Exxon Valdez Oil Spill Trustee Council

DRAFT FY23 – FY26 Work Plan

Fiscal Year 2024

Draft 02.15.2023 rev06.26.2024

This document includes projects funded for FY23 at the October 13, 2021, and January 18, 2022, and decisions made on proposals reviewed at the October 5, 2022, and November 30, 2022, Trustee Council meetings.
This document also includes decisions made on budget reallocation requests reviewed at the January 26, 2024, Trustee Council meeting.
For all projects reviewed for FY22, please see the FY22 – FY31 Work Plan, Fiscal Year 2022.

Previous funding decisions made for FY27-FY31 will be revisited by the Trustee Council in FY26.

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EVOSTC Projects
Draft **FY23 – FY26** Work Plan
Prepared by:
Exxon Valdez Oil Spill Trustee Council

This work plan contains funds approved for FY23-FY26

CHAD VANORMER Regional Forester Forest Service, Alaska Region U.S. Department of Agriculture	CRAIG O'CONNOR Special Counsel National Oceanic and Atmospheric Administration U.S. Department of Commerce
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The *Exxon Valdez* Oil Spill Trustee Council administers its programs free from unlawful discrimination against any persons based on race, religion, color, national origin, age, sex, physical or mental disability, marital status, pregnancy, or parenthood. Each state and federal agency that implements programs funded by the Trustee Council also has legally mandated anti-discrimination policies that apply to any contracts entered into as a result of this FY2023 Work Plan. To obtain more information about the anti-discrimination policies of individual agencies, click on the link provided below for that agency.

USDA: http://www.usda.gov/wps/portal/usda/usdahome?navid=NON_DISCRIMINATION

NOAA: https://www.noaa.gov/organization/inclusion-and-civil-rights

USDOI: http://www.doi.gov//pmb/eeo/index.cfm

ADF&G: http://www.adfg.alaska.gov/index.cfm?adfg=home.oeostatement

ADOL: http://doa.alaska.gov/dop/eeo/

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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 2023 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
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FY24-FY26 Budget Reallocation Recommendations

Budget reallocation requests were submitted by the projects below and reviewed at the January 26, 2024, Trustee Council meeting. Please see project pages in this work plan for additional details. Unless indicated, the amounts do not include GA as funds have already passed through fiscal managing agencies. Please note that 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.

Long-Term Research and Monitoring Program

					FY24-26 Reallocation Recommendation			
Page	**Project Number**	**Principal Investigator**	**Project Title**	**FY24-FY26 Total Reallocation Requested**	**Science Panel**	**PAC**	**Executive Director**	**Trustee Council Approved**
15	2422LTRM	Lindeberg	LTRM Science Administration	$713,278	$713,278	$713,278	$713,278	$404,188
106	24120113	Janzen	Data Management Program (amount includes GA)	$81,373	$81,373	$81,373	$81,373	$81,373

General Restoration

Page	**Project Number**	**Principal Investigator**	**Project Title**	**FY24-FY26 Total Reallocation Requested**	**Science Panel**	**PAC**	**Executive Director**	**Trustee Council Approved**
184	24220508	Thielke	Standardized High-Resolution Wetlands and Hydrography Data	$1,000,448	Did not review	$1,000,448	$0	$1,000,448

FY23 – FY33 Proposal Funding Recommendations

The funding described in this document is for the EVOSTC Annual Budget and the 2222LTRM Program Management Project which were submitted in FY22 in response to the FY22-31 Invitation. FY22 funding was approved at the January 18, 2022, Trustee Council meeting. FY23-FY31 funding requests for both projects and FY32-FY33 EVOSTC Annual Budget were decided on at the October 5, 2022, Trustee Council meeting. Additional FY23 funding for project 23120113 was approved for required data management services for project 23120114-N at the November 30, 2022, Trustee Council meeting. Please note that 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.

Trustee Council Administration

									FY22-33 Funding Amount Recommended			
Page	**Project Number**	**Principal Investigator**	**Project Title**	**# Years Proposed**	**FY23-26 Requested**	**FY27-31 Requested**	**FY32-33 Requested**	**Total Requested**	**Science Panel**	**PAC**	**Executive Director**	**Trustee Council Approved**
8	23220100	EVOSTC Admin	EVOSTC General Operating Budget	11	$6,193,844	$7,095,951	$2,950,634	$16,240,430	Not Applicable	$16,240,430	Not Applicable	$6,193,844

Long-Term Research and Monitoring (LTRM) Program

Page	**Project Number**	**Principal Investigator**	**Project Title**	**# Years Proposed**	**FY23-26 Requested**	**FY27-31 Requested**	**FY32-33 Requested**	**Total Requested**	**Science Panel**	**PAC**	**Executive Director**	**Trustee Council Approved**
15	2322LTRM	Lindeberg	LTRM Science Administration	9	$734,634	$1,810,073	$0	$2,544,707	Did not review	$2,544,707	$734,634	$734,634
15	2322LTRM	Hoffman	LTRM Fiscal & Outreach Administration	9	$2,260,170	$3,204,731	$0	$5,464,901	Did not review	$5,464,901	$2,260,170	$2,260,170
74	23120114-N	Matkin	Killer Whale Monitoring	4	$385,359	0	0	$385,359	$385,359	Did not review	$385,359	$126,000
106	23120113	Janzen	Data Management Program	1	$12,780	0	0	$12,780	Did not review	$12,780	$12,780	$12,780
			LTRM TOTAL		**$3,392,943**	**$5,014,804**	$0	**$8,407,746**	**$385,359**	**$8,022,387**	**$3,392,943**	**$3,133,584**

	FY23-26 Requested	**FY27-31 Requested**	**FY32-33 Requested**	**Total Requested**	**Science Panel**	**PAC**	**Executive Director**	**Trustee Council Approved**
FY23 TOTAL (Fall 2022 Meeting Cycle)	**$9,586,787**	**$12,110,755**	**$2,950,634**	**$24,648,175**	**$385,359**	**$24,262,816**	**$3,392,943**	**$9,327,428**

FY23 – FY26 Approved Projects

The funding described in this table is FY23 – FY26 approved funding amounts for the EVOSTC General Operating Budgets and EVOSTC Projects. Please note that 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. These projects were approved at the Council's October 2021, January 2022, October 2022, and November 2022 meetings. Please see FY22 – FY31 Work Plan, Fiscal Year 2022 for recommendations for projects that were not funded for FY22. The Fiscal Year for this Work Plan is FY23.

Trustee Council Administration

Page	Project Number	Principal Investigator	Project Title	# Years	Project Years	FY23 Approved	FY24 Approved	FY25 Approved	FY26 Approved	Total for FY23-FY26
8	23220100	EVOSTC Admin	EVOSTC General Operating Budget	4	FY23-FY26	$1,509,651	$1,626,605	$1,472,312	$1,585,277	$6,193,845

Long-Term Research and Monitoring

Page	Project Number	Principal Investigator	Project Title	# Years	Project Years	FY23 Approved	FY24 Approved	FY25 Approved	FY26 Approved	Total for FY23-FY26
11	22110853	Kaler et al.	Pigeon guillemot restoration	1	FY23	$48,560	$0	$0	$0	$48,560
13	22210128	Hollmen, Labunski et al.	Status and trends of EVOS injured seabirds	4	FY23-FY25	$294,894	$252,595	$177,274	$0	$724,763
91	22220201	Branson & Hetrick-Price	Chugach Regional Ocean Monitoring Program	4	FY23-FY26	$529,451	$517,738	$558,054	$589,310	$2,194,553
98	22220202	Hauri	Continuation and expansion of ocean acidification monitoring	4	FY23-FY26	$138,800	$120,900	$123,400	$124,900	$508,000
102	22220203*	Rhea-Fournier et al.	Walleye pollock-Pacific herring interactions	4	FY23-FY26	$439,448	$397,465	$294,421	$451,606	$1,582,940
101	23120113	Janzen	Data Management	4	FY23-FY26	$394,207	$411,819	$401,524	$373,476	$1,581,026
14	2322LTRM	Lindeberg	LTRM Science Administration	4	FY23-FY26	$177,451	$181,530	$185,698	$189,955	$734,634
14	2322LTRM	Hoffman	LTRM Fiscal & Outreach Administration	4	FY23-FY26	$544,215	$558,974	$573,444	$583,537	$2,260,170
26	22120111-C	Branch	Modeling and stock assessment of PWS herring	4	FY23-FY26	$142,324	$157,049	$159,716	$164,729	$623,819
32	22120111-E	Hershberger	Herring disease program	4	FY23-FY26	$340,276	$349,558	$359,580	$373,970	$1,423,383
37	22160111-F	Morella	Herring surveys and age, sex, and size collection and processing	4	FY23-FY26	$194,336	$194,086	$172,224	$177,807	$738,452

41	22220111-I	Rand et al.	Ecological interactions between Pacific herring and Pacific salmon in Prince William Sound, Alaska	4	FY23-FY26	$264,567	$174,303	$177,990	$182,704	$799,563
46	22120114-C	Arimitsu & Piatt	Forage Fish Distribution, Abundance, and Body Condition	4	FY23-FY26	$320,312	$330,005	$340,091	$350,586	$1,340,994
52	22120114-D	Ostle & Batten	Continuous Plankton Recorders	4	FY23-FY26	$87,736	$89,928	$92,175	$94,477	$364,316
55	22120114-G	Campbell	Oceanographic Conditions in PWS	4	FY23-FY26	$256,008	$262,407	$268,967	$275,692	$1,063,074
59	22120114-H	Coletti	Nearshore ecosystems the Gulf of AK	4	FY23-FY26	$700,465	$734,488	$601,513	$607,275	$2,643,741
62	22120114-I	Danielson	GAK1 Monitoring	4	FY23-FY26	$154,018	$152,471	$204,638	$210,507	$721,634
65	22120114-L	Hopcroft	Seward Line Monitoring	4	FY23-FY26	$242,009	$248,059	$254,264	$231,089	$975,421
69	22120114-M	Kaler	PWS Marine Bird Surveys	4	FY23-FY26	$410,406	$93,483	$331,540	$102,037	$937,465
74	23120114-N	Matkin & Durban	Long-term killer whale monitoring	1	FY23	$126,000	$0	$0	$0	$126,000
83	22120114-O	Moran & Straley	Humpback Whale Predation on Herring	4	FY23-FY26	$203,430	$199,754	$204,337	$203,411	$810,931
87	22200114-P	Esler & Lindeberg	Lingering Oil Component Project	1	FY25	$0	$0	$10,242	$0	$10,242
					LTRM TOTAL	**$6,008,914**	**$5,426,611**	**$5,491,087**	**$5,287,069**	**$22,213,680**

*Project 22220203 was terminated in FY23.

Mariculture

Page	Project Number	Principal Investigator	Project Title	# Years	Project Years	FY23 Approved	FY24 Approved	FY25 Approved	FY26 Approved	Total for FY23-FY26
113	22220300	Hetrick-Price	PWS kelp mariculture development for habitat restoration and local economy	4	FY23-FY26	$614,545	$588,385	$621,085	$129,013	$1,953,028
125	22220301	Poe et al.	Social, cultural and economic assessment of kelp mariculture opportunities for coastal villages within the EVOS spill zone	4	FY23-FY26	$668,224	$727,174	$775,129	$667,528	$2,838,055
134	22220302	Hoffman et al.	Sustainable mariculture development for restoration and economic benefit in the EVOS spill area	4	FY23-FY26	$2,637,726	$2,637,783	$2,637,489	$2,637,285	$10,550,283
					MARICULTURE TOTAL	**$3,920,495**	**$3,953,342**	**$4,033,703**	**$3,433,826**	**$15,341,366**

Education and Outreach

Page	Project Number	Principal Investigator	Project Title	# Years	Project Years	FY23 Approved	FY24 Approved	FY25 Approved	FY26 Approved	Total for FY23-FY26
160	22220400	Wong	Community Organized Restoration and Learning Network	4	FY23-FY26	$2,508,119	$2,444,292	$2,445,434	$2,603,513	$10,001,358
167	22220403	Twardock	PWS natural history symposium	4	FY23-FY26	$19,179	$19,179	$19,179	$19,179	$76,716
170	22220405	Johnson	Preservation of subsistence and cultural practices for the Alaska Native people of the Chugach region	4	FY23-FY26	$189,170	$189,170	$189,170	$189,170	$756,680
					EDUCATION & OUTREACH TOTAL	**$2,716,468**	**$2,652,641**	**$2,653,783**	**$2,811,862**	**$10,834,754**

General Restoration

Page	Project Number	Principal Investigator	Project Title	# Years	Project Years	FY23 Approved	FY24 Approved	FY25 Approved	FY26 Approved	Total for FY23-FY26
175	23230502	Lomax	Clean Water Act assessment of beaches with lingering oil	4	FY23-FY26	$138,740	$215,778	$178,684	$125,230	$658,432
178	22220503	Counceller	Alutiiq museum & archaeological repository sustainability project	3	FY23-FY25	$1,828,290	$1,504,863	$0	$0	$3,333,153
180	22220505	Johnson	Chugach region archaeological repository and museum	4	FY23-FY26	$2,914,360	$2,183,853	$468,346	$137,095	$5,703,654

182	22220507	Moonin	Port Graham Corporation general restoration and habitat protection	4	FY23-FY26	$1,485,496	$925,504	$1,092,000	$990,895	$4,493,895
184	22220508	Thielke	Geospatial wetlands and hydrography data across the EVOS region	3	FY23-FY25	$32,921	$32,921	$32,921	$0	$98,763
					GENERAL RESTORATION TOTAL	**$6,399,807**	**$4,862,919**	**$1,771,951**	**$1,253,220**	**$14,287,897**

Habitat Enhancement

Page	**Project Number**	**Principal Investigator**	**Project Title**	**# Years**	**Project Years**	**FY23 Approved**	**FY24 Approved**	**FY25 Approved**	**FY26 Approved**	**Total for FY23-FY26**
188	23230602	Johnson & Mazzacavallo	Kenai Peninsula streambank rehabilitation and protection	1	FY23	$395,796	$0	$0	$0	$395,796
190	22220608	Shepard et al.	Port Graham habitat enhancement	4	FY23-FY26	$1,500,000	$1,500,000	$1,000,000	$679,087	$4,679,087
192	22220610	Drzazgowski	Kenai Peninsula stream watch	4	FY23-FY26	$102,067	$102,067	$94,791	$87,515	$386,440
194	22220611	Martin	Big Eddy restoration and improvements	3	FY23-FY25	$3,434	$2,161,350	$2,161,350	$0	$4,326,134
196	22220612	Morse, Namitz, Stutzke	Eyak Lake weir restoration	3	FY23-FY25	$4,718,016	$113,745	$106,848	$0	$4,938,609
					HABITAT ENHANCEMENT TOTAL	**$6,719,313**	**$3,877,162**	**$3,362,989**	**$766,602**	**$14,726,066**

Habitat Protection (no projects approved in FY23)

	FY23 Approved	**FY24 Approved**	**FY25 Approved**	**FY26 Approved**	**Total for FY23-FY26**
GRAND TOTALS for FY23 – FY26	**$27,274,648**	**$22,399,280**	**$18,785,825**	**$15,137,856**	**$83,597,608**

EVOSTC General Operating Budget Description

Project Number: **23220100**

Project Title: EVOSTC General Operating Budget

Primary Investigator(s): Shiway Wang, EVOSTC Executive Director
Joy Maglaqui, EVOSTC Executive Assistant

PI Affiliation: EVOSTC **Project Manager:** ADF&G

EVOSTC Funding Requested:

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$1,497,845	$1,509,651	$1,626,605	$1,472,312	$1,585,277	$7,691,690
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$1,297,646	$1,328,454	$1,502,191	$1,391,568	$1,576,093	$7,095,951
FY32	***FY33***				***FY32-33 Total***
$1,457,877	$1,492,757				$2,950,634

Abstract:

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

- Program Management and Operations
- IT and Website Support
- Science Program
- Public Advisory Committee (PAC)
- Habitat Program
- Trustee Agency Funding

The budget estimates detailed within program components are projected based upon prior-year actual expenditures and expected needs for FY23 – FY31 and an additional two years (FY32 – 33) after program and project completion for staff to complete Council activities in preparation for the end of the Council. The component items cover operational costs associated with developing, implementing, and overseeing current Trustee Council program objectives. Starting in FY22, costs previously categorized under the Trustee Agency Project Management component were moved to Program Management and Operations and the Trust Agency Funding components. Each Trust Agency is allocated $50,000 to fund agency liaisons and staff to assist Trustees with any Council tasks and activities. Habitat Program activities are anticipated to wind down at the end of FY26 but may need additional time in the second five-year cycle to complete. Upon conclusion of the programs and projects, Council staff are anticipated to need at least two years to carry out actions including final reporting and archiving activities and physically closing the office.

