an intertidal foundation species parallel shifts in community composition. Glob Change Biol. doi:10.1111/gcb.13425

Date: May 2016

The Panel has no project specific comments.

Science Coordinator Comments – FY17

Date: May and September 2016

I have no project specific comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-I

Project Title: LTM Program – Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK-1

Primary Investigator(s): Seth Danielson

PI Affiliation: UAF

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$680,800

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|-----------|-----------|
| Auth: \$146,800 | Auth: \$148,400 | Auth: \$132,600 | \$125,600 | \$127,400 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$285,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-----------|------|
| \$0 | \$0 | \$0 | \$285,000 | \$0 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,007,000

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,260,000

Total Non-EVOSTC Funding (FY12-21): \$285,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

This project continues a nearly half-century time-series of temperature and salinity measurements at hydrographic station GAK-1. With first sampling in 1970, the data set consists of nominally monthly conductivity-temperature versus depth casts and a mooring outfitted with seven temperature/conductivity recorders distributed throughout the water column and a fluorometer at 20 m depth. The project monitors five important Alaska Coastal Current (ACC) ecosystem parameters that quantify and help us understand hourly to seasonal, interannual, and multi-decadal period variability in: 1) temperature and salinity throughout the 250 m-deep water column, 2) near surface stratification, 3) surface pressure fluctuations, 4) fluorescence as an index of phytoplankton biomass, and 5) along-shelf transport in the ACC. All of these parameters are basic descriptors that characterize the workings of the inner shelf and the ACC, an important habitat and migratory corridor for organisms inhabiting the northern Gulf of Alaska, including Prince William Sound, and resources injured by the *Exxon Valdez* oil spill. We are aware of over 90 publications utilizing data collected at station GAK-1, and since 2000 the citation list has grown by nearly three publications per year. These publications range from physical, chemical and biological oceanography to climate studies, fisheries research, fisheries management applications, and ecosystem-based management applications. We report that recent water temperatures remain warmer than the long-term average throughout the water column, while near-surface waters have freshened over time and near-bottom waters have salinized. We document an increase of stratification that carries important and far-

reaching implications for ecosystem dynamics. We are not proposing any major changes to this project in FY20.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel recognizes that this is an important project to monitor oceanographic changes, which are relevant to all the projects conducted in the GOA. The project continues to produce useful and informative data.

PI Response (9.27.19)

Thank you for your comments. We appreciate the positive feedback.

Science Director Comments – FY20

Date: September 2019

The long-term time series provided by this project has been used by over 90 publications, which is an increase of 21 more publications since the FY19 project proposal was submitted a year ago, demonstrating how valuable and useful these data are for understanding GOA ecosystem dynamics and trends. I appreciate the funding contribution (~\$700K) by UAF toward a replacement survey vessel for conducting monthly CTD profiles and annual mooring deployments following the breakdown of the R/V Little Dipper in 2017. I concur with the Science Panel's comments.

PI Response (9.27.19)

Thank you for your comments. We appreciate the positive feedback.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

Science Panel is interested in understanding better how the LTER program is integrated with the GAK1, Seward line and nearshore monitoring, specifically activities and monitoring.

PI Response (10/10/18)

Please see nearshore ecosystems (19120114-H, Coletti et al.) and Seward Line (19120114-L, Hopcroft) projects for comprehensive responses to this comment.

Science Coordinator Comments – FY19**Date: September 2018**

Milestones and tasks have been completed on planned. Thanks for the update regarding the replacement update for the R/V Little Dipper. Pleased to see that additional funding from other sources have been secured for the new set of moorings, this will add to the important long-term time series provided by the GAK1 mooring.

PAC Comments – FY19**Date: September 2018**

No project specific comments.

Executive Director Comments – FY19**Date: September 2018**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

This is an important long-term data collection project that needs to continue. The Panel supports the research and welcomes the news of the Long-Term Ecological Research (National Science Foundation) funding awarded to the PIs, which will ensure the stability of gathering long-term data while expanding the scope of the project. PIs are using graduate students productively.

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments.

PAC Comments – FY18**Date: September 2017**

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel has no project specific comments.

Date: May 2016

This long-term data set provides critical information to both Programs and to researchers beyond the Programs. The resultant data are heavily used. The Panel supports the continued funding of this work. The Panel also awaits seeing new analyses that integrate these environmental variables into the changing abundances of members of the food webs of importance.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-J

Project Title: LTM Program – Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay

Primary Investigator(s): Kris Holderied and Steve Baird

PI Affiliation: NOAA and KBRR

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$796,300

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|-----------|-----------|
| Auth: \$169,700 | Auth: \$174,400 | Auth: \$183,400 | \$135,700 | \$133,200 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$1,001,800

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|-----------|-----------|-----------|
| \$205,000 | \$213,000 | \$215,000 | \$182,800 | \$186,000 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,305,800

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,574,700

Total Non-EVOSTC Funding (FY12-21): \$2,153,800

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

The Cook Inlet/Kachemak Bay monitoring project provides year-round, high temporal resolution oceanographic and plankton community data to assess the effects of seasonal and inter-annual oceanographic variability on nearshore and pelagic species affected by the *Exxon Valdez* Oil Spill. We continue an 8-year time-series of year-round, monthly shipboard oceanography surveys along the estuarine gradient from Kachemak Bay into southeast Cook Inlet, as well as an 18-year time series of continuous nearshore water quality station observations in Kachemak Bay. Shipboard sampling includes conductivity-temperature-vs-depth casts, and phytoplankton and zooplankton net tows. Outputs from the project include seasonally resolved patterns and interannual shifts in oceanography, plankton abundance and community composition, and occurrences of harmful algal species. The project provides oceanographic and plankton data to support the GWA Nearshore Component in Kachemak Bay and provides year-round information on estuary-shelf oceanographic gradients to help evaluate the effects of local (within estuary) and remote (shelf, North Pacific) climate forcing on nearshore and pelagic ecosystems. Results show that: 1) water temperatures in 2018 were close to long-term averages through summer, then warmed above average in early fall and remained anomalously warm through July 2019 (up to 2 degrees C above average); 2) Kachemak Bay zooplankton community composition in summer 2017 returned to patterns observed in 2012-2015; and 3) abundances of the phytoplankton species that cause paralytic shellfish poisoning were surprisingly low in September 2018, despite warm conditions, but increases in these toxic species and in shellfish toxicity were observed in July 2019. No proposed project changes for FY20.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20**Date: September 2019**

The project is meeting goals on time. The Panel initially had concerns with this project being outside of the core area of interest, but we are pleased to see the usefulness of these data and the insights produced with connections to the EVOSTC-funded programs as a whole. This project collaborates with and provides data to Trustee and non-Trustee agencies. The Science Panel wonders whether quarterly plankton sampling could provide important new data on herring larvae that could be useful for collaborations with HRM projects.

PI Response (9.27.19)

We appreciate the comments of the science panel and Science Coordinator and are grateful that the ecosystem monitoring efforts supported by the EVOSTC in Kachemak Bay/Cook Inlet have also enabled additional collaborations with other funding agencies. We agree with the science panel that ichthyoplankton sampling to assess seasonal patterns in herring and other forage fish larvae would provide important data for both the Herring Research and Monitoring and Gulf Watch Alaska programs and we would be interested in further discussions with the Gulf Watch Alaska/Herring Research and Monitoring teams and science panel on how that might be incorporated into the program. The Kachemak Bay National Estuarine Research Reserve conducted a pilot study in Kachemak Bay in 2018-2019 to assess seasonal changes in nearshore fish communities and their sampling included both larval and adult fish. We will be analyzing those data in conjunction with our zooplankton and oceanographic data to improve our understanding of seasonal patterns in forage species and will work with other Gulf Watch Alaska and Herring Research and Monitoring investigators on those analyses. Kachemak Bay National Estuarine Research Reserve has also proposed a non-program project to the EVOSTC that would expand the pilot study efforts and provide seasonal information on larval, juvenile and adult fish that fills a current gap in our understanding of food web responses to environmental changes. Additionally, US Geological Survey researchers (including Gulf Watch Alaska principal investigators Yumi Arimitsu and John Piatt) have conducted forage species sampling in Cook Inlet with hydroacoustics and trawls for the past four summers, under a Bureau of Ocean Energy Management-funded program.

In addition, the Gulf Watch Alaska program is collaborating with other ichthyoplankton sampling programs including the Recruitment Processes Alliance at the NOAA Alaska Fisheries Science Center. To date, this involves including some of the ichthyoplankton time series in one of Gulf Watch Alaska's synthesis manuscripts (Suryan et al.) and leveraging the Gulf Watch Alaska/Long-term Ecological Research oceanographic vessel platforms of opportunity to collect ichthyoplankton samples for the NOAA Recruitment Processes Alliance to analyze. We intend to work with researchers and data from across these projects this year and are excited about how that will help us better understand nearshore and pelagic ecosystem changes and linkages.

Science Director Comments – FY20**Date: September 2019**

This project continues to provide important oceanographic and plankton data to help understand nearshore and pelagic food web dynamics. I appreciate the detailed results reported for FY19. This project will begin new collaboration(s) with non-program projects in FY20 - it is encouraging that other non-program projects will be leveraging TC-funded project data and vice versa. I concur with the Science Panel's comments.

PI Response (9.27.19)

Thank you for your comments. We appreciate the positive feedback.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel is pleased to see the multivariate analyses of community composition relating changes in temperature and chlorophyll and would like to see these type of analyses in other projects. In regard to the FY17 annual proposal, we would like clarification on how the Kachemak Bay phytoplankton samples in 2016 were processed improperly and what will be done to prevent this from happening again in the future. We note the increase in tunicates; what species are they? Are they pyrosomes as reported from SE AK and along the US west coast?

PI Response (10/10/18)

We appreciate the Science Panel's comment on our multivariate analyses for zooplankton community composition and plan to work with other Environmental Drivers component projects on more of these analyses in FY19. In FY16, the phytoplankton samples from all our EVOSTC-funded shipboard sampling stations were processed normally. However, some of the samples from intensive phytoplankton sampling at the Kasitsna Bay Lab dock (part of other NOAA programs) were processed with a different Lugol's preservative concentration that did not work effectively and has not been used since. While the dock sampling is not part of our EVOSTC-funded work, we do use those data to provide a better temporal context for our monthly shipboard sampling. Regarding tunicates, we have not detected pyrosomes in our zooplankton samples; we also have not detected an increasing trend in the tunicate larvaceans that appear through the 2016 results included in our last annual report. We will update those results in our FY18 annual report.

Science Coordinator Comments – FY19

Date: September 2018

I am pleased to see data from this project being used by several other GWA projects. Two papers using project data have already been published in FY18, demonstrating the usefulness of these data. I appreciate seeing the preliminary results from FY18. Project is on track. Steve Baird is an appropriate replacement for Jessica Shepherd as project PI.

PAC Comments – FY19**Date: September 2018**

No project specific comments.

Executive Director Comments – FY19**Date: September 2018**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

The Panel was happy to see that the PIs explained how data from this study tie into the decline in sea stars, marine mammal and seabird mortalities and changes in the presence of zooplankton species. The Panel was pleased to see how the funding is being used and how the PIs found connections as previously requested.

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments.

PAC Comments – FY18**Date: September 2017**

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|-------------|--------------------|-----------------|
| Do Not Fund | Do Not Fund | Do Not Fund | Do Not Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|-------------|--------------------|-----------------|
| May 2016 | Do Not Fund | Do Not Fund | N/A | N/A | N/A |
| Sept 2016 | Do Not Fund | Do Not Fund | Do Not Fund | Do Not Fund | Fund |

Science Panel Comments – FY17**Date: September 2016**

The Science Panel appreciated the PI's responses to our comments. The proposal is fundamentally sound. However, our primary concern was not addressed. The proposed research is beyond the core area of interest, and it remains unclear how the study would significantly advance the core mission of EVOSTC and justify a second cycle of \$800,000 in funding.

As noted in a follow-up Panel discussion with the Program Team Leads, the results from the original research proposal in Cook Inlet and Kachemak Bay provided data that may be useful to those interested in this project's study area, and, for example, the proposal may serve those with an interest in harmful algal blooms, bivalve mariculture, invasive species and to EVOSTC PIs currently sampling in PWS but who would be pleased to expand activities to the project area. However, the proposal did not demonstrate actual use of these data by other projects in either the Long-Term Monitoring Program or the Herring Program and it still remains to be seen just how relevant these data will be to EVOSTC.

Date: May 2016

The Panel does not recommend funding this project. The investigators propose to modify sampling conducted in 2012-2016 to profile oceanographic variables (water temperature, salinity, nutrients) and plankton from ship and shore in lower Cook Inlet and Kachemak Bay in response to the anomalously warm waters in 2014-2015. The warm-water event was concurrent with harmful algal blooms with consequences for shellfish, otters and murre, much like elsewhere along the West Coast. Higher frequency sampling (monthly, quarterly) on the eastern side of the study area together with semiannual (spring, fall) sampling across the entrance to Cook Inlet would better resolve the exchange of water masses and nutrients between the Gulf of Alaska and a hotspot for primary production and foraging by fishes, seabirds and marine mammals near lower Cook Inlet and outer in Kachemak Bay in response to changing oceanographic forcing. To compensate for this increased effort, sampling at locations on the northern side of Cook Inlet is proposed to be reduced.

The Panel does not feel that the proposed research is a priority, given the cost and the relative lack of connection to the larger program. Answers to the proposed hypotheses are largely self-evident as stated and seemingly could be tested with data already in hand. A more compelling justification for the proposed research would have been helpful. For instance, hypothesis 1 that lower Cook Inlet is mostly synchronous with PWS suggests that continued oceanographic measurements in Cook Inlet may be redundant. It is not clear that extending a modified version of the previous five years of research via monitoring would significantly advance our understanding of productivity and links to nearshore species, seabirds and marine mammals in the study area, especially given the expense of the project. The proposal also would have benefitted from a robust statement of how the expected outcomes of the proposed research would be integrated with those from the rest of the program. The methods appear to be appropriate; though including a fluorometer with the CTDs to profile chlorophyll fluorescence throughout the water column would have been beneficial.

Science Coordinator Comments – FY17**Date: September 2016**

I concur with the Science Panel's comments. The project offers sound science and is managed by an experienced team but the applicability of the data toward addressing the LTM Program's hypotheses appears weak at best after the first five years of funding.

Date: May 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel and Science Coordinator's comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-L

Project Title: LTM Program – Seward Line Monitoring

Primary Investigator(s): Russell Hopcroft

PI Affiliation: UAF

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$697,900

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|-----------|-----------|
| Auth: \$132,700 | Auth: \$136,100 | Auth: \$139,500 | \$143,000 | \$146,600 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$7,180,300

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-------------|-------------|-------------|-------------|-------------|
| \$1,424,000 | \$1,438,000 | \$1,411,800 | \$1,466,000 | \$1,450,500 |

Total Past EVOSTC Funding Authorized (FY12-19): \$878,500

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,168,100

Total Non-EVOSTC Funding (FY12-21): \$7,780,300

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

Long times-series are required for scientists to tease out pattern and causation in the presence of substantial year-to-year variability. For the 5-year period beginning in 2017, we are continuing multi-disciplinary oceanographic observations begun in fall 1997 in the northern Gulf of Alaska. Cruises occur in early May and early September to capture the typical spring bloom and summer conditions, respectively, along a 150-mile cross shelf transect to the south of Seward, Alaska. The line is augmented by stations in the entrances and deep passages of Prince William Sound. We determine the physical-chemical structure, the distribution and abundance of phytoplankton, microzooplankton, and mesozooplankton, and survey seabirds and marine mammals. These observations enable descriptions of the seasonal and inter-annual variations of this ecosystem. Our goal is to characterize and understand how different climatic conditions influence the biological conditions across these domains within each year, and what may be anticipated under future climate scenarios. We are not proposing any major changes to this project for FY20. Beginning in 2018, funding as one of the National Science Foundation's Long-term Ecological Research sites is allowing expanded sampling on the shelf upstream of Prince William Sound, including near Middleton Island, to help better understand spatial variability on the shelf. Preliminary results for 2019 indicate that after a return to average upper 100m water temperatures during May 2017 and 2018, temperatures during 2019 were again above average (0.64°C). Likewise, warm water associated zooplankton with smaller body size and lower lipid content that had declined, appear to have increased again.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel is pleased regarding the publications resulting from this project. In the FY19 work plan, we asked how the Long-Term Ecological Research (LTER) program is integrated with the GAK1, Seward line and nearshore monitoring, specifically activities and monitoring. We would like more clarification and details on what parts of this project are being funded by the LTER vs. EVOSTC.

PI Response (9.27.19)

We agree it can be confusing to track who is contributing to the various parts of the oceanographic surveys being conducted in the northern Gulf of Alaska. EVOSTC funds the Seward Line transect in addition to transects in Prince William Sound (PWS) during spring and fall cruises. The National Science Foundation funds the Northern Gulf of Alaska Long-term Ecological Research (LTER) program, which leverages EVOSTC spring and fall funding for the Seward Line and directly funds three additional transects upstream and downstream of the Seward Line, thereby greatly expanding the spatial coverage of oceanographic sampling (and seabird/marine mammal surveys - see 20120114-M). NSF LTER also fully funds the summer survey of all four sampling lines plus PWS (see Table 1).

Table 1. Funding sources for Northern Gulf of Alaska survey transects by spring, summer, and fall seasons.

| | EVOSTC | NSF LTER | NPRB | AOOS |
|--|---------------|-----------------|-------------|-------------|
| Spring Surveys | | | | |
| Seward Line & PWS | X | | | |
| Cape Suckling, Copper River/Middleton Island, and Kodiak Island/Albatross Bank Lines | | X | | |
| Summer Surveys | | | | |
| Seward Line & PWS | | X | | |
| Cape Suckling, Copper River/Middleton Island, and Kodiak Island/Albatross Bank Lines | | X | | |
| Fall Surveys | | | | |
| Seward Line & PWS | X | | | |
| Cape Suckling, Copper River/Middleton Island, and Kodiak Island/Albatross Bank Lines | | X | | |
| Ship time | X | X | X | X |
| Zooplankton processing | X | X | X | X |
| Logistics (travel, shipping, dock fees, etc.) | X | X | X | X |

The Seward line program has always been based on consortium funding (even during the joint NSF and NOAA GLOBEC years) and the LTER addition adds to the significant foundation that Gulf Watch Alaska (with EVOSTC/North Pacific Research Board [NPRB]/Alaska Ocean Observing System [AOOS]) have built. The sum of the parts is much greater than what one would be able to accomplish if Gulf Watch Alaska and LTER were run by two different groups on two different sets of cruises. For example, Gulf Watch Alaska and LTER both benefit greatly from shared vessel time (e.g., mobilization, demobilization, and transits). EVOSTC also benefits from LTER with the addition of ship time in PWS during summer (\$50K/day). LTER brings a lot of funding for students so that data collected under Gulf Watch Alaska will find even more applications than would have been possible without the LTER expansion.

Science Director Comments – FY20

Date: September 2019

The PIs continue to be highly productive, with one accepted manuscript and four additional manuscripts in review this past year. As mentioned in the proposal, funding as one of the NSF's Long-Term Ecological Research sites starting in 2018 has allowed for expanded sampling on the shelf upstream of PWS, including Middleton Island, to help better understand spatial variability on the shelf. These long-term time series data are used by management agencies such as ADFG for salmon forecasting and NOAA for their GOA Ecosystem Status reports. No specific comments or questions.

PI Response (9.27.19)

We appreciate these comments and are encouraged by our expanded efforts and the key oceanographic information we can provide to agencies.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

Science Panel is interested in understanding better how the LTER program is integrated with the GAK1, Seward line and nearshore monitoring, specifically activities and monitoring.

PI Response (10/10/18)

The Northern Gulf of Alaska (NGA) LTER program provides a massive leveraged expansion of the GAK1 (19120114-I) and Seward Line programs (19120114-L), by adding additional monitoring transects, times of year, measurement types (and resolutions), process studies, ecological modeling efforts, and educational activities that each extend the reach of both the GAK1 and Seward Line time-series. Put another way, the NGA LTER adds (both logistically and financially) to the GWA program rather than replaces or duplicates its activities. Please see the nearshore ecosystems project (19120114-H, Coletti et al.) for comprehensive response regarding integration between the Environmental Drivers component, the LTER, and the Nearshore component.

The LTER expands spatial coverage, with transect measurements near Kodiak, Middleton Island, the Copper River, and Kayak Island. In this regard, the LTER greatly improves connectivity between the recently added GWA seabird diet studies at Middleton Island associated with the forage fish project (19120114-C, Arimitsu and Piatt) and the Environmental Drivers Component. The LTER provides increased temporal coverage with the addition of cruises each July. New process studies complement

the monitoring of the GWA program by examining ecosystem dynamics to provide deeper mechanistic understandings of the controls that impact the ecosystem at all of the Seward Line stations, including GAK1. New measurements include carbon export, iron concentration and limitation, plankton growth (both primary and secondary), and the role of the Copper River plume in stimulating production. Modeling will help us better understand ecological consequences of events such as the recent marine heatwave and the manner in which the runoff, iron, and the shelf carbon cycles impact the shelf ecosystem. Additional expansions from collaborative efforts also include assessments of the macro-jellyfish (funded by the Pollock Conservation Cooperative Research Center), larval fish (to be analyzed by NOAA), and various physiological measurements (funded by the North Pacific Research Board and the National Science Foundation [NSF]).

Additionally, the LTER program is providing ship time in support of the new mooring that will be deployed on the mid/outer shelf near Seward Line station GAK7. A modest amount (9%) of this mooring's new equipment was leveraged with LTER and GAK1 project funds; the bulk of the new equipment comes from the MJ Murdock Charitable Trust (50%) along with the Alaska Ocean Observing System (28%) and University of Alaska Fairbanks (UAF) (13%). This mooring will provide year-round core physical, chemical, and biological monitoring that will immediately open doors to extending and comparative analyses with data from the Seward Line, GAK1, and the GWA mooring in PWS (project 19120114-G) maintained by the PWS Science Center. LTER is also facilitating measurements at much higher resolution than have been possible under GWA. Use of R/V Sikuliaq on one cruise per year allows us to integrate undulating towed CTD measurements, 5-frequency fisheries acoustics, water column velocity profile measurements, and many other novel underway data collections such as surface nitrate and surface heat fluxes that have not been possible in the past. For example, we now are using a nitrate sensor to collect full-resolution macronutrient profiles from the CTD in real-time.

The LTER program maintains a significant outreach component as part of its activities, and in the NGA project we have teamed up with NOAA's Teacher at Sea program. We also will have several undergraduate NSF internships to award each summer and will directly fund multiple UAF graduate students who will work with both GAK1 and Seward Line data to increase our publication output.

We note that Figure 5 in 19120114-G Campbell and Figure 2 in this proposal tell conflicting stories. The Panel would like the PIs to consider why this may be and see this reconciled. The Science Panel is curious to know what the PI's thoughts are regarding the change in 2016-17 zooplankton species (warm vs. cold) and if this observed change is related to herring declines over the same period.

PI Response (10/10/18)

The Environmental Drivers PIs have been pondering differences between the GOA shelf and PWS since the inception of the program. On the shelf, we think these species are constantly seeded into the branch of the North Pacific current that flows northward as the Alaska Stream, with warmer waters favoring longer survival and potentially even their reproduction. These species are then mixed across the shelf and into the Alaska Coastal Current by winds and other processes during their northward transport. As noted in Campbell's response (19120114-G, PWS oceanography) to this question, we can only conclude that these warm-water taxa have taken a better foothold in PWS than on the shelf proper, possibly due to lags in warming and cooling in PWS. There are, however, other possible explanations that we are exploring. For example, Campbell's sampling is confined to the upper 50 m (compared to 100 m for the Seward Line project) and occurs in bays rather than the deeper passages of PWS; both factors possibly favoring higher catches of these species. Furthermore, most cold water GOA species move downward

into deeper waters during winter, and this then leaves these southern species (that don't move downward) as the prominent community members in surface waters during winter. More fully examining these differences between projects is planned as one of the synthesis activities during the current 5-year funding cycle.

While it is true that these warm-water taxa are less energetic than many resident species, even the resident taxa appeared to be atypically lipid-poor during the warm years, so it is hard to know which was of greater influence in potentially affecting herring populations.

Science Coordinator Comments – FY19

Date: September 2018

Milestones and tasks have been completed as planned. PI continues to be productive: one paper is accepted and another published in FY18. This project, along with the GAK1 monitoring, is an important long-term data collection project. I look forward to seeing results from sampling around Middleton Island and the integration with the predator-prey project.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

This is an important long-term data collection project that needs to continue. The Panel is enthusiastic about the incorporation of an LTER site to expand the scope of this project. The Panel is pleased to see that sampling will occur around Middleton Island, and that there will be integration with the predator-prey project.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17**Date: September 2016**

The Science Panel appreciates transfer of funds among projects to support additional sampling relevant to the spill area.

Date: May 2016

The Science Panel notes that this transect of moorings has value as professed in the proposal for purposes of assessing long-term environmental forcing of the base of the pelagic food chains.