To accommodate the new five-year EVOSTC meeting cycle, approval of this budget also authorizes staff to finalize an annual budget for each of the following 10 budget cycles (FY24 – FY33). Each fiscal

year after FY22 is adjusted by an increase of 2.5% from the year before to include anticipated changes such as inflation, merit-step increases, payroll benefit increases, and cost of living adjustments. The five-year plan also adjusts for biennial review conducted by entities including the Science Panel and Public Advisory Committee, Council staff and agency staff as applicable. Biennial review will occur during FY24 to review progress during the first two years of multiyear projects, FY26 to review progress during years three and four of multiyear projects, FY28 to review progress during years five and six of multiyear projects, FY30 to review progress during years seven and eight of the multiyear projects. Future Council meetings and full-review cycles are also anticipated to occur in FY26 and FY31.

Funding Recommendations (September 2022):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Not applicable	Fund for FY23-FY26

PAC Comments

Date: September 2022

It is noted that the PAC expressed support for the Council staff's needs to continue administering the programs.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Not applicable	Not reviewed

Funding Recommendations (January 2022):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Not applicable	Not applicable	Fund FY22

PAC Comments

Date: September 2021

It is noted that members of the PAC acknowledged and commended staff for the work being done and there were concerns expressed by individual PAC members of the amount of work for the number of staff. One PAC member mentioned that combining the Science Director and Executive Director positions seemed like a great deal of responsibility to ask of one person but that the acting ED seems to be performing well.

Long-Term Research and Monitoring Program Project Descriptions

Project Number: **22110853 *FY23 LAST YEAR OF PROJECT***

Project Title: Pigeon Guillemot Restoration Research in Prince William Sound

Primary Investigator(s): Robb Kaler

PI Affiliation: USFWS **Project Manager:** USFWS

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$47,361	$48,560	$0	$0	$0	$95,921

See FY21 Work Plan for FY17-21 funding history.

Non-EVOSTC Funding

First line is from National Fish and Wildlife Foundation Grant, second line is USFWS in-kind support

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$28,600	$28,600	$0	$0	$0	$57,200

Total Past EVOSTC Funding Authorized (FY07-22): $2,724,061

Total EVOSTC Funding Authorized (FY07-22) and Requested (FY23): $2,772,621

Total Non-EVOSTC Funding (FY12-23): $2,477,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.12.2021, budget updated 08.12.2021.*

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 have more than doubled from 2014-2018 (69 to 167 individuals) and numbers of known 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.

Our 2021 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 early June 2021 and numbers of guillemots continued to increase at the Naked Island Group compared to previous years (2014-2019). Nest

counts of black-legged kittiwakes were conducted and while results are pending, preliminary indications are that 2021 has been a “poor” 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, which will assist interpretation of pigeon guillemot population trends.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: September 2021

This project would continue to monitor mink presence-absence at the Naked Island group and the population trend of pigeon guillemots nesting there. It would also continue to monitor productivity of black-legged kittiwakes at 22 colonies in PWS as an index of forage fish, in particular herring, availability to guillemots and other predators. The PIs note additional species of waterfowl and seabirds that appear to have benefited from the removal of mink. We are supportive of the project and have no substantive comments on the proposal other than to encourage the PIs to begin publishing results from this work.

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC.

Project Number: **22210128**

Project Title: Status and trends of EVOS injured seabirds in the Kenai Peninsula coast and Kachemak Bay

Primary Investigator(s): Tuula Hollmen, Elizabeth Labunski et al.

PI Affiliation: ASLC, USFWS **Project Manager:** ADF&G, USFWS

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	*FY24*	***FY25***	***FY26***	***FY22-26 Total***
$289,810	$294,894	$252,595	$177,274	$0	$1,014,574

See FY21 Work Plan for FY17-21 funding history.

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$87,221	$91,813	$52,052	$47,433	$0	$278,519

Total Past EVOSTC Funding Authorized (FY12-22): $568,410

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $863,304

Total Non-EVOSTC Funding (FY12-23): $279,338

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.13.201.*

We propose an integrated study of status and trends of Kittlitz's murrelet (*Brachyramphus brevirostris*), marbled murrelet (*B. marmoratus*), and pigeon guillemot (*Cepphus columba*) in two regions impacted by the *Exxon Valdez* Oil Spill (EVOS): Kenai Peninsula Coast and Kachemak Bay. Our overall goal is to provide information about trends in abundance and productivity of these three injured seabird species that are not recovering from EVOS or whose recovery status in unknown, thus supporting the EVOSTC in assessment of their recovery status. Kittlitz's murrelet and marbled murrelet two seabird species that were impacted by EVOS, with an estimated 5-10% and 6-12% of the spill zone population killed by acute oiling, respectively. Recovery status of Kittlitz's murrelets following the EVOS remains unknown, while marbled murrelets have not recovered to their pre-Spill numbers. Kittlitz's murrelet became a candidate species for listing under the Endangered Species Act 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. The marbled murrelet is more abundant and widespread in Alaska but remains a species of conservation concern due to evidence of population declines and is listed as a Threatened species from British Columbia to California. Pigeon guillemot populations in Prince William Sound have declined by an estimated 67% since the 1970s, and an estimated 10-15% of the spill area population died from acute oiling. Pigeon guillemots will be monitored in the Kenai Peninsula coast study area.

Our objectives for murrelets 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 objectives for pigeon guillemot are to estimate current population size, trends in distribution, and trends in relative abundance in the Kenai Peninsula coast study area.

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. Available historical data provide a cost-efficient opportunity to examine decadal trends, patterns of distribution over time, and habitat use. Furthermore, historical and on-going oceanographic and zooplankton studies in the region will enable us to examine potential influences of environmental conditions on murrelet and guillemot population trends. 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.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: September 2021

This continuing project will extend time series on abundance, distribution, and estimates of productivity of marbled and Kittlitz's murrelets and pigeon guillemots in Kachemak Bay and the Kenai Fjords for an additional five years. The project was approved for funding by the Council in FY20 but delayed the start of the project due to COVID-19 related challenges. Field work did occur in FY21, but two surveys were not conducted as planned due to the ongoing pandemic. Surveys are scheduled for FY22.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC.

Project Number: 2422LTRM (Integrated Program Management only)

Project Title: Gulf Watch Alaska Long-Term Research and Monitoring Program of Marine Conditions and Injured Resources

Primary Investigator(s): Mandy Lindeberg, Katrina Hoffman

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

Note: This program proposal includes the Integrated Program Management project (formally project 21120114 A-B). The Integrated Program Management project was approved for FY22 at the January 18, 2022 meeting. FY23-26 was approved at the October 5, 2022 meeting.

PIs for this project submitted a budget reallocation proposal for review, which proposed using funds from the Program Coordination and Science Synthesis (project 2222LTRM-A) for data collection and analyses within other projects that were compromised due to funding reductions in FY22-FY26, or loss of funding for FY27-FY31. Portions of a fully funded project (114-C Monitoring Long-Term Changes of Forage Fish Populations) relied on data collected by parts of other projects that were not funded (114-E Long-Term Monitoring of Marine Bird Abundance, 111-K Prince William Sound Aerial Juvenile Fish Surveys). Another project (114-N Long-term killer whale monitoring) was funded for only two years, yet new results indicate the importance of this project running the full length of Gulf Watch Alaska and allowing it to be included in our final synthesis regarding the effect of recent heatwaves on the recovery potential of EVOS injured resources.

EVOSTC Funding Requested (includes 9% GA)

Please contact the EVOSTC office for updated funding amounts.

EVOSTC Funding Requested for Science Program Management, NOAA (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
e$177,649	$177,451	$181,530	$185,698	$189,955	$912,283
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$331,536	$329,306	$468,463	$338,491	$342,276	$1,810,073

Non-EVOSTC Funding NOAA

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$104,212	$106,817	$109,488	$112,225	$115,031	$547,773
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$117,906	$120,854	$123,875	$126,972	$130,147	$619,754

Total Past EVOSTC Funding Authorized (FY12-22): $1,769,449

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,886,900

Total Non-EVOSTC Funding (FY12-23): $790,329

EVOSTC Funding Requested for Fiscal and Outreach Program Management, PWSSC (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$531,103	$544,215	$558,974	$573,444	$583,537	$2,791,272
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$626,576	$620,047	$636,484	$652,812	$668,813	$3,204,731

Total Past EVOSTC Funding Authorized (FY12-22): $3,275,803

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $3,820,018

Total Non-EVOSTC Funding (FY12-23): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.13.2021.*

Coordination, collaboration, and program management are critical components in the continued success of the Gulf Watch Alaska (GWA) Long-term Research and Monitoring (LTRM) program. The GWA LTRM program management team (PMT) provides the structure to ensure key goals are met within the program. These include ensuring individual project compliance through timely data and report submission and administration of project funding. In addition, the PMT provides maximum benefit to program principal investigators, stakeholders, and other *Exxon Valdez* Oil Spill Trustee Council foci through facilitated meetings, organized community events and support for the collaboration and creation of synthesis products.

To accomplish these goals, we propose the continued partnership between the National Oceanic and Atmospheric Administration (NOAA) and Prince William Sound Science Center (PWSSC) to provide leadership and oversight of the comprehensive GWA LTRM program. NOAA personnel will provide program management, oversight of science synthesis and modeling, and oversee reporting from components and projects. PWSSC will provide administration of the NOAA grant to non-Trustee agencies and organizations, program coordination, meeting logistics, and coordinate outreach and community involvement activities.

Administrative personnel for GWA will remain the same, with two minor exceptions. Program Lead, Administrative Lead for non-Trustee agencies, and Program Coordinator personnel will not change. The former Science Coordinator will become the Science Lead, ensuring continuity. We will hire a new Science Coordinator and we have a new Outreach Coordinator. An important addition for FY22-FY31 is the Science Synthesis and Modeling Component. The Science Lead will oversee this component to build upon synthesis efforts of the previous 10-years, and with the Science Coordinator, expand synthesis and modeling within GWA LTRM and with collaborators. The expertise and experience of this management team will ensure success and broad contribution of the GWA LTRM program to stakeholders throughout the region.

Budget Reallocation Recommendations (January 2024):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Partially Fund*

*The Council approved reallocation of funds to unfunded projects 114-E and 111-R/K. The Council did not approve reallocation of funds to project 114-N.

Science Panel Comments

Date: January 2024

The Gulf Watch Alaska Long-Term Research and Monitoring (GWA LTRM) program consists of highly integrated projects that rely on coordination and collaboration among them to maintain efficiencies and broaden the collective knowledge gained from each. The EVOSTC's decision to fund some projects and not others resulted in leaving some funded projects fragmented and unable to achieve their goals. Thus, the LTRM Program Management Team (PMT) wishes to redirect funds from the Science Coordinator position in project 2222LTRM-A (Program Coordination and Science Synthesis) to specific data collection and analyses within other projects that were compromised due to funding reductions in FY22-FY26, or loss of funding for FY27-FY31. Specifically, data collection from unfunded projects 114-E (Long-term monitoring of marine bird abundance) and 111-R/K (Prince William Sound aerial juvenile fish surveys) was to be implemented in funded project 114-C (Monitoring long-term changes for forage fish populations). Additionally, the PMT is requesting to reallocate funds to an existing PI to conduct the pelagic component synthesis, which was not approved for FY27-FY31, and to support a reduced project 114-N (Killer whale monitoring). This will maintain the integration and continuity within the LTRM program that was established during the first 10 years of the Gulf Watch Alaska and Herring Research and Monitoring programs. The Science Panel strongly supports this proposal.

The PMT is an exceptional group with a deep, broad, collective knowledge of the ecological history in the spill area and the important questions remaining to be answered about lingering effects of the oil. Answers to those questions are essential to the mandate of the EVOSTC, and beyond that to a fuller understanding of the ecology of Prince William Sound (PWS), the spill area, and the greater Gulf of Alaska (GOA). The LTRM coordination and synthesis work has been excellent and key to the success of this program, and the PMT has maintained the trust and support of the investigators and the EVOSTC Science Panel over the years. Now, their wish to continue funding for components they view as crucial to the greater good of the highly successful overall program should be favorably considered by the EVOSTC.

In essentially all cases, the longer that systematic monitoring studies such as those in PWS and the GOA continue, the more interesting and important they become. A recent example eloquently illustrates this point. Interannual variability, and multi-year anomalies, such as the Pacific Marine Heatwave (PMH) in the last decade, have meaning primarily in the context of longer-term knowledge. Had EVOSTC studies been suspended before the PMH struck, many of its effects on individual species affected by the spill and modes of interactions in the PWS and GOA ecosystems would have been missed. However, they were not missed, and much was learned about essential ecosystem processes (see for example Arimitsu et al. 2020, Piatt et al. 2020, Suryan et al. 2021). Not

funding specific GWA project components will decrease the resolution of what can be learned about resiliency and ongoing recovery after the PMH. Environmental events are seldom predictable, so systematic research such as long-term studies must be maintained. All of this is crucial to fulfilling the mandate of the EVOSTC to understand the effects of the spill.

We believe that the elimination of funding for those important components of the LTRM program near the end of this unprecedented study was short-sighted and detrimental to science and the legacy of the EVOSTC. The highly successful program has run this long, so why disrupt it near the end? The GWA LTRM program has had, and will continue to have, a high benefit-cost ratio, in part because of the large amounts of non-EVOSTC funding it leverages. The proposed reallocations are based on the informed judgment of the PMT, which the Science Panel fully supports. We provide additional justification for funding these eliminated components below.

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Justification for supporting pelagic component synthesis

This work was included in the 2222LTRM-A proposal for the FY27-31 funding cycle. The Council approved work for the FY22-FY26 cycle, with the proposal to be reviewed again in FY26 for the next 5-year funding cycle. Given the uncertainty of funding from the Research subaccount after FY26, the Science Panel believes it would be logical to fund this work now to ensure a comprehensive synthesis effort that includes all ecosystem components. Emergent knowledge of ecosystem function created from the syntheses noted above stands among the program's greatest scientific contributions.

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Justification for supporting work in unfunded project 114-E (Long-term monitoring of marine bird abundance)

Seabirds are highly visible, tractable ecosystem sentinels and are often the first to signal changes in prey populations and food webs important to many species. Not funding this project left a data gap in the analyses of important predator-prey relationships, on which project 114-C deliverables are dependent. Furthermore, studies of seabirds have been important in distinguishing effects of the EVOS from those of climate change and other ecosystem variability in the spill area and the greater GOA ecosystem.

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Justification for supporting work in unfunded project 111-R/K (Prince William Sound aerial juvenile fish surveys)

Many species of juvenile fishes are crucial to higher trophic-level predators, ecosystem function, and commercial fisheries as they recruit to harvestable sizes. But they are difficult to enumerate. Therefore, combinations of approaches offer the best opportunities to monitor distributions and abundance, both of which can provide advanced knowledge of dynamics important to setting future subsistence and commercial quotas, and help explain variability in consumer populations. This is of particular importance in the case of herring, an injured resource that has not recovered. The PWS aerial surveys are designed to provide crucial information on distribution and abundance of juvenile fish species, including herring, to supplement and ground-truth information gathered by vessel-based surveys of project 114-C. The aerial surveys also provide an index of juvenile herring abundance years before herring reach the age of recruitment to the fishery, which could be especially important in view of the recent (decadal scale) changes in herring spawn distribution.

Furthermore, the aerial survey data set is the only long-term index of year-class strength of herring, and is essential to proper management of this ecologically and commercially important stock, and the continuation of the commercial herring fishery.

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Justification for continued support for limited work in project 23120114-N (Long-term killer whale monitoring)

Killer whales, the highly visible apex predators in PWS, the GOA, and beyond, were the most extremely damaged species by the EVOS. The AT-1 population will likely go extinct as a result. The AB pod, also heavily impacted, appeared to be recovering but newly available data suggest increased mortality during the recent heatwave. Studies the PIs have undertaken are contributing important scientific knowledge needed for the conservation of this iconic species, as well as on stock structure of killer whales in the spill area and in the broader region that absolutely must be factored into their overall management. An excellent Opinion piece on the important issue of killer whale bycatch allocations to commercial fishing fleets and the stability of killer whale populations recently appeared in the Anchorage Daily News (Matkin 2024). Although that immediate concern was identified beyond the EVOS spill area, knowledge gained within the spill area from studies supported by the EVOSTC, e.g., Myers et al. (2021), is of central importance to identifying this problem and will be yet another legacy of EVOSTC-sponsored research. The value of EVOSTC research in broader domains cannot be overstated.

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References

Arimitsu ML, et al. (2020) Heatwave-induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators. Global Change Biology 2021 (27):1859-1878.
Piatt JF, et al. (2020) Extreme mortality and reproductive failure of common murres resulting from the northeast Pacific marine heatwave of 2014-2016. PLoS ONE 15(1):e0226087.
Matkin C. (2024) OPINION: Protecting killer whales in the Bering Sea requires following the science. Anchorage Daily News 1 Jan 2024. (attached to the end of this review)
Myers HJ, et al. (2021) Passive acoustic monitoring of killer whales (Orcinus orca) reveals year-round distribution and residency patterns in the Gulf of Alaska. Scientific Reports 11:20284.
Suryan RM, et al. (2021) Ecosystem response persists after a prolonged marine heatwave. Scientific Reports 11:6235.