Science Coordinator Comments – FY17**Date: May and September 2016**

I concur with the Science Panel's comments.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-M

Project Title: LTM Program – PWS Marine Bird Population Trends

Primary Investigator(s): Kathy Kuletz, Robb Kaler

PI Affiliation: USFWS

Project Manager: USFWS

EVOSTC Funding Requested FY17-21: \$570,600

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------------|-----------------|----------------|------------|-----------|
| Auth: \$24,900 | Auth: \$222,200 | Auth: \$24,900 | \$248,000* | \$50,700* |

*Requests include 9% GA. *Includes additional annual requests of \$25.8K to extend at-sea seabird surveys to project 20120114-L.*

Funding From Non-EVOSTC Sources FY17-21: \$336,700

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------|----------|----------|------------|------------|
| \$23,000 | \$56,000 | \$23,000 | \$134,300* | \$100,400* |

Total Past EVOSTC Funding Authorized (FY12-19): \$953,700

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,252,300

Total Non-EVOSTC Funding (FY12-21): \$548,700

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

We will conduct small boat surveys to monitor the abundance of marine birds in Prince William Sound (PWS), Alaska. The surveys are conducted every two years and therefore occur during July 2018 and 2020 during the current Gulf Watch Alaska (GWA) funding cycle (FY17-21). Fifteen July surveys over a 30-year period have monitored population trends of marine birds in PWS after the *Exxon Valdez* oil spill. These surveys are the primary means to determine whether populations injured by the spill are recovering. Data collected from 1989 to 2018 indicated that pigeon guillemots (*Cephus columba*), marbled murrelets (*Brachyramphus marmoratus*), and Kittlitz's murrelets (*B. brevirostris*) are exhibiting long-term declines in PWS. Black-legged kittiwake (*Rissa tridactyla*) densities have also declined in PWS, at the same time that nearly complete kittiwake breeding failures were observed (2016-2018). We will continue to examine overall population trends for all marine birds in PWS, which benefit the nearshore and forage fish components of GWA, the Herring Research and Monitoring program, and the pigeon guillemot restoration project (project 20100853, PI Kuletz/Kaler/Irons) at the Naked Island Group. We are requesting additional funds in FY20 and FY21 to continue offshore seabird surveys on the Seward Line (project 20120114-L, PI Hopcroft) that are now a part of the Northern Gulf of Alaska Long-Term Ecological Research (LTER) project. Leveraged funding previously acquired is insufficient to support the extended sampling of the LTER. These surveys continue a 20-year time series on the Seward Line and link shifts in seabird abundance and cross-shelf distribution to annual and long-term patterns observed in the inshore waters of PWS.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund Reduced | Fund Reduced | Not Reviewed | Fund Reduced | Fund Reduced |

Science Panel Comments – FY20

Date: September 2019

The Science Panel raised some questions about the additional funding request, which is mainly a result of obtaining LTER funding that now requires longer trips (and an additional July sampling date) that were not judged by the PIs to be needed for this proposal until now. The Panel notes July data could be valuable, but the original proposal was funded for the spring and fall surveys, which were decided on as the most important times of the year for these projects. If additional days of funding were obtained, to allow for the extended duration of fall and spring surveys, it is not clear what the seabird observer would be doing during those additional days or whether critical data being gathered.

PI Response (9.27.19)

We appreciate the careful review of our request for funds to support a marine bird and mammal observer on recently expanded oceanographic surveys in and around the spill affected area. Supporting additional survey days allows the seabird observer to continue collecting data following standardized protocols over a larger geographic area. This is significant when you consider the huge extent of the northern Gulf of Alaska and continental shelf, a spatially data poor region. Consideration of funding spring and fall surveys is appreciated and will ensure that we maintain the spring and fall Seward Line time series while also conducting seabird observations as part of the newly established National Science Foundation funded Northern Gulf of Alaska Long-term Ecological Research (LTER) survey lines from Cape Suckling to Kodiak Island.

Foregoing the July surveys would save \$10.3 K, or 44% of the requested \$23.3K per year. However, we believe this small amount of annual funding would provide a large benefit to understanding seabird ecology in the Gulf of Alaska. The July surveys (oceanographic and zooplankton), though a recent addition to the Gulf of Alaska offshore studies, will continue into the foreseeable future as a long-term monitoring component of Gulf Watch Alaska, with strong links to other Gulf Watch Alaska, LTER, and EVOSTC projects. The seabird component would be a missing aspect of the mid-summer LTER program. An important part of conducting the July LTER surveys is that the time period overlaps with and thus complements EVOSTC, LTER, and other projects, including:

- The July survey captures an important part of the seabird's life cycle, being the summer breeding period. It thus occurs in conjunction with seabird productivity monitoring at selected Gulf of Alaska colonies by the Alaska Maritime National Wildlife Refuge and others.*
- July surveys would correspond to Prince William Sound (PWS) marine bird surveys (US Fish and Wildlife Service/Migratory Bird Management, EVOSTC funded); ongoing surveys in the Lower Cook Inlet (US Geological Survey, Bureau of Ocean Energy Management funded); Kenai Fjords (National Park Service and EVOSTC funded project 19120114-H); and Middleton Island seabird productivity and diet studies (EVOSTC funded project 19120114-C).*
- Without the July component, the offshore data misses an important seasonal component to better understand the northern Gulf of Alaska marine ecosystem, particularly as it relates to the period of highest marine productivity.*

In addition, the Panel is still very concerned about the every other year sampling (see FY19 Work Plan comments). While we appreciate the financial constraints explained by the PIs in their previous responses, we wondered whether the LTER surveys are conducted every year and whether there would be an opportunity for the project to reallocate funds to put a bird observer on those cruises to obtain some data annually.

PI Response (9.27.19)

We are a bit unclear about the every other year sampling comment. Comments referenced in the FY19 work plan state there were no “project specific comments” for this project. We are assuming the science panel is referring to comments made in the FY18 work plan. Our response to the FY18 comments are briefly summarized here.

- We agree with the science panel that, ideally, we would improve trends analysis by adding surveys to include even numbered years to our current ‘odd year’ July surveys.*
- Budgetary constraints make such an effort impractical (a rough estimate for an even year survey is \$180K per year).*
- Even selecting a much reduced number of transects to survey during even years (by ‘subset of sites’ we presume the panel is referring to transects), the cost of gearing up and operating a survey in PWS is not substantially reduced by reducing the number of transects.*
- We have some indication of what a reduced level of effort can provide, based on an analysis conducted for US Fish and Wildlife Service by WEST, Inc. (Nielson et al. 2003). In brief, although the effect varied among species, on average, the coefficient of variation (CV) would not decrease substantially at 80% of our current effort, but increased substantially after that, which would greatly reduce our ability to detect population trends of < 50%. However, for many species with low CVs at 100% of the original sample size (i.e., CV around 0.2 or less), the CV almost doubles when the sampling effort is reduced to 30%; this would particularly affect power to detect trends for rare species and species of concern, such as Kittlitz’s murrelet.*
- If additional funds were added to this project to cover a reduced survey during even years, we would first want to conduct an analysis to determine what level of effort would be statistically robust, and how those transects or regions (sites) should be selected.*

Again, we are willing to investigate the concept of an even year survey, but we would like to hear recommendations from the science panel given the options discussed (e.g., full survey or reduced survey after power analysis with a defined sampling area).

The Seward Line and LTER surveys do include transects within PWS and because the LTER surveys occur every year a July survey could help compensate for, but not replace, the lack of data on summer seabird abundance in PWS during ‘off years’ of the PWS surveys. July Seward Line and LTER surveys can provide information on trends in seabird abundance but cannot replicate the experimental design of current PWS marine bird surveys to determine population abundance in oiled vs. unoiled areas of PWS. If support for a seabird observer on the July LTER cruises is not approved, it would not be feasible to reallocate funding from other parts of the project without compromising the continuation of the spring and fall Seward Line time series, or of the PWS marine bird surveys.

We would also like to add that we have attempted to obtain funds to support seabird surveys in conjunction with the LTER. While we have received temporary supplements, the support was not long-term, other than the original Seward Line spring and summer surveys, which are currently supported by the North Pacific Research Board.

Nielson, R., S. Howlin, L. McDonald. 2003. "Bootstrapping to investigate effects of sample size on variance and bias of estimated species totals for Prince William Sound Marine Bird Surveys". Report by WEST, Inc. to U.S. Fish and Wildlife Service, Anchorage, Alaska, April 28, 2003.

The Panel would like to know what the cost would be for only extending the spring and fall surveys. We recommend a fund for this project contingent on the removal of the new July survey on the LTER cruise from the FY20 proposal and budget.

Science Coordinator Notes: Additional funding request without the new July surveys including GA is \$14.5K, revised total for this project including GA is \$233,400.

Science Director Comments – FY20

Date: September 2019

Currently, this project provides data for assessing whether seabird populations injured by the spill are recovering in PWS. Project goals are being met on time. This project collaborates with the nearshore and forage fish components of the program, the Herring Research and Monitoring program and the pigeon guillemot restoration project (20110853). Alaska Maritime National Wildlife Refuge (USFWS) also includes these data in their annual report on the status and trends of seabirds in Alaska.

The USFWS PIs also have been conducting seabird surveys twice a year (spring and fall) as part of the Seward Line project (20120114-L) starting in 2006. Starting in 2018, the Seward Line survey expanded via an NSF Long-Term Ecological Research (LTER) which added significantly more days at sea (8 extra days during spring and fall surveys, 18 days for new July survey). Because the Seward Line is now part of the LTER surveys, it is not possible to conduct only the Seward Line portion of the cruises. The extended surveys in 2018 and 2019 were funded by the North Pacific Research Board, with contributions from NFS and NOAA. However, these leveraged funds are insufficient to continue the extended Seward Line/LTER seabird surveys starting in FY20. Information from this effort provides data on the seasonal and interannual variability of seabird distribution in the northern GOA along strong cross-shelf and alongshore environmental gradients and integrates with and informs other GWA components. Observers also document marine mammal activity that is important to protected resources managers. This project is requesting an additional \$25.8K annually (includes GA) for FY20 and FY21 to continue support for a seabird observer on the annual Seward line/LTER surveys and an additional July survey. I concur with the Science Panel's comments.

PI Response (9.27.19)

We thank the Science Coordinator for a summary of the justification for requesting additional funds and description of the heavily leveraged aspect of this opportunity.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19**Date: September 2018**

We have no project specific comments.

Science Coordinator Comments – FY19**Date: September 2018**

Gratified that marine bird datasets will be integrated across the rest of the GWA program. Project is on track. No other project specific comments.

PAC Comments – FY19**Date: September 2018**

No project specific comments.

Executive Director Comments – FY19**Date: September 2018**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

The Panel is pleased with the work the PIs are conducting and impressed with the survey coverage. Would it be worth surveying a subset of sites to monitor annually?

PI Response (10/11/2017):

We agree with the Science Panel that, ideally, we would improve trends analysis by adding surveys to include even numbered years to our current ‘odd year’ July surveys. However, budgetary constraints make such an effort impractical. The additional time and costs would include boat preparation and post-survey maintenance, hiring extra personnel or covering salary of in-house personnel, lodging, per diem, fuel, and additional data control and analyses. Even selecting a much reduced number of transects to survey during even years (by ‘subset of sites’ we presume the panel is referring to transects), the cost of gearing up and operating a survey in Prince William Sound (PWS) is not substantially reduced by reducing the number of transects. A rough estimate of surveys during even years would be \$150-180K per year, in addition to the current \$222K per odd year under the current work plan.

If additional funds were added to this project to cover a reduced survey during even years, we would first want to conduct an analysis to determine what level of effort would be statistically robust, and how those transects or regions (sites) should be selected. Such an analysis could be useful for future

planning but would require additional funds for a contract or to cover time for the U.S. Fish and Wildlife Service (USFWS) biometrician.

We have some indication of what a reduced level of effort can provide, based on an analysis conducted for USFWS by WEST, Inc. in 2003 (Nielson et al. 2003). In brief, although the effect varied among species, the conclusion was that, on average, the coefficient of variation (CV) would not decrease substantially at 80% of our current effort, but increased substantially after that, which would greatly reduce our ability to detect population trends of < 50%. The report states: "However, for many species with low CVs at 100% of the original sample size (i.e., CV around 0.2 or less), the CV almost doubles when the sampling effort is reduced to 30%." We add that for species of conservation concern, typically with low or variable numbers, an unusually low or high abundance estimate in any given year will result in much reduced probability of detecting change in the population over time. The report also notes, however, that "... a systematic sample of blocks across habitats will likely provide more precise estimates of species abundance than the stratified random sample." With additional years of data since 2003, analysis of sampling effort by habitats may help with design of a reduced effort during even years. Alternative to reduced surveying during even years, additional funds for the PWS marine bird surveys could be directed towards 'winter' (March) surveys. The March survey had fewer transects than July surveys, but has not been funded since 2010. The species composition of PWS changes substantially between July and March, with nine species or species groups primarily represented only in March (see Table 1 of the WEST, Inc. report); these were waterfowl, seaducks, and grebes. March surveys would provide population estimates and trends for all species during this critical season.

Literature Cited:

Nielson, R., S. Howlin, L. McDonald. 2003. "Bootstrapping to investigate effects of sample size on variance and bias of estimated species totals for Prince William Sound Marine Bird Surveys". Report by WEST, Inc. to U.S. Fish and Wildlife Service, Anchorage, Alaska, April 28, 2003.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-------------|----------------------|----------------------------|------------|---------------------------|------------------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

The Panel has no project specific comments.

Date: May 2016

There are no project specific comments.

Science Coordinator Comments – FY17

Date: May and September 2016

I have no project specific comments.

Executive Director Comments – FY17

Date: September 2016

I have no project specific comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-N

Project Title: LTM Program – Long-term killer whale monitoring

Primary Investigator(s): Craig Matkin

PI Affiliation: North Gulf Oceanic **Project Manager:** NOAA

EVOSTC Funding Requested FY17-21: \$726,100

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|-----------|-----------|
| Auth: \$152,800 | Auth: \$151,300 | Auth: \$142,100 | \$140,300 | \$139,500 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY17-21: \$125,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|----------|----------|----------|----------|----------|
| \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 |

Total Past EVOSTC Funding Authorized (FY12-19): \$982,300

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,262,100

Total Non-EVOSTC Funding (FY12-21): \$242,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

This project is a continuation of the long-term photo-identification based program that has continuously monitored killer whale populations in Prince William Sound since 1984. A primary focus has been on resident killer whales and the recovery of AB pod and the threatened AT1 population of transient killer whales. These two groups of whales suffered serious losses at the time of the oil spill and have not recovered at projected rates. Assessment of population dynamics, feeding ecology, movements, range, and contaminant levels for all major pods in the area will help determine their vulnerability to future perturbations and environmental change, including oil spills. In addition to population dynamics from annual photo-identification, this project uses other techniques to determine the health and trends of the population. These techniques have included biopsy/skin sampling to compare genetics between populations, occasional biopsy/blubber to investigate contaminants, prey sampling of flesh, fish scales, and whale scat to investigate diet, behavioral observation, and remote acoustic monitoring to determine important off-season habitat. During FY18 and FY19 remote recording hydrophones have been recovered and redeployed in Montague Strait, Hinchinbrook Entrance, and Kenai Fjords. Initial investigation of this raw acoustic data suggests that strong fall activity in Montague Strait still occurs, but in 2016-18 it was 2-3 weeks later than in past years. To the extent possible we are adjusting the field effort dates to improve late summer/fall encounter rates. Between our surveys and contributed photos, we were able to confirm that all seven of the remaining Threatened AT1 transient population have survived to 2019. AB pod has not yet been photographed in 2019. We are not proposing any major changes to this project for FY20.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20**Date: September 2019**

The Science Panel appreciates the work that comes out of this project and is pleased to see the involvement of a graduate student in this project. The Panel has no specific comments or questions.

PI Response (9.27.19)

Thank you for your comments. We appreciate the positive feedback.

Science Director Comments – FY20**Date: September 2019**

Project tasks and goals are being completed on time. A manuscript reporting killer whale feeding habits from chemical analyses is in prep. I appreciate the preliminary results reported for FY19, the addition of a grad student who will analyze the acoustic data, and the in-kind support for sample analysis. No specific comments or questions.

PI Response (9.27.19)

Thank you for your comments. We appreciate the positive feedback.

PAC Comments – FY20**Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20**Date: October 2019**

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19**Date: September 2018**

We agree with the Science Coordinator that the diet analysis and understanding killer whale feeding ecology is important. It behooves the PI to locate another lab to process the biopsy samples and continue the work. We would like to know if the PI has any publications planned for the future.

PI Response (10/10/18)

Thanks for your comments regarding our long-term killer whale monitoring project and for giving me a chance to respond. I agree with the importance of a paper summarizing the results of the stable isotope and contaminant work as it relates to killer whale diet. We have obtained the commitment of another

chemist at the Northwest Fisheries Science Center (NWFSC) who will completely reconstruct the statistical analysis (this is needed because the original chemist retired and is unreachable). Hopefully, this paper will be completed this winter.

In regard to continuing the blubber chemistry segment of the study there are a number of reasons that we have elected not to continue it, at least not on an annual basis. To summarize:

- 1. The NWFSC was supporting 90% of the costs outside of the fieldwork and has had their staff and budget seriously reduced in recent years. They can no longer support the chemist required to do the analytical, statistical, and interpretive work. Additional funds would be required to contract with another lab and chemist to take responsibility for this type of work.*
- 2. We have attempted to eliminate the invasive aspects of our study that requires piercing of the whales' bodies. This was stimulated in part by the death of a southern resident killer whale (SRKW) that was clearly attributed to the infection resulting from the wound associated with tagging. Hence, within our project, and for killer whale research in the North Pacific, there is restructured emphasis on remote acoustic monitoring and collection of prey and scat material.*
- 3. We have added a non-invasive, genetics-based scat study to examine feeding habits in more detail. This will be used in conjunction with the prey sampling program already in place to continue what we believe is a more robust and detailed examination of killer whale feeding ecology. This component of the project is possible due to the concurrent work being completed on the endangered SRKW population and the NWFSC desire to compare those results with our study. We could not fund this work independently within our budget. The geneticist, Dr. Kim Parsons, who is working with us on the project, provides the following response: "Molecular genetic prey identification from marine mammal feces has proved valuable for a number of species of interest. For southern resident killer whales, fecal genetic analyses have allowed us to generate data from a large ($n > 400$) number of fecal samples collected over multiple seasons and years. This sampling approach generates relative proportions of prey species detected in each fecal sample representing samples from across individuals, geographic regions and time periods. From these data, we have been able to genetically assign each fecal sample to individual whales and characterize the diet of the SRKW population across both seasons and geographic regions, detecting both common and rare, but potentially important, prey species. In addition, we are currently optimizing existing salmon genetic stock identification methods for future application to fecal samples, allowing us to assign salmon detected in killer whale feces to individual stocks. The unique ability to hone in on stocks of importance to endangered marine predators provides critical information supporting their conservation and management".*
- 4. Chemical analysis of killer whale blubber certainly has value and contaminant trends as well as stable isotope values have been instructive. We could discuss a program of sampling at 3-5 year intervals to keep the trend data alive. There would need to be concurrent discussions in regard methods of funding this, particularly the lab work, interpretation, and analysis.*

Our group sincerely thanks you for your consistent and unflagging support over the years, which has been the backbone for compiling a unique long-term database on killer whales in PWS/Kenai Fjords.

Science Coordinator Comments – FY19

Date: September 2018

Project tasks are being completed as planned. The PI's efforts to secure other funding sources is noted and appreciated. From the FY12-16 Final Report, it is apparent that biopsy sampling provided

important results regarding contaminants and stable isotope analyses (i.e., probable changes in diet, contaminant levels supports this change in diet). However, the PI is deemphasizing the collection of biopsy samples for examination of feeding habits due in part to the retirement of the chemist at NOAA Northwest Region who led the project. The biopsy sampling and data are one of the more intriguing aspects of this work at this stage.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel applauds the work being conducted by the PI demonstrating the impact of oil on killer whales depends on whether the group of whales is transient or resident. These results help refine the restoration goal of this species, which might otherwise not capture the genetic differences between pods. These differences suggest unanswered questions about their social activities, which will be further addressed by the PI. The Panel appreciates that the PI does an excellent job regarding outreach.

Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments.

PAC Comments – FY18

Date: September 2017

There are no project specific comments.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17**Date: May and September 2016**

There are no project specific comments.

Science Coordinator Comments – FY17**Date: May and September 2016**

I have no project specific comments.

Executive Director Comments – FY17**Date: September 2016**

I have no project specific comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20120114-O

Project Title: LTM Program – Long-term monitoring of humpback whale predation on Pacific herring in Prince William Sound

Primary Investigator(s): John Moran and Jan Straley

PI Affiliation: NOAA and UAS

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$865,700

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|------------------|------------|------------|
| Auth: \$161,900 | Auth: \$155,000 | Auth: \$187,400* | \$184,400* | \$177,000* |

Requests include 9% GA.

** Totals in FY19-21 include additional annual requests of \$27,000 (+ 9% GA) that will be used to conduct an early spring survey (March). Funding for this survey was previously funded by NOAA.*

Funding From Non-EVOSTC Sources FY17-21: \$814,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|-----------|-----------|-----------|
| \$220,000 | \$220,000 | \$120,000 | \$127,000 | \$127,000 |

Total Past EVOSTC Funding Authorized (FY12-19): \$1,096,200

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$1,457,600

Total Non-EVOSTC Funding (FY12-21): \$1,150,700

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

The humpback whale monitoring project is part of the Gulf Watch Alaska pelagic component's integrated predator-prey survey. Humpback whale predation has been identified as a significant source of mortality on over-wintering Pacific herring in Prince William Sound (PWS) and a likely top-down force constraining their recovery. Humpback whales in PWS have a higher percentage of herring in their diet and forage longer on herring during non-summer months than their counterparts in Southeast Alaska. Currently, North Pacific humpback whales in the Gulf of Alaska may be experiencing nutritional stress and increased use of inland waters like PWS could result in increased predation on herring. We will continue to evaluate the impact by humpback whales foraging on Pacific herring populations in PWS following protocols established during 2007/08 and 2008/09 (EVOSTC project PJ090804). Prey selection by humpback whales is determined through acoustic surveys, visual observation, scat analysis, and prey sampling. Chemical analyses of skin and blubber biopsy samples provide a longer-term perspective on shifts in prey type (trophic level from stable isotopes) and quality (energy content). These data are combined in an updated bioenergetic model that allows us to assess the impact of recovering humpback whale populations on the PWS ecosystem. By integrating with the forage fish and fall/winter marine bird components, we

contribute to a comprehensive understanding of bottom-up influences and top-down controls on the PWS herring population. We are not proposing changes to this project for FY20.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Panel would like the PIs to discuss: if there's a decrease in predation of herring in humpback whales, what age-class of herring would that affect and when would one expect to see a response in the herring population? These questions should be addressed and interpreted, not just in these comments but in future proposals and reports. We emphasize the inclusion of interpretation and discussion of data (not necessarily analyses), in the proposal.

PI Response (9.27.19)

This is an interesting question and knowledge of the biology of herring and whales is needed to fully address this question. Adult herring have a higher energy density than juveniles and form large, dense shoals during spawning and overwintering. Adult herring have been the preferred prey for humpback whales in Prince William Sound (PWS). Humpback whales follow overwintering herring into PWS in September through Montague Strait and then to Port Gravina through the winter and spring when spawning occurs. We have found ~200 whales feeding on large schools of herring in the early study years (2007-2014) and have more than 400 individual whales in our catalog. We have documented all age classes of herring being consumed by whales. The 2017-18 decrease in herring predation by whales parallels the dramatic decline of herring in PWS (Fig. 1 below).

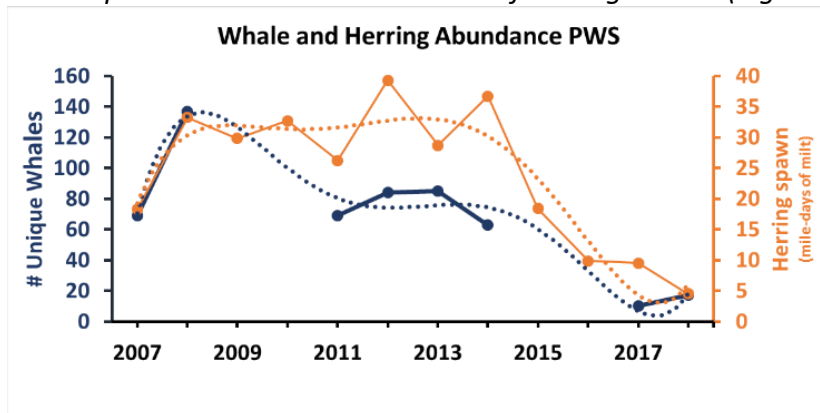


Figure 1 (Fig. 7 in our 2018 annual report). In PWS the humpback whale decline parallels the herring decline, their major food source. Miles-day herring spawn is used as an annual indicator for change in herring abundance. The trajectory could indicate a carrying capacity with a plateau, then steep decline (with a bit of a lag) during the marine heatwave (that never fully dissipated in the Gulf of Alaska, and re-intensified in 2018).

Humpback whales in PWS rely on adult herring as their primary prey in the fall and winter. With herring biomass at record lows in 2017-2018 far fewer whales (less than 20) were present in the same areas where up to ~200 whales had been documented feeding each year on herring during 2007-2014. However, when adult herring are scarce, we see a switch to age zero, one, and two year old herring. Younger herring form small, disperse schools which require increased foraging cost for the whales

resulting in a lower energetic return. Whales increased their predation on juvenile herring beginning in 2015.

There has been insufficient recruitment of herring to determine what age structure would be most impacted by whale predation. The Gulf Watch Alaska integrated predator-prey surveys and the Herring Research and Monitoring program will discuss the possibility of determining answers to some of these questions. In the future, further discussion and the inclusion of interpretation of data will be addressed in proposals.

In Figure 1 of the proposal regarding the index on whale abundance: has there been a shift in whale distribution in recent years? It is important to try to distinguish changes in abundance with changes in distribution to the extent possible. The high variability in whale counts between sampling periods cannot be explained by whale population dynamics alone. There appears to be a seasonal signal in the counts, although this may not be a fixed effect. We would like to see mark and recapture methods applied to generate population estimates with confidence intervals, such as those used in Teerlink et al. (2015) to assess population estimates.

PI Response (9.27.19)

There has not been a shift in distribution within PWS, but an actual decline in numbers of whales sighted. Our effort and track lines have been consistent and cover most of the sound. Similar declines in humpback whale numbers have also been documented in Southeast Alaska. Neither of these regions are closed populations and there is potential that whales that generally feed in PWS are foraging elsewhere in the Gulf of Alaska. We are connected with a network of researchers in the North Pacific, including Hawaii and the California Current to determine if whales that formerly fed in PWS are now feeding elsewhere, or potentially deceased. We recently submitted the PWS humpback whale catalog to an automated matching program (happywhale.com) to see if these whales have been feeding elsewhere in the North Pacific. Both PIs are leading working groups to determine declines in humpback whale numbers on the breeding grounds and in Alaska are the result of migration or mortality.

The variability among surveys is due to the behavior and biology of humpback whales. These are seasonal migrants that generally winter in tropical waters and feed in higher latitudes. The departure from feeding areas is staggered with some whales leaving early and some later, with some returning from the wintering areas earlier and some later. There also are some whales overwintering in higher latitudes. On the feeding areas, humpback whales are dispersed in summer and aggregate in the fall when herring come into deep bays and fjords to overwinter. Thus, a seasonal peak is evident in the fall and a seasonal low is evident in the winter, with numbers increasing in spring as whales return. The very low numbers in 2017 in September were alarming and persisted into 2018. A September survey is currently underway and we will soon know if conditions are staying the same or changing.

We will apply a mark-recapture model to these data, as we did for our earlier data (Straley et al. Deep-Sea Research Part II 147 (2018) pp. 173–186). As stated in our methods to assess the impact of predation more information is needed than an abundance estimate as described in our paper:

"Although mark-recapture models provide an estimate of abundance, they do not describe seasonal trends. Consequently, we used the number of unique whales seen each month for establishing seasonal patterns, then adjusted the pattern to account for the estimated number of whales present. The data used to describe the seasonal attendance pattern, included calves because by fall calves have

become intermittently independent and become more independent with age (Straley, unpublished data). By fall calves were feeding on the same prey as other whales. We also included individuals identifiable in poor quality images. This number represents a lower bound to the daily attendance pattern for whales in each location. Daily attendance was estimated by fitting linear models to the observed numbers. Inflection points for linear models were determined visually. We used the attendance patterns to establish a lower bound (as described above) and the Huggins estimate of abundance to establish the upper bound to the whale attendance pattern.”

Keep in mind the Teerlink et al. (2015) data were collected in a very small area of PWS in the summer and no data on prey were collected. The purpose was very different from our study. We are addressing how many whales each day are foraging on herring. While knowing how many whales in a season are present is relevant for some questions, that number provides little detail on day to day foraging. Also, we are studying this population of whales that mostly leaves during the winter (although a few overwinter), then returning in spring and they are often different whales. Hence, immigration and emigration are huge issues, which violates the basic assumptions of mark recapture models.

Science Director Comments – FY20

Date: September 2019

I am encouraged that a manuscript is in prep that will discuss the decline in humpback whale populations in conjunction with the marine heat wave. This will make another contribution to the growing list of manuscripts from this program that begins to examine ecosystem response to the marine heat wave. I concur with the Science Panel’s comments.

PI Response (9.27.19)

The paper includes a 30+ year time series of data from Southeast Alaska as well. As a side note: two abstracts have been submitted to conferences. PI Straley will present at the the joint Wildlife Society /Fisheries Society meeting on October 3 2019. Straley just submitted an abstract to the Ocean Sciences meeting in February 2020. Abstracts are available upon request.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel would like to see these data linked with forage fish and seabird data. If whales aren't there is it directly correlated with herring numbers? Namely, does reduced herring biomass lead to fewer whale observations?

PI Response (10/10/18)

Anecdotally, yes, the decline in whale abundance mirrors the recent drop in herring biomass. Prior to recent marine heatwave adult overwintering and spawning herring were the preferred prey for whales in PWS. Our 2017 and 2018 surveys found fewer whales in PWS and a shift in feeding behavior to more dispersed prey such as juvenile herring. We saw similar shifts in whale abundance and feeding behaviors in Southeast Alaska. Quantifying the relationship between whales, birds, and herring is one of the objectives of the Pelagic Component's integrated predator-prey surveys that were piloted in 2014 and adopted during the current five year funding cycle. We have acoustic data from herring schools in September and December of 2017 and March and September of 2018 to compare with earlier surveys. The December and March survey vessels were funded through NOAA, but with no additional support for data analysis. However, we are exploring options to have these data analyzed, which will collectively provide valuable information on the relationship between whales and herring when herring abundance is extremely low.

Also, changes in whale abundance should be distinguished from shifts in whale distributions to the extent possible. Comparison of whale trends in PWS with the greater North Pacific may be helpful.

PI Response (10/10/18)

Yes, there are two possibilities for the decline in whale numbers within PWS: 1) they died, or 2) they moved. Unfortunately, there is no effort to determine trends for the greater population of humpback whales in Alaska or any attempts to survey offshore.

The PIs are leading the SPLISH Project (Survey of Population Level Indices for Southeast Alaska Humpback) to assess trends in abundance, calf production, spatial and temporal distribution, prey composition, and body condition for humpback whales in northern Southeast Alaska, and work closely with the Glacier Bay National Park long term monitoring program for humpback whales. These are the only projects in the state addressing humpback whale abundance trends.

Due to the lack of a comprehensive humpback whale survey in Alaska, data from our PWS and southeast Alaska surveys have been relied on by NOAA for section 7 consultations under the Endangered Species Act, establishing critical habitat, and evaluating unusual mortality events.

Science Coordinator Comments – FY19

Date: September 2018

The project is on track. NOAA vessels were leveraged for FY17 and FY18 for this project and 18120114-E Bishop to conduct winter and early spring surveys and will no longer be available for FY19 and beyond. Funding (\$29.4K includes GA) is requested for only the spring cruise in March to continue work as described in both original project proposals. March surveys have provided an important assessment of spring conditions prior to herring spawning, whale abundance, and quantification of predator consumption of pre-spawning herring schools. These data are useful to the HRM program. Both projects 114-O and E are proposing to continue a spring/March cruise with requested funding. Is each project requesting its own vessel? If so, is there any way to share a vessel to reduce costs?

PI Response 9.5.18

Yes, each project is requesting their own vessel. When identifying projects with unfunded needs, we did have a lengthy discussion about sharing vessels, as the nearshore team also requested funding for March survey in PWS (that project did not rank in top 3 to request funds). We concluded that projects 19120114-E (fall/winter seabirds) and 19120114-O (humpback whales) would not be able to share a charter vessel. March surveys for marine birds and whales have different objectives, methods, and proposed spatial coverage (Figs. 1 and 2) and, therefore, require separate survey vessels. For example, the marine bird surveys (Fig. 1) are fixed transects sampled annually using the chartered vessel as the survey platform. In contrast, the whale survey route changes annually depending on where the whale and herring aggregations are (Fig. 2), and once an aggregation is encountered, the chartered vessel that is also used as the survey platform engages in focal following of predators and prey. Timing also differs. For marine birds, surveys would be conducted in early to mid-March before spring migration. On the other hand, we attempt to time whale surveys just prior to herring spawning in late March or early April. This is often too late for winter bird work.

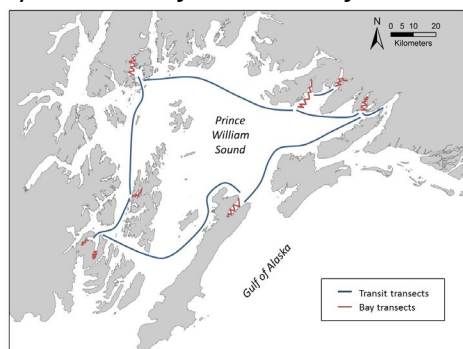


Figure 1. Proposed dedicated marine bird surveys to occur in November and March in Prince William Sound, AK. Surveys will replicate our longest time series (2007 - 2016) and most consistent data.

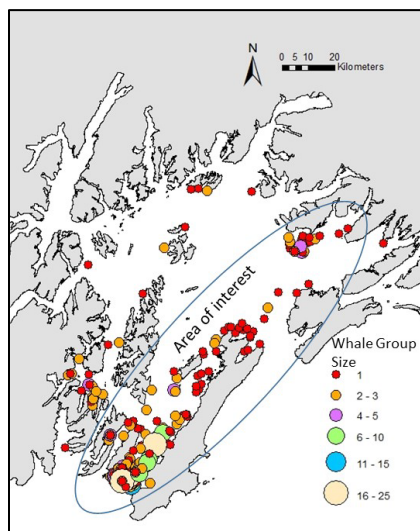


Figure 2. Area of interest for spring whale surveys in Prince William Sound, AK. Given limited vessel time, effort will focus on southern PWS an area of high whale and pre-concentrations.

PAC Comments – FY19

Date: September 2018

No project specific comments.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel was excited to see the results presented in Figure 1 in the proposal and encourages the PIs to make comparisons to the relevant study conducted by the National Center for Ecological Analysis and Synthesis (NCEAS) working group. Results shown in Figure 1 of the proposal are important and so strikingly incompatible with what was suggested previously by the time series analysis of the NCEAS working group (Ward et al 2017). That working group's model, of necessity, made some quite restrictive assumptions. Can the PIs look at the NCEAS model, and consider whether the new findings invalidate one or more key conclusions from that synthesis work?

PI Response (10/11/2017):

Thank you for the close review of project 18120114-O's work plan. Comparisons to Ward et al. (2017) are problematic because these authors depend on summer whale counts from western PWS (Teerlink et al. 2014), while our project focuses on fall/winter and spring time periods when herring form large, dense schools that are most vulnerable to whale predation. Observations of whales and prey when herring are aggregated allow us to study the potential impact of foraging humpback whales on herring as a possible contributor to the lack of herring recovery. The following are three important differences between our approach and the Teerlink et al. (2014) approach to modeling whale predation on herring:

- 1. The Teerlink et al. (2014) study estimates the number of whales that use PWS in summer, not the number that are present at any given time (for example, 10 whales spending 90 days in the Sound would have the same effect on prey as 900 whales spending one day in the Sound). It is important to know how many whales are feeding on herring for how many days within the Sound and the Ward et al. (2017) paper does not address this.*
- 2. Ward et al. (2017) used whale population estimates from summer surveys, when overall whale abundance is generally low in PWS compared to other seasons. Our work identified adult herring as the preferred prey of humpbacks in PWS, especially when herring are aggregated in the fall, winter, and spring (spawning); thus, whale numbers peaked in the fall and spring, and dropped during the summer months.*
- 3. Neither Ward et al. (2017) nor Teerlink et al. (2014) identify prey consumed by humpback whales.*

Additionally, the Panel is concerned that objective #3 may be overly ambitious and suggests rewording and editing to "predation rate"?

PI Response (10/11/2017):

With regards to objective #3 being overly ambitious and the Science Panel's suggestion of rewording and editing to "predation rate"? We agree and will change the wording of this objective.

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments.

PAC Comments – FY18**Date: September 2017**

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17**Date: May and September 2016**

There are no project specific comments.

Science Coordinator Comments – FY17**Date: May and September 2016**

I have no project specific comments.

Executive Director Comments – FY17**Date: September 2016**

I have no project specific comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Project Number: 20200114-P

Project Title: LTM Program – Lingering Oil Component Project

Primary Investigator(s): Mandy Lindeberg, Ron Heintz

PI Affiliation: NOAA, Sitka Sound
Science Center

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$65,200

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|----------|----------|
| \$0 | \$0 | \$0 | \$52,200 | \$13,100 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$22,400

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|----------|----------|
| \$0 | \$0 | \$0 | \$11,200 | \$11,200 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$65,200

Total Non-EVOSTC Funding (FY17-21): \$22,400

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/23/19.*

Oil from the *Exxon Valdez* remains sequestered under beaches throughout the spill area. This lingering oil, as it is known, has been a source of concern for the federal and state government and the public for over 30 years. In 2015 the United States and State of Alaska governments advised the federal district court they would not be filing for additional damages based on the presence of lingering oil and the “reopener claim.” In their joint status report, the Governments noted that, although the Governments would not pursue the additional claim, “[the *Exxon Valdez* Oil Spill Trustee] Council (EVOSTC) and its member agencies have discretion to consider and proceed with actions to reduce residual oil in the Spill area. . . .” In subsequent Council meetings, the Trustees noted their commitment to continuing lingering oil monitoring to ensure that the oil is not bioavailable or creating damage to the spill area habitat and its resources. Subsequent Councils requested EVOSTC staff develop a lingering oil monitoring project to address targeted areas to effectively monitor the presence and condition of lingering EVOS oil.

This project was developed in coordination with EVOSTC staff to provide a sensible monitoring program that continues past efforts. Past monitoring projects began with an initial assessment in 2001 where over 9,000 pits were excavated to estimate how much oil remained on beaches in Prince William Sound. Results from this survey showed oil was lingering in the environment longer than expected and not changing in its chemical composition or “weathering”. Additional surveys were conducted from 2003-2015 to determine the oil’s extent and to refine model estimates.

Recommendations from these surveys were to continue monitoring these known sites periodically on a 5 year cycle to maintain the oil chemistry time series and evaluate any change. This project fulfills those recommendations.

In recent years the *Exxon Valdez* oil spill has become an important case study in the long-term impacts of oil spills and there are few agencies capable of producing the long-term data that the EVOSTC-funded studies provide. This project proposes a low-cost presence/absence approach to monitoring that can be combined with previously Council-funded modeling efforts to provide managers with up to date information on where oil is located and its potential to cause injury.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Panel appreciates this low-cost project that addresses the need for periodic lingering oil monitoring. The Panel also expressed some concern regarding the description of sampling (page 5 of the proposal), “Samples will be collected from all pits in which oiling is visible. If oiled sediments are not observed, additional samples will be collected from locations where oil is known to exist.” This statement might be misinterpreted as an unending search for oil. The Science Panel asks the proposers to please clarify.

PI Response (9.27.19)

We appreciate the Council’s dedication to lingering oil and continued monitoring. We certainly do not want to get into an unending search for oil and have revised the narrative so there is a limit to our efforts. The sentences now read:

“In the event that our random selections fail to encounter contaminated sediments, we will re-open pits in known locations to obtain samples for archiving. NOAA maintains records of the specific locations where oil has previously been found. Should this approach be necessary we will collect no more than five total samples for archiving within the time we have available for sample collection.”

Science Director Comments – FY20

Date: September 2019

This project proposes an effective low-cost presence/absence approach to monitoring that can be combined with previously Council-funded modeling efforts to provide managers with up to date information on where oil is located and its potential to cause injury. This project would fulfill the recommendations made by surveys conducted from 2003-2015 which were to continue monitoring these known sites periodically on a 5-year cycle to maintain the oil chemistry time series and evaluate any change in presence and weathering. The study design appears to have been well-thought out and methods are based on those previously established. The PIs are highly qualified, have been involved with Council-funded work since the Council’s inception and previously led past lingering oil monitoring efforts.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

Lingering Oil Project Descriptions

(Please see the Long-Term Monitoring (Gulf Watch Alaska) and Herring Research and Monitoring Programs)

Data Management for Programs and Projects Descriptions

Project Number: 20120113

Project Title: Data Management for Programs and Projects

Primary Investigator(s): Carol Janzen

PI Affiliation: AOOS

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$1,217,300

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------------|------------|------------|
| Auth: \$218,000 | Auth: \$218,000 | Auth: \$218,000 | \$290,100* | \$273,100* |

*Requests include 9% GA. *Includes request for additional funding for data management services for potentially six non-program projects starting in FY20.*

Funding From Non-EVOSTC Sources FY17-21: \$14,400

| FY17 | FY18 | FY19 | FY20 | FY21 |
|---------|---------|---------|---------|---------|
| \$2,700 | \$2,800 | \$2,900 | \$3,000 | \$3,000 |

Total Past EVOSTC Funding Authorized (FY12-19): \$3,784,342

Total EVOSTC Funding Authorized (FY12-19) and Requested (FY20-21): \$4,347,642

Total Non-EVOSTC Funding (FY12-21): \$2,978,600

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19 (revised 9/27/19), budget updated 8/23/19.*

The Exxon Valdez Oil Spill Trustee Council (EVOSTC) requires a data management program composed of tools covering the entire data lifecycle, from immediately after data collection, to long-term preservation, to discovery and reuse. During the 2012-2016 EVOSTC five-year funding cycle, the Alaska Ocean Observing System (AOOS) provided data management services for both the "Long-Term Monitoring of Marine Conditions and Injured Resources and Services" Program, referred to as Gulf Watch Alaska (GWA), and the "Herring Research and Monitoring" (HRM) Program. These two programs leveraged the existing data management capacity of AOOS, and have also helped inform and improve the overall AOOS data and metadata management, access, and visualization tools. The AOOS team and infrastructure continue to provide data services to the EVOSTC for the 2017-2021 funding cycle to maintain continuity and build upon the ongoing efforts and data management system development. New in 2020 (Year 9) is the addition of six Non-Program projects, which are being added to the Data Management workplan upon request from the EVOSTC. As before and with these new projects, AOOS will continue to provide access to the tools and services for which the principal investigators (PIs) of the GWA and HRM Programs depend. The Research Workspace will be maintained and supported to upload, organize, and document data, as well as to facilitate program administration. This platform is familiar to GWA and HRM PIs and allows data to be made promptly and securely available to team members and program administrators. The enhanced metadata editor accessed through the Research Workspace helps researchers more easily generate flexible yet

robust, standards-compliant metadata. As in previous years, GWA and HRM Program data will be shared publicly (or ‘published’) through the AOOS Gulf of Alaska Data Portal, where it can be accompanied by any supplemental files or project documentation. The same publication pathway for the FY20 additional Non-Program project datasets is planned. Publishing through AOOS is beneficial to making the data available to a wide-ranging and established network of resource managers, scientists, and the general public to support decision-making. In addition, the GWA and HRM Program and new Non-Program datasets will ultimately be submitted to DataONE with a digital object identifier (DOI) for long-term preservation and broad access across multiple data repositories. Through the AOOS data management system, the significant expertise of the data management staff within its technical partner organization, Axiom Data Science, is leveraged. The Axiom staff have extensive experience with the GWA and HRM Programs and their associated data through the prior eight-years working with these programs. Building upon these established relationships and infrastructure, AOOS is well-poised to deliver continued success in its data management services to facilitate the access and curation of data from Program and Non-Program projects to support decision-making related to Spill affected ecosystems.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|------------------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel appreciates the data management program services that this program provides. The Panel agrees with the Science Coordinator on the value of having all data from TC-funded science projects managed by this program and would like more information regarding the costs.

PI response (9.27.19)

The Data Management team appreciates the EVOSTC and Science Panel taking the time to share their positive impressions of this proposal, and for commending our efforts to improve the data management services provided in the previous five-year effort. Information related to the costs is provided in the below response to the Science Coordinator comments.

Science Director Comments – FY20

Date: September 2019

The Data Management Team continues to provide valuable support to the programs for seamless uploading and sharing of data with PIs and making data publicly available. I appreciate the well-organized proposal, including details of all FY19 program accomplishments. The program is requesting an additional \$71.7K for data management services for up to six non-program projects for FY20. The program is already managing data for the Gulf Watch Alaska and Herring Research and Monitoring programs. Data Management oversight of all TC-funded projects will ensure that data from all TC-funded science projects are consistently maintained, archived and made publicly available through AOOS and DataOne data portals. This will also help facilitate integration between all TC-funded program and non-program projects. However, I have requested the PI provide more detail as to why the cost is slightly higher per project for up to six non-program projects of FY20.

PI response (9.27.19)

The PI for the Data Management Program is not requesting additional hours for program management of the Non-Program projects. The individual project data management services provided by Axiom for these projects do not change much from year-to-year, with the exception of the first year when the new projects are being initiated (thus transferring, formatting, and documenting any associated legacy datasets), and in the final year (when datasets are being curated for archive). Some projects will also require additional time to onboard funded PIs to the Research Workspace, entrain them to the data management procedures consistently used across EVOSTC programs, and to familiarize them with metadata tool and best practices for authoring preservation-quality documentation in the first year. The 19110853 Pigeon Guillemot Restoration project will require curation of five or more prior years of data in order to update population statuses and trends. Thus, at the project onset, some historical data salvage effort will be necessary to consolidate, organize, standardize, format, and author standards-compliant metadata. The level of work for curating historical data requires effort beyond the routine annual data management workflow. Slight variation between projects on annual budgets are based on the project budgets provided us relative to anticipated data volumes and data workflow across years. The additional costs for providing data services to these new projects is highest in year 2020 as a result. Costs are also a little higher than middle-years during the last year of a project.

The data management services cost under the Axiom Data Science FY17-21 subaward alone for the Gulf Watch Alaska and Herring Research and Monitoring Programs is approximately \$182,000 per year (\$910,000 total across the 5 years, not including AOOS/ASLC charges or the 9% GA).

- In the FY17-21 work plan for restoration, research and monitoring project draft by the EVOSTC in FY19, there are seven projects generating data in the HRM program and 11 in the GWA program for 18 total projects.*
- On average, the data management service cost per project over the lifetime of the 5-year program is \$10,111 per year.*

For the expanded data management services, the cost estimate provided in the FY20 workplan for the Axiom Data Science subaward is indeed highest in the first year at \$63,000 for six projects (not including the AOOS/ASLC PI and contractual charges or the 9% GA). On average, the data management services cost under Axiom per project in FY2020 alone is \$10,500 (6), which is slightly higher than the GWA and HRM project year average of \$10,111. FY2020 is the first year for all the Non-Program projects, afterwhich the cost goes down for the next two years, increasing again near the end as needed for data curation and preparation for final archival. Assuming all projects are funded, the six projects total \$246,000 over the next 5 years (not including the AOOS portion nor the 9% GA). Please see Tables 3 and 4 in the Workplan for more details.

Comparing the average annual cost per project per year normalizes the variable costs from year to year and the period of the programs (3 to 5 years).

| Name | Total Proposed Cost | Total Number of Funded Projects | Total Project Years* | Average Project Cost |
|----------------------|----------------------------|--|-----------------------------|-----------------------------|
| HRM & GWA Programs | \$910,000 | 18 | 90 | \$10,111 |
| Non-program projects | \$246,000 | 6 | 25 | \$9,840 |

****The GWA & HRM projects are anticipated to each be funded over a 5-year duration, as per the FY17-21 workplans. Therefore, the total project years is 18 project * 5 years = 90 project years. The duration of the non-program projects varied across projects from 3 to 5 years. 3 projects proposed a 5-year duration (15), 1 project proposed a 4-year duration (4), and 2 projects proposed a 3-year duration (6), which equals 25 project years.***

Over the entire lifecycle of the proposal non-program projects, the average per project per year cost is \$9,840, which is on par with the average GWA and HRM program project cost per year of \$10,111. The actual data management service cost for the non-program projects will depend on the actual number of projects that are recommended for funding by the Science Panel.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel applauds the Data Management team for the progress they have made with the program. The process for uploading and sharing data, making data publicly available appears to be seamless. The Data Management team provides detailed instructions and good support to PIs and programs, EVOSTC staff and reviewing committees. We recognize that the PI compliance is high, which is a reflection of how well the program is functioning and supporting the long-term monitoring programs. We note that Table A could be effectively summarized to highlight the high compliance rates and data availability.

Science Coordinator Comments – FY19

Date: September 2018

I use the Workspace to provide documents to the Science Panel and other reviewing committees. I greatly appreciate how much easier it is to share information. Program is on track except for one task due to technical difficulties and scheduled for the next quarter.