PAC Comments

Date: January 2024

Excerpt from Draft Meeting Notes: Kopchak supported the reallocation and stated it was a commendable effort by researchers and administrators to figure out how to reallocate resources to continue the whole of system approach since species and issues are connected. Whissel moved to approve the reallocation, and Bauer seconded the motion. Whissel supported Kopchak's comments and appreciated a practical solution to find efficiencies to achieve the overall goal and address budget shortfalls. Docken agreed with Whissel. The PAC conducted a roll call vote, with six members in support of the motion and George Skladal not voting. The motion passed.

Executive Director Comments

Date: January 2024

I concur with the Science Panel and PAC.

Funding Recommendations (Fall 2022):

Science Panel	PAC	Executive Director	Trustee Council
No fall meeting	Fund	Fund FY23 – FY26	Fund FY23 – FY26

Science Panel Comments

Date: September 2022

No fall meeting. Please see 2222LTRM for comments on the FY22-31 proposal.

PAC Comments

Date: September 2022

It is noted that the PAC expressed support for the Council staff's needs to continue administering the programs.

Executive Director Comments

Date: Fall 2022

My recommendation is to fully fund this management project for FY23-FY26, given the spending scenario for the research account and the uncertainty of available research funds after FY26.

The Science Administration component and the Fiscal and Outreach component provide valuable services that are not duplicated elsewhere. Council staff do not provide these services; in 2009, the Council at the time decided to contract these services to 3rd parties as a cost-saving measure to downsize the Council office and staff.

This Integrated Program Management Team has been efficiently operating since the beginning of the long-term programs which were initiated in 2012. The primary purpose of the fiscal administration (PWSSC) is to provide administrative leadership and coordination for the LTRM program and the mariculture ReCon program (project 22220302). PWSSC acts as the NOAA grant fiscal agent for 24 non-federal and state agency funded projects which total ~$4.5M/year. PWSSC is also responsible for all LTRM program coordination and outreach & community involvement activities, including program website maintenance. If the fiscal and outreach component is not funded, the 5-year NOAA grant which provides funds for the GWA, HRM and Data Programs and the mariculture ReCon program will be cancelled; a significant amount of agency investment has already been put into this grant which is already operational for FY22. ADF&G will have to process and manage 24 additional contracts which means a significant increase in workload for ADF&G and an already reduced Council staff. Additional Council staff time will be needed to perform program coordinator duties including required report editorial services to meet State library archiving requirements and tracking deliverables for all projects. The GWA and HRM websites will go offline, and the Council-required outreach, education & community involvement will not be supported. The Council's office will not be able to operate efficiently if this component is not funded.

The primary purpose of the science administration (NOAA) is to provide program leadership for the LTRM program, coordination, and oversight of science syntheses of data collected across the program and leveraging of funding through partnerships and collaborations. If this component is not

funded, there will be a substantial decrease in the quality of work and products relative to what has been produced by the science program over the past 10-years. This will include loss of synthesis products and integration as requested by the Invitation to inform resource managers, decision makers, stake holders and the public. The program will have a reduced ability to leverage funds through partnerships and collaborations.

Project Number: **22160111-B**

Project Title: Annual Herring Migration Cycle: Movement between Kayak Island and Prince William Sound

Primary Investigator(s): Alisha Cypher & Mary Anne Bishop

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$130,893	$188,308	$110,661	$47,420	$49,115	$526,398
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$48,230	$48,340	$49,501	$48,570	$48,050	$242,691
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $2,147,693

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $2,336,001

Total Non-EVOSTC Funding (FY12-23): $587,070

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

Over the course of last 10 years, we have learned a great deal about the migration patterns of Pacific herring (*Clupea pallasii*) in Prince William Sound (PWS). Acoustic telemetry has allowed us to passively track tagged herring as they migrate to and from PWS via the Ocean Tracking Network (OTN), acoustic arrays located at the entrances and passages between PWS and the Gulf of Alaska. During the FY17-21 'Annual Herring Migration Cycle' project, we found that the PWS herring population consists of both residents and migrants and that larger fish are more likely to migrate. Here, we propose to use similar methodology to determine whether there is population connectivity in the form of adult movement between PWS and a nearby spawning site, Kayak Island (FY22-26). While Kayak Island and PWS are treated as distinct populations, these sites are within the migration range of Pacific herring and previous work showed that they are genetically similar. During FY23 and FY24, we will tag at Kayak Island a total of 400 Pacific herring with acoustic transmitters that have a battery life of 2.5 years. The OTN arrays will detect movement of Kayak Island herring in and out of

PWS and additional receivers at Kayak Island and known spawning areas in eastern PWS will detect herring at spawning grounds. Detection data will be used to calculate the proportion of Kayak Island herring that migrate into PWS and determine movement patterns in terms of timing and use of entrances and spawning areas. These methods will allow us to evaluate two hypotheses: 1) *Kayak Island herring migrate into PWS* and 2) *Kayak Island herring will be present at PWS spawning arrays in winter and early spring.*

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Do Not Fund

Science Panel Comments

Date: May 2021

This excellent but ambitious proposal tackles a key issue related to the status and geographical range of herring in PWS: the potential connection between herring spawning in PWS and herring spawning on Kayak Island. The PIs present two key hypotheses: 1) Do Kayak Island herring migrate into PWS, and 2) Are Kayak Island herring present at PWS spawning arrays in winter and early spring. They propose using acoustic telemetry to determine the potential connectivity between herring spawning in PWS versus those that may spawn on the shores of the adjacent Kayak Island where substantial spawn deposition has been observed in recent years. Resolving the issue of herring connectivity between PWS and Kayak Island is essential for evaluating the current state of herring in PWS, and the effects of oil on herring.

Several observations are necessary to understand the significance of this proposal. First, spawn deposition on Kayak Island has been documented in recent years, but not necessarily observed or documented in previous years, although it might have been present at times. Although not quantified, the recent spawning on Kayak is thought to be substantial, and large enough to have been detected by satellites. Another key observation is that spawn distribution within PWS has changed recently, with more spawn concentrated in the southeastern shorelines – or locations closest to Kayak Island (as seen by work conducted by Branch and associates). Such temporal and spatial variation in spawn has been observed elsewhere in the range of herring in the eastern Pacific, especially in the Strait of Georgia. Here is the important implication: if some herring spawn outside of the locations usually regarded as within the Sound, then recent SSB (spawning stock biomass) estimates may be underestimated. If so, and if confirmed by the work in this proposal, then this result would have implications for many other projects. Here is one: In proposal (22120114-O Long-term Monitoring of Humpback Whale Predation on Pacific Herring in Prince William Sound) the proponents show an apparent relationship between whales and spawn deposition over the last 12 years, although the year 2020, when spawn occurred on Kayak Island, is an outlier. (As an aside, the proponents for the humpback whale proposal see the change in whales as the dependent variable, suggesting that they think that whales respond to low herring biomass, but the opposite might also hold: could herring actively avoid areas with high whale concentrations? Olfactory-based avoidance mechanisms are plausible, and observed in other fish species.

PI Response:
Thanks for your observations that highlight the need for this research. It has been hypothesized that the herring may have moved because of predation pressure by whales (Thorne, unpublished). It has also been hypothesized that the change in spawning may be related to the loss of older year classes (McGowan et al. 2021). Regardless of the cause, it is important to determine if there is a significant movement of herring between the spawning areas.

McGowan, D. W., T. A. Branch, S. Haught, and M. D. Scheuerell. 2021. Multi-decadal shifts in the distribution and timing of Pacific herring (Clupea pallasii) spawning in Prince William Sound, Alaska. Canadian Journal of Fisheries and Aquatic Sciences https://doi.org/10.1139/cjfas-2021-0047

The proposal is ambitious in the sense that it is tackling a large, important topic and, because of the dependence on technology that can go awry, there is some risk involved. We believe that this is a risk worth taking and are confident that the PIs are highly capable and will maximize the opportunities for useful scientific productivity no matter the outcome.

PI Response:
We agree that there are risks and appreciate the Science Panels confidence.

We noted that a lack of exchange of adult herring between Kayak Island and PWS cannot be used to rule out connectivity, as herring spawning at Kayak Island could result in larvae that subsidize herring populations in PWS through larval drift. Nevertheless, the proposed project should be able to determine whether genetic exchange involves adult herring.

PI Response:
We agree with the potential of connectivity through larval exchange.

In a revised proposal, we ask the PIs to comment about the ongoing functionality of existing receivers and any need to service them (e.g., remove biofouling) to maintain full functionality for the proposed project.

PI Response:
To assure full functionality of the arrays, to date 45 of the 49 receivers in the Ocean Tracking Network array have been replaced with VR2AR receivers that are recovered, cleaned, and serviced annually. The remaining four receivers that do not yet show signs of biofouling (as indicated by large tilts) will be replaced by 2022, before this project begins. Receivers used on the spawning grounds are also recovered, cleaned, and replaced annually. We have added text regarding the status, functionality, and continued maintenance of Ocean Tracking Network receivers under the Section 4.B. Procedural and Scientific Methods (see added subsection 'Array Maintenance and Functionality', p 10-11).

Date: September 2021

This proposal provides an opportunity to look for linkages or 'connectivity' between herring spawning in waters outside of, but adjacent to PWS, on beaches on Kayak Island. Observations of such spawning have occurred approximately concurrently (last few years) with observations of changes in herring spawn distributions within PWS. Therefore, a plausible hypothesis is that some part of the PWS population may have spawned outside of PWS, specifically on Kayak Island. The

demonstration of such a connection between herring found near Kayak Island and PWS herring would be a game-changer for most types of future research and monitoring of PWS herring. An interesting implication of such a connection is that the apparent PWS herring population, as estimated largely from fishery-independent spawn surveys, may not have declined as severely as the escapement evidence indicates, because recent and past spawning biomass estimates have not included any spawn observations from Kayak Island. Therefore, the work in this proposal might reveal that some key assumptions used for past biomass assessments may need to be revisited.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

Kayak Island was noted as an important area by the Science Panel to include in spawning biomass estimates and included in the FY22-31 Invitation as an area of interest for the LTRM focus area. This study has produced useful data and insights into herring movement.

Project Number: **22120111-C**

Project Title: Modeling and stock assessment of PWS herring

Primary Investigator(s): Trevor Branch

PI Affiliation: University of WA **Project Manager:** NOAA/PWSSC

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$141,717	$142,324	$157,049	$159,716	$164,729	$765,536
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$167,963	$166,322	$183,648	$186,650	$192,636	$897,219

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$0	$0	$0
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $1,730,617

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,872,941

Total Non-EVOSTC Funding (FY12-23): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.12.2021, budget updated 08.12.2021.*

Pacific herring play a central role in the Prince William Sound ecosystem, and sustained valuable fisheries, but collapsed in 1993 and have not recovered. Rebuilding herring is a core goal of this program, and stock assessments are used to assess their past and present status to determine if fisheries can reopen safely. Over the past ten years we created a Bayesian age-structured assessment model (BASA), expanded it to fit to new time series and disease data, placed Prince William Sound herring in the context of global herring populations, and examined factors affecting recruitment, natural mortality, spawning location, and spawn timing in this population. Over the next ten years we propose to revise and expand BASA and conduct annual stock assessments of Prince William Sound herring. In addition, we propose to review best practices for managing highly variable fish populations and use this information to provide advice for management of Prince William Sound herring. The main tool we will use is a management strategy evaluation that comprises an operating model of truth that generates data mimicking those available in reality, the data are fed into BASA, and then a harvest control rule is used to set catches in the next year. By

repeating this process, we can (1) evaluate different harvest control rules, (2) assess the trade-offs between cost and frequency of future surveys, (3) and test the robustness of the management system and BASA to misspecification. Unless higher priorities arise, we also propose to develop a spatial model of herring to capture key components of fishing, spawning, and movement; and to develop a simplified ecosystem model focusing on key competitors and predators (humpback whales, pink salmon, and pollock) to allow for more holistic predictions of herring abundance. Our proposal will provide useful advice to better manage Prince William Sound herring.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

This modeling project has been funded for the past ten years. During this time, a Bayesian age-structured assessment model (BASA) for PWS herring was developed, expanded to fit to new time series, e.g., age-1 aerial survey index and disease data (including a simulation test of the usefulness of disease data), sensitivity tested (e.g., alternative maturity schedules), and other model improvements were incorporated. Beyond stock assessment, this project also evaluated PWS herring dynamics relative to global herring populations, and examined factors affecting recruitment, natural mortality, spawning location, and spawn timing in PWS.

We remain very appreciative of the work conducted in this project over the years. The BASA model has proven to be very useful to examine and test model assumptions. It has also provided value added in the meta-analysis of global herring populations that provided insights on PWS herring recovery, examination of ecological and environmental factors affecting recruitment, and a better understanding of spawning timing and location. In terms of publications, the project has been very productive with three peer-reviewed articles, three more undergoing review and another in preparation. During this time, two graduate students were funded and graduated, and a total of three years of funding was provided to two postdocs.

The PIs have proposed a new 10-year work plan for this project to include eight objectives. Objective 1 involves the conduct of routine annual stock assessments of PWS herring including updated data. We appreciate further refinements of BASA, including incorporation of the latest disease information, as well as the proposed annual reporting of stock assessments of PWS herring to ADF&G and the fishing industry. However, before the conclusion of this project, the PIs should plan to transfer the BASA model to ADF&G, including the training of ADF&G biometricians for its operation. Herring biometricians in ADF&G's Central Region (PWS), Southeast Region (Sitka) and statewide office (Juneau) should be invited. This might be accomplished as part of a workshop or as a small focus group of herring stock assessment modelers. Development of a "how-to" manual may be useful to help facilitate future transitions associated with turnover of ADF&G biometric staff. Thus, we suggest that plans for transferring the model to ADF&G for routine stock assessment should be an important part of this current proposal. This transfer certainly would not prevent future research proposals by the PIs using BASA.

PI Response:
We appreciate the kind words and the support of the BASA model and further development. The annual model code and data will be posted on the Gulf of Alaska Data Portal and can be downloaded and run by ADF&G scientists or adapted for use in other regions. In addition, one of the workshop topics proposed by Scott Pegau covers modeling and would be a good avenue for transfer of knowledge and to allow for future implementation of the model. We discussed these ideas and comments this week with Dr. Sherri Dressel, with whom over the past 10 years we organized two sessions where the past student (Trochta), experienced in Bayesian models and in BASA, flew to Juneau to work with a focused small group of biometricians to discuss features of the model. We intend to continue this more informal training approach in the future because running Bayesian stock assessment models requires substantial background knowledge and is best explained to a small group. For the incoming University of Washington MS student, four quarter-long courses constitute the background knowledge needed in age-structured modeling, Bayesian methods, AD Model Builder, and C++ or equivalent. We recognize that adapting and adopting the BASA model and MSE methodology for management of Prince William Sound and other State herring stocks will require staffing of ADF&G scientists with a similar background acquired from courses taught by Prof. Cunningham at UAF Juneau, or Profs Punt and Branch at the University of Washington. Given considerations of ADF&G biometric staffing, we agree with the Science Panel that the development of a "how-to" manual would be useful and will plan to prepare documentation for ADF&G in case current staffing does not allow immediate implementation of model features or the MSE, and to help bridge gaps resulting from any staff turnover both at the University of Washington and ADF&G. With this in mind, we added the following text to the proposal in Section 4, Project Design, B.

Procedural and Scientific Methods, pages 5 and 6: "The annual stock assessments could also be run by ADF&G scientists with a suitable background in AD Model Builder and Bayesian age-structured models. In the past we have conducted informal training with a select group of biometricians, and we anticipate this would continue given that biometricians with a suitable background are available, such that by the end of the project, annual Prince William Sound stock assessments could be run by ADF&G using BASA. In addition, a "how-to" manual will be made available to assist in the transfer of knowledge and enhance the ability of ADF&G to adopt the methods developed in this project if biometricians with suitable backgrounds are not immediately available. This would also bridge any gaps resulting from personnel turnover at either the University of Washington or ADF&G."

Objective 2 involves a review of best practices to manage highly variable fish populations. Three options were proposed. Among these, option 1 seems to be most appealing as it should result in a set of harvest control rules to be included in the proposed management strategy evaluation (MSE). Option 2 is a review of how uncertainty is incorporated into catch setting in other regions. While this may be a worthwhile endeavor, we place lower priority on option 2 for the purposes of PWS herring at this time. Apropos to this option, it may be sufficient to report the probability that the true spawning biomass is below the fishery threshold, as was done in the assessment for 2020 as reported in the most recent annual report. Option 3 does not seem to be necessary, as performance metrics used to assess control rules are rather well known and easily assembled; indeed, common ones that might be included in the proposed herring MSE are already listed under this option.

PI Response:
In Section 4, Project Design, B. Procedural and Scientific Methods, on pages 6 and 7, we have retained option 1 (review of harvest control rules) and deleted option 3 (performance metrics) given this feedback. We now expound slightly on option 2 (how to include uncertainty in biomass estimates in catch setting) to make it more clear why this is directly relevant—in short, the Bayesian assessment provides a distribution of possible stock status, requiring managers to weigh risk against catch levels, such that catches could be higher if the uncertainty in the stock assessment was smaller. This is a key difference compared to non-Bayesian stock assessments. This also ties directly into the costs and benefits of different streams of data being collected.