There is one question from the Science Panel in 2017 (from the FY18 Work Plan) that needs a follow up: Are the ADFG herring data sets available on the DataOne portal? If not, they should be made accessible.

PI Response (10/13/2017):

The ADFG Prince William Sound datasets have been submitted to the Research Workspace for sharing among collaborators. Some of these datasets have been made available to the public through both the GOA data portal and DataONE. An inventory of these datasets and their publication status are shown in the below table.

The data management team is awaiting a final decision from ADFG Commercial Fisheries division about whether to make the remainder of the data available publicly. We will update the EVOSTC and the EVOS Science Panel with this information as soon as we have a response.
Has this been done?

PI Response 9.6.18

The ADFG Prince William Sound datasets through 2017 (with the exception of the acoustic and scale measurement data) have been submitted to the Research Workspace for sharing among collaborators.

- *Some of these datasets have been made available to the public through both the GOA (Gulf of Alaska) data portal and DataONE.*
- *An updated inventory of these datasets and their publication status are attached. (See xlsx file attached).*

In March 2018, the data management team received the final decision from ADFG Commercial Fisheries division to allow the remainder of the data to be made available publicly with appropriate permissions.

- *A copy of this communication is attached below this response, as an email from Sherri Dressel.*

Since that time, the following actions have been taken by the Data Management team to prepare these data for archive.

1. *The visualization of the Herring ASL data (including biomass, survey, ASL, spawn, marine mammal, and marine bird datasets) has been updated through 2017 in the GOA data portal.*
2. *For all datasets, the ADFG Use Constraints disclaimer described in the Dressel email below has been added to the portal overview page for each dataset and to the corresponding metadata.*
3. *The FGDC version of the historical metadata records (created by Steve Moffitt) has been migrated into the contemporary ISO metadata standard within the Research Workspace. This is a necessary precursor towards data archive and helps to ensure that metadata can be more readily updated by the PI in the coming years.*
4. *As the ADFG database structure evolved over many decades, there were inconsistencies in the presentation of some of the aerial survey data. In consultation with ADFG, updates were made to correct errors within the data files.*

It should be noted that many of these data are long-term historical datasets that, while a considerable resource to the Herring Research and Monitoring Program, extend beyond the life of the 2012-2016 Data Management Program. It is our intention to help ensure the long-term preservation of these data by submitting them to DataONE within this funding cycle, assuming confirmation from ADFG about the readiness of those data.

PAC Comments – FY19

Date: September 2018

The PAC noted the importance of data management and supports providing more administrative support for uploading data, metadata, and reports.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18

Date: September 2017

The Panel greatly appreciates the PI's efforts on this project. The coordination between the data management program and the HRM and LTM Programs has greatly improved. The proposal was well written and organized.

Can the PI confirm that data will be available and not require specially approved access to get to the data?

PI Response (10/13/2017):

The process for making data from the EVOS Gulf Watch Alaska (GWA) and Herring Research and Monitoring (HRM) programs publicly available is as follows. Project PIs upload preliminary and final datasets to the Research Workspace within one year of collection for sharing among collaborators. PIs maintain ownership of the data they have submitted to the Research Workspace; therefore, they have access to data from the 2012-16 and 2017-21 funding cycles without needing special permissions. Once data are finalized (e.g., within one year of data collection, in most cases) data are published from the Research Workspace to the AOOS Gulf of Alaska (GOA) data portal. All data published to the GOA portal are accessible by the public with no restrictions or specially approved access. In the portal, these data are discoverable alongside the publicly-available final data from the 2012-2016 GWA and HRM projects. These data are further made available to the public through the Research Workspace DataONE member node, a preservation-oriented data repository that is openly accessible to the public. The DataONE archives, similar to the GOA portal, will continue to be updated with final data from the 2017 to 2021 funding cycle.

To navigate to the public-facing data in the GOA portal:

- 1. Visit the AOOS website (<http://data.aos.org>) and select the Gulf of Alaska portal (image below), or navigate directly to the portal at <http://portal.aos.org/gulf-of-alaska>.*
- 2. To view data, click on Data Layer Catalog*
- 3. From the catalog labels on the left hand side, select the Gulf Watch or Herring Projects*
- 4. Click on the project you want to open from the list.*
- 5. To view data files, click 'Project Data' in the upper right (top image below). Browse the files and click those you want to download*

Are the ADFG herring data sets available on the DataOne portal? If not, they should be made accessible.

PI Response (10/13/2017):

The ADFG Prince William Sound datasets have been submitted to the Research Workspace for sharing among collaborators. Some of these datasets have been made available to the public through both the GOA data portal and DataONE. An inventory of these datasets and their publication status are shown in the below table.

ADFG Herring Surveys, Prince William Sound: aerial survey route, biomass, age sex length, and spawn
EVOS Herring Research Workspace c <https://workspace.aos.org/project/283281/files>

| Dataset | Years | Public in GOA portal? | GOA portal link | Archived with DataONE? | DataONE doi link |
|--|-----------|--|---|------------------------|---|
| Aerial herring biomass observations | 1973-2016 | yes; visualized & available for download | http://portal.aos.org/gulf-of-alaska.php#module-metadata/ad7118be-ea24-11e0-b488-0019b9dae22b/ee8a692c-ea24-11e0-b73c-0019b9dae22b | yes; 2007-09 only | https://search.dataone.org/#view/df35a.22.16 |
| Aerial herring spawn observations | 1973-2016 | yes; visualized & available for download | http://portal.aos.org/gulf-of-alaska.php#module-metadata/ad7118be-ea24-11e0-b488-0019b9dae22b/ee8a753e-ea24-11e0-a20d-0019b9dae22b | yes; 2007-09 only | https://search.dataone.org/#view/df35a.22.17 |
| Aerial herring spawn observations | 1973-2016 | yes; visualized & available for download | http://portal.aos.org/gulf-of-alaska.php#module-metadata/ad7118be-ea24-11e0-b488-0019b9dae22b/79b1cc76-5f1f-41d7-bb79-3f7e995d6d89 | yes; 2007-09 only | https://search.dataone.org/#view/df35a.22.18 |
| Aerial survey marine bird observations | 2008-2016 | yes; visualized & available for download | http://portal.aos.org/gulf-of-alaska.php#module-metadata/258864ed-5fe3-4ae1-af41-fee3222612aa/d3964546-4786-11e5-953e-00265529168c | yes; 2007-09 only | https://search.dataone.org/#view/df35a.22.19 |
| Aerial survey marine mammal observations | 2008-2016 | yes; visualized & available for download | http://portal.aos.org/gulf-of-alaska.php#module-metadata/c893364d-0e8a-42de-8947-9212b588cc43/00357656-e3b9-4d22-9d03-345fb0b7320 | yes; 2007-09 only | https://search.dataone.org/#view/df35a.22.20 |
| Aerial survey sea lion observations | 2008-2016 | yes; visualized & available for download | http://portal.aos.org/gulf-of-alaska.php#module-metadata/c893364d-0e8a-42de-8947-9212b588cc43/d39650b8-4786-11e5-9543-00265529168c | yes; 2007-09 only | https://search.dataone.org/#view/df35a.22.21 |
| Age Sex Length Data | 1973-2014 | no | - | yes | https://search.dataone.org/#view/df35b.273.7 |
| Age Sex Length Data | 2015-2016 | no | - | no | - |
| PWS Herring Acoustics | 1997-2014 | no | - | no | - |
| Scale Measurement Data | 1982-2016 | no | - | no | - |
| PWS Herring Acoustic | 1997-2014 | no | - | no | - |
| Scale Measurement Data | 1982-2016 | no | - | no | - |

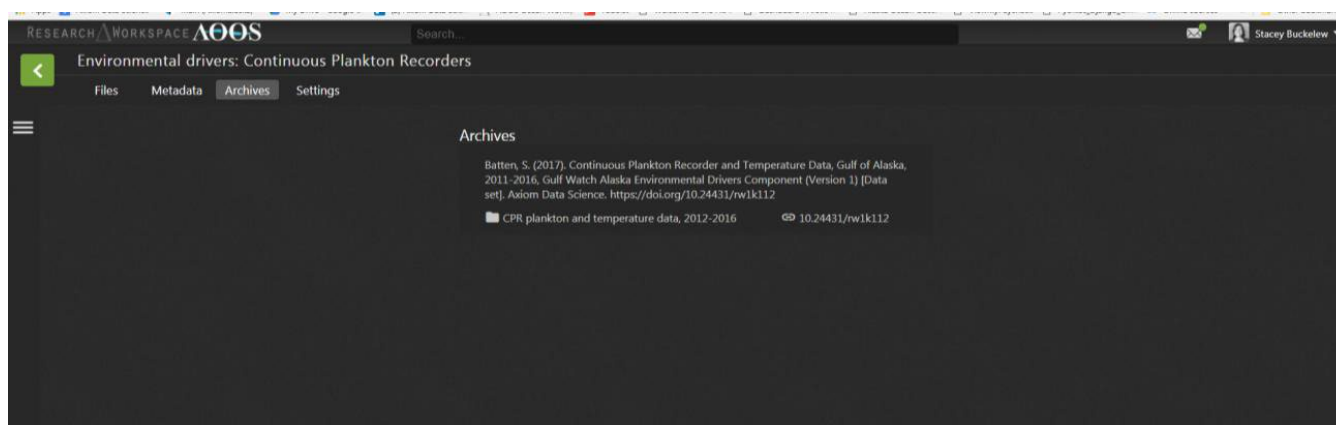
The data management team is awaiting a final decision from ADFG Commercial Fisheries division about whether to make the remainder of the data available publicly. We will update the EVOSTC and the EVOS Science Panel with this information as soon as we have a response.

What is the status on linking DataOne to Workspace for all the projects?

PI Response (10/13/2017):

In June 2017, we launched the Research Workspace DataONE1 Member Node, a preservation-oriented data repository serving as the archival home for datasets published from the Research Workspace (news release here). Datasets published from the Research Workspace to the Research Workspace DataONE Member Node are issued a citable digital object identifier (DOI), and are discoverable through DataONE search interfaces alongside datasets and metadata from the other 40+ repositories that make up the DataONE federation. The final data holdings from the 2012-2016 GWA and HRM programs were archived in the Research Workspace DataONE Member Node and are now publicly discoverable and citable through both the AOS Gulf of Alaska data portal² and the DataONE Search³ catalog. These archived resources are linked to any related datasets from the EVOS historical data salvage project (conducted by NCEAS), which are also stored in DataONE. Within the Research Workspace, the GWA and HRM program datasets archived with DataONE are visible under the Archives tab within each project (see below image). Here PIs can view the resource title, DOI, and link to the associated data and metadata. Additionally, the DOI is reflected in the Gulf of Alaska data portal, from which any member of the public can navigate from the Gulf of Alaska portal to the archived dataset within DataONE.

In future Research Workspace updates, an archive page will be added to the EVOS GWA and HRM campaign which lists the archive dataset citations for the entire program (as opposed to individually by projects), and this list will include links to DataONE.



Science Coordinator Comments – FY18

Date: September 2017

I concur with the Science Panel's comments. I greatly appreciated the Key Highlights section.

PAC Comments – FY18

Date: September 2017

The PAC emphasizes the importance of being able to access raw data, not just scientific papers. The PAC is pleased with the improvements made to make data available in recent years.

Executive Director Comments – FY18

Date: September 2017

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | Fund | Fund | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY17

Date: September 2016

We appreciate the Team Lead's thorough responses to our questions and comments. We do not have any additional questions or comments on the revised proposal.

Date: May 2016

The Panel appreciates the refocusing of the data management program to better meet the needs of the Programs and the EVOSTC. Making the data collected by the Programs available to other

researchers and trust agencies is the primary goal of the data management program. The development and implementation of the data portal in conjunction with the partnership with DataONE in the first five-year program has helped to meet that goal.

The Panel was encouraged to see a more defined data policy that provided clear repercussions for non-compliant PIs. The Panel was gratified to learn that AXIOM has developed or is developing a presumably online training course for PIs on how to construct metadata for their projects, so as to address one cause for slow compliance with data submittal timetables.

The Panel is concerned about the availability of data from the first five-years of the Program to the new and continuing PIs. Milestone 2 on page 21 of the proposal needs further clarification. "Some PIs in the current funding cycle may need access to previously collected datasets in the Workspace." Does this mean that new and continuing PIs will not be able to routinely access data collected in the first five-year Program unless they submit a special request? Access to both the historical data assembled by NCEAS and data collected by projects in the first five years is critical to the success of both Programs.

The Panel strongly encourages the continued coordination and collaboration with both major Programs (Long-Term Monitoring and Herring Research) in the design and updating of the system.

The Panel was concerned that the Program lead was unable to answer several questions regarding the design of the Program and the PI appeared unfamiliar with the content of the proposal, thus inhibiting a full discussion of the Workspace functionality.

Science Coordinator Comments – FY17

Date: May and September 2016

I concur with the Science Panel's comments.

Executive Director Comments – FY17

Date: September 2016

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17

Date: September 2016

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

Non-Program Science Project Descriptions

Project Number: 20110853

Project Title: Pigeon Guillemot Restoration Research in Prince William Sound

Primary Investigator(s): Kathy Kuletz, Robb Kaler, David Irons

PI Affiliation: USFWS

Project Manager: USFWS

EVOSTC Funding Requested FY17-21: \$531,700

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------------|-----------------|-----------|-----------|-----------|
| Auth: \$149,800 | Auth: \$173,400 | \$69,500* | \$69,500* | \$69,500* |

*Requests include 9% GA. *Includes USDA-FS request for ~\$17K annually for permit fees.*

Funding From Non-EVOSTC Sources FY 17-21: \$713,000

First line is from National Fish and Wildlife Foundation Grant, Second line is USFWS in-kind support

| FY17 | FY18 | FY19 | FY20 | FY21 |
|-----------|-----------|----------|----------|----------|
| \$215,600 | \$215,600 | \$0 | \$0 | \$0 |
| \$98,000 | \$98,000 | \$28,600 | \$28,600 | \$28,600 |

Total Past EVOSTC Funding Authorized (FY07-19): \$2,538,700

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$2,677,700

Total Non-EVOSTC Funding (FY07-21): \$2,420,300

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

Historically, the Naked Island group had the largest breeding population of pigeon guillemot (*Cepphus columba*) in Prince William Sound (PWS), Alaska, but it declined over 90% after the 1989 Exxon Valdez Oil Spill. Following the effects of the oil spill, predation of adults and their nests by introduced American mink (*Neovison vison*) was the primary factor limiting population recovery. During a 5-year pigeon guillemot restoration project, which included mink removal from guillemot nesting areas, counts of pigeon guillemots at Peak, Naked and Story islands has more than doubled from 2014-2018 (69 to 167 individuals) and numbers of nests increased more than four times (11 to 51 nests). In 2019, we began a second 5-year monitoring effort (2019-2023) at the Naked Island group. Our objectives were to: (i) search for evidence of mink in guillemot breeding areas, (ii) monitor the recovery of pigeon guillemots, and (iii) monitor relative food availability, using black-legged kittiwakes (*Rissa tridactyla*) as indicators. Overall, our 2019 effort to continue monitoring the population recovery of pigeon guillemots at the Naked Island group was highly successful. No mink were recorded visiting bait stations and no mink tracks were observed at the 10 high-use areas identified during previous intensive trapping efforts. Guillemot population counts were conducted in late May and numbers of guillemots continued to increase at the Naked Island group. Nest counts of black-legged kittiwakes were conducted and while results are pending, initial impressions are 2019 is a "moderate" year for fish availability in PWS. Together, these data will inform future management actions by determining if mink are absent from the islands, measure the rate of recovery of pigeon

guillemots following the removal of mink, and provide an indicator for productivity patterns of ocean conditions to help interpret pigeon guillemot population trends.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

The Science Panel finds the results exciting and are expecting that the PIs will work in the coming year toward publication of the results of the mink eradication and at least preliminary results of the pigeon guillemot response. The data are compelling and support the authors' conclusions.

PI Response (9.25.19): Thank you for your comments. We also find the results exciting and we are working on a publication that will summarize the mink removal in pigeon guillemot nesting areas and the results of the pigeon guillemot recovery to date. We hope to submit a paper by January 2020 if not sooner.

This has been a very successful active restoration project with an exponential increase of the population of pigeon guillemots on the Naked Island group from 69 birds in 2014 to 183 birds in 2019. This number is still far below the estimated pre-spill population of more than 2000 nesting guillemots at the Naked Island group and pigeon guillemots are still listed as not recovered in the spill area. Continuing this project for the next four years will allow us to monitor populations of pigeon guillemots in the absence of mink predation, and if the guillemot numbers start to decrease, then we have the opportunity to analyze what other factors may be affecting their recovery. This project also collects food availability data concurrently. Several other studies are collecting data on other population levels of species such as herring (various components of the Herring Research and Monitoring Program (HRM), humpback whales (J. Moran), killer whales (C. Matkin), and other marine birds in PWS (Kaler and Kuletz, Marine Bird Surveys; M. Bishop fall and winter seabird abundance). Environmental data such as sea surface temperature, zooplankton abundance, and currents in PWS are also being collected by components of the HRM and the Environmental Drivers component; these can all be used to determine which factors may be affecting changes in the population of guillemots.

In addition to pigeon guillemots, other bird species are beginning to benefit from the lack of mink predation at the Naked Island group. Dusky Canada geese, which declined on the Copper River Delta after the 1964 earthquake and are a species of concern for the ADF&G and the USFS, were at the highest level recorded in 2019. Tufted and horned puffins and parakeet auklets, while previously uncommon in PWS, are increasing in numbers which is important to tourism. A new black-legged kittiwake colony recently formed on Naked Island. We anticipate that arctic terns and black oystercatchers, once common on these islands, will also increase nesting efforts.

This project also continues the breeding black-legged kittiwake time series data which spans 36 years in PWS and include population trends and reproductive success. One of the main prey items for black-legged kittiwakes in PWS are juvenile herring and previous studies have shown that population trends and reproductive success track the availability of juvenile herring. Maintaining data collection for this time series was recently (2018) added to the PIGU project. The black-legged kittiwake time series have

since been incorporated into a synthesis manuscript for Gulf Watch Alaska. Preliminary results show a response similar to other piscivorous predators to the decline in herring and the marine heatwave in the GOA. Inclusion of the black-legged kittiwake time series to synthesis efforts of EVOSTC programs (HRM and GWA) expands our understanding of ecosystem-wide impacts from depressed herring populations to multiyear marine heatwave in the GOA.

Science Director Comments – FY20

Date: September 2019

This project completed the first year of continued monitoring of population recovery at the Naked Island group following five years of mink removal efforts. No mink were detected in FY19. Numbers of guillemots continued to increase at the Naked Island group, up from 69 in 2014 to 185 in 2019. This project exemplifies positive results from direct seabird restoration efforts. Results from this project will be used in the next status TC report on injured resources. Productivity of black-legged kittiwakes was also monitored for the first time as part of this project as a proxy for seabird food availability. In the FY19 proposal, it is noted that kittiwakes have been monitored in PWS for 35 years and unpublished data have been used to classify years in terms of food availability (i.e., good, moderate, and poor) for seabirds in PWS. Given that this is such an important long-term data set, this may be a good opportunity for collaboration with other program projects to investigate how kittiwake food availability and productivity responded to environmental changes over several decades, and to perturbations such as the marine heatwave in 2014-2016. I concur with the Science Panel's comments.

PI Response (9.25.19): The breeding black-legged kittiwake time series data spans 36 years in PWS and include population trends and reproductive success. One of the main prey items for black-legged kittiwakes in PWS are juvenile herring and previous studies have shown that population trends and reproductive success track the availability of juvenile herring. Maintaining data collection for the black-legged kittiwake time series was recently (FY18) added to the PIGU project. This long-term data set is incorporated in one of the four synthesis manuscripts being produced by the Council-funded Gulf Watch Alaska program. Preliminary results show a similar response as other piscivorous predators to the decline in herring and the marine heatwave in the GOA. Inclusion of the black-legged kittiwake time series to synthesis efforts of EVOSTC programs (HRM and GWA) expands the scope of understanding ecosystem wide impacts from depressed herring populations and a continued marine heatwave in the GOA. We look forward to further collaboration with Gulf Watch in the future.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY19

Date: September 2018

The Science Panel greatly appreciates the detailed responses by the PI to the Science Coordinator's questions. We acknowledge the importance of this follow-up project and determining if and when the mink might return. This information will add to what we already know about fox predation on seabirds. Furthermore, the utility of this method of culling mink improves our ability to conserve and restore pigeon guillemots and other ground-nesting seabirds. We continue to be impressed with the results of the first five years of this project, one of the few in which active restoration was observed in a surprisingly short amount of time. We also recognize that it will not cost much more to conduct the black-legged kittiwake monitoring (\$7.5K) and believe this would cost-effectively add forage fish availability information to this project and knowledge of seabird ecology in PWS.

Science Coordinator Comments – FY19

Date: September 2018

Determining if mink are truly absent from the islands is important but also when or if mink might return and what numbers will the start having an effect on PIGU populations again. Furthermore, I was gratified to hear the strong PAC support for this project, including the BLKI monitoring at the PAC meeting. I have several questions for the PIs:

PIs propose to search for evidence in mink in PIGU breeding areas through 3 years of winter/spring monitoring using bait stations, camera traps and track surveys focused on 10 previously high-density mink areas to determine the need for continued management of mink. Is this sufficient compared to monitoring 70% of the coastline? How will mink movement be accounted for?

PI Response 9.6.18

We trapped for two months each year for five years at the Naked Island group and found 11 areas (10 accessible) with 2 Km or less shoreline where 5 to 10 mink were trapped. During our 5-year effort, 68% (72 of 106) of mink were caught in these 11 areas, from which we interpret that these areas provide preferred habitat. Further support for our interpretation includes the ADF&G American Mink info page (<http://www.adfg.alaska.gov/index.cfm?adfg=americanmink.printerfriendly>) which reports mink are found in close association with water, preferring saltwater beaches, riparian habitats of lakeshores, marshes, and stream banks, with coastal mink selecting shallow vegetated slopes and tidal slopes with protection from wave action. As much of the Naked Island group coastline is composed of steep cliffs with little riparian, marshes or streambank habitat, focusing our efforts on the 10 proposed areas is a reasonable approach. Additionally, based on patterns observed from our trapping efforts, once a male mink was removed from a territory, another male quickly moved in. Many of the females were also captured in these high mink density areas. If mink remain at the Naked Island group, or if new mink arrive (highly unlikely; please see additional comments below under PIGU population model question), we surmise that they would select territories in preferred habitats, which are these 11 areas. We feel that our plan is sufficient to capture evidence of mink coming into the pigeon guillemot nesting areas. Based on the patterns observed during pre-mink trapping using bait stations and cameras, as well as patterns of movements of males as fewer females were present during the trapping effort, we are confident that our approach using bait stations, cameras, and track surveys will detect mink if they are present.

PIs propose to monitor relative food availability by conducting BLKI productivity surveys for 5 years and using productivity as an index for food availability. PIs also state that “the forage fish project (Arimitsu and Piatt; 19120114-C) and Middleton Island seabird research led by Dr. Scott Hatch (Institute for Seabird Research and Conservation) will provide background on forage fish availability in the northern Gulf of Alaska and PWS region.” Isn’t this sufficient for providing information on forage fish availability?

PI Response 9.6.18

Obtaining PWS-wide forage fish population/biomass estimate was not feasible given the funding available so Drs. Yumi Arimitsu and John Piatt’s forage fish project shifted directions for 2017-2021 to integrate directly with the humpback whale study (Moran and Straley, Gulf Watch Project 1912011-O). The forage fish monitoring now focuses survey efforts during the fall (September/October) and at areas with high densities of fall whale observations (Montague Strait, Bainbridge Passage, Bligh Island). Owing to these different sampling times (July versus late September/early October), we are not confident the forage fish study will provide sufficient information during the July PIGU chick rearing period. Regarding BLKI monitoring at Middleton Island led by Dr. Scott Hatch (Institute for Seabird Research and Conservation), we agree it will provide background on forage fish availability in the northern Gulf of Alaska, but Middleton Island is 100 Km from Hinchinbrook Entrance and most kittiwakes from Middleton do not forage in PWS during the chick rearing period.

I appreciate the leveraging of other data and equipment from the GWA projects and using a less costly method of BLKI productivity monitoring as a proxy but I’m concerned that this may not be appropriate or as useful as we would like it to be. The PI’s rationale is that there is 35 years of data that shows strong evidence that BLKI productivity in PWS is directly linked to food availability and provides good indices of “good”, “moderate”, and “poor” years regarding food availability for seabirds in PWS. BLKI do well when sand lance, herring and capelin are present, previous studies also show that PIGU have higher nesting success when the same lipid-rich forage fish are available.

The assumption is that high BLKI productivity = good food availability for PIGU. And BLKI are coastal and offshore pelagic foragers? And PIGU typically forage in nearshore benthic environments (Golet et al. 2002). They eat sand lance, herring and smelt but also demersal fish such as gadid, sculpins, and blennies. Are BLKI an appropriate indicator of food availability for PIGU?

PI Response 8.6.18

As you mentioned, PIGUs have higher nesting success with lipid rich forage fish are available, as do BLKI. BLKI are the only indicator available, they are not perfect, but they would add information to help interpret the PIGU population trends.

How would the BLKI productivity monitoring be used to interpret PIGU observations?

So, if PIGU populations on Naked Island group continue to increase and BLKI productivity is high, then you would infer that this increase is due to the absence of mink and good food availability?

PI Response 8.6.18

Yes

But if what if BLKI productivity is low? Then the increase in PIGU populations would be due to only the absence of mink? And this would indicate that PIGU are finding enough to eat but something different than BLKI?

PI Response 8.6.18

If BLKI productivity is low and PIGU populations increase, there are two reasons regarding food: (i) Since the PIGU population is very low compared to carrying capacity it takes less total food to be successful and will change as the PIGU population increases; (ii) The PIGU can and do feed on demersal fish, but as has been pointed out, they can do better when high-lipid forage fish are abundant. There is another scenario that may happen, which is of concern. The PIGU remain stable (like 2018) or decline. If we have the BLKI data and they are doing well, then we suspect it is not a food issue, but something else. If the BLKI are doing poorly, then we might suggest the reason for the PIGU not increasing despite being well below carrying capacity is lack of food. We think this scenario is a strong reason to monitor the BLKI, especially since the PIGU did not go up this year.

PIGU Population Model: this addresses the SP's comments from 2017 (see Science Panel comments – from FY18). Question – can mink emigrate from other areas? Does this need to be taken into account in the model?

PI Response 9.6.18

We believe it is highly unlikely that mink will immigrate to the Naked Island group. While mink are native to mainland PWS and inhabit other larger islands in PWS (e.g., Knight, Hinchinbrook, Hawkins, Bainbridge, Latouche, and Elrington islands) they never swam to the Naked Island group, Smith Islands, Seal Island, or Montague Island. Looking at a map of PWS one observes that all these islands are in the middle of PWS several miles from other islands and the mainland. In 1951 the USFWS gave ADF&G money to introduce mink to Montague Island to increase trapping opportunity in PWS. The origin of mink to the Naked Island group followed two fox farms at the island group that were active from about 1900 to 1940. Following the end of fox farming on the islands, a family homesteaded and continue to have an in-holding and house on Peak Island. In the 1970s, one of the family's sons living in Cordova decided he wanted to trap mink at the Naked Island group and started live-trapping mink from other islands, taking one or two a year out to the island group. The mink population did not increase quickly so the son continued to release mink for about 10 years. After extensive trapping in PWS we know that the first mink caught in an area is likely to be a male, because males travel more defending their territory. We suspect that the son kept catching males and brought them to the Naked Island group and finally he caught a female. By 1998 the mink population had increased enough that there was 60% PIGU nest predation. We trapped 106 mink off the island so the population level was likely about 100. We expect that they increased from a few to about 100 in about 15 years. Given this evidence we do not feel it is necessary to include immigration or emigration into the population models.

PAC Comments– FY19

Date: September 2018

The PAC recognized the excellent results from this project, with one member stating that PIGU have been observed in PWS in higher numbers. Several PAC members also strongly supported the kittiwake monitoring as these seabirds have not been doing well either.

Executive Director Comments – FY19

Date: September 2018

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY18**Date: September 2017**

The Panel approves of the additional funding requested for a full field season to remove all mink from 70% of the shoreline where PIGU nested or currently nest. Again, the panel is very pleased with how quickly the population is increasing. As noted in past work plans, unless expanded trapping is permitted, the observed success will likely be temporary. A subsequent increase in the mink population resulting from only a partial eradication will probably, again, decimate the PIGU population over time. As noted in last year's work plan, population projections of both predator and prey may be useful to evaluate the merits and timeliness of future management agency decisions regarding predator controls.

Science Coordinator Comments – FY18**Date: September 2017**

I concur with the Science Panel's comments.

PAC Comments– FY18**Date: September 2017**

There are no project specific comments.

Executive Director Comments – FY18**Date: September 2017**

I concur with the recommendations of the Science Panel, Science Coordinator and Public Advisory Committee.

FY17 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|---------------|---------------------|------|--------------------|-----------------|
| Fund | Fund | Fund | Fund | Fund |

FY17 Funding Recommendations:

| Date | Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|-----------|---------------|---------------------|------|--------------------|-----------------|
| May 2016 | Fund | Fund | N/A | N/A | N/A |
| Sept 2016 | Fund | Fund | Fund | Fund | Fund |

Science Coordinator Comments – FY17**Date: May and September 2016**

I concur with the Science Panel's comments.

Science Panel Comments – FY17**Date: September 2016**

We have no additional comments for this project.

Science Panel Comments – FY17**Date: May 2016**

This project has continued to demonstrate marked progress toward the recovery of a historically important PIGU nesting site on Naked Island and the Panel is supportive of continued funding. The Panel has noted in past work plans that, unless expanded trapping is permitted, this success may only be temporary with mink remaining in other areas of the island. Ultimately, lacking a program to fully eradicate mink from this island, redistribution of a rebounding mink population would be expected to once again cause a PIGU population decline over the long term. Population projections of both predator and prey may be useful to evaluate the merits and timeliness of future management agency decisions regarding predator controls.

Science Coordinator Comments – FY17**Date: May and September 2016**

I concur with the Science Panel's comments.

Executive Director Comments – FY17**Date: September 2016**

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY17**Date: September 2016**

The PAC meeting was Sept. 22, 2016 and fund recommendations are included in the table above. Any project-specific comments from that meeting will be added to the Work Plan when the comments are finalized in the meeting notes.

FY16 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|------------|---------------------------|------------------------|
| Fund | Fund | Fund | Fund | Fund |

Science Panel Comments – FY16**Date: September 2015**

Trapping of mink to promote restoration of pigeon guillemots is already a remarkable success story, well ahead of expected time frames for recovery. The project is well along to remove all mink from PIGU nesting sites, and a positive PIGU population response has already been observed.

Documentation of population trends of predator and prey over the full 5-year course of this project will make for an excellent case study. However, over the long term, the question is whether this success will be temporary or sustained, given that mink remain on other parts of the islands. The PIs have made estimates of PIGU population doubling times as a result of mink eradication from nesting sites. Additionally, it would be informative to estimate mink population trends in the absence of an ongoing trapping program after the conclusion of this project. Ultimately, lacking a program to fully eradicate mink from these islands, redistribution of a rebounding mink population would be expected to once again cause a PIGU population decline over the long term. Population projections of both predator and prey may be useful to evaluate the merits and timeliness of future management agency decisions about predator controls.

Science Coordinator, Executive Director Comments – FY16

Date: September 2015

I concur with the Science Panel's comments.

Public Advisory Committee Comments – FY16

Date: September 2015

There are no project specific comments.

Project Number: 20200126 WITHDRAWN

Project Title: Nearshore Fish Community Assemblages Associated with Different River-Estuary Settings

Primary Investigator(s): Coowe Walker, Steve Baird

PI Affiliation: KBNERR

Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$324,800

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-----------|-----------|
| \$0 | \$0 | \$0 | \$162,700 | \$162,100 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$324,800

Total Non-EVOSTC Funding (FY17-23): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

Existing long-term monitoring studies in the Cook Inlet region area supported through the *Exxon Valdez* Oil Spill Trustee Council Gulf Watch program cover a wide range of nearshore and pelagic ecosystem components, but generally do not include river-mouth nearshore habitats that are likely important habitat for juvenile salmon and forage fish. Recent work led by the Kachemak Bay National Estuarine Research Reserve (KBNERR) indicate that such habitats may be very important for some Species of Greatest Conservation Need (SGCN) identified by the state of Alaska, particularly juvenile salmonids, including Pink Salmon (*Oncorhynchus gorbuscha*) Sockeye Salmon (*O. nerka*), and Dolly Varden (*Salvelinus malma*) which are identified by the EVOSTC as recovered resources, and forage fish, including Pacific herring (*Clupea pallasii*), which are identified by the EVOSTC as not recovering (Guo 2019, Hoem Neher 2013a, Hoem Neher 2013b, Walker et al. 2013).

The purpose of this project is to **provide insight into how forage fish and juvenile salmonids associated with nearshore settings respond to ecosystem changes in order to fill a gap in current project research and monitoring efforts.** In Kachemak Bay, there is ongoing Gulf Watch monitoring of ecosystem changes over time measured through marine environmental drivers and nearshore algae, invertebrates, birds and mammals. There are also long term continuous water quality monitoring stations, harmful algal bloom monitoring networks, as well as focused research efforts, such as the EPSCoR Fire and Ice project, which is looking at connections between freshwater inputs

and nearshore fish communities. Collectively, these efforts provide a strong foundation for understanding ecosystem changes, however there is a need for more attention to be focused on nearshore fish, which provide the link between marine environmental conditions and predators. To fill this gap, we will 1) Identify sites that complement Gulf Watch, NERR, and EPSCoR Fire and Ice sampling efforts; 2) Characterize physical (water flow, temperature, salinity, turbidity, dissolved oxygen, substrates) and biological (seaweed wrack, plankton) habitat characteristics; 3) Determine temporal trends in fish community structure (i.e., species, abundance, size frequency); 4) Examine the influence of different habitat features on fish community trends; and 5) Explore relationships between prey availability, fish diet and condition. This information will help link ocean conditions monitored through the EVOSTC funded Gulf Watch Alaska program, as well as other research in the area, with nearshore habitats and early life stages of forage fish and salmonids.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|--------------------------|
| Do Not Fund | Do Not Fund | Not Reviewed | Do Not Fund | Not Applicable Withdrawn |

Science Panel Comments – FY20

Date: September 2019

The Panel recognizes the potential value of filling a gap in the GWA program, though the proposal was cursory. It fell short of building a compelling case for gathering this basic information. The panel needed more information on the methods to properly evaluate whether the data would be robust enough to adequately meet proposed objectives, including sample size, sampling frequency, specifics on nutrient collection and processing and how specific locations will be selected (will particular sediment types be selected? Vegetated or unvegetated?). The utility of sampling fish stomachs collected by anglers at the derby is unclear. A flowmeter placed in the mouth of the plankton net is standard practice to accurately quantify volume of water sampled.

PI Response (9.26.19):

Thank you for recognizing the potential value of this proposed work. We appreciate the opportunity to provide additional information. Our goal is to develop methods for measuring nearshore fish community sensitivity to ecosystem changes that will compliment current GWA (and EPSCoR Fire and Ice) monitoring efforts.

Sample size, frequency and locations

The GWA Environmental Drivers team conducts monthly sampling that captures oceanographic variability, including plankton, along the Bay's axis (SW to NE) and the Bay's width (S to N). Through this sampling, patterns of marine and freshwater inputs and circulation patterns that influence ocean habitat variables, such as temperature and salinity, as well as biological sensitivities measured through plankton (phyto and zoo) responses have emerged (Holderied and Shepherd 2017¹). The patterns indicate broad differences between the inner Bay and outer Bay, and also between the northern portion of the outer Bay and the southern portion. These patterns can be used to identify four potential "oceanographic habitat" zones in the Bay (see attached Figure). The outer, mid and inner Bay zones align with GWA zooplankton stations. Spatially, the zooplankton station in the outer Bay is much farther from the nearshore, so we have stations located on both the northern and southern coasts in the outer Bay in order to address variability in across-bay environmental drivers. Within each of these zones, we will sample nearshore fish communities in benthic habitats that are

recognized as being important by the NOAA Essential Fish Habitat program and documented in the NOAA Nearshore Fish Atlas: eelgrass, kelp beds, sand and gravel and bedrock habitat types (NOAA Fisheries 2019). Overall sample size will be dependent on the number of different habitat types within each zone. From our pilot studies and knowledge of the Bay, we anticipate that not all the oceanographic zones in the Bay will have all four habitat types. However, most zones will have at least three of the four habitat types. Therefore, at a minimum, sample size will be: 4 zones x 3 habitat types= 12 sites.

Sites will be repeatedly sampled according to the monthly tide cycle (at perigee, approximately once a month) from May through October in 2020 and 2021. We anticipate that this sampling frequency will adequately capture temporal variability based on our pilot studies, and this frequency corresponds to both the EPSCoR Fire and Ice project and GWA sampling frequency.

Our pilot studies standardized sampling each of six sites to within two hours of the low slack tide. Since the number of proposed sites here is potentially twice that, we expect an increased strain on sampling time so we will sample sites at any tide. Although this adds tidal variability to our sampling, we are afforded more hours per day to successfully sample all sites during the project. Additionally, we will be able to test the influence of tide level (i.e., low, mid, high) and tide action (i.e., flood, slack, ebb) on overall fish community by simply recording this information during sampling or including it from NOAA tide datasets. We will stratify the order each site will be sampled each month to reduce bias (e.g., the seagrass habitat in the inner-bay zone will not always be the sampled as the first site nor only at low tide). We believe this to be the most practical approach to carry out the sampling design considering the number of days we expect sampling will be delayed due to weather.

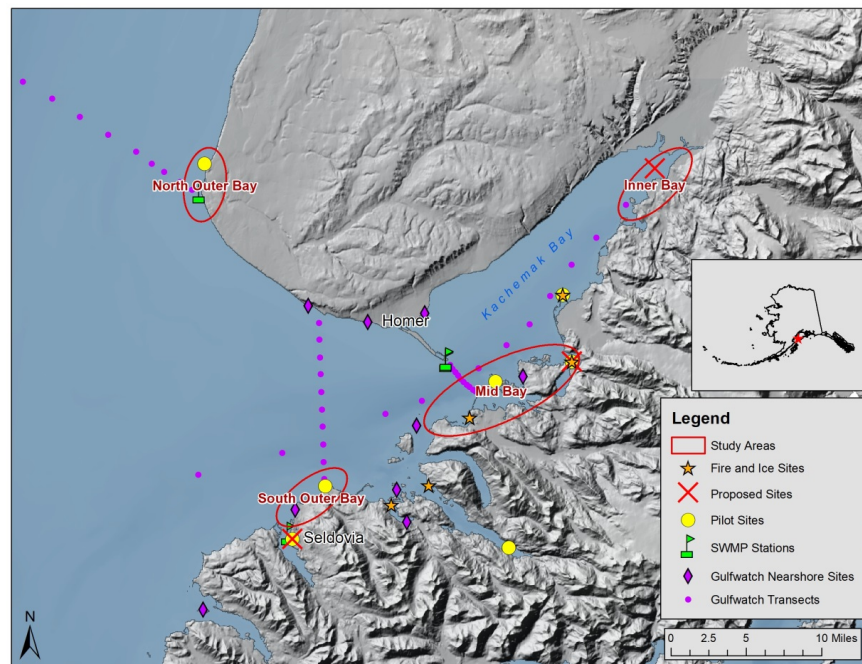


Figure showing oceanographic habitat zones identified through the GWA program. Within each zone, 3-4 different benthic habitat types will be sampled monthly.

Assessing effects of forage fish change

Our focus is on developing metrics for nearshore fish forage species and salmonids that can be used to detect spatial and temporal sensitivity to environmental changes. Using key species, such as cod, sand

lance, herring and salmon, that we know are significant to marine bird, mammal and fish predators, we will develop an index of relative abundance in the different habitats and zones, compare differences and similarities across the Bay, and identify metrics that are sensitive to environmental changes and can be used to track relative population composition changes over time.

After further consideration, we agree with the reviewers that a direct connection between stomach contents of angler caught predator fish (King salmon) and nearshore forage fish, may be difficult to establish for the scale of this project. However, we do encourage the EVOSTC to consider this approach for monitoring changes in forage fish community composition through predator fish diet monitoring in the future. (It would be similar to the approach used by the Hatch GWA Pelagic Component project to measure forage species community composition from seabird diet data at Middleton Island, with the added benefit of incorporating citizen scientists.)

Details on nutrient sampling and processing:

Water sample collection - During each sampling event, surface and bottom water samples will be taken using three blacked-out 1L Nalgene bottles that will be rinsed three times with ambient water then used to collect three separated water samples for both surface and bottom depths. These water grabs will be used to measure nutrient content, chlorophyll A, and suspended solids. Samples will be kept in a cooler with ice packs and immediately brought back to the laboratory for analyses preparation.

Nutrient analysis – Sample nutrients will be prepared at KBNERR’s laboratory, then sent for analysis at the Virginia Institute of Marine Science (VIMS), where NERRs System Wide Monitoring Programs (SWMP) have their samples processed. In sample preparation, glass syringes are fitted with 0.45µm perforated filters, filled with at least 30 mL of sample, then filtered into Starstedt vials with 27 mL. All glassware and sample filtering equipment are triple rinsed with de-ionized water, then triple rinsed or primed with sample. After filtering, samples are kept in a freezer (-20 °C) until sent for analyses. Sample processing occurs at VIMS in accordance to the NERR’s SWMP protocols (VIMS 2009). These protocols are based on methods established by the US EPA (Arar, Budde, and Behymer 1997). Four nutrient analyte measurements will be returned: Ammonia (NH₃), Nitrite + Nitrate (NO_x), Silicates (Si), and Orthophosphate (OPO).

Suspended solids - Total suspended solids (mg/L) will be measured at KBNERR’s laboratory in accordance to the NERR’s SWMP protocols (VIMS 2009). Water samples will be filtered on a vacuum manifold (5-7 psi) through pre-weighed 0.45 µm Whatman GF/F filters. One L sample will be run through the vacuum until “dry”. Filters will be stored in a freezer (-20 °C) or immediately placed in oven at 60 °C to be dried for at least four hours. After which, filter weight will be recorded. If the weight is not within 0.5 mg of the first weight, then filters will be returned to the oven to dry for one hour. Drying and re-weighing will continue until samples reach a constant weight.

Plankton sampling

Plankton sampling will include both phytoplankton and zooplankton, following similar procedures to those employed by the GWA Environmental Drivers team, including the use of flow meters to measure water volumes, with one modification. Plankton will be sampled in a horizontal tow through the water column, rather than a vertical tow because of the shallower depths encountered in the nearshore area. This modified zooplankton sampling technique should allow for comparisons between plankton sampled in deeper locations (Rob Campbell, GWA PI, pers. comm.).

¹ Holderied, K. and J. Shepherd. 2017. Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay to understand recovery and restoration of injured near-shore species. Annual Project Report. 2017-17120114J.

¹ Nearshore Fish Atlas of Alaska. NOAA Fisheries. 2019.

<http://www.fisheries.noaa.gov/alaska/habitat-conservation/nearshore-fish-atlas-alaska>. Website accessed: 9-25-19

Science Director Comments – FY20

Date: September 2019

The quality of the data and applicability may be of value to TC-funded programs and for other trustee agency work. However, I have several concerns and concur with the Science Panel's comments.

The analyses described to examine fish community composition and species abundance are routinely applied for these types of analyses and would be appropriate. However, I did not see any details on how forage fish data from sampling king salmon stomachs will be analyzed and ground-truthed. How will these stomach samples be compared to beach seine samples to determine if king salmon diet sampling is a cost-effective method to study nearshore forage fish availability?

PI Response (9.26.19):

We recognize the concerns about connecting angler caught king salmon stomach contents to nearshore beach seine samples, and agree that it is probably best not to include it in this proposal. This idea is probably best suited for a separate project that can assess forage fish utilization in a broad area (Kachemak Bay, Lower Cook Inlet) by predators such as king salmon. This piece of our original proposal was designed to get samples opportunistically from angler citizen scientists, and to fill a gap in understanding how changes in forage fish potentially affect predators. Dropping this from our proposal will not change the other outcomes.

The beach seine protocol for this project will be different from that used by the Epscor Fire and Ice project. The proposal states that the differences between the projects will be assessed to determine which protocol is most efficient and effective. If it is discovered that the Fire and Ice protocol is more efficient and effective, will this project change its protocol accordingly? Is there a way to calibrate the beach seine data for comparisons if needed or warranted?

PI Response (9.26.19):

The protocols that we proposed are based on NOAA nearshore fish assessments, and are the similar to protocols used in the past for assessing nearshore fish in the Kachemak Bay area. The Fire and Ice project is using different protocols, and one of the primary differences is that their nets have a larger mesh size. During pilot studies this year, we have been able to qualitatively compare catches, and it appears that the Fire and Ice samples are not capturing larval stages of fish because the mesh size is too big. We anticipate that this is one of the biggest differences between the protocols. In order to assess differences, we will compare the area seined (effective net length x distance sampled), removing all fish smaller than the Fire and Ice seine mesh size from the comparison. Another big difference in protocols is that Epscor measures effort by time sampled. If necessary (as in, we cannot translate Epscor sampling to area) we can approximate a measure of time for our sampling. We will

then consider the pros and cons of the two protocols and work with GWA PIs to evaluate which protocol would be most appropriate for use in long term monitoring.

There are 5 goals for this project that are to be accomplished in a two-year time frame. This seems unrealistic to me. Are there other project personnel that are not listed in section 9 of the proposal that will be dedicated to this project? In the budget workbook most of the funding requested is allocated for personnel not listed in the proposal. What are the project roles of the research technicians listed in the budget? And who will be responsible for the 9 deliverables listed in Section 5.

PI Response (9.26.19):

Objectives 1, 2 and 3 are the core sampling efforts for this project.

Objective 4 relates to determining trends in fish communities based on results from Objectives 1-3. This may be over reaching, and would more appropriately be an objective for a future study.

Objective 5 relates to potential prey and diets of nearshore forage fish. We agree that this may be too much for a two year study, and propose to remove the fish diet (in forage fish and predator fish) component of the objective. We believe that exploring prey availability through zooplankton analysis could be achieved through this proposal, and would provide valuable information for comparisons with ongoing GWA sampling.

PI Coowe Walker will provide leadership for product deliverables 1-5, synthesizing project outputs and outcomes and disseminating information with project partners and colleagues. For product deliverables 1-2, PI Steve Baird will be responsible for data management, analysis, and sharing. Research technicians will be responsible for leading field sampling, data management, analysis, protocol validation, data sharing, and presentation and product development.

For deliverables 6-9, KBNERR's Coastal Training Program Coordinator, Syverine Bentz will provide leadership for engagement and education on the project. Education specialists will be responsible for translating science content and assisting education and communications specialist with development of outreach, education and training materials. Budget for these deliverables will be provided by KBNERR.

The proposal aims to determine temporal trends in fish community structure and the influence of different habitat features on fish community trends. Given that this is only a two-year project, is it really feasible to detect any meaningful trends?

PI Response (9.26.19):

We agree that it would be premature to be able to detect meaningful interannual variability trends with a two year study. However, since we are sampling every month for two years, we will be able to measure seasonal (monthly level) trends¹. In terms of habitat, two years should be adequate for determining spatial trends in zone and habitat based on the proposed design.

It is also noted that the overhead rate for KBNERR for this basic project is relatively high compared to existing Trustee Council funded projects (~53%).

PI Response (9.26.19):

KBNERR is currently a partner on GWA oceanographic studies, and that project is administered under the Cooperative Ecosystem Studies Unit (CESU) rate of 17.5%. However, the University administration has noted that this CESU agreement has expired, and no new projects can be administered between UA and EVOSTC until it is renegotiated.

¹ Robards MD, Piatt JF, Kettle AB, Abookire AA. 1999. Temporal and geographic variation in fish communities of lower Cook Inlet, Alaska. Fishery Bulletin: volume 97, issue 4.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

Project Number: 20200127

Project Title: Gulf Watch Ocean Acidification Sampling

Primary Investigator(s): Jeff Hetrick, Rob Campbell, Steve Baird, Wiley Evans

PI Affiliation: Alutiiq Pride Shellfish Facility, PWSSC, KBNERR, Hakai Institute
Project Manager: NOAA

EVOSTC Funding Requested FY17-21: \$68,600

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|----------|----------|
| \$0 | \$0 | \$0 | \$34,300 | \$34,300 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$68,600

Total Non-EVOSTC Funding (FY17-21): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 9/16/19, budget updated 9/16/19.*

The Chugach Regional Resources Commission (CRRC) operates the Alutiiq Pride Shellfish Hatchery (APSH) and the Alaska Ocean Acidification Laboratory in Seward, Alaska. This project would incorporate ocean acidification sampling into the Gulf Watch Program currently funded by *Exxon Valdez* Oil Spill (EVOS) Trustee Council (TC). The Gulf Watch program, through its routine sampling, would add the collection of ocean acidification samples to several of its sampling sites. This would add to the current data set from these sites and offer a broader understanding of ocean acidification in the Prince William Sound and Lower Cook Inlet. The Prince William Sound Science Center (PWSCC) and the Kachemak Bay National Estuarine Research Reserve (KBNERR) are current partners in the Gulf Watch program and routinely conduct marine (vessel) sampling transects on a time series. The cost to sample and process ocean acidification samples (\$34,300 per year) would be the only additional cost to the PWSCC and KBNERR existing programs and would go directly to CRRC.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Fund | Fund | Not Reviewed | Fund | Fund |

Science Panel Comments – FY20

Date: September 2019

This project is straightforward, low-cost and important in understanding climate change. Interannual and seasonal trends may be examined. Why is BIA funding being discontinued?