Objectives 3-6 concern the development and use of an MSE. Specifically, the PIs propose to conduct an MSE involving an operating model (i.e., "truth") that generates data mimicking those available in reality. The resultant data are then fed into BASA, and then a harvest control rule is used to set annual catches for the next year. By repeating this process, the PIs propose to: (1) evaluate different harvest control rules, (2) assess the trade-offs between cost and frequency of future surveys, (3) and test the robustness of the management system and BASA to misspecification. We suspect that the results of the MSE will be highly dependent upon the assumptions made about future recruitment, so careful thought should go into recruitment, perhaps involving alternative recruitment scenarios. The proposal includes a list of alternative control rules. To this, we recommend including alternative fishery thresholds to open or close the fishery at low levels of spawning biomass.

PI Response:
Under item 6, on page 9, we propose examining the effect of different recruitment relationships. This is not meant to be exclusive, and the MSE could also look at other recruitment scenarios identified as important, such as autocorrelated recruitment, random recruitment, or multiple consecutive years of good recruitment (or bad recruitment). Under item 4 rule we propose to examine the effects of allowing fishing at different biomass levels (the example given is 25% vs. 40% of unfished spawning biomass), which covers this request.

We appreciate the proposed assessment of tradeoffs between cost and frequency of future surveys. Undoubtedly, this effort would build upon the work by Muradian et al. (2019). That paper examined the relative contributions of several time-series data on the model output and performance. Several questions arise but the key one concerns the data that provides the most useful output of the model for herring assessment. Specifically we questioned the cost:benefit of the acoustic assessments and the specific implications of the results presented in Table 3 of that report. We had difficulty duplicating some of the cost estimates including the aerial survey, which was estimated to cost about $16 K/year, and does not appear to be correct to us. We request that the PIs carefully check these cost estimates for the proposed MSE work.

PI Response:
We will revisit estimates of cost for each survey into the future, for the future MSE work, which will differ from average costs of $16k/yr for the 33 aerial surveys conducted during 1980-2013 (Muradian et al. 2019), supplied by ADF&G. Notably, the proposed budget for the 2022 aerial survey is about $60k.

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

Results of the cost:benefit MSE will be critical to future decision-making about which data sets to maintain as EVOS funding comes to an end. Likewise, tests of the robustness of management to BASA model misspecification will be important to set future herring research priorities.

Objective 7 involves creation of a spatial model to capture subpopulation structure and objective 8 involves the development of a model of intermediate complexity (MICE) to integrate important competitors and predators into the herring model. The PIs propose to develop a MICE for PWS herring that only models the abundance and interactions of the key species suspected of having strong interactions with herring: humpback whales, pink salmon, and Alaskan pollock. We strongly support the use of these models but we are disappointed with the timeline proposed. The philosophy for this objective seems to be to wait until the data are available, then extract insight from modeling the data. We suggest giving a higher priority to the spatial model, expecting that there will be data issues. However, some spatial data are already available – for instance, fisheries data by area, spawning timing by location, and results from the PWS herring migration study. Moreover, if proposal 22220111-G is funded, it would make sense to begin the study design right away to explore scenarios for connectivity of Kayak Island herring to PWS herring. We also discussed the need for finer versus broader spatial details. For example, an appropriate scale for disease should be considered. We noted that herd immunity involves multiple spatial scales. With other diseases, sustained local hotspots have caused diseases to persist showing that interaction of moving groups of herring is influential.

PI Response:
While it would be ideal to prioritize spatial models and MICE models, it requires substantial training to develop these skills over and above the training required for stock assessments and MSE work. Thus, the proposed timeline takes into account the training required rather than the availability of data. We have already identified an incoming MS student who will be capable of conducting stock assessments and MSE work but plans to move on to a different topic and area of interest for their PhD. When they graduate, we will hire and train one or two PhD-level students to develop and run the more advanced spatial models and MICE models. If we hired three students at the start of the ten-year period, to work on all three projects simultaneously (MSE, spatial, MICE), there would be no funds to continue with modeling for the final five years of the proposal.

This proposal strikes close to the core of all EVOSTC work because it informs the status of a key resource that was impacted by oil. Further, the past performance and output of the assessment modelling has set the direction for much of the associated collaborative and interdependent projects. Moreover, it appears to us that the proposed MICE for PWS herring has considerable potential to evaluate the management of the PWS herring fishery in an ecosystem context. Such an outcome would be a welcome result of the EVOS Trustee Council program.

PI Response:
We appreciate these kind comments.

Date: September 2021

In many ways, this proposal sits at the core of all EVOSTC work because it informs the stock status of herring, a key ecosystem component and fishery resource in PWS that was impacted by the oil spill. A Bayesian age-structured assessment model (BASA) for PWS herring was developed to reconstruct the history of herring stock status in PWS. It has been expanded to fit new time series, sensitivity analyses have been conducted, and other model improvements were incorporated. This project also evaluated PWS herring dynamics relative to global herring populations, and examined factors affecting recruitment, natural mortality, spawning location, and spawn timing in PWS.

The PIs have proposed a new 10-year work plan for this project to include eight objectives. Objective 1 is to conduct ongoing annual stock assessments of PWS herring. Objective 2 involves a review of best practices to manage highly variable fish populations. Objectives 3-6 concern the development and use of a management strategy evaluation that would evaluate different harvest control rules, assess the trade-offs between cost and frequency of future surveys, and test the robustness of the management system and BASA to misspecification. Objective 7 involves creation of a spatial model to capture subpopulation structure and objective 8 involves the development of a model of intermediate complexity (MICE) to integrate important competitors and predators into the herring model. The MICE modeling would be transformative by taking an ecosystem approach to the assessment and management of PWS herring. We note the synergy of this last objective with the new pink salmon - Pacific herring study, if it is funded.

The PI has been very responsive to our previous comments. We appreciate the PI's consideration of mechanisms for transfer of the BASA model to ADF&G scientists and agrees with the PI's plan to post model code and data on the Data Portal, provide informal in-person training such as was done by former student John Trochta, consideration of a potential workshop as proposed by Scott Pegau, and preparation of a "how to" manual to facilitate future knowledge transfer to bridge gaps created by personnel turnover at UW or ADF&G. We appreciate and agree with the PIs clarifications and responses to our remaining comments.

This has been a very productive project, yielding three peer-reviewed publications, three more undergoing review and another in preparation. During this time, two graduate students were funded and graduated, and a total of three years of funding was provided to two postdocs.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: Fall 2021

The BASA model developed from this project will be one of the legacies of the HRM program which will be transferred to ADFG to assist and improve herring stock assessments and management. Council-funded herring projects provide data for this modeling project. I concur with the Science Panel comments.

Project Number: **22120111-E**

Project Title: Herring Disease Program

Primary Investigator(s): Paul Hershberger, Maureen Purcell

PI Affiliation: USGS **Project Manager:** USGS

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$344,250	$374,095	$314,696	$322,953	$394,661	$1,750,655
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$406,945	$419,543	$432,420	$376,436	$387,092	$2,022,436

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$124,245	$127,724	$131,396	$135,129	$138,910	$657,404
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$142,857	$146,917	$151,092	$155,387	$159,804	$756,057

Total Past EVOSTC Funding Authorized (FY12-23): $2,373,850

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $2,747,945

Total Non-EVOSTC Funding (FY12-23): $657,569

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.12.2021, budget updated 08.12.2021.*

The Herring Disease Program (HDP) involves a combination of field observations, controlled laboratory experiments, novel tool development, and mathematical models to better understand, forecast, and mitigate disease impacts to Prince William Sound (PWS) herring populations. Field surveillances will involve annual assessments of the primary herring pathogens occurring in PWS, including viral hemorrhagic septicemia virus (VHSV), *Ichthyophonus*, and erythrocytic necrosis virus (ENV). Additional field studies will investigate how other Gulf of Alaska and PWS fishes impact the ecology of these pathogens for Pacific herring. *In vivo* laboratory experiments will be based on the successful production of specific-pathogen-free (SPF) Pacific herring and will be directed towards understanding basic epizootiological principles of these diseases. A large laboratory focus will involve evaluating possible *Ichthyophonus* transmission routes to Pacific herring, including the possible involvement of egg consumption on transmission. Novel disease forecasting tools will be developed and further optimized, including the plaque neutralization test to detect VHSV neutralizing antibodies and the possible application of RTqPCR on gill tissues to assess VHSV

exposure history in Pacific herring. Finally, disease models will be developed to evaluate the relative importance of disease cofactors and evaluate roles of VHSV antibodies and herd immunity in disease potential. The HDP is either fully integrated, or sharing sampling platforms, with other proposed *Exxon Valdez* Oil Spill Trustee Council projects including

- Genetic and physiological mechanisms of virus and oil interactions in Pacific herring (Whitehead),
- Herring / Pink Salmon interactions (Rand et al.),
- Modeling and stock assessment of Prince William Sound herring (Branch),
- PWS Herring Assessment (Morella), and
- Pacific Herring Connectivity Between PWS and Kayak Island (Cypher).

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

This is a very productive research project that continues to make many contributions to the primary literature as well as provide essential information to regional managers and scientific colleagues. Noteworthy in this proposal is the expanded degree of interaction and collaboration with other PIs. This has been one of the most successful projects, and the new 10-year proposal is well thought out overall. This proposal provides some of the most comprehensive information about marine fish disease ecology worldwide. There are two primary objectives that relate to their potential ecological and management impacts: 1) to evaluate epidemiological consequences of herd immunity to VHSV and 2) to identify *Ichthyophonus* transmission mechanisms.

The focus on herd immunity of the PWS herring population is very interesting. The proposed approach of PCR analysis for VHSV should provide a much more sensitive assay for exposure/immunity than neutralizing antibody assays. Is it known in fish that previous exposure may not include circulating VHSV antibodies, but that T-cell responses can ramp up upon exposure? While this is established in mammals, is this a possible situation in herring? Some comparisons of populations from other locations may be telling, as could the rapidity of an antibody response in fish presumed to have had previous exposure to VHSV.

PI Response:
Yes, an analogous process to what the Science Panel describes most likely occurs in the herring / VHSV model system. The Science Panel is correct that the presence of circulating antibodies to a particular agent are typically transient and often decline to undetectable levels after several months. The host typically remains protected after these antibody levels are no longer detectable because the lymphocytes responsible for producing these antibodies are primed and ready to start production as soon as re-exposure occurs. We recognize that something similar occurs in the herring / VHSV system because we have found fully protected groups of fish with only 27% of the individuals demonstrating

detectable levels of neutralizing antibodies. Our task in this project is to identify and quantify an immune system marker, specific to VHSV, that is a reliable indicator of prior exposure. We are hopeful that RT qPCR detections on the gills will provide this deductive ability. If this technique is not effective, we will move onto other specific immune markers that may include identification of activated lymphocytes or immunoglobulin T responses in herring. As the reviewer suggests, we plan to compare these responses in controlled situations using laboratory herring with known exposure histories and using wild herring from different various locations.

The proposed focus on ovivory in herring and *Ichthyophonus* transmission is appropriate. It is unclear if the pollock egg consumption (winter?) is of unfertilized or fertilized eggs (embryos) at spawning of developing embryos in the water column, please clarify. What will be used in experiments and how does this compare to natural exposures in PWS? Do embryos or developing pollock larvae need to be consumed for transmission, or does *Ichthyophonus* exist in ovarian eggs prior to spawning? The proposed research in this proposal appears to be duplicated in proposal 22220203; this needs to be reconciled.

PI Response:
We will start the experimentation by using eggs collected from female pollock and herring ovaries, as this represents the most available source of eggs. These eggs will be assessed for the presence of Ichthyophonus and they will be fed out to SPF laboratory herring to attempt parasite transmission. We will also attempt to collect some naturally spawned and fertilized eggs from pollock and herring; however, the collection logistics are much more difficult to solidify using the available sampling efforts and platforms. We are less interested in sampling larval herring for Ichthyophonus, as we have no indication that the parasite demonstrates true vertical transmission (i.e., is present inside the egg and infected the F1 generation). Rather, it is more likely that the parasite occurs on the outside of the chorion and is transmitted to adult herring that consume the parasite occurring out the outside eggs surface. From this perspective, we feel justified starting our investigations using eggs collected from inside the ovaries.

The apparent redundancy with the walleye pollock proposal (22220203) is an administrative artifact because that proposal is not part of GWA. The pollock proposal will provide all the pollock samples from the field and the Herring Disease Program (22120111-E) will provide all the laboratory diagnostics and experimentation. The Herring Disease Program was limited to a certain budget within the GWA program; therefore, the expanded efforts needed to accommodate the pollock diagnostics and experimentation are reflected by a modest staffing request for laboratory support in the walleye pollock proposal (22220203). This budget item will be better defined in the revised pollock proposal.

We appreciated the focus on sublethal impacts of disease and oil on herring. It is likely that this impact will be much greater than simply studying mortalities. The cross-generational effects of oil and disease exposure is exciting, as is the continued use of pathogen-free herring established by the PI.

We also greatly appreciate the effort and productivity of the PIs. However, there was some concern that PI Hershberger may be over-committed with collaborations and other efforts on collaborating proposals. It is suggested that the PI Hershberger describe percent effort on herring disease research in terms of what is proposed across all collaborative projects.

PI Response:
The Science Panel's recognition of our scope of work is much appreciated. Indeed, the project is very expansive and cross-disciplinary. As we have mentioned before, the cross-disciplinary nature of the EVOSTC programs, including GWA provides a unique opportunity in the field of disease ecology. The typical impediment to addressing these comprehensive studies in disease ecology has been cost and the unavailability of interdisciplinary teams involving specialists in disease ecology, population assessment, food webs, genetics, toxicology, and ecology. In this case, these and other specialists reflect the fundamental pillars of GWA and other EVOSTC programs. We consider this a generational opportunity to address real issues in disease ecology and we plan to take full advantage of the opportunity. Taken as a whole, the relative HDP efforts will be roughly partitioned into the following partner categories:

	Herring Disease Program	*Rand / Heintz / Gorman (pink salmon)*	*Fournier (walleye pollock)*	*Whitehead (toxicology and genetics)*	*Herring Movement (Cypher)*	***Total Time***
2022	*45%*	*5%*	*5%*	*40%*	*5%*	*100%*
2023	*45%*	*5%*	*5%*	*40%*	*5%*	*100%*
2024	*60%*	*5%*		*30%*	*5%*	*100%*
2025	*80%*	*5%*		*10%*	*5%*	*100%*
2026	*75%*	*5%*	*5%*	*10%*	*5%*	*100%*
2027	*55%*	*5%*	*5%*	*30%*	*5%*	*100%*
2028	*100%*					*100%*
2029	*95%*		*5%*			*100%*
2030	*95%*		*5%*			*100%*
2031	*100%*					*100%*

<u>Other Changes to the proposal since the initial submission:</u>
Since this proposal was initially submitted, Dr. Groner accepted a new position at Bigelow Laboratories in Maine. Owing to her geographic and career change, a new junior scientist will be hired to assume a portion of the laboratory and field tasks. With her new position, Dr. Groner's contributions to the project be greatly diminished, and these changes are reflected in the revised project administration and budget. Briefly, she is no longer listed as a Co-PI; rather, she will contribute as a PWSSC contractor during FY22 and FY23, during which time she will complete the two modelling exercises described in the proposal. Her involvement in the project will sunset after FY23. As a result of these administrative changes, some budgeting details have changed since the original submission:

- *a new subcontract is requested for Bigelow Labs for Dr. Groner (administered through the PWSSC) to accomplish the disease modelling exercises outlined in the proposal,*
- *requested personnel funding for the USGS Marrowstone Marine Field Station was reduced to accommodate the Bigelow contract.*

The budgeting changes are cost-neutral and, although annual budget requests have changed slightly, the total EVOS TC funding request for the 10-year Herring Disease Program remains the same.

Date: September 2021

The PIs have addressed questions adequately. The percentage effort for the primary PI (Hershberger) is not completely clear. We request that the PIs include the time commitment of the PIs that are on multiple proposals in terms of person months rather than the broad percentage provided in the table that is simply percentage for the overall project, not PI-specific. Based on previous track record, there is minimal concern regarding them accomplishing what they have proposed, even though it is quite ambitious.

Regarding ovivory, we understand that assessing unfertilized eggs collected from sexually mature females would be logistically more feasible, but some data on presence of parasites in oocytes from the ovary is needed and probably should have been presented or mentioned. We would like to know why samples of eggs and embryos from different species cannot be screened using molecular techniques in order to determine *Ichthyophonus* presence. It seems like this would be a good approach to determine the stage (oocyte, egg/embryo, late embryo) and the potential for transmission through ovivory. This would also provide some quantification in terms of exposure through diet when fed to lab herring. Collection of herring spawn over the first days to week of deposition seems critical and certainly seems feasible. For pollock, it seems that at least some sampling of unfertilized oocytes (from females collected) and some fertilized eggs/embryos from the environment should be sampled via the commercial fishery or agency observers and analyzed for *Ichthyophonus*. While it is understandable that this effort is not easy, it is critical to the hypothesis if pollock is to be included in this proposal. Are the herring and pollock "egg cultures" where *Ichthyophonus* was recovered from unfertilized or fertilized eggs known?

Finally, a component of this project relies on sample collection and analyses described in proposal 22220203. If the proposal 22220203 is not funded, the PIs will need to consider how they will include a pollock component in this proposal.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC. No specific comments.