PI Response (9.27.19)

The BIA funding was for a "Landscape Conservation" grant which provided funding for two years. The grant program was only available for two years. BIA has held the grant up as a template for successful projects. CRRC has chosen to fund our Community Sampling program through internal funds and our E.P.A. Indian General Assistance Program (IGAP) water quality program.

Science Director Comments – FY20

Date: September 2019

The costs are relatively low, given that the request for funding is for processing of samples and 1-month FTE director salary for oversight of the project. The PIs have extensive experience with collecting and analyzing ocean acidification data, and the Ocean Acidification and Research lab is located in the Alutiiq Shellfish Pride Hatchery (ASPH) which has been operating since 2012 and processing water samples for 12 partners throughout Alaska with results in .001% accuracy. Alaska Ocean Observing System already manages and houses data from the ASPH lab; thus the familiarity with the data will make for streamlined data management by the TC-funded Data Management Program. The PI should note that the TC-funded Data Management Program will be providing services for managing all TC-funded projects. As written, the proposal does not include when data will be posted and available online. If this project is funded, the PIs will work with the Data Management Program Team to submit data according to their timelines.

PI response (9.27.19)

All of our data from processed samples, when finalized, is available to our partners on google docs. Our continuous monitoring program is part of IPACOA which AOOS is a part of and that data is available zero time. Our discrete sampling program data is shared with our partners and they can choose to make it public if they choose. I'm sure we can accommodate any data reporting requirements from EVOSTC.

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

Project Number: 20200128

Project Title: Status and Trends of Marbled Murrelet, Kittlitz's Murrelet, and Pigeon Guillemot in a Changing Northern Gulf of Alaska Ecosystem

Primary Investigator(s): Tuula Hollmen, John Maniscalco, Marc Romano, Erik Osnas

PI Affiliation: ASLC, USFWS

Project Manager: USFWS

EVOSTC Funding Requested FY17-21: \$320,900

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-----------|-----------|
| \$0 | \$0 | \$0 | \$160,700 | \$160,200 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$14,700

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|----------|------|
| \$0 | \$0 | \$0 | \$14,700 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$320,900

Total Non-EVOSTC Funding (FY17-21): \$14,700

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 11/1/19, budget updated 11/1/19.*

We propose to study status and trends of marbled murrelet, Kittlitz's murrelet, and pigeon guillemot along the Kenai Peninsula Coast, an important concentration area for these species and a region impacted by EVOS. Our overall goal is to provide information about trends in abundance and productivity of injured seabird species that are not recovering from EVOS or whose recovery status is unknown, thus supporting the EVOSTC in assessment of their recovery status. Our study builds on data from surveys conducted in Kenai Fjords in 2006-2008 and from year-round surveys conducted in Resurrection Bay since 2011, and offers a unique opportunity to assess status of these three seabird species at a comparison site in Kenai Fjords. Our objectives are to 1. Estimate current population sizes and decadal trends in abundance, 2. Characterize abundance patterns and identify factors influencing patterns, and 3. Estimate productivity trends. Knowledge gained about population levels and trends in productivity will provide information to assess recovery status of these species. Our results will be comparable to surveys conducted in other regions, making the data usable in integrated modeling efforts in the EVOS area. Robust survey protocols provide high statistical power to detect trends, identify patterns of change, and understand determinants of habitat quality in the rapidly changing fjord environments. Our project builds a team of expertise and partnerships among multiple state and federal agencies, private non-profit entities and the university to accomplish scientific, management, and education objectives outlined in the proposal.

FY20 Funding Recommendations for Proposal Dated 11/1/19 (February 2020):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|-------------|--------------------|---------------------|
| Do Not Fund | Do Not Fund | Do Not Fund | Do Not Fund | Fund Contingent* |

*Recommends a fund contingent upon the integration of proposals 20200128 and 20200130 and addressing external and agency reviewers', and Science Panel's concerns and comments as determined by the Science Director, in coordination with Trustees. Fiscal year start for this project will be FY21.

FY20 Funding Recommendations for Revised Proposal Dated 9/27/19 (October 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|-----------------|--------------------|-----------------|
| Not Reviewed | Defer to TC | Not Reviewed | Defer to TC | Deferred |

FY20 Funding Recommendations for Revised Proposal Dated 8/16/19 (September 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|-----------------|--------------------|-----------------|
| Do Not Fund | Do Not Fund | Not Reviewed | Do Not Fund | Deferred |

Science Panel Comments on Revised Proposal Dated 11/1/19 – FY20

Date: December 2019

The Panel appreciates the external and agency reviews. The external reviewers' assessments and recommendations are consistent with the recommendations that the Science Panel offered on the original proposals in September. The Panel recently reviewed the revised proposals, considered the external and agency reviewers' comments, and offers the following recommendations below. These include specific recommendations for further follow up in a FY21 proposal (see bold text below) coordinated with other murrelet researchers.

The Science Panel feels that this revision is improved over the original proposal. The Panel agrees with one of the reviewers that this project has excellent outreach and education potential with its strong linkages to the National Park Service ranger program and the Alaska SeaLife Center. The Panel reiterates the recommendation for more explicit coordination with proposal 20200130 in regard to scientific collaboration, data sharing and standardizing methods.

The Panel recommends that the proposers of this project and proposal 20200130 integrate their proposals into one proposal that addresses the concerns (see Table 1) for review for FY21. We believe that this will ensure standardization of methods and analyses, and facilitate data sharing and collaboration. Power analyses would be helpful in this regard. Considering that the same biometrician is a co-PI on both proposals, this should be fairly easy to do. The Panel also recommends that the proposers address the peer reviewers' thoughtful comments and concerns, some of these are included in Table 1.

Table 1. List of tasks that the Science Panel would like to see achieved in a consolidated revised proposal for proposals 20200128 and 20200130 to be submitted for review for FY21. This will ensure standardization of methods and analyses, ensure their adequacy for detecting trends, and

facilitate data sharing and collaboration both among groups studying seabirds and between seabird groups and other EVOSTC funded projects.

| Section | Task |
|------------------|---|
| Hypotheses | Provide more explicit hypotheses: The Panel would like to see stronger hypotheses; there are some opportunities to develop these. For example, data will be collected for other species in proposal 20200128 but there is no discussion on how these data will be used. Also, the Statistical Methods section in proposal 20200128 lists some data that will be collected on other potential covariates. This could be another opportunity for testing hypotheses. |
| Goals | The Panel recommends the proposers investigate the impact of gill netting on recovery to the extent possible, as suggested by external reviewer 2. |
| Survey methods | The survey description in proposal 20200130 cites previous published works but still requires more details for the reader who is not as familiar with these methods. The Panel agrees with the agency reviewers' questions regarding number of surveys and the lack of a power analysis. |
| Data analysis | Power analysis to determine the best approach to deal with the high variance of KIMU and MAMU abundance, refining sampling frequency. The Panel shares external reviewer 1's minor concern of the lack of power analysis and discussion that likely could easily be addressed. |
| Data analysis | Power analysis - or other statistical methodology - for trend data to determine how many surveys and how many years' data are needed to detect a trend: One of the objectives in this proposal and in proposal 20200130 is to detect population trends. Have the PIs determined if five years of data is enough to detect a trend? If this is not sufficient time to detect a trend, the Panel then wonders about the value of these data. Specifically, what are the biological implications if regional differences in trends are, or are not detected. The Panel agrees with external reviewer 1's concern of being able to compare data over space and time; this is extremely important. |
| Data analysis | Address and discuss other factors that can affect the interpretation of the HY:AHY ratio to estimate murrelet productivity. The Panel shares external reviewer 1's concerns about the use of the HY:AHY ratio to estimate productivity for all proposals. This ratio seems to be standard practice, but its validity depends on some key assumptions. For instance, it can be influenced by high adult mortality, making productivity seem higher than it really is. However, the Panel recognizes that this ratio could be a useful indicator particularly when used in combination with abundance trends, provided that statistical tests of trends have sufficient statistical power to detect trends. |
| Data integration | Explicit integration with other trophic levels (and respective projects), especially forage fish. The Panel feels that integration with other trophic levels was weak, especially with (forage) fish. |

| | |
|------------------|--|
| Data integration | Strengthen stated connections with the herring and GWA programs. The Panel felt that the stated connections with the herring and GWA programs were minimal. |
| Collaboration | Build upon mentioned collaborations with M. Kissling and work done by K. Nesvacil. As one of the reviewers mentioned, there is an opportunity to collaborate with other researchers studying murrelets (M. Kissling and K. Nevascil). The Panel would like to see these collaborations described in more detail. |

Science Director Comments on Revised Proposal Dated 11/1/19 – FY20

Date: January 2020

I concur with the Science Panel's comments and recommendation. Combining this proposal with proposal 20200130 will facilitate standardization of methods and analyses as discussed to allow for meaningful analyses and comparisons between locations. The budgets for the two projects can remain segregated within a coordinated proposal. In summary, I recommend combining this project with 20200130 into one proposal which addresses the reviewers' and Science Panel's concerns for submission and review for FY21.

PAC Comments on Revised Proposal Dated 11/1/19 – FY20

Date: February 2020

The PAC concurs with the Science Panel's comments and recommendation.

Executive Director Comments on Revised Proposal Dated 11/1/19 – FY20

Date: February 2020

I concur with the Science Panel's comments and recommendation.

Science Director Comments on Revised Proposal Dated 9/27/19– FY20

Date: October 2019

The PIs have adequately addressed the Science Panel and Science Coordinator's concerns and submitted a revised the proposal as requested by individual Trustees. The PIs provided clarification on Objective 4, that the camera study for nesting birds is being treated as a "proof-of-concept" study to prove the utility of these monitoring methods for application in other remote regions of concern in Alaska. While the PIs provide justification for the camera study in their response and also have considerable experience in remote monitoring techniques of marine animals in Alaska, the nesting pigeon guillemot camera study was removed from the proposal as suggested. The PIs provide a sufficiently detailed description of the structure of the models in the revised proposal as requested. The revised proposal is strengthened and together with the existing long-term dataset, will allow this project to assess the status and trends of these three species that have not recovered from EVOS.

Science Panel Comments Proposal Dated 8/16/19 – FY20

Date: September 2019

The Science Panel viewed this as the strongest of the three murrelet proposals we reviewed. The Science Panel recognizes the value of assessing the status and trends of these three species but was concerned both about the details of the monitoring efforts in this proposal and the nesting

observation. Objectives 1-3 on monitoring distribution and abundance seemed attainable. The methods were well described and likely to yield the desired information. The existence of prior data will allow this project to assess the status and trends quickly rather than waiting for a new long-term dataset to emerge. Though statistical methods for these objectives were generally well described, the Science Panel did not fully understand the structure of the models that were to be compared by AICc and would request more explicit description to evaluate their utility.

PI Response (9.27.19)

We would like to thank the Science Panel and Science Coordinator for their thoughtful comments on our proposal. Our responses are inserted below, and revisions to address these comments are included in our revised proposal. We have revised the first paragraph in Section C (Data Analysis and Statistical Methods) to provide a more detailed description of the structure of the models.

The Science Panel had stronger concerns about Objective 4. We agree that the data would be valuable but are concerned about the methods used to obtain the data. For example, how feasible is it to climb trees to place cameras near nests and without disturbing birds?

PI Response (9.27.19)

In the past, most marbled murrelet nesting activity has been monitored through repeated (sometimes daily) site visits, including repeated tree climbing, by researchers whose studies have resulted in the acquisition of highly important data regarding murrelet nesting behavior, success and failure (e.g., Nelson and Hamer 1995; Nelson and Peck 1995). The use of modern technology in the form of HD trail cameras at marbled murrelet nest sites offers the opportunity to collect much more detailed (24/7) information with minimal disturbance because no repeat visits will be necessary after cameras have been placed. Cameras will only be retrieved after the fledging season. With only one site visit early in the season for camera placement, disturbance will be minimal and is not expected to result in any lasting effects on the murrelets. Although this technology is new, PIs on this proposal have several years of experience successfully collecting data on nesting seabirds and marine mammals in the proposed study area using a variety of remote still- and video-imagery.

How experienced are the investigators at doing this to ensure success?

PI Response (9.27.19)

Co-PI JM has extensive experience scaling old growth trees with tree spikes, harnesses, and other safety equipment. He is also very familiar with nesting habitat and related behavior of murrelets in forested areas. Movement in trees will be slow, methodical, and stealthy.

How often do batteries have to be replaced in cameras?

PI Response (9.27.19)

We use new Lithium Ion batteries in our cameras each season which last 3-5 months while recording >1000 images. Therefore, battery replacement will not be necessary during the entire nesting season.

The Science Panel suggests that this objective be removed from the proposal or more clearly justified (including assurance that sample sizes of observations will be sufficient to provide robust estimates).

PI Response (9.27.19)

While the research team has considerable experience in remote monitoring techniques of marine animals in Alaska, the application of these methods to nesting murrelets is new and being treated as a 'proof-of-concept'. Proving the utility of these monitoring methods will provide more detail on logistics to obtain sample sizes, ability to provide robust estimates of nesting activity, and their applicability in other remote regions of concern in Alaska. We have removed the nest monitoring component from objective 4 of our revised proposal.

Science Coordinator Note (9.27.19): Pls provide details regarding the procedural and scientific Methods, data Analysis and statistical methods for Objective 4: Monitor nesting of marbled murrelet and pigeon guillemot in Kenai Fjords and Resurrection Bay that is not included in this work plan. Please contact the EVOSTC office for more information.

Objective 6 was viewed by the Science Panel as being too vague and were left with the feeling that the integration of these data would be left to others unnamed in the proposal. Who's doing the population modeling and how would that be accomplished?

PI Response (9.27.19)

We have removed Objective 6 from our revised proposal and clarified in the project narrative that our goal is to provide data that can be integrated in data analyses of broader scope. Robust sampling method used in this project provide data that enable integration of results to surveys conducted at other locations, however, such integrated modeling efforts are beyond the scope of this proposal.

The panel was pleased by the many proposed connections to other EVOSTC projects (including the herring program), agencies and tribes.

PI Response (9.27.19)

We appreciate the feedback and would like to thank the reviewers again for the thoughtful comments.

The panel felt that a single comprehensive monitoring-focused project across the region could be of value. The Trustees may want to consider requesting a single comprehensive monitoring-focused project across the regions in the three proposals that does not include the nest monitoring due to high costs, feasibility issues and limited sample sizes.

Science Director Comments Proposal Dated 8/16/19 – FY20

Date: September 2019

I concur with the Science Panel's comments.

PAC Comments Proposal Dated 8/16/19 – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments Proposal Dated 8/16/19 – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

Science Director Comments on Revised Proposal Dated 9/27/19– FY20

Date: October 2019

The PIs have adequately addressed the Science Panel and Science Coordinator’s concerns and submitted a revised the proposal as requested by individual Trustees. The PIs provided clarification on Objective 4, that the camera study for nesting birds is being treated as a “proof-of-concept” study to prove the utility of these monitoring methods for application in other remote regions of concern in Alaska. While the PIs provide justification for the camera study in their response and also have considerable experience in remote monitoring techniques of marine animals in Alaska, the nesting pigeon guillemot camera study was removed from the proposal as suggested. The PIs provide a sufficiently detailed description of the structure of the models in the revised proposal as requested. The revised proposal is strengthened and together with the existing long-term dataset, will allow this project to assess the status and trends of these three species that have not recovered from EVOS.

Project Number: 20200129

Project Title: Population Trends and Nesting Ecology of the Marbled Murrelet in the Kodiak Archipelago

Primary Investigator(s): Robin Corcoran, Donald Lyons

PI Affiliation: USFWS, Oregon
State University

Project Manager: USFWS

EVOSTC Funding Requested FY17-21: \$962,700

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-----------|-----------|
| \$0 | \$0 | \$0 | \$249,900 | \$712,800 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$231,700

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-----------|-----------|
| \$0 | \$0 | \$0 | \$127,000 | \$104,700 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$962,700

Total Non-EVOSTC Funding (FY17-21): \$231,700

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 11/1/19, budget updated 11/1/19.*

Marbled Murrelets (*Brachyramphus marmoratus*) are declining throughout most of their range, including Alaska, and are listed as Threatened from California to British Columbia. An estimated 12,800–14,800 murrelets were killed by the *Exxon Valdez* Oil Spill (EVOS) in 1989 and this species has not met its recovery objective of an increasing or stable population following the spill. The decline likely has resulted from the combined cumulative impacts of climate-related changes in the marine ecosystem and human activities including logging, fisheries bycatch, and chronic and catastrophic oil pollution. We are seeking funding to initiate a three-year study (2020-2022) of the nesting ecology of the Marbled Murrelet and relationships to foraging locations in the Kodiak Archipelago. This study will determine summer population trends and an index of productivity for the species within the Kodiak Archipelago for comparison with long-term surveys conducted in other regions in the Gulf of Alaska, such as Prince William Sound and Cook Inlet. Regional comparisons of trends may shed light on why populations have been slow to recover from EVOS. We will attach transmitters to adult Marbled Murrelets to locate nests, evaluate habitat selection, and explore threats to nest survival. We will investigate two primary nesting habitats of the Marbled Murrelet in the archipelago: 1) old-growth Sitka spruce forest, and 2) steep-sloped treeless terrain. Locating and monitoring nests to quantify nesting propensity and survival will allow us to determine vital rates to improve population modeling, explore why the species has failed to recover, and identify how factors other than oil may be inhibiting recovery. This proposed study will result in the largest sample of Marbled Murrelet

nesters monitored to date within Alaska. Spatial data collected from transmitters will allow us to examine foraging associations that may explain the relationship between climate-related changes in the marine ecosystem and continued population declines.

FY20 Funding Recommendations for Proposal Dated 11/1/19 (February 2020):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------------------|--------------------------|--------------------------|
| Do Not Fund | Do Not Fund | Not Applicable Withdrawn | Not Applicable Withdrawn | Not Applicable Withdrawn |

FY20 Funding Recommendations for Proposal Dated 8/16/19 (October 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|--------------|--------------------|-----------------|
| Do Not Fund | Do Not Fund | Not Reviewed | Do Not Fund | Deferred |

Science Panel Comments on Revised Proposal Dated 11/1/19 – FY20

Date: December 2019

The Panel appreciates the external and agency reviews. The external reviewers' assessments and recommendations are very consistent with the recommendations that the Science Panel offered on the original proposals in September. The Panel recently reviewed the revised proposals, considered the external and agency reviewers' comments, and offers the following recommendations:

The Science Panel appreciates the amount of time and effort that went into crafting this proposal. However, the external reviewers' assessment that this project is overly-ambitious and costly aligns with the Panel's review of both the initial and revised proposal. The Panel also agrees with the external reviewers' conclusion that this project is understaffed for the amount of work proposed.

The Panel also expresses a number of other concerns. Specific comments include that Goal 1 (at-sea surveys) of the proposal appears to be already funded and will continue to be funded by Kodiak NWR. Thus, most of the cost is for the proposed nesting work (Goals 2 and 3). The Panel remains concerned about the ability of the minimal number of staff on the ground to cover the large study area proposed, especially when considering requirements to set up, maintain and monitor camera systems. The Panel is also concerned that the ability to meet Objective 6 (investigate depredation rates of adult marbled murrelets) depends upon ability to locate carcasses, which may be challenging. As noted by one of the reviewers, mortality of murrelets after VHF tagging is reported to be 34% (Peery et. al. 2006), which will compromise the ability to estimate vital rates (part of Goal 2).

On balance questions raised by the external reviewers and the Science Panel about the likely success of this project led the Panel to recommend against funding.

Science Director Comments on Revised Proposal Dated 11/1/19 – FY20

Date: January 2020

I concur with the Science Panel's comments and recommendation. I recognize the time and effort that went into revising this proposal and appreciate the decrease in funds requested for FY20. However, I recommend a do not fund as the concerns and questions raised by external reviewers

and the Science Panel about the likely success of this project outweigh any information that may be gained.

PAC Comments on Revised Proposal Dated 11/1/19 – FY20

Date: February 2020

Not Applicable

Executive Director Comments on Revised Proposal Dated 11/1/19 – FY20

Date: February 2020

Not Applicable

Science Panel Comments on Proposal Dated 8/16/19 – FY20

Date: September 2019

The Science Panel recognized the value of assessing the status and trends of this species but was concerned both about the details of the monitoring efforts in this proposal and the nesting observation. The Panel felt that the monitoring goal (goal 1) was reasonable, but prior data was a bit limited - essentially two data points. This limits the value of repeating this survey, though it is still valuable as a before - after - recovery comparison, as the PIs point out. The focus of this proposal on a single species also decreased the enthusiasm of the Science Panel for this proposal relative to the other two proposals (20200128 and 20200130) and the greater distance from the oiled region was somewhat of a concern. But the main concerns were the ambitious nature of the proposal, the large fund request, uncertainty about how many birds and nests could be sampled, and the utility of all the data to achieve the goals of the EVOSTC, despite being interesting academically. For example, how feasible would it be to tag 40 birds the first year and 80 in subsequent years? How feasible would it be to climb trees placing cameras 30 m away from nests and without disturbing birds? How experienced are the investigators at both tasks to ensure success? How often do batteries have to be replaced in cameras? Who is doing the population modeling and how would it be accomplished? Ultimately, the Science Panel was not convinced that the level of detail and justification provided in the proposal were sufficient to justify the large funding request. The Panel appreciated the link to the herring program. The Panel felt that a single comprehensive monitoring-focused project across the region could be of value. The Trustees may want to consider requesting a single comprehensive monitoring-focused project across the regions in the three proposals that does not include the nest monitoring due to high costs, feasibility issues and limited sample sizes.

PI Response (9.27.19) Please see below in Science Coordinator Comments-FY20

Science Director Comments on Proposal Dated 8/16/19 – FY20

Date: September 2019

I appreciate that there are substantial funds from other sources (\$139K- \$92.5K) to support this project for the first three years. I recognize the value of this project, but I share the Science Panel's concerns. This is an expensive project and I recognize that the equipment for this project is costly but required in order to accomplish the goals. In the budget form, 10 surveillance cameras will be purchased in FY20 and an additional 10 cameras to be purchased in FY21. These cameras are the highest cost line item in the budget at \$1800 each (\$18K for each year), is there a reason that the first 10 cameras cannot be reused in FY21? Is it because the first 10 tree nests identified in FY20 will be monitored in FY21 and the additional 10 cameras to be purchased in FY21 will be used for any new nests identified? Do murrelets exhibit nest-site fidelity?

Up to 40 murrelets will be tagged with transmitters in FY20, and up to 80 in both FY21 and FY22. What is the expected lifetime of the tags? Have these specific tags been successfully used before? Is there a reported failure rate due to transmitter failure or loss? What is the statistical justification for the sample sizes?

PI Response (9.27.19)

We thank the Science Panel and Science Coordinator for providing the opportunity to respond to comments on our proposed project, “Population trends and nesting ecology of the Marbled Murrelet in the Kodiak Archipelago.” We believe our proposal would directly address the Exxon Valdez Oil Spill Trustee Council goals and appreciate the opportunity to better describe the proposed work and resulting benefits.

An estimated 12,800–14,800 Marbled Murrelets were killed by the Exxon Valdez Oil Spill (EVOS) in 1989. This species has not met its recovery objectives and continues to experience population declines. By monitoring populations of Marbled Murrelets at-sea in the Kodiak Archipelago we will achieve the EVOS Trustee Council (EVOSTC) goal of “monitoring the recovery of resources from the initial injury.” Using radio-telemetry to track individual movements and cameras to monitor nests we can quantify vital rates and achieve the goal of “monitoring how factors other than oil may inhibit full recovery or adversely impact recovering resources.” Evaluating risk of predation and both marine and terrestrial habitat associations of Marbled Murrelets we can “collect data on physical and biological environmental factors that drive ecosystem-level changes.” Both the 1994 EVOS Restoration Plan and the Invitation for Proposals 2017-21 emphasize that the distinction between the effects of the spill and those of other natural or human-caused stressors on injured resources is not fully understood. In our current rapidly changing and increasingly variable environment, the ability to distinguish the effects of the oil spill from other factors becomes more and more difficult. While generating population estimates and trends for non-recovered species within the spill zone are important, identifying current causes of declines are of equal value in achieving the goals of the EVOSTC. Data from our study will inform management strategies to adapt to current environmental conditions and address threats. Below, we respond to each concern raised by the Science Panel and Coordinator within the context of each of our three proposed goals.

Goal 1: Determine trends in summer Marbled Murrelet abundance and productivity within the Kodiak Archipelago. Compare to long-term surveys conducted in other regions, such as Prince William Sound.