Project Number: **22160111-F**

Project Title: Herring surveys and age, sex, and size collection and processing

Primary Investigator(s): Jennifer Morella

PI Affiliation: ADF&G **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$156,617	$227,363	$194,086	$172,224	$177,807	$928,097
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$183,596	$189,592	$195,811	$202,259	$208,946	$980,203

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$55,030	$56,405	$57,815	$59,261	$60,742	$289,253
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$62,261	$63,817	$65,413	$67,048	$68,724	$327,263

Total Past EVOSTC Funding Authorized (FY12-22): $1,048,117

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,275,480

Total Non-EVOSTC Funding (FY12-23): $437,135

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

The proposed project will conduct spring aerial surveys to document Pacific herring milt distribution and biomass as well as the distribution and abundance of sea lions, other marine mammals, and birds associated with herring schools or spawn. This proposed project will also provide a research platform (R/V Solstice) for an adult herring disease sample collection and processing. Finally, this proposed project will collect and process age, sex, and size samples of herring collected by the acoustics survey, spawning surveys, and disease sampling. Aerial survey and age, sex, and size data have been collected since the early 1970s and are an essential part of the age-structured models used by the Alaska Department of Fish and Game to estimate the historical and future biomass for fisheries management. This project will help to meet the overall program goals of providing sound scientific data and products to inform resource managers and the public of changes in herring stocks and in the PWS ecosystem.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The work described in this proposal is designed to collect data in support of other projects, especially the biomass assessment project (22120111-C Branch). Additionally, this project also provides a platform for collection opportunities in support of other projects. In recent years we have discussed whether the project should be evaluated similarly to others where we consider the importance and clarity of the hypotheses and the likelihood of relevant scientific output, especially in the form of peer-reviewed papers, are taken as indicators of the significance and probability of success of the project. Given the role of this project is primarily data collection in service of other projects, different metrics of success may need to be applied.

PI Response:
Thank you for recognizing the role of this project.

With reference to the vitally important tasks of conducting aerial surveys of spawn and collection of specimens in support of biological assessment, the PI has a sterling record: both for data collection and cooperation and collaboration with the PIs in many projects. We acknowledge this significant contribution and suggest that the many collaborators who use data from this project might consider additional acknowledgement of this project's contributions, perhaps in the form of inclusion of the PI as a manuscript co-author and at the very minimum recognition in the acknowledgements.

PI Response:
This is the current practice regarding use of data within the program.

The information collected from this work is essential for all herring-related project work as well as other work funded by EVOSTC. The PI has done an excellent job of reporting the results in a form useful to other researchers. During the proposal review, however, we were advised of a change in the PI for this project. We suggest that this is an opportune time to consider a different kind of reporting for this essential work. For instance, it might be beneficial to see some form of a longer, more detailed technical report that would describe the methods and results, with special attention given to both the limitations and merits of the approach. A specific task might be some documentation about the nature of interannual variation in the estimates of spawn miles and commenting on the potential both for missed spawns related to unusual spawning dates (early and later than the surveys) or survey interruptions related to weather or equipment malfunction.

PI Response:
We agree with the need for an error analysis associated with the methods and the topic is expected to be further addressed in the workshop proposal.
There is a specific question that requires clarification. On page 11 of the proposal there is a comment about ‘reader drift’. What is this and is it important? Also, we expect to see the qualifications (including CV) for the new project PI included in the revised proposal.

PI Response:
Reader drift is the divergence of age estimates by different readers over time. It is essential for their use in stock assessment that age estimates do not differ by readers over time. Current protocols include independently interpreting age by two or three readers followed by discussion of any discrepancies to reach a consensus on age estimation and further spot checking by the crew leader.

These protocols are established to prevent reader drift in age estimates. I have updated the sentence on page 11 (Section 4, Project Design, B. Procedural and Scientific Methods) to better define reader drift. Qualifications have been updated in Section 10, Project Personnel, to reflect the change in PI.

Date: September 2021

This project is essential both for annual herring assessments as conducted by ADFG and for other research projects supported with EVOSTC funds. While we appreciate the positive responses of the PI to most of our recommendations, the response to the specific recommendations about documentation of methodologies and sources of error etc. was unclear. The PI advises that this recommendation will be addressed through a workshop. However, if the proposed workshop does not proceed as planned, then this important task will not be addressed. To reiterate, we advise that it is in the interest of all researchers who access any output from herring assessments and related work to have an accessible document that explains the methods and sources of error associated with all aspects of this project for all years that work has been conducted. Such a document would be comprehensive and explain strengths and weaknesses of aerial and shipborne surveys, including the implications of related topics, such as 'reader drift' during annual analyses of age through herring scales. The PI advises that such a document will be produced from a future workshop. We will leave the specific choice of reporting venue to the PI. However, we suggest that a workshop might not be a suitable venue to compile and describe all aspects of the methodology and sources of error. We expect the report to be thorough and probably too long for typical workshop reports. However, if the workshop cannot proceed then another report format should be used. We consider this requirement for this report as 'expected' and not optional and will consider this in future reviews of this project.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC. I look forward to seeing a technical report that includes explanations and summaries of methods used since 1970 as strongly suggested by the Science Panel.

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 & Arial Milt Surveys.
FY18: the project has a new PI, correct number is 18160111-F Haught
FY19: correct number is 19160111-F Haught
FY20: correct number is 20160111-F Haught
FY21: correct number is 21160111-F Haught
FY22: the project will have a new PI (Morella), correct number is 22160111-F

Project Number: **22220111-I**

Project Title: Ecological interactions between Pacific herring and Pacific salmon in Prince William Sound, Alaska

Primary Investigator(s): Peter Rand, Rob Campbell, Ron Heintz, Kristen Gorman

PI Affiliation: PWSSC, Sitka Sound Science Center, UAF

Project Manager: NOAA/PWSSC

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$251,826	$397,535	$405,058	$347,194	$335,598	$1,737,212
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$244,480	$94,729	$0	$0	$0	$339,209

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$0	$0	$0
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $251,826

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $649,361

Total Non-EVOSTC Funding (FY12-23): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

Since the collapse of the Pacific herring (*Clupea pallasii*) population in Prince William Sound (PWS), Alaska during the mid-1990s, hatchery production of pink salmon (*Oncorhynchus gorbuscha*) in PWS has increased dramatically. Importantly, ecological interactions between these species may have consequences for recruitment of both populations. We propose a retrospective analysis and focused field campaigns over a six-year period aimed at developing the following seven products. (1) Analyses of historical and current data describing each species co-occurrence in near-shore and off-shore habitats, (2) evidence of direct predation by each species on the other, (3) competition for dietary resources including estimates of age-0 herring and juvenile pink salmon body condition, and (4) prevalence of a key pathogen, viral erythrocytic necrosis. We propose constructing (5) a bioenergetic model to estimate the predatory demand of pink salmon on larval herring in

southwestern PWS, a major migratory pathway for salmon. The model will be developed in collaboration with a post-doctoral associate funded by a separate Trustee Council mechanism. Incorporation of our results with environmental observations will lead to (6) a model to explain variation in marine survival of PWS pink salmon. Finally, we propose using data and relationships developed here to (7) construct a model to forecast PWS pink salmon returns. Our fieldwork and analyses will capture dynamics across ontogenetic shifts in herring and pink salmon during spring when age-1+ herring co-occur with pink salmon fry in nearshore waters, summer when emigrating pink salmon encounter larval herring over deeper waters, and late summer when age-0 herring rely on prey fields previously exploited by out-migrating juvenile pink salmon. Our field campaign is based on preliminary analysis of existing data, which will be formalized through the proposed retrospective analysis. The project will support a M.S. student through the University of Alaska Fairbanks, Marine Biology program.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

This 5-year proposal is intended to provide information that can be used to examine whether increased production of pink salmon in PWS is constraining herring stock recovery. It responds to a suggested area of interest in the FY22-31 Invitation for Proposals: *An examination of the role of hatchery-produced pink salmon, wild pink salmon, on herring ecology in PWS and the Gulf of Alaska*. The PIs propose to test three hypotheses: (1) foraging pink salmon and herring are commonly co-located; (2) pink salmon can consume a large biomass of herring, and (3) herring and pink salmon selectively consume similar prey items that are in limited supply.

As a result of this research, the PIs intend to provide: (1) a synthesis of existing data that identifies where, when, and at what life stages pink salmon and herring might be interacting in PWS; (2) new data describing juvenile pink salmon and juvenile herring diet composition including isotopic analysis; and (3) estimates of the potential number of larval herring consumed by juvenile pink salmon. Diets are planned to be examined using traditional gut analysis and stable isotope analysis (SIA). These diet data will be used for bioenergetic modeling, as well as isotopic analysis to determine whether or not (and presumably, the degree to which) pink salmon are directly consuming herring.

The proposed work was relatively well presented, although improvements can be made. For instance, the use of hypotheses, objectives, components, and results/products were sometimes confusingly presented and it was not always clear how they relate to one another. Although a study involving all life stages is proposed, the PIs anticipate interactions to be most likely between emigrating juvenile pink salmon and larval and/or juvenile herring. As a result, descriptions of those analyses are more fully described. In a revision, the Science Panel expects more explanations throughout the proposal. In some places, clarity is compromised by syntax errors and unnecessary brevity. For instance, the first hypothesis confusingly states “Foraging pink salmon, and herring that

are suitably sized for consumption, are commonly co-located." As another example, hypothesis 2 states "pink salmon can consume a significant biomass of herring." "Significant" could mean 'large or substantial' or statistically significant but even so this might not be biologically meaningful at the ecosystem level. A reverse case might also hold so that modest consumption might have ecologically significant (or ecologically meaningful) effects. On page 7, it is not clear to us how objectives 2 and 4 differ. These are just a few examples that should be addressed in a revision.

PI Response:
The proposal has gone through an extensive revision in being merged with another project initially proposed by PI Rand. In working through the revision, we focused our efforts on clarifying the language so as to avoid brevity and include details so as to be specific about our hypotheses and methods. The revision was a useful exercise for all PIs, Rand, Campbell, Heintz and Gorman, to discuss the proposal details and work towards a clear and integrated project that meets the initial objectives of both studies. The integrated proposal retains this project number (22220111-I). Because the proposal revisions are so extensive, we do not refer to proposal sections and page numbers in our comment responses.

In a revised proposal, we recommend consideration of the merits of polymerase chain reaction (PCR) for diet analysis. The Panel also raised some questions that could be addressed in a revised proposal. For instance, how synchronous is the release from the hatcheries? Is it spread over many weeks or months? It would seem that hatchery release patterns and their timing would be important to the degree of overlap with herring.

PI Response:
We agree with the comments by the Science Panel. In the revised proposal, we merged our study with that of Rand et al. and now include DNA barcoding in diet work. Our initial budget cap limited us on several fronts including employing DNA-based diet work, in addition to conducting significant fieldwork. The new project allows for synergies between both studies including the use of DNA-based diet studies and conducting more fieldwork. We added details about the timing of sampling relative to hatchery releases of pink salmon in PWS.

There are obvious overlaps between this proposal and proposal 22220111-L (Rand, Campbell & Groner). For example, this proposal plans to undertake bioenergetic modeling to determine the extent to which juvenile pink salmon consume larval herring. This proposal plans the bioenergetic modeling to provide initial estimates of herring consumption by pink salmon. Whereas the other proposal would be able to further refine these estimates by considering consumption differences between odd and even years that vary in pink salmon run strengths. We consider the more thorough consideration of consumption differences in odd versus even years of higher value (as described in proposal 22220111-L). Given this, if both proposals are funded, the provision of initial estimates of herring consumption in this proposal would seem to be unnecessary if examined more completely in proposal 22220111-L. Other areas of overlap should be addressed, as well.

PI Response:
Yes, this is why we decided to combine efforts into one proposal. Again, the initial budget cap on our smaller proposal dictated that we could not complete multiple years of field collections. By combining efforts with Rand et al. we are now in the position to work on a more detailed bioenergetic model that is outlined in the proposal.

We strongly recommend that the PIs of both herring-pink salmon interaction studies consider merging efforts into one, well-organized, comprehensive proposal. By combining the two, some cost savings and efficiencies may be realized. A combined proposal can still include separate research components conducted by a different set of co-PIs, as appropriate. But the relationships among these components can be articulated into a well-organized and sound proposal. If this recommendation is disregarded and two separate revised proposals are submitted in August, we expect to see that overlap between proposals is eliminated and the relationships of one proposal to the other is very clearly stated in both proposals. The last alternative (not preferred by the Panel) is two competing proposals, which will likely result in one or the other being recommended for funding.

PI Response:
We understand the concerns of the Science Panel on overlaps between the two projects. In response, we have combined our efforts into one large proposal that continues to meet the initial objectives of both studies.

Date: September 2021

This proposal aims to resolve long-standing questions about the roles that pink salmon and Pacific herring play in each other's population dynamics in PWS. The PIs propose retrospective analyses and field studies over a 6-year period including (1) analyses of co-occurrence in nearshore and offshore habitats, (2) evidence of predation by each species on the other, (3) competition for dietary resources (using visual examination of stomach contents, DNA barcoding, bulk and compound-specific carbon and nitrogen stable isotope techniques, and examination of age-0 herring and juvenile pink salmon body condition), (4) prevalence of a key pathogen, viral erythrocytic necrosis, (5) development of a bioenergetic model to estimate the predatory demand of pink salmon on larval herring in southwestern PWS, a major migratory pathway for salmon, (6) construction of a model to explain variation in marine survival of PWS pink salmon, and (7) a development of a model to forecast PWS pink salmon returns. The proposal lays out five clear hypotheses and an associated list of objectives. Scientific methods are clearly described and justified. The proposed research builds on existing datasets already produced by EVOSTC: SEA, APEX, GWA, HRM, and other sources (ADF&G, NSF, NOAA, NPRB, and NCEAS). Coordination and collaboration with other EVOSTC components are well described.

This project should, once and for all, establish the role of pink salmon in regulating Pacific herring production in PWS and develop tools for predicting pink salmon marine survival. The potential role of pink salmon on herring in PWS is palpable, as PWS is home to the largest pink salmon hatchery system in the world and the herring stock is depressed. If there is an effect of hatchery pink salmon, this is the place to look. In addition to considering the role of pink salmon on herring, the PIs will also examine the opposite effect of age-1+ (juvenile and adult) herring feeding on pink salmon fry. The proposed research will also help address how these past and future environmental changes, such as marine heat waves, can affect populations dynamics of herring and pink salmon.

We are excited about this new proposal, which combines proposals 22220111-I and 22220111-L. The PIs have joined forces and taken our previous comments seriously and produced a very well written proposal. Co-PIs Rand and Campbell, as well as Heintz and Gorman, have each worked together on related herring research in the past. Collectively, they form a strong research team.

PAC Comments

Date: September 2021
No specific comments.

Executive Director Comments

Date: October 2021
I concur with the Science Panel and PAC.

Project Number: **22120114-C**

Project Title: Monitoring long-term changes in forage fish distribution, relative abundance, and body condition in PWS and the Northern GOA

Primary Investigator(s): Mayumi Arimitsu, John Piatt

PI Affiliation: USGS **Project Manager:** USGS

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$347,956	$320,312	$330,005	$340,091	$350,586	$1,688,950
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$358,855	$365,665	$373,488	$381,507	$389,726	$1,869,240

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$482,500	$482,500	$482,500	$482,500	$482,500	$2,412,500
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$482,500	$482,500	$482,500	$482,500	$482,500	$2,412,500

Total Past EVOSTC Funding Authorized (FY12-22): $2,634,356

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $2,954,668

Total Non-EVOSTC Funding (FY12-23): $3,728,400

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

In the wake of the *Exxon Valdez* oil spill (EVOS) and subsequent crash of Pacific herring in Prince William Sound (PWS), efforts to monitor changes in forage fish have been integral to assessing the recovery of injured resources in the spill-affected region. For example, during the first 10-years of Gulf Watch Alaska (GWA), data from this project documented a heatwave-induced forage fish collapse which resulted in reduced energy flow through the pelagic food web that led to unusual mortality events in birds and mammals and fishery closures in the Gulf of Alaska (GOA). The primary goals of the GWA forage fish monitoring project are to: (1) monitor abundance and quality of key forage species, and, (2) better understand how underlying predator-prey interactions influence recovering species and pelagic ecology within PWS and the northern GOA; including top-down and bottom-up regulation of forage fish in the middle trophic level. Proposed work during the FY22-31 funding cycle will include the following objectives: continue (1) fall PWS Integrated Predator Prey (IPP) surveys, (2) spring/summer Middleton Island seabird diet sampling, (3) summer PWS aerial

survey validation, and (4) summer/fall forage fish condition indices. We will expand analyses of formerly ancillary samples to provide new indices of juvenile salmon and juvenile walleye pollock. This will include determining hatchery vs. wild proportions and condition (size, energy density) for 10 years of archived plus future samples of juvenile pink and chum salmon collected by seabirds and developing an index of energy content of fall PWS juvenile walleye pollock using samples collected during IPP trawl sampling. Our continued efforts will extend and expand information on forage fish abundance and quality over time, improve our ability to identify drivers of predator-prey interactions, and further document recovery of resources affected by the oil spill and marine heatwaves.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

This proposal seeks to continue a long-term study on forage fish in Prince William Sound (PWS) and nearby waters as one project in the multidisciplinary Gulf Watch Alaska Long-Term Monitoring Program: Pelagic Ecosystem Monitoring Component. The PIs identify an additional $4,825,000 in matching funds. The project is one of five projects in the Pelagic Ecosystem Monitoring Component, with the other projects focusing on killer whales, seabirds (2), and humpback whales; and it is a partner in the Integrated Predator Prey (IPP) project in the Pelagic Ecosystem Monitoring Component of the program. The objectives of this project are to continue to provide indices of forage fish abundance, including species composition and biomass within persistent predator foraging areas using shipboard hydroacoustic profiling, trawls, and other sampling methods, and by following foraging humpback whales; continue to provide indices of forage fish abundance/availability by sampling seabird diets on Middleton Island; continue to measure physical and biological parameters in PWS during integrated surveys using CTDs, nutrient sampling, and zooplankton sampling; continue to assess the quality of forage fish as prey, such as age, size, growth, and body condition by targeted sampling of sand lance and spawning capelin in two areas of predictable aggregations in PWS; and continue shipboard validation of the species composition of forage fish schools located during aerial surveys by a separate project.