Scope of inference and historical data in the Kodiak Archipelago

We focus our proposed study on the Marbled Murrelet to pursue a wholistic understanding of the factors affecting populations. We know almost nothing about nest ecology, adult survival, and diet of murrelets in Alaska. Using only at-sea productivity counts to assess reproductive success may be biased due to differences in detectability of juveniles versus adults and inability to account for emigration and immigration. Without evaluating stressors affecting the species within the terrestrial nesting environment, threat-analyses are incomplete. The archipelago has very high at-sea densities and inland flight activity by murrelets, and the terrain is more accessible in comparison to most other regions in Alaska where the species nests (highest peaks are <1400 m, no point on land is further than 24 km from the sea). The Kodiak Archipelago provides likely the most cost-effective study site for murrelets in Alaska. The accessibility of our study sites and the expertise of our project team give

us the best chance at identifying potential drivers of population change. Evaluating these drivers will shed light on why the species has failed to recover within the EVOS spill zone and is declining across its range in Alaska.

The Kodiak Archipelago is important breeding habitat in the Gulf of Alaska, and it also provides crucial wintering grounds. An estimated 17% of the Alaska population of Marbled Murrelets winters in the archipelago. Density estimates increase in winter, indicating movement into the region following the breeding season. For instance, Piatt and Ford (1997) estimated 21,900 as the breeding (May-July) population estimate for Marbled Murrelets in the Kodiak Archipelago, and 27,800 as nonbreeding (February-April, August-October). Annual at-sea winter seabird surveys were conducted at four major bay systems on Kodiak Island from 1986-2007 (Zwiefelhofer et al. 2008). During this period mean density estimates for Marbled Murrelets in the four bays ranged from 2.36-3.70 birds/km², with declining trends over time in three of the four survey regions (two of which were statistically significant). A very similar but more extensive at-sea Fall and Winter survey was conducted on Kodiak Island from 1979-1984, extending the data series (density estimates 3.6-11.1 birds/km²; Zwiefelhofer and Forsell 1989).

Multi-species at-sea monitoring and Marbled Murrelet nest monitoring

The current marine nearshore bird survey conducted by Kodiak National Wildlife Refuge (included as cost-share to our proposed study) is a multi-species effort. Similar to the other two EVOSTC murrelet proposals under review, our proposed project will have population estimates and productivity indices for Pigeon Guillemots, one of the most common breeding bird species in the Kodiak Archipelago and another species not recovered from the effects of the spill. Our survey will also establish breeding population estimates for Black Oystercatcher in the archipelago, a species considered to have very likely recovered from the oil spill, but for which data is lacking. Previous surveys by Kodiak NWR biologists in both winter and summer estimated comparable numbers of around 1,700 oystercatchers in 2005 (Tessler et al. 2007). Current nearshore marine bird surveys 2011-2016 estimate 1,410-1,958 oystercatchers in June. These population estimates represent approximately 13-18% of the estimated North American population for this species, indicating the archipelago as an important region for monitoring.

Unfortunately, Kittlitz's Murrelets are rarely sighted in the marine waters around the Kodiak Archipelago (Stenhouse et al. 2008, Madison et al. 2011) despite a nine-year nesting ecology study during which time 146 nests were monitored on the southwestern end of Kodiak Island (Lawonn 2012, Knudson et al. 2017). During coastal and marine bird surveys conducted by Kodiak NWR in May through August from 1984-2005 only 34 Kittlitz's Murrelets were recorded (see Appendix 1 in Stenhouse et al. 2008). Region-wide, the majority of the population of this species occurs outside the spill zone. The ratio of Marbled Murrelets to Kittlitz's Murrelets counted on transect in the current Kodiak marine bird surveys from 2011-2016 was 203:1. Due to the rarity of the species at-sea in the archipelago, we will be unable to determine reliable population estimates or trends. However, by evaluating threats to ground nests of the Marbled Murrelet we can identify those likely encountered by nesting Kittlitz's Murrelets in the archipelago.

Distance from spill location

During the breeding season it is estimated that most Marbled Murrelets (97%) in Alaska are concentrated in the Alexander Archipelago (62.9%), Prince William Sound (13.9%), and the Kodiak Archipelago (14.3%) (Piatt and Ford 1997). The Kodiak Archipelago is one of the most important

regions in Alaska for this species. The archipelago lies within the spill zone, but it was not as heavily directly impacted by the spill as Prince William Sound. Comparing Marbled Murrelet population trends in the archipelago to Prince William Sound in the absence of additional information on vital rates, however, is of limited utility.

Goal 2: Determine nesting locations, quantify vital rates, and evaluate threats to habitat and nest survival within the Kodiak Archipelago.

Nest Sampling: Sample size

We propose to examine habitat associations in forested and treeless habitat types by comparing habitat characteristics at nest sites to those at random near-nest control sites. The variability in habitat associations across each of the two major habitat types is currently unknown; prior work on Marbled Murrelet habitat associations anywhere in Alaska is limited. Consequently, conducting an *a priori* power analysis to determine adequate sample sizes to identify significant landscape and/or vegetation characteristics is not possible. Similarly, rates of murrelet nest failure are also not well known or documented, providing us little guidance on sample size needed to develop precise estimates of daily nest survival. An important reference point for determining sample size is a previous and similar study of Kittlitz's Murrelet nesting in the Kodiak Archipelago, where a sample of 53 nests resulted in significant findings on both habitat associations and breeding ecology (Lawonn et al. 2018a, 2018b). We determined our sample size goal of 100 nests across the study period (20 nests in year one and 40 nests/year in years two and three) as a compromise to maximize nest data obtained and safely exceed the aforementioned Kittlitz's Murrelet study sample size, while keeping capture and tagging requirements realistic. It would be our strong preference to have a more quantitative basis for our nest sampling sample size goal, but this challenge is a testament to how groundbreaking and valuable the proposed work would be.

Nest Sampling: Camera use, purchase, and deployment strategies

The Marbled Murrelet is a small diving seabird in the family Alcidae. Unlike other members of Alcidae, the species is a solitary and dispersed nester, making it difficult to assess nest site fidelity. Studies have documented multi-season use of up to 18% of nest trees by Marbled Murrelet, but have been unable to confirm use by the same individual across breeding seasons (Burger et al. 2009). Few radio telemetry studies have documented re-nesting by an individual following a failed attempt within one breeding season. In these instances, individuals have re-used the same forest stand, but use of the same nest tree has not been confirmed (Hébert et al. 2003). Our proposed project to track breeding Marbled Murrelets to nest sites in the Kodiak Archipelago will allow us to evaluate rates of re-nesting and subsequent outcomes of re-nesting attempts. Without an understanding of the rate of re-nesting, studies may underestimate reproductive output.

Marbled Murrelets may not reproduce every year (De Santo and Nelson 1995). Due to inconsistent breeding intervals and unproven nest site fidelity, cameras must be re-deployed to monitor nests in the archipelago each year of our study. Concentrating monitoring on nests of individuals currently wearing transmitters will provide a wholistic picture of reproductive ecology by allowing us to spatially identify marine foraging areas associated with nest observations (e.g., type and number of prey deliveries to chicks).

When we double our sample size of captured individuals in FY21 (from $n=40$ to $n=80$), we expect to find twice as many nests as FY20. We will then need twice the number of surveillance cameras to

monitor tree nests. All cameras purchased in FY20 will be used in FY21, but we will need an additional 10 cameras. Note that ground nests will be monitored using Reconyx digital game cameras purchased in the same quantities as surveillance cameras (10 purchased FY20, and an additional 10 purchased FY21). As stated in our submitted budget, all equipment purchased in FY20 with the exception of transmitters and Reconyx camera batteries will be reused in FY21 and FY22.

Nest Sampling: Camera placement and maintenance

Axis Bullet HD surveillance cameras monitoring tree nests will be installed at or slightly above nest height in an adjacent tree and will be connected via a Cat5e cable to a control box stored within a pelican case at the base of the tree (accessible from the ground). The battery to power the camera and a 1 TB hard drive recording video data will also be housed within the pelican case. These items can be accessed by ground-based field crews without disturbing the nest. Cameras will record 24-hour video. Batteries in surveillance video cameras on tree nests will need to be replaced by ground-crews every three to six days. All costs associated with charging and replacing these camera batteries are included in the budget. Ground-based field crews will use generators to charge camera batteries, and these yearly costs are included in the Field Camp Setup expenses in the commodities section of our budget. Batteries in Reconyx digital game cameras monitoring ground nests will only need to be replaced once or twice during the season.

The costs associated with our contracted tree-climbing service reflect expected time needed to install and remove cameras from discovered nests each year. These cameras are the same model used by the Oregon Marbled Murrelet Project, conducting a similar study radio-tagging murrelets along the Oregon Coast (2017-2019). Katelyn Stoner, Project Manager and PhD Student for this proposed project, was a Crew Leader for the Oregon Marbled Murrelet Project during the 2019 field season. She assisted a contracted tree-climber in installing these cameras in adjacent trees 30 m from discovered nest sites, as proposed in our methods.

Bird Sampling: Capture sample size

Our nest sampling sample size goal (100 nests over the course of the study) was an important criterion to help determine our capture sample size goal. To convert that nest sample into a capture sample, we accounted for both breeding propensity of captured and tagged murrelets, and the expected rate of tag failure and/or loss ($\leq 5\%$). Previous studies in Port Snettisham, Alaska, Desolation Sound, British Columbia, and Icy Bay, Alaska used radio telemetry to track Marbled Murrelets to nest sites and observed nesting rates of 41%, 65%, and 79% of all tagged birds respectively (Bradley et al. 2004, Barbaree et al. 2014, Kissling et al. 2015a). We set our capture sample size goal to reflect a conservative nesting rate of 50% within the Kodiak Archipelago based on these past findings. Consequently, we propose to deploy up to 80 transmitters per year to maximize the number of adults we can track and monitor while keeping capture efforts realistic. This capture effort is consistent with prior murrelet tracking studies. When Kissling et al. (2015b) radio-tagged Kittlitz's Murrelets in Icy Bay, on average 7 murrelets were captured per night over the five-year study with an on-average high of 12 murrelets per night in 2010. Densities observed in areas where captures were conducted in Icy Bay are similar to those observed within our proposed study sites in the Kodiak Archipelago (Table 1).

Table 1. Murrelet at-sea densities observed at 2007-2012 capture sites in Kissling et al. (2007) and in proposed study sites in the Kodiak Archipelago.

| <u>Kodiak Archipelago June 2011-2016</u> | <u>Icy Bay July 2005</u> |
|--|--------------------------|
|--|--------------------------|

| | Foul (80km²) | Kaiugnak (150km²) | Sulua (40km²) | Main Bay (110km²) | Taan Fjord (24km²) |
|-------------------------------|--------------------------------|-------------------------------------|---------------------------------|-------------------------------------|--------------------------------------|
| Density birds/km ² | 6-10 | 3-8 | 7-8 | 8 | 16 |

Bird Sampling: Capture and tagging feasibility

We chose to include a pilot year with a goal of radio-tagging 40 birds to allow the capture team leeway in the first year to hone methods and identify specific capture locations within each study site. In the first year of our proposed study, capture efforts will be led by Michelle Kissling, PhD student at University of Montana (former Wildlife Biologist for USFWS), and Jenna Cragg, Province of British Columbia, Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Michelle Kissling has been studying wildlife and seabirds, primarily *Brachyramphus murrelets* in Alaska, for over 20 years. She has captured, handled, and processed over 1,200 murrelets on 150 capture nights, including over 300 VHF and satellite transmitter attachments, and has trained other researchers on these techniques. Jenna Cragg captured Marbled Murrelets for 17 capture nights from 2014-2016. Additionally, Katelyn Stoner, Project Manager and PhD Student for this proposed project, assisted with processing Marbled Murrelets during capture and transmitter attachment while working for the Oregon Marbled Murrelet Project in 2019; Donald Lyons, co-Primary Investigator, has multiple years of experience with nighttime at-sea captures and tagging of common murre and multiple cormorant species using similar methods. These combined experiences make the capture team well qualified to achieve success in capture and tagging efforts for the proposed study.

Bird Sampling: Tag specifications and resiliency

The transmitters (ATS A4330 Avian Prong and Suture, 2.5g) will last one breeding season attached to an individual. The expected battery-life of the transmitters (90 days) will be sufficient to monitor the movements of tagged adults throughout the breeding season. Our methods propose to attach transmitters using a subcutaneous anchor which will increase retention time over suture-only attachment methods without increasing disturbance to tagged individuals. Previous studies tracked individuals with transmitters attached by subcutaneous anchor for an average of 67 days and found that transmitters can remain attached for over 90 days (Whitworth et al. 2000, unpub. data, M. Kissling, U.S. Fish & Wildlife Service). As mentioned above, previous studies using radio telemetry to track Marbled Murrelets to nest sites observed nesting rates of 41%-79% (Bradley et al. 2004, Barbaree et al. 2014, Kissling et al. 2015a). All three of these previous studies attached transmitters using a subcutaneous anchor as we are proposing. The observed rates of nesting account for rates of tag-loss and allow us to predict high retention rates for our proposed study.

Vital rates and population modeling

Dispersed solitary nesting behaviors, cryptic plumage, and secretive movements suggest adaptation to predator avoidance by Marbled Murrelets. While at-sea monitoring alone may assess bottom-up influences on demography (e.g., variability in quality and quantity of available forage), these studies are unable to investigate rates of top-down population impacts from predators. We will investigate both influences on populations through the use of cameras to observe prey deliveries to chicks and predation events at nest sites. Our proposed project will increase understanding of predation pressure on survival of the Marbled Murrelet. Radio-transmitters will allow us to track depredated adults to nests or dens of avian or mammalian predators respectively. We can then quantify risk of predation for breeders and explore how that risk changes throughout the nesting cycle. Inland visitation of nest stands by Marbled Murrelets occurs year-round with the exception of periods coinciding with molt (Naslund 1993). It follows that threats, particularly risk of predation, experienced by Marbled Murrelets at nest sites can impact survival throughout the annual cycle.

Current population models of Marbled Murrelets are limited due to inadequate data on vital rates. Reliable demographic estimates and the factors that affect those rates are critical for population modeling (Peery et al. 2006). By tracking adults and monitoring nest sites, we can evaluate adult survival, reproductive success, and breeding propensity. We can then create a deterministic matrix population model for the Kodiak Archipelago building upon prior exploratory modelling efforts for this species (e.g., Peery and Henry 2010). Population modeling 2020-2022 will be conducted as part of Katelyn Stoner's PhD at Oregon State University under the direction of Dr. Donald Lyons. Objectives will include both estimating population growth rate (λ) and conducting a detailed sensitivity (elasticity) analysis to identify highly influential vital rates. Dr. Jared Laufenberg, biometrician in the USFWS Region & Inventory & Monitoring Program, is already analyzing the at-sea data collected from 2011-2016. We will coordinate with Dr. Laufenberg to standardize methods across years during this partnership to examine trends.

Goal 3: Determine drivers of nesting and foraging habitat selection at the individual and population levels.

Foraging sites and collaboration with Herring Monitoring Program

Understanding spatial relationships between terrestrial nesting sites and marine foraging sites we can inform conservation planning and management strategies. Using a combination of systematic at-sea surveys and marine home range delineation using VHF transmitter data we can identify and track shifts in marine hotspots. By observing prey species delivered to chicks, we can examine how murrelet diet reflects changes in oceanic climate regime shifts. We can compare observed prey deliveries to forage fish surveys currently conducted in PWS and lower Cook Inlet for the Long Term Monitoring Program examining forage fish distribution, abundance, and body condition (Arimitsu et al. 2018, EVOSTC Project 16120114-O, continuing as 19120114-C) to assess the relationship between prey availability and prey selection by Marbled Murrelets.

Thank you very much for your consideration of our proposal, "Population trends and nesting ecology of the Marbled Murrelet in the Kodiak Archipelago." Please contact us if any additional questions arise during your evaluation.

Science Coordinator Notes (9.27.19): Literature cited by the PI Response is not included in the work plan comments. Please contact the EVOSTC office for literature cited.

Science Coordinator Comments (10.11.19): The PIs provide detailed responses to comments and questions. They provide compelling evidence for the feasibility of this study through successful previous studies, the PIs' collective experience in the subject matter and partnerships with researchers who have extensive experience with tagging and working with marbled murrelets. The Science Panel questioned the utility of this project to achieve the goals of the Trustee Council. The PIs state that using radio-telemetry to track individual movements and cameras to monitor nests we can quantify vital rates (i.e., diet and predation at nest sites), and achieve the goal of "monitoring how factors other than oil may inhibit full recovery or adversely impact recovering resources." I appreciate the PIs' thoroughness in their responses, which I feel are adequate and instills confidence that this study will be successful. However, at this juncture, a revised proposal that includes the additional information requested would need to be reviewed. I stand by my Do Not Fund recommendation of the original proposal for FY20.

PAC Comments on Proposal Dated 8/16/19 – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments on Proposal Dated 8/16/19 – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

Project Number: 20200130

Project Title: Status and Recovery of Kittlitz's Murrelet and Marbled Murrelet within the EVOS affected area

Primary Investigator(s): Elizabeth Labunski, Robert Kaler, Kathy Kuletz, Erik Osnas

PI Affiliation: USFWS

Project Manager: USFWS

EVOSTC Funding Requested FY17-21: \$247,500

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-----------|-----------|
| \$0 | \$0 | \$0 | \$117,900 | \$129,600 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$97,500

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|----------|----------|
| \$0 | \$0 | \$0 | \$48,100 | \$49,400 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$247,500

Total Non-EVOSTC Funding (FY17-21): \$97,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 11/1/19, budget updated 11/1/19.*

Kittlitz's murrelet (*Brachyramphus brevirostris*) and marbled murrelet (*B. marmoratus*) are two seabird species that were impacted by the *Exxon Valdez* Oil Spill (EVOS), with an estimated 5-10% and 6-12% of the spill zone population killed by acute oiling, respectively (Carter & Kuletz 1995). Recovery status of Kittlitz's murrelets following the EVOS remains unknown, while marbled murrelets are considered to be not recovering (EVOSTC 2014). Kittlitz's murrelet became a candidate species for listing under the Endangered Species Act (ESA) in 2004 and was found not warranted for listing in 2013 due to insufficient or inconclusive knowledge, but remains a species of conservation concern for the US Fish and Wildlife Service (FWS). The marbled murrelet is more abundant and widespread in Alaska, but remains a species of conservation concern due to evidence of population declines (Piatt et al. 2007) and is listed as a Threatened species from British Columbia to California. Both murrelet species require at-sea surveys to obtain population estimates, as they do not nest in colonies, and nest sites are inland, cryptic, and difficult to find and monitor (Day et al. 1999; Kuletz et al. 2011a, 2011b). The overall goal of this project is to provide updated population trend information for both *Brachyramphus* species throughout the spill zone with our field work focused on Kachemak Bay and Lower Cook Inlet (LCI). Results will be compared to vessel-based surveys conducted at other EVOS impacted areas, including core murrelet sites (i.e., Kodiak Archipelago, Resurrection Bay, Northwestern Fjord, Prince William Sound) in southcentral Alaska (Fig. 1). This project will fully analyze existing murrelet survey data along with updated population estimates. Integrating data sets and assessing population trends over a broad range will inform the *Exxon*

Valdez Oil Spill Trustee Council (EVOSTC) efforts to determine recovery of these affected species. This would be the first proposed effort to bring together data on both murrelet species, in conjunction with oceanographic data, from all sub regions of the spill zone. We propose to conduct vessel-based surveys to update population trend data for Kachemak Bay, a region affected by the EVOS. Available historic data and the relative accessibility of Kachemak Bay murrelet populations provide a cost-efficient opportunity to examine decadal trends, patterns of distribution over time, and habitat use. Furthermore, historic and on-going oceanographic and zooplankton studies in the LCI region will enable us to examine potential influences of environmental conditions on murrelet trends.

FY20 Funding Recommendations for Proposal Dated 11/1/19 (February 2020):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|-------------|--------------------|---------------------|
| Do Not Fund | Do Not Fund | Do Not Fund | Do Not Fund | Fund Contingent* |

*Recommends a fund contingent upon the integration of proposals 20200128 and 20200130 and addressing external and agency reviewers', and Science Panel's concerns and comments as determined by the Science Director, in coordination with Trustees. Fiscal year start for this project will be FY21.

FY20 Funding Recommendations for Proposal Dated 8/23/19 (October 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|---------------|------------------|-----------------|--------------------|-----------------|
| Do Not Fund | Do Not Fund | Not Reviewed | Do Not Fund | Deferred |

Science Panel Comments on Revised Proposal Dated 11/1/19 – FY20

Date: December 2019

The Panel appreciates the external and agency reviews. The external reviewers' assessments and recommendations are very consistent with the recommendations that the Science Panel offered on the original proposals in September. The Panel recently reviewed the revised proposals, considered the external and agency reviewers' comments, and offers the following recommendations below. These include specific recommendations for further follow up in a FY21 proposal (see bold text below) coordinated with other murrelet researchers.

This proposal is similar to proposal 20200128 (but in a different geographic area) but with a less well-articulated statistical analysis. The Panel was also concerned that some of the goals were vague and unsubstantiated and could have benefited from a more thorough description of rationale, methods, and analytical approaches. The Panel appreciates the PI's response to cost sharing and recognizes the substantial funding support from FWS.

The Panel recommends that the proposers of this project and proposal 20200128 integrate their proposals into one proposal that addresses the concerns (see Table 1) for review for FY21. We believe that this will ensure standardization of methods and analyses and facilitate data sharing and collaboration. As with proposal 20200128, statistical power analyses would be helpful to address sampling questions and trend analyses. Considering that the same biometrician is a PI on both proposals, this should be fairly easy to do. The Panel also recommends that the proposers address the peer reviewers' thoughtful comments and concerns, some of these are included in Table 1.

Table 1. List of tasks that the Science Panel would like to see achieved in a consolidated revised proposal for proposals 20200128 and 20200130 to be submitted for review for FY21. This will ensure standardization of methods and analyses, ensure their adequacy for detecting trends, and facilitate data sharing and collaboration both among groups studying seabirds and between seabird groups and other EVOSTC funded projects.

| Section | Task |
|----------------|--|
| Hypotheses | Provide more explicit hypotheses: The Panel would like to see stronger hypotheses; there are some opportunities to develop these. For example, data will be collected for other species in proposal 20200128 but there is no discussion on how these data will be used. Also, the Statistical Methods section in proposal 20200128 lists some data that will be collected on other potential covariates. This could be another opportunity for testing hypotheses. |
| Goals | The Panel recommends the proposers investigate the impact of gill netting on recovery to the extent possible, as suggested by external reviewer 2. |
| Survey methods | The survey description in proposal 20200130 cites previous published works but still requires more details for the reader who is not as familiar with these methods. The Panel agrees with the agency reviewers' questions regarding number of surveys and the lack of a power analysis. |
| Data analysis | Power analysis to determine the best approach to deal with the high variance of KIMU and MAMU abundance, refining sampling frequency. The Panel shares external reviewer 1's minor concern of the lack of power analysis and discussion that likely could easily be addressed. |
| Data analysis | Power analysis - or other statistical methodology - for trend data to determine how many surveys and how many years' data are needed to detect a trend: One of the objectives in this proposal and in proposal 20200130 is to detect population trends. Have the PIs determined if five years of data is enough to detect a trend? If this is not sufficient time to detect a trend, the Panel then wonders about the value of these data. Specifically, what are the biological implications if regional differences in trends are, or are not detected. The Panel agrees with external reviewer 1's concern of being able to compare data over space and time; this is extremely important. |
| Data analysis | Address and discuss other factors that can affect the interpretation of the HY: AHY ratio to estimate murrelet productivity. The Panel shares external reviewer 1's concerns about the use of the HY:AHY ratio to estimate productivity for all proposals. This ratio seems to be standard practice, but its validity depends on some key assumptions. For instance, it can be influenced by high adult mortality, making productivity seem higher than it really is. However, the Panel recognizes that this ratio could be a useful indicator particularly when used in combination with abundance trends, provided that statistical tests of trends have sufficient statistical power to detect trends. |

| | |
|------------------|--|
| Data integration | Explicit integration with other trophic levels (and respective projects), especially forage fish. The Panel feels that integration with other trophic levels was weak, especially with (forage) fish. |
| Data integration | Strengthen stated connections with the herring and GWA programs. The Panel felt that the stated connections with the herring and GWA programs were minimal. |
| Collaboration | Build upon mentioned collaborations with M. Kissling and work done by K. Nesvacil. As one of the reviewers mentioned, there is an opportunity to collaborate with other researchers studying murrelets (M. Kissling and K. Nevascil). The Panel would like to see these collaborations described in more detail. |

Science Director Comments on Revised Proposal Dated 11/1/19 – FY20

Date: January 2020

I concur with the Science Panel's comments and recommendation. Combining the two proposals will facilitate standardization of methods and analyses as discussed to allow for meaningful analyses and comparisons between locations. The budgets for the two projects can remain segregated within a coordinated proposal. In summary, I recommend combining this project with 20200128 into one proposal which addresses the reviewers' and Science Panel's concerns for submission and review for FY21.

PAC Comments on Revised Proposal Dated 11/1/19 – FY20

Date: February 2020

The PAC concurs with the Science Panel's comments and recommendation.

Executive Director Comments on Revised Proposal Dated 11/1/19 – FY20

Date: February 2020

I concur with the Science Panel's comments and recommendation.

Science Panel Comments on Proposal Dated 8/23/19 – FY20

Date: September 2019

The Science Panel recognizes the value of assessing the status and trends of these two species but viewed this proposal as the weakest of the three murrelet proposals we reviewed. The proposal was similar in approach to the monitoring objectives of the other proposals (though geographically distinct) but was not as well developed as the other proposals. A substantial portion (\$130,000) of the total \$629,500 budget was allocated to the cost of vessel refurbishment or replacement of the vessel. As mentioned in overarching comments, integrating these monitoring objectives into a geographically comprehensive plan would be useful.

PI Response (9.28.19): We understand the reviewer's concerns of the costs associated with obtaining a vessel to conduct surveys. We will work cooperatively with the Alaska Maritime National Wildlife Refuge, based in Homer, to reduce costs by refurbishing their 25-ft whaler for under \$35,000. This reduction results in a total request for Year 1 of \$105,000.

The proposed July surveys would provide current population estimates for both murrelet species in Kachemak Bay. Data collected will be comparable to six years of historic survey data and will provide population trends for both species.

The study design and methods are also consistent with on-going and proposed surveys throughout the spill zone (PWS Marine Bird Survey project 20120114-M, previous Lower Cook Inlet surveys, and proposed Kenai Fjords and Resurrection Bay surveys). Having multiple long-term population and trends data for the EVOS region will allow us to evaluate the recovery status of Kittlitz's and marbled murrelets. Few areas have substantial populations of both murrelet species, and Kachemak Bay will be an important component of a more comprehensive plan.

Science Director Comments on Proposal Dated 8/23/19 – FY20

Date: September 2019

I concur with the Science Panel's comments. I appreciate that total contributions for contributed salaries and survey support are equal or greater to the proposed budget. However, the FY20 budget includes \$130K for vessel refurbishment or replacement for one vessel. Are there any other cost-effective measures that can be made? Any other entities in Homer that would be able to provide in-kind or reduced cost vessel services such as KBNERR or NOAA?

PI Response (9.28.19): See above.

Science Coordinator Comments (10.11.19): The recommendation for this project is a do not fund for FY20, but we suggest that this project be included in an integrated monitoring proposal or included within the GWA program to be reviewed at a later date.

PAC Comments on Proposal Dated 8/23/19 – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments on Proposal Dated 8/23/19 – FY20

Date: October 2019

I concur with the recommendations of the Science Panel and Science Director.

Project Number: 20200131

Project Title: Alaska SeaLife Center Facility Project

Primary Investigator(s): Tara Reimer

PI Affiliation: Alaska SeaLife
Center

Project Manager: ADFG

EVOSTC Funding Requested FY17-21: \$4,296,800

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-------------|------|
| \$0 | \$0 | \$0 | \$4,296,800 | \$0 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$4,296,800

Total Non-EVOSTC Funding (FY17-23): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 1/09/19, budget updated 1/09/19.*

The construction of the Alaska SeaLife Center in Seward, which opened in 1998 to conduct research, wildlife response, and public education, is the keystone legacy organization created as a result of the *Exxon Valdez* Oil Spill (EVOS). Nearly thirty years on, data continues to be produced indicating that habitat and ecosystem recovery remains constant, adaptations have been required, and more understanding is needed. To continue our research and restoration, ASLC must repair, replace, and improve our building infrastructure, life support, and research support systems. Provision from the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) for these projects is key to ASLC's mission to continue serving as a significant resource for generating and sharing knowledge that promotes understanding and stewardship of Alaska's marine ecosystems.

FY20 Funding Recommendations for Revised Proposal Dated 1/09/19 (February 2020):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|-----------------------------|-----------------------------|-----------------------------|
| Not Applicable | Not Applicable | Not Applicable Withdrawn | Not Applicable Withdrawn | Not Applicable Withdrawn |

FY20 Funding Recommendations for Proposal Dated 5/31/19 (October 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|--------------|--------------------|-----------------|
| Not Applicable | Not Applicable | Not Reviewed | Defer to TC | Deferred |

Science Panel Comments for Revised Proposal Dated 1/09/19 – FY20**Date: December 2019**

Not Applicable

Science Director Comments for Proposal Dated 1/09/19 – FY20**Date: January 2020**

Not Applicable

PAC Comments for Proposal Dated 1/09/19 – FY20**Date: February 2020**

Not Applicable

Executive Director Comments for Proposal Dated 1/09/19 – FY20**Date: February 2020**

Not Applicable

Science Panel Comments for Proposal Dated 5/31/19– FY20**Date: September 2019**

Not Applicable

Science Director Comments for Proposal Dated 5/31/19– FY20**Date: September 2019**

Not Applicable

PAC Comments for Proposal Dated 5/31/19– FY20**Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments for Proposal Dated 5/31/19– FY20**Date: October 2019**

Defer to TC

Habitat Enhancement Project Descriptions

Project Number: 20180117

Project Title: Kenai Watershed Forum (KWF) Stream Watch Program

Primary Investigator(s): Brandon Bornemann

PI Affiliation: KWF

Project Manager: USFWS

EVOSTC Funding Requested FY17-21: \$295,300

| FY17 | FY18 | FY19* | FY20 | FY21 |
|------|----------------|----------------|-----------|----------|
| \$0 | Auth: \$52,400 | Auth: \$47,100 | \$102,900 | \$92,900 |

*Requests include 9% GA. *FY19 funding was also approved on 9 April 2018 to accommodate for the FY19 Field Season.*

Funding from Non-EVOSTC Sources FY 17-21: \$125,500

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|-----------|------|------|
| \$0 | \$0 | \$125,500 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$99,500

Total EVOSTC Funding Authorized (FY17-19) and Reauthorized (FY20-21): 295,300

Total Non-EVOSTC Funding FY17-21: \$125,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 8/16/19.*

The proposed Kenai Peninsula Stream Watch Program (Project) is a grass roots volunteer program that seeks to address EVOSTC restoration plan goals of protecting and restoring riparian habitat and water quality through a comprehensive, interdisciplinary process focused on education and restoration. The program was originally forged by a group of concerned anglers and the United States Forest Service (USFS) in 1994 to address the fish habitat degradation occurring on the Russian and upper Kenai Rivers. Since the program's inception, these original sites have experienced dramatically less fish habitat degradation, which can directly be linked to Stream Watch activities. Due to the success of these sites and a growing need at others, the Stream Watch program expanded in 2011 and again in 2018 under the umbrella of the Kenai Watershed Forum (KWF) across the peninsula. Now celebrating its 25th anniversary, the Kenai Peninsula Stream Watch Program continues to follow its mission *to assist land management agencies with hands-on restoration projects and peer-to-peer education on the Kenai Peninsula* through directed volunteer labor. Volunteer activities leverage public land management efforts to *Restore Riparian Habitat and Water Quality* through coordination provided by volunteer coordinators. Overall program goals include:

- Protect riparian habitat by seasonally installing, maintaining, and removing habitat protective fencing (3+ miles in 2018).
- Protect riparian habitat by providing consistent educational messaging to river users across the peninsula to encourage river stewardship, utilizing social and print media, peer-to-peer interactions, and the maintenance of regulatory signage.

Restore critical habitat by removing habitat endangering debris (6,000lbs in 2018) on fresh water and coastal habitats and removing fish passage barriers as they arise

- Restore riparian habitat by conducting seasonal stream bank revetment projects in conjunction with agency partners.

Kenai Watershed Forum proposes this Project as a continuation of an EVOSTC investment in 2018 and 2019. Through support of the Council, KWF expanded the program into the southern peninsula to implement this nationally recognized program at extreme-high use sites in the area. EVOSTC can not only support existing efforts but amplify prior investments and ensure the valuable resources that Stream Watch activities provide remain available in the Southern Peninsula. These funds will provide the resources needed to implement three seasons of protecting, restoring, and enhancing critical riparian habitat on the Southern Kenai Peninsula, covering the costs of: volunteer coordinator personnel and travel, the development and distribution of educational interpretive resources and signage, and supplementing supplies and equipment needed volunteers to accomplish the comprehensive restoration and education activities.

FY20 Funding Recommendations (February 2020):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|------|--------------------|-----------------------------|
| Not Applicable | Not Applicable | Fund | Fund | Not Applicable Withdrawn |

FY20 Funding Recommendations (October 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|--------------|--------------------|-----------------|
| Not Applicable | Not Applicable | Not Reviewed | Fund | Deferred |

PAC Comments – FY20

Date: February 2020

[No comments.](#)

Executive Director Comments – FY20

Date: February 2020

[No comments.](#)

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

KWF is a well-respected organization that works to mitigate the impacts of recreational use in the important Kenai Watershed. The Kenai Watershed has been a focus of Council restoration activities for many years and this proposal adds a grace note to the Council's history of support of this productive riparian habitat.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------|---------------------|------|--------------------|-----------------|
| Not Applicable | Not Applicable | Fund | Fund | Fund |

PAC Comments – FY19**Date: September 2018**

No comments.

Executive Director Comments – FY19**Date: September 2018**

No comments.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------|---------------------|------|--------------------|-----------------|
| Not Applicable | Not Applicable | Fund | Fund | Fund |

PAC Comments – FY18**Date: April 2018**

No comments.

Executive Director Comments – FY18**Date: April 2018**

No comments.

Project Number: 20180119

Project Title: ADNR/DPOR Outreach Project

Primary Investigator(s): Rys Miranda, Shawna Popvici

PI Affiliation: ADNR/DPOR **Project Manager:** EVOSTC

EVOSTC Funding Requested FY17-21: \$151,700

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|-----------------|-------------------|----------|------|
| \$0 | Auth: \$102,600 | Reauth: \$102,600 | \$49,100 | \$0 |

Requests include 9% GA.

Funding From Non-EVOSTC Sources FY 17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$102,600

Total EVOSTC Funding Authorized (FY17-19) and Reauthorized (FY20-21): \$151,700

Total Non-EVOSTC Funding FY17-21: \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, date 8/23/19, budget updated 8/23/19.*

The EVOS Outreach and Education project proposal is for the purpose to continue the work the Exxon Valdez Oil Spill Trustee Council (EVOSTC, or the Council) has requested which includes interpretation and public outreach services within the Exxon Valdez oil spill area, on EVOSTC parcels, and/or on DPOR managed lands. This project will work to enhance EVOSTC's public outreach by informing and educating the public about the Exxon Valdez oil spill event, its lasting impacts to the State of Alaska, and its achievements to mitigate those impacts on spill-affected habitats, species, and services. Thus, new interpretive materials created will tell the story of the Exxon Valdez oil spill, the Council, and the habitat conservation, enhancement, and/or restoration projects that have taken place or are taking place at the identified sites. Final tasks will be identified by the EVOSTC office.

FY20 Funding Recommendations (February 2020):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|------|--------------------|-----------------|
| Not Applicable | Not Applicable | Fund | Fund | Fund |

FY20 Funding Recommendations (October 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|--------------|--------------------|-----------------|
| Not Applicable | Not Applicable | Not Reviewed | Fund | Deferred |

PAC Comments – FY20

Date: February 2020

[No comments.](#)

Executive Director Comments – FY20

Date: February 2020

[No comments.](#)

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

During 2018-2019 ADNR created excellent outreach products focusing on education about the spill, highlighting the Council's restoration activities. These interpretive panels/informational kiosks, films and presentations provide helpful information about varied recreational and fishing areas that have been preserved or enhanced by the Council for public use and access.

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------|---------------------|------|--------------------|-----------------|
| Not Applicable | Not Applicable | Fund | Fund | Fund |

PAC Comments – FY19

Date: September 2018

The PAC feels that this project provides excellent outreach. One PAC member is especially pleased with the use of interpretive panels and the fact that they give credit to the EVOSTC for this restoration work.

Executive Director Comments – FY19

Date: September 2018

No comments.

FY18 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------|---------------------|------|--------------------|-----------------|
| Not Applicable | Not Applicable | Fund | Fund | Fund |

PAC Comments – FY18

Date: April 2018

No comments.

Executive Director Comments – FY18

Date: April 2018

No comments.

Project Number: 20190124 WITHDRAWN

Project Title: PWS Instream Flow Protection

Primary Investigator(s): Joe Klein

PI Affiliation: ADF&G

Project Manager: ADF&G

EVOSTC Funding Requested FY19-23: \$494,400

| FY19 | FY20 | FY21 | FY22 | FY23 |
|-----------|-----------|----------|----------|----------|
| \$148,600 | \$84,800* | \$87,000 | \$83,700 | \$90,300 |

*Requests include 9% GA. *Includes additional request of \$500 for travel and \$500 for supplies in FY20.*

Funding From Non-EVOSTC Sources FY 19-23: \$230,000*

| FY19 | FY20 | FY21 | FY22 | FY23 |
|----------|----------|----------|----------|----------|
| \$58,000 | \$43,000 | \$43,000 | \$43,000 | \$43,000 |

**Uncommitted Leverage Resources*

Total Past EVOSTC Funding Authorized (FY18 & FY19): \$148,600

Total EVOSTC Funding Authorized (FY18) and Reauthorized (FY19-23): \$494,400

Total Non-EVOSTC Funding FY18-23: \$230,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/16/19, budget updated 9/3/19.*

The Alaska Department of Fish and Game (ADF&G) and the U.S. Forest Service (USFS) collaboratively propose to acquire the necessary hydrologic data and jointly file for reservations of water on identified priority streams and lakes within western Prince William Sound (PWS). Securing adequate instream flows in these priority reaches with reservations will provide protection for perpetuity to injured fish and wildlife habitats within these important areas affected by the *Exxon Valdez* Oil Spill. The objective of this project is to collect the hydrologic data needed to file reservation of water applications on two lakes and four streams to maintain healthy habitat for fish species and the services of subsistence and passive use affected by EVOS. This project will also benefit affected wildlife species dependent on healthy rivers and lakes, including bald eagles, common loons and river otters. Project objectives will be accomplished by collecting sufficient hydrologic data to meet DNR guidelines, quantifying instream flow requirements for fish species at various life stages and preparing reservation of water applications for submittal to DNR to protect fish and wildlife habitat, migration, and propagation.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|--------------|--------------------|--------------------------|
| Not Applicable | Not Applicable | Not Reviewed | Defer to TC | Not Applicable Withdrawn |

PAC Comments – FY20**Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20**Date: October 2019**

Defer to TC

FY19 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------|---------------------|------|--------------------|-----------------|
| Not Applicable | Not Applicable | Fund | Fund | Fund |

PAC Comments – FY19**Date: September 2018**

No project specific comments.

Executive Director Comments – FY18**Date: October 2018**

The ED has some reservations regarding this project and thus relies on trust agency support in recommending this project to fund.

Project Number: 20200132 WITHDRAWN

Project Title: Protecting Freshwater Resources in the EVOS Area from New Infestations of the Macrophyte Elodea spp.

Primary Investigator(s): Dan Coleman

PI Affiliation: ADNR

Project Manager: ADFG

EVOSTC Funding Requested FY17-21: \$1,795,800

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-------------|-----------|
| \$0 | \$0 | \$0 | \$1,007,100 | \$788,700 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$140,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|----------|----------|
| \$0 | \$0 | \$0 | \$95,000 | \$45,000 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$1,795,800

Total Non-EVOSTC Funding (FY17-21): \$140,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/23/19, budget updated 8/23/19.*

This proposal links aquatic invasive species infested waters in the Matanuska-Susitna Valley (Mat-Su) to Elodea-free freshwaters within the jurisdictional boundaries of the Exxon Valdez Oil Spill (EVOS). Urban and remote water bodies within Southcentral Alaska are connected by floatplanes. A vector for translocating aquatic invasive plants, floatplanes incidentally collect aquatic invasive vegetation at infested lakes and deposit fragments to the next lake visited, thereby introducing new species to the system. Common waterweed (*Elodea* spp.) is the first aquatic invasive plant detected in Alaska. Invasive populations are established in 19 water bodies, several of which are floatplane accessible. Once established, Elodea alters systems in ways that can support illegally introduced northern pike, threaten salmon, grayling and other native fish; and restrict access for sport, personal use and subsistence users. Barring eradication, widespread Elodea infestations within Alaska are expected to cause environmental impacts as well as economic losses to commercial fisheries and floatplane pilots estimated in the millions annually. Floatplanes are the primary mode of transport to Elodea-infested Alexander and Sucker lakes. To reduce traffic on these lakes, the Alaska Department of Fish and Game closed both to sport fishing in 2019. The closure was a hardship to commercial flight service providers that offer fishing tours to these waters. Lack of responsiveness to large source populations of Elodea, such as those in the Mat-Su which are known to be visited by floatplanes that consecutively utilize Kenai Peninsula waters, reduces the ability of the EVOS Trustee Council to protect habitat, species and previous investments in habitat restoration.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------------|-------------------------|--------------|---------------------------|-----------------------------|
| Not Applicable | Not Applicable | Not Reviewed | Defer to TC | Not Applicable Withdrawn |

PAC Comments – FY20**Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20**Date: October 2019**

Defer to TC

Project Number: 20200133 WITHDRAWN

Project Title: Using Early Detection and Rapid Response to Eradicate Elodea from the Kenai Peninsula

Primary Investigator(s): Kyle Graham

PI Affiliation: USFWS

Project Manager: USFWS

EVOSTC Funding Requested FY17-21: \$436,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-----------|------|
| \$0 | \$0 | \$0 | \$436,000 | \$0 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$53,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|----------|------|
| \$0 | \$0 | \$0 | \$53,000 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$436,000

Total Non-EVOSTC Funding (FY17-21): \$53,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 9/4/19, budget updated 8/22/19.*

Elodea is Alaska's first known submerged freshwater invasive plant. It is widely considered to be a threat to Alaska's salmon and freshwater resources with significant ecological and economic consequences. Under the right conditions, Elodea can alter water chemistry, degrade spawning habitat, hinder boat and float plane traffic, and reduce property values – all from the propagation of a single plant fragment. Fortunately, a number of organizations and concerned individuals are taking action and having success using Early Detection and Rapid Response (EDRR). This approach involves a highly collaborative process lead by the Kenai Peninsula - Cooperative Weed Management Area (KP-CWMA) and has resulted in the early detection of five infestations of Elodea followed by rapid treatment, resulting in the eradication of all known infestations on the Kenai Peninsula

The KP-CWMA was formed in 2003 by the Homer and Kenai Soil & Water Conservation Districts, in partnership with the U.S. Forest Service, the Alaska Department of Natural Resources Division of Agriculture, and private forestry groups. Today, KP-CWMA partners include state, federal, borough, non-profit(s), and a host of concerned citizens. Guided by the KP-CWMA Strategic Plan since 2007, partners meet quarterly, maintain a Kenai Peninsula Priority Invasive Plant List, a Reed Canary Grass Strategic Management Plan, and an Integrated Pest Management (IPM) Plan for Eradicating Elodea.

Collaborative revisions of this proposal, along with the pressing threat of Elodea, have sparked conversations within the Chugach National Forest and Kenai Fjords National Park; both federal

entities are currently exploring an internal programmatic NEPA approach to streamlining the environmental review process for new infestations.

The KP-CWMA partnership is requesting the financial support of the Exxon Valdez Oil Spill Trustee Council (EVOSTC) for costs related directly to rapidly responding to future Elodea infestations. At this time, the partnership is requesting the funding authorization only for \$436,000.00 annually. When an Elodea infestation is detected, the partnership will establish a site-specific work plan and detailed budget. These documents will be submitted to the Trustee Council through the EVOS Executive Director as part of the request to release the pre-authorized EVOSTC funds. This immediate funding will facilitate the rapid response needed for eradication success. In any given year, if Elodea is not detected on the Kenai Peninsula, the authorized funds will remain in the EVOS Trust Account.

Invasive species eradication is a landscape investment in existing functioning habitat and habitat restoration. The EVOSTC has significantly invested in a variety of projects on the Kenai Peninsula addressing EVOS injured resources or injured services. Given the severe and widespread degradation of habitat Elodea has when left unchecked, EVOSTC investment in Elodea eradication will maintain a healthy ecosystem and ensure the benefits of the existing EVOSTC-funded projects in the region.

FY20 Funding Recommendations:

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|--------------|--------------------|-----------------------------|
| Not Applicable | Not Applicable | Not Reviewed | Defer to TC | Not Applicable Withdrawn |

PAC Comments – FY20

Date: October 2019

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20

Date: October 2019

Defer to TC

Project Number: 20200134

Project Title: Parks Habitat Restoration and Protection Project – Diamond Creek, Izaak Walton, Slikok Creek

Primary Investigator(s): Rys Miranda

PI Affiliation: ADNR

Project Manager: ADFG

EVOSTC Funding Requested FY17-21: \$3,106,500

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-------------|------|
| \$0 | \$0 | \$0 | \$3,106,500 | \$0 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$3,106,500

Total Non-EVOSTC Funding (FY17-21): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 6/28/19, budget updated 6/28/19.*

This project will restore and protect habitat at three state park units that continue to be adversely impacted by human activities, including recreational access. Two park units, Izaak Walton and Slikok Creek are within the Kenai River Special Management Area and the (EVOS) area of impact. Diamond Creek SRS, an EVOSTC small parcel acquisition (KEN 29: Tulin Parcel), is also within the EVOS area of impact. Restoration and protection strategies at Izaak Walton and Slikok Creek will include elevated, light-penetrating (ELP) walkways and river access stairs to allow foot traffic to travel above sensitive riverbank and prevent impacting riparian resources. The Diamond Creek SRS component consists of developing a trailhead to manage access and human impacts to prevent further deterioration of habitat at the site. This overall project will benefit the injured resources Bald Eagle, Dolly Varden, Sockeye Salmon, and Pink Salmon and the injured services Recreation and Tourism.

FY20 Funding Recommendations (February 2020):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|-----------------------------|-----------------------------|-----------------------------|
| Not Applicable | Not Applicable | Not Applicable Withdrawn | Not Applicable Withdrawn | Not Applicable Withdrawn |

FY20 Funding Recommendations (October 2019):

| Science Panel | Science Director | PAC | Executive Director | Trustee Council |
|----------------|------------------|--------------|--------------------|-----------------|
| Not Applicable | Not Applicable | Not Reviewed | Fund | Deferred |

PAC Comments – FY20**Date: February 2020**[Not applicable.](#)**Executive Director Comments – FY20****Date: October 2019**[Not applicable.](#)**PAC Comments – FY20****Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20**Date: October 2019**

There has been broad support for habitat enhancement projects that the Council engages in with ADNR and also in combination with other state and federal agencies. These projects focus on areas of high public use, such as for hunting, fishing, recreation and subsistence activities and work to create durable infrastructures, such as light-penetrating, elevated walkways and riverbank restoration, to support and mitigate recreational and other uses of these important and fragile watersheds.

Project Number: 20200135

Project Title: Kenai River Special Management Area: Eagle Rock Facility Improvements

Primary Investigator(s): Rys Miranda

PI Affiliation: ADNR

Project Manager: ADFG

EVOSTC Funding Requested FY17-21: \$6,419,000

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|-------------|------|
| \$0 | \$0 | \$0 | \$6,419,000 | \$0 |

Requests include 9% GA.

Funding from Non-EVOSTC Sources FY 17-21: \$0

| FY17 | FY18 | FY19 | FY20 | FY21 |
|------|------|------|------|------|
| \$0 | \$0 | \$0 | \$0 | \$0 |

Total Past EVOSTC Funding Authorized (FY17-19): \$0

Total EVOSTC Funding Authorized (FY07-19) and Requested (FY20-21): \$6,419,000

Total Non-EVOSTC Funding (FY17-21): \$0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/20/19, budget updated 8/20/19.*

This project will develop the Bookey Parcel to augment the existing Eagle Rock Unit of the Kenai River Special Management Area. Improvements at the Bookey Parcel seeks to improve safety and habitat. The department is committed to providing safe access to recreational opportunities at its park units. Currently, parking at the existing Eagle Rock facility is very limited compared to the demand and overflows into a ditch line at the other side of the Kenai Spur Highway. Additionally, access into the facility is through a residential neighborhood. This project will remedy those two major issues by (1) constructing a 60-stall parking facility at the Bookey Parcel, suitable for truck with trailer design vehicle, and (2) constructing an access road directly off of Kenai Spur Highway, through the Bookey Parcel, and into Eagle Rock, completely bypassing the residential neighborhood. In addition to the safety improvements, this project will also protect habitat and improve managed access to the parcel's Kenai River frontage. Habitat protection will come in the form of elevated light-penetrating walkways and stairs to keep foot traffic off of sensitive riparian vegetation while maintaining access. Floating docks will also be constructed to help shield the riverbank from erosive boat-induced wave action. This project will benefit the injured resources Dolly Varden, Sockeye Salmon, and Pink Salmon and the injured services Recreation and Tourism.

FY20 Funding Recommendations:

| Science Panel | Science Coordinator | PAC | Executive Director | Trustee Council |
|----------------------|----------------------------|--------------|---------------------------|------------------------|
| Not Applicable | Not Applicable | Not Reviewed | Defer to TC | Fund |

PAC Comments – FY20**Date: October 2019**

The current term PAC members are in the process of being seated and thus a PAC meeting was not held in 2019.

Executive Director Comments – FY20**Date: October 2019**

Defer to TC