The team proposes to analyze archived samples of juvenile pink and chum salmon (wild and hatchery fish) obtained from prey returned by rhinoceros auklets to provision chicks at Middleton Island since 2010 to produce a 21-year time series of body condition indices for these species. These analyses may help understand interannual variability in juvenile salmon growth in relation to environmental variability and competition between wild and hatchery stocks.

The proposers are very competent, have been highly productive, and have strong collaborations within the GWA LTRM Program and with other studies in the Gulf of Alaska. The results to date have been invaluable to the current understanding of ecosystem variability in PWS and the Gulf of Alaska, particularly as it is related to atmospheric forcing.

PI Response:
We thank the reviewers for these positive comments on our work thus far and look forward to continuing this work in the future should the GWA-LTRM program funding be awarded.

While we agreed that this is a strong proposal by a reliable and productive team, we do have some questions about methodology that should be addressed.

1) It is not clear what will become of the fish they catch to validate the composition of schools located by the aerial surveys. Certainly, the fish will be identified to species. Will some of these samples also be measured and weighed, and aged using otoliths? If so, how many? Will the energy density of fish captured in June be calculated for comparison with capelin and sand lance collected for body condition analysis in July?

PI Response:
The main purpose of the aerial validation work is to identify species and age of the schools observed in the plane. The majority of schools encountered thus far on the aerial validation trips are herring. Although sand lance are also observed from the airplane, that species is typically verified by camera because sand lance are best collected with a purse seine or mid-water trawl, and neither of these methods are fast enough to deploy while the airplane is circling overhead. Capelin are rarely encountered during aerial surveys. Therefore, no, we will not catch fish during aerial validation efforts that could be compared to July sand lance or capelin samples.

We clarified details of how the fish would be measured by adding the following text to the second paragraph on page 12 (Section 4, Project Design, B. Procedural and Scientific Methods):
Herring, which is the only species classified by age class during surveys, will be captured during aerial validation and identified to species, aged with scales, and measured for length and weight. Other schools will be verified to species at least, and any fish caught will be measured for length and weight. Approximately 10% of flight time (4-6 hours) will be dedicated to validation effort on an annual basis.

In the same paragraph we added a brief summary on the validation results from 2014-2021:
A total of 80 schools were validated between 2014 and 2021 (average: 13 schools/year, range: 2 in 2020 due to low effort during the pandemic to 25 schools in 2021). Of those, 85% of schools were correctly classified by species, and 75% of herring schools were correctly classified by age-class. One school was incorrectly classified to species because it was determined to contain both age-0 herring and age-0 sand lance, and 8% of herring schools were incorrectly classified to age-class because of mixed-age schools (e.g., schools composed of age-1 and age-2+ fish).

2) 200 capelin and 200 sand lance will be weighed, measured and frozen in the field during targeted sampling to determine body condition and later aged in the lab using otoliths. Energy density of a random sample of 10 aged fish of each species will be calculated. It is not clear if this will be a total of 10 fish of each species, or 10 each of known ages (e.g., 10 age 0, 10 age 1, etc.). Apparently, they will not be stratified by sex or date—does that matter? Will a sample of just 10 fish/summer be sufficient to characterize the condition of the capelin and sand lance populations in PWS?

PI Response:
We have previously shown that total energy of age-1 sand lance were sensitive to the marine heatwave, while age-0 sand lance did not vary over time (von Biela et al. 2019). This is because age-0 fish typically put their energy towards somatic growth rather than lipid storage. For capelin, sex and maturity determine variability in lipid content (Montevecchi and Piatt 1984), so we will sample energy density of mature males for that species. In Section 4, Project Design, B. Procedural and Scientific Methods, paragraph 1 on page 13, we clarified that 10 age-1 sand lance and 10 mature male capelin will be assessed for energy density.

Montevecchi, W.A. and J. Piatt. 1984. Composition and energy contents of mature inshore spawning capelin (Mallotus villosus): Implications for seabird predators. Compend. Biochem. Physiol. 78A:15-20.

von Biela, V.R., M.L. Arimitsu, J.F. Piatt, B. Heflin, S.K. Schoen, J.L. Trowbridge, and C.M. Clawson. 2019. Extreme reduction in nutritional value of a key forage fish during the Pacific marine heatwave of 2014-2016. Marine Ecology Progress Series 613:171-182.

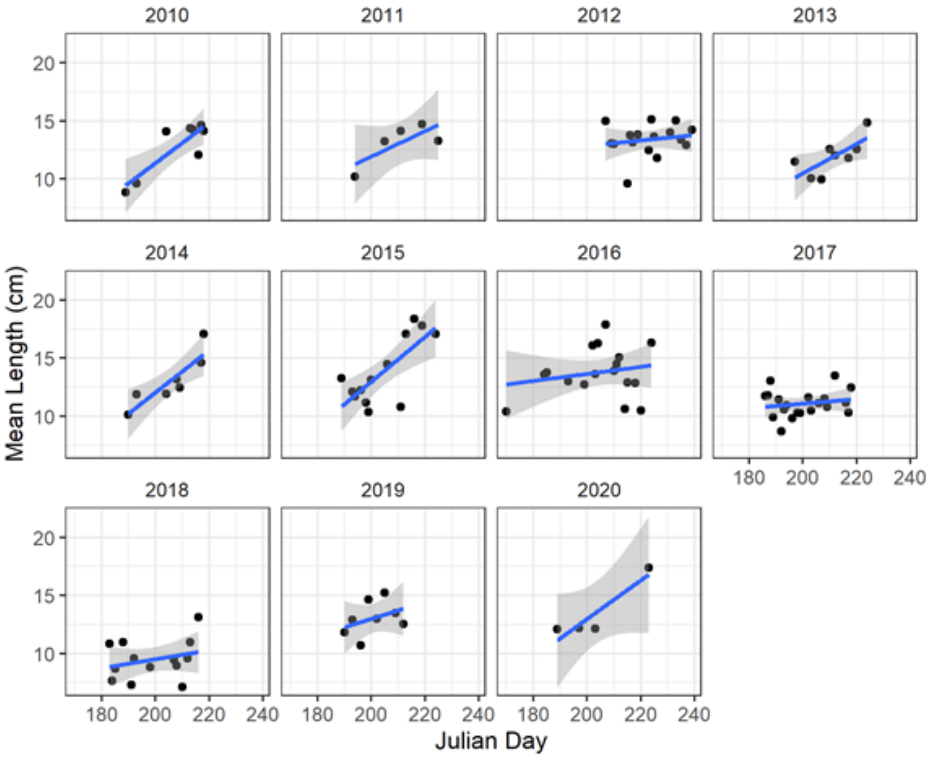
3) A similar question was raised about sample sizes for the juvenile pink and chum salmon collected from provisioning auklets at Middleton Island. Will 10 wild and 10 hatchery fish collected over a period of a month or so be sufficient to characterize the annual condition of these species? The example of pink salmon growth (Fig. 8) shows that they do indeed grow in some years, but maybe not all years, and that in all years the data are very noisy and not compelling. Apparently, the fish in those samples were not stratified as wild or hatchery. How confident are the PIs that all of these fish, past and future, originated in PWS? In short, this addition to the bigger project requires significantly greater explanation and justification. It also would be helpful to know the cost of this new work to better evaluate it in the larger context of the budget.

PI Response:
We agree that the new salmon project could be better justified and have added more details to this section. For example, we clarified the answer to the energy density sample size question in Section 4, Project Design, B. Procedural and Scientific Methods on page 14 with the following text:
Sample size of 10 fish is based on the sample size we use for similar analysis of sand lance (von Biela et al. 2019). Analyses of juvenile chum from Bristol Bay found relatively low CVs (3%) in energy density measures (Burrill et al. 2018), and therefore we anticipate that our sample size will be successful in detecting change over time.

It is true that this index of growth may not be as informative as we'd like, but we intended it to be a starting point and example of the data we already have in hand. To reduce the noisy data in the original version of Figure 8, we revised the analysis to use the mean of samples on each day as the response, which produced a much better fit ($R2 = 0.53$, $p < 0.001$). We will not know if these fish are hatchery or wild until we look for hatchery marks on the otoliths, but it's possible that stratifying could help improve the fit of the growth index. We clarified this and the specific issue of cost in Section 4, Project Design, B. Procedural and Scientific Methods, at the bottom of page 14 and top of page 15 by adding the following text: Because the samples are collected over the course of the chick rearing period (ca. 5- 6 weeks), existing information on size may be useful for understanding interannual variability in growth of juvenile salmon (Fig. 8), as previously documented in juvenile salmonids measured over time in southeast Alaska (Orsi and Ferguson 2017). We found the

interaction between Julian day and year explain 53% of the variation in the mean length per day ($p < 0.001$). This relationship could be strengthened once we process otoliths to know which samples originate from wild vs. hatchery populations. The bulk of the costs for this part of the work (i.e., $34K in year 1 of the project) will support GS9 salary for lab work associated with processing 11 years of archived samples. After year 1 no extra costs are incurred to process annual samples in the lab as we are already planning similar work for other forage fish species. We are working closely with Pete Rand (PWSSC) and Jennifer Morella (ADF&G) to ensure that methods are complementary.

We also revised Figure 8 as follows: Figure 8. Juvenile pink salmon mean length by Julian day and year (OLS: $R^2 = 0.53$, $p < 0.001$). Samples were collected by seabirds at Middleton Island.



Date: September 2021

This proposal seeks continued funding over an additional ten years for the long-term study of forage fish in Prince William Sound (PWS) and nearby waters, as one project in the multidisciplinary Gulf Watch Alaska Long-Term Monitoring Program: Pelagic Ecosystem Monitoring Component. The objectives of this project are to provide indices of forage fish abundance, including species composition and biomass, within persistent predator-foraging areas using shipboard hydroacoustic profiling, trawls, and other sampling methods, and by following foraging humpback whales; continue to provide indices of forage fish abundance/availability by sampling seabird diets on Middleton Island; continue to measure physical and biological parameters in PWS during integrated surveys using CTDs, nutrient sampling, and zooplankton sampling; continue to assess the quality of forage fish as prey, such as age, size, growth, and body condition by targeted sampling of sand lance and spawning capelin in two areas of predictable aggregations in PWS; and continue shipboard validation of the species composition of forage fish schools located during aerial surveys by a separate project. The PIs are highly qualified to undertake this important work and have been extremely productive, and the proposal in general is strong.

We had concerns from the March 2021 review that were, overall, adequately addressed. We asked for clarification regarding the fate of the fish captured for validation of aerial survey observations. The PIs responded that herring only will be targeted, as sand lance and capelin are difficult to capture under the time constraints of the aerial survey. Results from prior validations for herring were summarized. We also asked for clarification of analyses to be conducted on sand lance and capelin collected during dedicated sampling. We also wondered if a total of ten individuals of each species would suffice as an index of the energy density of those populations. The PIs clarified that only age-1 sand lance and adult male capelin would be analyzed. They addressed the other, more important, question of sample size by citing a prior publication of their group (von Biela et al. 2019) that appears to justify the sample size. Finally, we had a similar question about the justification for sample sizes of juvenile pink and chum salmon to be collected from seabirds at Middleton Island and analyzed for body condition – will ten fish of each species be sufficient to characterize condition when they are collected over a period of 5-6 weeks, particularly if as they say, they will stratify the samples between wild and hatchery origin? The response of the PIs was that this is the sample size they use for sand lance, and that salmon sampled from Bristol Bay had low CVs (3%) in energy density measures. This answer was not compelling, however, the cost for this aspect of the overall project is negligible and not a distraction from the larger goals.

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: Fall 2021

I concur with the Science Panel and PAC.

Project Number: **22120114-D**

Project Title: Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf

Primary Investigator(s): Clare Ostle, Sonia Batten

PI Affiliation: MBA, NPMSO **Project Manager:** NOAA/PWSSC

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$85,567	$87,736	$89,928	$92,175	$94,477	$449,884
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$96,837	$99,256	$101,736	$104,277	$106,882	$508,988

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$128,351	$131,605	$134,892	$138,262	$141,715	$674,825
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$145,256	$148,884	$152,603	$156,416	$160,323	$763,481

Total Past EVOSTC Funding Authorized (FY12-22): $1,785,467

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,873,203

Total Non-EVOSTC Funding (FY12-23): $1,784,956

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

As the base of marine food-webs, plankton are a fundamentally important functional group in marine ecosystems, and a reflection of current environmental conditions due to their rapid generation times and short lifecycles. 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 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. Data 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 and sizes of plankton). Variability in any, or all, of these indices can cascade through to higher trophic levels such as herring, salmon, birds, and mammals that forage across the region. Recent results show that interannaul variability in plankton dynamics is high and that the plankton

has responded to the recent warm conditions, with changes evident in abundance, sizing, composition, and timing. The CPR is designed to be easy to deploy on commercial maritime vessels and sample autonomously. Thus, CPR sampling has been unimpacted by the COVID-19 pandemic, with the tried and tested longevity of the CPR methodology ensuring that the samples and data are collected analysis. As climate change, and the likely associated changes in environmental conditions, continues to impact the Gulf of Alaska ecosystem it is more important than ever to maintain consistent time-series that depict these changes.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The PIs propose to continue monitoring large phytoplankton and zooplankton with a Continuous Plankton Recorder near the sea surface across the Alaskan shelf from lower Cook Inlet across the slope into the Gulf of Alaska monthly, six times per year during spring and summer for another 10 years. They will produce indices of plankton abundance, seasonal cycles, and community composition. The objectives and sampling protocol will remain the same.

We continue to appreciate the value of the CPR studies and its contribution to our understanding of PWS and GOA more broadly and see value in continuing this project as proposed. The project continued meeting its objectives during the pandemic.

PI Response:
We would like to thank the science panel for their positive comments and support of the CPR work in the GOA; we very much enjoy working with the group and are excited about the potential for a further 10 years of fruitful collaborations.

We concluded that integration of all five of the LTRM Environmental Driver components (CPR, PWS, Cook Inlet/Kachemak Bay, GAK 1, Seward Line) should be pursued using existing and proposed resources to better demonstrate the combined value of these efforts and as planning for the post-EVOSTC era when funding will no longer be available. We understand why administratively these enterprises are kept separate in the present proposal but urge each of them to consider ways in which the datasets can be integrated and used to present a more holistic picture of the region and the extent to which inshore areas are predictable (or not) from offshore areas (and vice versa). We defer to the program managers and project PIs to determine the best approach to tackle this synthesis; one suggestion is to recruit some of the postdoctoral fellows proposed under the broader LTRM heading to address this region-wide synthesis of oceanographic conditions using already existing data.

PI Response:
Continued integration among all GWA projects, including Environmental Drivers, is a priority for the next 10 years of GWA-LTRM. For Environmental Drivers, the Danielson et al. (in review) paper

provides examples of spatial and temporal scales of variability in near-surface ocean temperatures across the GOA from all sources within and various sources outside GWA. We will expand on these efforts on the physical environment by conducting similar analyses with sub-surface temperatures and salinity, which strongly link to nutrients. Additional integration steps will focus on similar analyses for phytoplankton and zooplankton, ultimately integrating the two approaches to propose mechanisms of change in species abundance and composition, onshore vs. offshore production, etc. Correct, the Environmental Drivers component will be using their three years of postdoc funding to support these efforts. Furthermore, Environmental Driver PIs will work with the GWA Synthesis and Modeling component over the next 10 years to highlight integrated analyses within work plans and annual reports.

Danielson, S.L., T.D. Hennon, D.H. Monson, R.M. Suryan, R.W. Campbell, S.J. Baird, K. Holderied, and T.J. Weingartner. in review. Marine temperature variations in the northern Gulf of Alaska across years of marine heatwaves and cold spells. Submitted to Deep-Sea Research II Special Issue.

Date: September 2021

The goal of this continuing proposal is to continue monitoring large phytoplankton and zooplankton with a Continuous Plankton Recorder near the sea surface across the Alaskan shelf from lower Cook Inlet across the slope into the Gulf of Alaska monthly, six times per year during spring and summer for 10 years. The objectives and sampling protocol remain the same. We recommended that the PIs take the next step in integration by synthesizing their findings with the four other projects in the Environmental Driver Component to provide an integrated region-wide perspective. Although the PIs responded that this would be a priority, we are still seeking clarification about how this project will contribute specifically to these syntheses. What data would be used, how would it fit into the overall analysis and what role would the PIs play? The PIs have been productive, and continued funding of this important component of the Long-term Research and Monitoring program.

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: Fall 2021

I concur with the Science Panel and PAC.

Project Number: **22120114-G**

Project Title: Long-term monitoring of oceanographic conditions in PWS

Primary Investigator(s): Robert Campbell

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$249,762	$256,008	$262,407	$268,967	$275,692	$1,312,836
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$282,582	$289,635	$296,888	$304,311	$311,919	$1,485,336

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$225,000	$225,000	$225,000	$225,000	$225,000	$1,125,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$225,000	$225,000	$225,000	$225,000	$225,000	$1,125,000

Total Past EVOSTC Funding Authorized (FY12-22): $2,433,562

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $2,689,570

Total Non-EVOSTC Funding (FY12-23): $2,224,900

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

This project will continue physical and biological measurements that may be used to assess trends in the marine environment and bottom-up impacts on the marine ecosystems of Prince William Sound (PWS) that were highly impacted by the 1989 oil spill. Regular (~6 per year) vessel 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: in central PWS, at the entrances (Hinchinbrook Entrance and Montague Strait), and at four priority bays that were part of the *Exxon Valdez* Oil Spill Trustee Council-funded Sound Ecosystem Assessment project in the 1990s and the Herring Research and Monitoring project in the 2010s.

Additionally, an autonomous profiling mooring will be deployed each year 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 mounted on the profiler will also capture images of zooplankton, large phytoplankton and other particles to very high resolution.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

This proposal continues routine oceanographic surveys of PWS to extend ongoing time series of physical (temperature, salinity, turbidity), biogeochemical (nitrate, phosphate, silicate, dissolved oxygen) and biological (chlorophyll-a concentration, zooplankton abundance and composition) parameters in central PWS, at the entrances, and in four bays that were part of the EVOSTC-funded Sound Ecosystem Assessment project in the 1990s and the Herring Research and Monitoring project in the 2010s. Also, an autonomous profiling mooring will be deployed each year in central PWS that will conduct frequent (twice daily) profiles of the same physical, biogeochemical, and biological parameters as the surveys, plus a plankton camera mounted on the profiler that will capture images of zooplankton, large phytoplankton and other particles. This project also provides a platform for fall and winter observations of seabird abundance (project 22120114-E).

As detailed in the annual report and this proposal, we note the value of these observations to document recent marine heatwaves and their impacts on zooplankton community composition, as well as a decades-long decline in productivity of PWS. This project has been meeting its objectives consistently, with little impact of the Covid-19 shutdown. This project has also been productive in terms of publications and presentations. In just the past year, the project resulted in three peer-reviewed journal articles, four EVOSTC reports, and one popular article. The proposed study design and analytical methods are sound and consistent with those employed to date. It is highly commendable that the camera and machine vision systems have led to value-added applications, such as salmon enumeration in clear-water streams. The machine vision system also has potential in aging of salmon scales. We also note that this is one of the most integrated projects, with 50% match with non-EVOSTC funds. At $2.8 M for 10 years (~$280 K per year), the project provides overall good value for the important data being collected.

PI Response:
I thank the Science Panel for their kind words, the many years of effort put into this project is now starting to pay dividends. The PWS Science Center has made a significant commitment to making this project possible, including the purchase and refit of our research vessel, and continuous upgrades to instruments, laboratory and other working facilities. We have been very successful in leveraging new proposals off of this project and will continue to look for new opportunities, there are several proposals in development at present. It is always difficult to predict how long it will take for those proposals to be successful, but I note that in the last five years of the project over $1.1 M of leveraged projects were funded by the North Pacific Research Board and NOAA.

Finally, we offer the following comment regarding synthesis to all five oceanography projects: PWS oceanography, Cook Inlet oceanography, GAK1, Seward line, and CPR. Specifically, we recommend an integrative synthesis of all five oceanography projects to be included in the proposal(s). In addition to reporting project results separately for each area as proposed, there is opportunity for a region-wide synthesis that draws all results together for a broader perspective. For example, a synthesis might address connectivity of PWS and Cook Inlet to the northern GOA, predictability of Cook Inlet oceanography from PWS oceanography, and so on. We defer to the program managers and project PIs to determine the best approach to tackle this synthesis; one suggestion is to recruit some of the postdoctoral fellows proposed under the broader LTRM heading to address this region-wide synthesis of oceanographic conditions using already existing data.

PI Response:
Continued integration among all GWA projects, including Environmental Drivers, is a priority for the next 10 years of GWA-LTRM. For Environmental Drivers, the Danielson et al. (in review) paper provides examples of spatial and temporal scales of variability in near-surface ocean temperatures across the GOA from all sources within and various sources outside GWA. We will expand on these efforts on the physical environment by conducting similar analyses with sub-surface temperatures and salinity, which strongly link to nutrients. Additional integration steps will focus on similar analyses for phytoplankton and zooplankton, ultimately integrating the two approaches to propose mechanisms of change in species abundance and composition, onshore vs. offshore production, etc. Correct, the Environmental Drivers component will be using their three years of postdoc funding to support these efforts. Furthermore, Environmental Driver PIs will work with the GWA Synthesis and Modeling component over the next 10 years to highlight integrated analyses within work plans and annual reports.

Danielson, S.L., T.D. Hennon, D.H. Monson, R.M. Suryan, R.W. Campbell, S.J. Baird, K. Holderied, and T.J. Weingartner. in review. Marine temperature variations in the northern Gulf of Alaska across years of marine heatwaves and cold spells. Submitted to Deep-Sea Research II Special Issue.

Date: September 2021

This proposal collects important ongoing oceanographic observations in PWS. It also provides a platform for fall and winter observations of seabird abundance (project 22120114-E). These observations have documented recent marine heatwaves and their impacts on zooplankton community composition and has documented a decades-long decline in PWS productivity. This project has been achieving its objectives and has resulted in many publications and presentations. The proposed study design and analytical methods remain sound. The PI for this specific project is commended for the high level of collaboration with other LTRM components, other EVOS-funded projects, proposed new mariculture and E&O projects, and other entities.

In addition to comments on this specific proposal, in March we also offered a general comment to all five EVOS-funded oceanography projects asking for a plan to synthesize these into a comprehensive, integrated picture of oceanographic conditions across the northern Gulf of Alaska. The PIs for all five oceanographic projects provided the identical response to this request. We seek clarification specifically about how the PI of this project (22120114-G) has contributed to the present syntheses (Danielson et al. in review) and will contribute to these syntheses moving forward. The present generic response across all 5 proposals is not sufficient. What data would be used and how would they fit into the overall analysis and what will be the role of the PI in each case?

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: Fall 2021

I concur with the Science Panel and PAC.

Project Number: **22120114-H**

Project Title: Nearshore Ecosystems in the Gulf of Alaska

Primary Investigator(s): Heather Coletti et al.

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$688,712	$700,465	$734,488	$601,513	$607,275	$3,312,453
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$617,415	$627,883	$638,002	$648,470	$652,144	$3,183,914

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$572,400	$557,500	$567,700	$573,100	$578,700	$2,869,400
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$584,400	$590,300	$596,300	$602,600	$609,000	$2,982,600

Total Past EVOSTC Funding Authorized (FY12-22): $4,366,912

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $5,067,377

Total Non-EVOSTC Funding (FY12-23): $4,632,700

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

Long-term monitoring provides a foundation of knowledge capable of recognizing and responding to changes in marine ecosystems in the Gulf of Alaska (GOA) and across the globe. We propose to extend ongoing monitoring of a diverse suite of taxa throughout the nearshore food web and across the GOA to provide continued evaluation of the status and trends of more than 200 species, including most of those injured by the 1989 *Exxon Valdez* oil spill (EVOS). The Gulf Watch Alaska (GWA) Nearshore monitoring program connects ecosystem components by sampling ecologically important and human-valued species throughout the nearshore food web, from primary producers to mid-level consumers to top predators. The monitoring design includes spatial, temporal, and ecological features that support inference regarding drivers of change. Recent examples of the application of the monitoring data include assessment of change in sea otter populations related to EVOS recovery in Prince William Sound and density-dependent factors on the Katmai coast; assessment of the relative roles of static versus dynamic drivers in structuring benthic communities;

mussel population dynamics across the northern GOA; timelines and mechanisms of recovery of nearshore EVOS injured resources; the response of rocky intertidal communities to the recent Pacific marine heatwave (PMH); documenting changes in sea star communities after onset of sea star wasting syndrome; and responses of mussel populations to loss of sea stars across the northern GOA. Nearshore data have also contributed to a larger GWA synthesis on responses of marine systems to the PMH, including contrasts of pelagic and nearshore biomes. History tells us to expect the unexpected and that change is inevitable. Continued monitoring will facilitate science, conservation, and management of nearshore marine resources by identifying ecological change at appropriate spatial and temporal scales across the GOA and allow ongoing evaluation of the status of spill injured resources.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The PIs propose to extend ongoing monitoring of the nearshore food web across the Gulf of Alaska over the next 10 years to provide continued evaluation of the status and trends of more than 200 species, including most of those injured by the 1989 *Exxon Valdez* oil spill. Their goals are to determine 1) the current structure of the nearshore food web and the spatial and temporal scales over which changes occur, 2) whether changes are from broad-scale environmental variation or local perturbations and 3) whether the magnitude and timing of these changes correspond to those occurring in the pelagic ecosystem.

The objectives and sampling protocol remain the same for this continuing proposal. Their six objectives are to 1) determine status and detect patterns of change in a suite of nearshore species and communities, 2) identify the temporal and spatial extent of these changes, 3) identify potential causes of change in biological communities, including those related to climate change, 4) evaluate the current status of injured resources in oiled areas and identify factors potentially affecting present and future trends in population status, 5) involve a graduate student to determine the impacts of environmental drivers on the performance of key taxa and trophic relationships and 6) communicate results to the public and resource managers to preserve nearshore resources.

We recognize the importance of the nearshore monitoring component and continuing the project as proposed. We appreciated the level of synthesis presented at the recent FY20 science workshop as well as the productivity of the group as presented in the proposal.

PI Response:
The PIs thank the EVOSTC Science Panel for their continued support and recognition of the importance of the nearshore environment. As a single project with many PIs, we will continue to strive for integration and synthesis within and beyond the nearshore component.

Please clarify the number of new graduate students proposed. The timeline indicates that two grad students are being requested. However, objective 5 states that a grad student will be involved and the executive summary states that a grad student and postdoc will be involved; a postdoc is not included in the timeline or elsewhere in the proposal.

PI Response:
We propose to have MS level grad students (one student at any given time) throughout the entirety of the project, which we estimate to be 4-5 MS students over the total of the proposal timeline. The postdoc position will be filled for the first three years of the project (FY22-24) to continue to support analysis and synthesis of nearshore data streams with the entire program. We added specific text in the proposal to objective 5 (see Section 4, Project Design, B. Procedural and Scientific Methods, pages 11-12) to clarify. We also modified the timeline (Section 7, Project Status of Scheduled Accomplishments, pages 26-27) to include the number of MS students anticipated (a minimum of 4, but potential for 5) and added the postdoc position from FY22 through FY24.

Date: September 2021

The goal of this continuing proposal is to extend ongoing monitoring of the nearshore food web across the Gulf of Alaska over the next 10 years for evaluating the status and trends of more than 200 nearshore species, including most of those injured by the 1989 *Exxon Valdez* oil spill. The objectives and sampling protocol remain the same. The PIs have been productive, and we recommend continued funding of this important component of the Long-term Research and Monitoring program.

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: Fall 2021

I concur with the Science Panel and PAC. It is noted that this is a highly leveraged project with additional funding sources that almost match the 10-year funding request.

Project Number: **22120114-I**

Project Title: Oceanographic Station GAK-1 Long Term Monitoring of the Alaska Coastal Current

Primary Investigator(s): Seth Danielson

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$136,337	$154,018	$152,471	$204,638	$210,507	$857,971
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$250,360	$168,803	$137,100	$140,366	$144,093	$840,722

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$0	$0	$0
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $1,396,337

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,550,355

Total Non-EVOSTC Funding (FY12-23): $575,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 03.29.2021, budget updated 08.12.2021.*

This program continues a now half-century-long time series of temperature and salinity monitoring at oceanographic station GAK-1. The GAK-1 data set is the single longest regularly repeated water column hydrographic profile times series in all of Alaska's coastal waters. Sampling began in 1970 and consists of quasi-monthly vessel-based conductivity-temperature versus depth (CTD) casts. In 1998, the monthly measurements were augmented with a mooring eventually outfitted with up to seven temperature/conductivity dataloggers distributed between 20 m and 250 m depth and optical sensors near 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 variability in (1) temperature and salinity throughout the 250 m deep water column; (2) near surface stratification; (3) surface pressure fluctuations; (4) chlorophyll a 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 (GOA), including Prince William Sound. We are aware of over 100 publications employing data collected at station GAK-1 and since 2010 the citation list has grown on average by nearly five publications per year. GAK-1 data is used within at least fifteen graduate student Masters theses and doctoral dissertations, many dozens of peer-reviewed papers, and both State of Alaska and federal management agency reports. The topics covered by these publications range from physical, chemical and biological oceanography to paleoclimate studies, fisheries research and management, and ecosystem-based management applications. The GAK-1 data set provides a consistent, curated, long-term baseline for assessing temporal change of environmental conditions in the GOA.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The PIs propose to continue monitoring the GAK-1 Oceanographic Station. The project monitors five important Alaska Coastal Current (ACC) ecosystem parameters from surface to depth including temperature, stratification, surface pressure, chlorophyll a fluorescence as an index of phytoplankton biomass, and along-shelf currents. The project has been productive over the years and the PIs have made the case that this knowledge enhances our understanding of the physical conditions in the Gulf of Alaska, including Prince William Sound. The objectives and sampling protocol will remain the same as in previous iterations of this proposal in order to maintain continuity of the dataset.

We concluded that integration of all five of the LTRM Environmental Driver oceanographic proposals (CPR, PWS, Cook Inlet/Kachemak Bay, GAK 1, Seward Line) should be pursued using existing and proposed resources to better demonstrate the combined value of these efforts and as planning for the post-EVOSTC era when funding may no longer be available. We understand why administratively these enterprises are kept separate in the present proposal but urge each of them to consider ways in which the datasets can be integrated and used to present a more holistic picture of the region and the extent to which inshore areas are predictable (or not) from offshore areas (and vice versa). We defer to the program managers and project PIs to determine the best approach to tackle this synthesis; one suggestion is to recruit some of the postdoctoral fellows proposed under the broader LTRM heading to address this region-wide synthesis of oceanographic conditions using already existing data.

PI Response:
Continued integration among all GWA projects, including Environmental Drivers, is a priority for the next 10 years of GWA-LTRM. For Environmental Drivers, the Danielson et al. (in review) paper provides examples of spatial and temporal scales of variability in near-surface ocean temperatures across the GOA from all sources within and various sources outside GWA. We will expand on these efforts on the physical environment by conducting similar analyses with sub-surface temperatures and salinity, which strongly link to nutrients. Additional integration steps will focus on similar

analyses for phytoplankton and zooplankton, ultimately integrating the two approaches to propose mechanisms of change in species abundance and composition, onshore vs. offshore production, etc. Correct, the Environmental Drivers component will be using their three years of postdoc funding to support these efforts. Furthermore, Environmental Driver PIs will work with the GWA Synthesis and Modeling component over the next 10 years to highlight integrated analyses within work plans and annual reports.

Danielson, S.L., T.D. Hennon, D.H. Monson, R.M. Suryan, R.W. Campbell, S.J. Baird, K. Holderied, and T.J. Weingartner. in review. Marine temperature variations in the northern Gulf of Alaska across years of marine heatwaves and cold spells. Submitted to Deep-Sea Research II Special Issue.

Date: September 2021

We recognize the value of continuing this important work. In addition to comments on this specific proposal, in March we also offered a general comment to all five EVOS-funded oceanography projects asking for a plan to synthesize these into a comprehensive, integrated picture of oceanographic conditions across the northern Gulf of Alaska. The PIs for all five oceanographic projects provided the identical response to this request. We seek clarification specifically about how the PI of this project (22120114-D) has contributed to the present syntheses (Danielson et al. in review) and will contribute to these syntheses moving forward. The present generic response across all 5 proposals was not sufficient. What data would be used and how would they fit into the overall analysis and what will be the role of the PI in each case?

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: October 2021

This is a continuing 10-year project that was first funded by the Council in 2012 but sampling on the GAK-1 line started in 1970 making it the single longest regularly repeated water column hydrographic profile times series in all of Alaska's coastal waters. There have been 108 publications to date that have included data from the GAK-1 line.

Project Number: **22120114-L**

Project Title: Seward Line Monitoring

Primary Investigator(s): Russell Hopcroft, Seth Danielson

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$236,108	$242,009	$248,059	$254,264	$231,089	$1,211,529
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$176,338	$180,745	$185,264	$189,895	$194,644	$926,886

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$0	$0	$0
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $1,404,208

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,646,217

Total Non-EVOSTC Funding (FY12-23): $7,780,300

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

Long times-series are required for scientists to tease out pattern and causation in the presence of substantial year-to-year variability. For the 10-year period beginning in 2022, we propose to continue multi-disciplinary oceanographic observations begun in fall 1997 in the Northern Gulf of Alaska. Cruises occur in early May, July, and mid-September to capture the typical spring bloom, summer conditions, and fall transition, 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.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The goal of this project is to characterize and understand how climate influences biological conditions both seasonally and interannually. Oceanographic observations along a 150-mile cross-shelf transect south of Seward began in 1997. The PIs propose to extend this time series for another 10 years beginning in 2022. Cruises occur in May, July, and September so that they span the spring bloom, summer, and fall transition. Observations include physical-chemical ocean measurements, phytoplankton, microzooplankton, mesozooplankton, seabirds and marine mammals.

We recognize the importance of long-term observations of ocean conditions and lower trophic levels as critical to identifying long-term trends, regime shifts, and shorter period fluctuations, such as marine heat waves, on the Gulf of Alaska ecosystem. The Seward Line is particularly valuable as it represents the most comprehensive long-term multidisciplinary oceanographic sampling program in the Gulf of Alaska. The proposal continues the well-documented sampling design used in previous years. We note that this project has been productive in terms of peer-review publications and master's student theses in recent years, as reported in the recent FY20 annual report.

PI Response:
We thank the Science Panel for their positive views regarding our work.

We request the PIs to clarify why the budget is so much higher in the first 5 years. We appreciate that matching funds cannot be reported because they are not required, but also noted the contributions to the project by NSF-LTER, NPRB and AOOS and would appreciate further clarification about specifically what EVOSTC funds cover. In other words, if EVOSTC funds were not forthcoming, what pieces of this project would be lost?

PI Response:
Perhaps not sufficiently obvious in the proposal, the Seward Line budget contains the postdoc funds that will contribute to synthesis and integration across the entire Environmental Drivers Component (and beyond to other GWA components as appropriate). Specifically, and in consultation with the Science Coordinator, we will use the funds to support two postdocs part-time –a zooplankton ecologist and a physical oceanographer – who hope to transition into permanent positions at UAF over the next few years. We have spread that salary for each across the first 5 years with the hope that after that they will have both built up their research portfolios and will be taking over duties currently undertaken by Hopcroft and Danielson, respectively. In this way we are paving the way for PI transitions most likely to occur over this decadal period.

As the Science Panel realizes, the NGA/Seward Line is a highly leveraged consortium. The LTER budget, in particular, was built assuming the core Seward Line activities of the past two decades would still be covered primarily by the AOOS/EVOSTC/NPRB consortium and as such, LTER funds were

used to add new stations, new cruises, new measurements, new investigators, and graduate students. In short, it does not duplicate any EVOSTC funding but leverages off it. EVOSTC funding supports the technician who analyzes all our towed zooplankton nets for the Spring and September cruises, supports biological and nutrient sampling during the monthly GAK-1 cruises, and covers costs of chlorophyll and nutrients analyses at all of our PWS stations (in addition to PWS zooplankton), modest field supplies, and travel costs to PI meetings. Loss of EVOSTC funding would thus stop the analyses that best report on large-bodied copepods during spring, and euphausiids year-round. Furthermore, EVOSTC funding ensures that the Seward Line cruises continue to place a high priority on attaining samples within PWS on all cruises. Loss of EVOSTC funding would reduce our emphasis here and result in western PWS data gaps.

Finally, we offer the following comment regarding synthesis to all five oceanography projects: PWS oceanography, Cook Inlet oceanography, GAK1, Seward line, and CPR. Specifically, we recommend an integrative synthesis of all five environmental driver projects to be included in the proposal(s). In addition to reporting project results separately for each area as proposed, there is opportunity for a region-wide synthesis that draws all results together for a broader perspective. For example, a synthesis might address connectivity of PWS and Cook Inlet to the northern GOA, predictability of Cook Inlet oceanography from PWS oceanography, and so on. We defer to the program managers and project PIs to determine the best approach to tackle this synthesis; one suggestion is to recruit some of the postdoctoral fellows proposed under the broader LTRM heading to address this region-wide synthesis of oceanographic conditions using already existing data.

PI Response:
Continued integration among all GWA projects, including Environmental Drivers, is a priority for the next 10 years of GWA-LTRM. For Environmental Drivers, the Danielson et al. (in review) paper provides examples of spatial and temporal scales of variability in near-surface ocean temperatures across the GOA from all sources within and various sources outside GWA. We will expand on these efforts on the physical environment by conducting similar analyses with sub-surface temperatures and salinity, which strongly link to nutrients. Additional integration steps will focus on similar analyses for phytoplankton and zooplankton, ultimately integrating the two approaches to propose mechanisms of change in species abundance and composition, onshore vs. offshore production, etc. Correct, the Environmental Drivers component will be using their three years of postdoc funding to support these efforts. Furthermore, Environmental Driver PIs will work with the GWA Synthesis and Modeling component over the next 10 years to highlight integrated analyses within work plans and annual reports.

Danielson, S.L., T.D. Hennon, D.H. Monson, R.M. Suryan, R.W. Campbell, S.J. Baird, K. Holderied, and T.J. Weingartner. in review. Marine temperature variations in the northern Gulf of Alaska across years of marine heatwaves and cold spells. Submitted to Deep-Sea Research II Special Issue.

Date: September 2021

In this ongoing project, the PIs seek to extend the time series of oceanographic observations along a 150-mile cross-shelf transect off Seward, AK, by another 10 years. Cruises occur in May, July, and September so that they span the spring bloom, summer, and fall transition. Observations include physical-chemical ocean measurements, phytoplankton, microzooplankton, mesozooplankton, seabirds and marine mammals. These observations, which began in 1997, have been invaluable to understanding ecosystem changes on various time scales.

We appreciate the PI's explanation about the joint AOOS/EVOSTC/NPRB funding for this project, the specific use of new LTER funds, and clarification about the specific use of EVOSTC funding.

In its review of draft proposals, we provided a comment to all of the oceanographic proposals. That comment was that there are opportunities for broader synthesis of oceanographic conditions across the northern Gulf of Alaska. We went on to suggest that an integrative synthesis should be included in the revised proposals. The PIs noted a recent synthesis by Danielson et al. (which the SP has not yet seen) and indicated that the intention is to conduct similar analyses of subsurface temperatures and salinity, similar analyses for phytoplankton and zooplankton, and to develop an integration that will propose mechanisms of change in species abundance and composition, contrast onshore vs. offshore production, etc. We seek clarification specifically about how the PI of this project (22120114-L) will contribute to these syntheses. What data would be used and how would they fit into the overall analysis and what will be the role of the PI?

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC.

Project Number: **22120114-M**

Project Title: PWS Marine Bird Population Trends and Associated Shelf Waters

Primary Investigator(s): Robb Kaler

PI Affiliation: USFWS **Project Manager:** USFWS

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$96,001	$410,406	$93,483	$331,540	$102,037	$1,033,467
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$369,172	$106,221	$333,393	$115,724	$100,334	$1,024,843

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$29,053	$30,429	$32,841	$33,841	$35,879	$162,043
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$36,513	$39,228	$38,225	$41,027	$41,918	$196,911

Total Past EVOSTC Funding Authorized (FY12-22): $1,333,801

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,744,207

Total Non-EVOSTC Funding (FY12-23): $435,182

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

We propose to conduct marine bird surveys in Prince William Sound (PWS) and the Northern Gulf of Alaska (NGA). In PWS, we will conduct small boat surveys to monitor abundance of marine birds during July in alternating years (2023-2029) to continue the time series used to monitor population trends for marine birds following the 1989 *T/V Exxon Valdez* oil spill (EVOS). Data indicate that pigeon guillemots (*Cepphus columba*), marbled murrelets (*Brachyramphus marmoratus*), Kittlitz's murrelets (*B. brevirostis*), and tufted puffins (*Fratercula cirrhata*) are exhibiting long-term declines in PWS. Furthermore, declines of offshore-associated genera of marine birds in PWS suggest that changes have occurred in the pelagic food webs of PWS. Because many seabirds use waters outside of PWS, we propose to include marine bird surveys in the shelf waters of the NGA. For offshore waters, at-sea seabird surveys will be conducted in spring, summer, and fall in collaboration with the multi-disciplinary Seward Line and the NGA Long Term Ecosystem Research site (NGA-LTER; 2018-present). The Seward Line portion is funded by the EVOSTC and North Pacific Research Board and will assess how seabird abundance and distribution responds to Environmental Drivers and lower

trophic level changes. Together, the PWS and NGA-LTER surveys will (i) build upon long-term data sets to monitor population recovery of marine bird species following the EVOS, and (ii) provide managers and researchers with a tool to track impacts of environmental variability and climate change on upper trophic level marine predators. This project compliments the Nearshore and Pelagic Monitoring Components of the Gulf Watch Alaska Long - Term Research and Monitoring program (GWA-LTRM) by providing data on marine bird habitat use, changes in distribution, and population trends. Results will expand the capacity of the GWA-LTRM program to interpret observed marine ecosystem patterns in the NGA.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

This proposed continuing project is one in the multidisciplinary GWA LTRM Program: Pelagic Ecosystem Monitoring Component. The PIs identify an additional $358,954 in matching funds over the next 10 years. Surveys have occurred on the same set of randomly selected transects every even year since 2010. The PIs are well-qualified to undertake the important long-term research they propose, and have very strong collaborations. The PIs have contributed to various peer-reviewed publications, but apparently have no first-authored journal papers reporting results of their GOA work to date—none are listed in either of the proposers' CVs or in the Literature Cited section of the proposal.

PI Response:
Thank you for the comment regarding first-author publications. Upon completion of the 2017-2021 PWS marine bird report to the EVOSTC, we intend to prepare a first-authored manuscript summarizing population estimates, trends, and associated factors influencing patterns, 1989-2018. Unfortunately, postponing the 2020 July marine bird surveys in PWS due to COVID-19 restrictions has been a setback. Building off efforts taken over the past five years to synthesize the marine bird data (including the Cushing et al. 2018 publication), we plan to do more directed synthesis products over the next 10 years. These synthesis products will use marine bird data collected across GWA components. While we have not been first authors on synthesis articles during the earlier funding cycle, we were part of two GWA synthesis products (Arimitsu et al. 2021, Suryan et al. 2021). We have also been collaborating with the Nearshore Component to integrate our shoreline survey data from PWS for a community analysis of nearshore marine birds with respect to spatial-temporal factors.

While we see the value of continuing this project, we suggest that the case for funding could be improved by developing some mechanistic, predictive hypotheses focused on change in abundance and/or distribution. We note that with the data already in hand, this should be possible, and would show clearly that the PIs are thinking about how data can be used and may also provide insights into analytical/modeling approaches for their data. We would like justification for continuing the pelagic surveys in connection with the NSF LTER project. How do data collected on those surveys improve on

the information on variability in seabird abundance and distribution gathered from the Seward Line? How much additional cost is associated with this aspect of the proposal?

PI Response:
We agree that for the next 10-year cycle, it would be useful to continue these surveys and our analyses within a framework of hypotheses, and we can build these into the project description. In fact, we have been working on a number of hypothesis-based papers and analyses using data from the PWS and Northern Gulf of Alaska (NGA)-LTER surveys. While some of these hypotheses and products could focus more specifically on the PWS and NGA-LTER surveys, we think results are more robust and compelling when integrated with other marine bird data from these regions. For example, combined with data in the North Pacific Pelagic Seabird Database, the PWS and NGA-LTER data will be important components of a project recently granted by the North Pacific Research Board (NPRB) to PIs W. Sydeman and K. Kuletz (Modeling seabird distribution and abundance in Alaskan large marine ecosystems: synthesis of change; July 2021 to July 2023). This project, and related publications, will use VAST modeling to derive population estimates for the NGA to address hypotheses for seabirds related to: (1) at-sea vs colony-based trends in populations, (2) seasonal fluxes of distribution and abundance, (3) whether and how seabirds track the velocity of climate change. The hypotheses associated with these components include: (1a) At-sea population estimates will be significantly greater than colony-based estimates and (1b) trends for species with high-quality colony data will better track at-sea data than that of burrow-nesting (difficult to assess) species; (2a) Timing of within-season shifts in community structure will vary by ecological region depending on species-specific habitat preferences and regional timing in oceanographic dynamics and (2b) within-season community assemblages will shift composition more drastically (at decadal-scale) in regions impacted by sea ice (i.e., NGA will show less change than the northern Bering or Arctic seabird communities); and (3) seabird distribution tracks sea surface isothermal shifts within regions (i.e., within the NGA).

Our preliminary analyses have been presented in numerous professional and public fora, as well as in reports and associated integrative publications. They illustrate the link between the PWS and NGA-LTER as reflected in the seasonal and interannual shifts in seabird distribution from inner PWS to the outer shelf. Another example is the 2014 influx of murres (and other species) into the inner shelf and PWS prior to and during the 2014-2016 marine heat wave; a significant signal of ecosystem shift (Arimitsu et al. 2021). Seabirds shift locations seasonally as well as in response to interannual and decadal changes in the environment, thus looking only at PWS patterns of abundance limits our ability to understand the influence of climate change. The greater spatial and seasonal scope of the NGA-LTER surveys will expand our ability to interpret patterns observed in PWS, across the NGA shelf, and for the Nearshore Component surveys. The NGA-LTER surveys only began in 2018, thus full analysis of the broader cross-shelf and along-shelf comparisons has yet to be examined. We anticipate that the three-season and along-shelf gradients will greatly improve our understanding of patterns for these interconnected oceanographic regions. We will soon be submitting the first long-term examination of seabird response to NGA dynamics based on Seward Line data, a subset of the NGA-LTER with a longer time frame (Cushing et al. in prep).

Thus, the PWS and NGA-LTER surveys will be important components of analyses that improve our understanding of changes in seabird populations and communities over time. The information will benefit seabird management and conservation, including the use of seabirds as ecological indicators for ecosystem-based management of Alaska's fisheries. The PWS and NGA-LTER surveys are currently

being examined as seabird indicators for the Ecosystem Chapter/ Gulf of Alaska for the North Pacific Fisheries Management Council. The NGA-LTER surveys comprise between 10% (PWS survey years) and 45% (PWS non-survey years) of the annual cost of this project and is heavily leveraged by support of the Seward Line via NPRB grants and USFWS in-kind contributions.

Arimitsu, M., J. Piatt, S. Hatch, R. Suryan, S. Batten, M. A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, S. Pegau, A. Schaefer, S. Schoen, S. K., J. Straley, and V. von Biela. 2021. Heatwave-induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators. Global Change Biology. https://doi.org/https://doi.org/10.1111/gcb.15556

Cushing, D. A., K. J. Kuletz, L. Sousa, R. H. Day, S. L. Danielson, E. A. Labunski, and R. R. Hopcroft. Seabird responses to physical variability along a cross-shelf transect in the northern Gulf of Alaska during spring, 1998-2019. In prep.

Cushing, D.A., D.D. Roby, and D.B. Irons. 2018. Patterns of distribution, abundance, and change over time in a subarctic marine bird community. Deep-Sea Research Part II: Topical Studies in Oceanography 147:148–163.

Suryan, R. M., M. L. Arimitsu, H. A. Coletti, R. R. Hopcroft, M. R. Lindeberg, S. J. Barbeaux, S. D. Batten, W. J. Burt, M. A. Bishop, J. L. Bodkin, R. Brenner, R. W. Campbell, D. A. Cushing, S. L. Danielson, M. W. Dorn, B. Drummond, D. Esler, T. Gelatt, D. H. Hanselman, S. A. Hatch, S. Haught, K. Holderied, K. Iken, D. B. Irons, A. B. Kettle, D. G. Kimmel, B. Konar, K. J. Kuletz, B. J. Laurel, J. M. Maniscalco, C. Matkin, C. A. E. McKinstry, D. H. Monson, J. R. Moran, D. Olsen, W. A. Palsson, W. S. Pegau, J. F. Piatt, L. A. Rogers, N. A. Rojek, A. Schaefer, I. B. Spies, J. M. Straley, S. L. Strom, K. L. Sweeney, M. Szymkowiak, B. P. Weitzman, E. M. Yasumiishi, and S. G. Zador. 2021. Ecosystem response persists after a prolonged marine heatwave. Scientific Reports 11:6235 https://doi.org/6210.1038/s41598-41021-83818-41595.

Date: September 2021

This proposed continuing project is one in the multidisciplinary GWA LTRM Program: Pelagic Ecosystem Monitoring Component. Surveys in PWS have occurred on the same set of randomly selected transects every even year since 2010 and have been of great value in tracking population change of a variety of marine birds in multiple foraging guilds. Their surveys on the Seward Line likewise have been of high value in understanding pelagic marine bird responses to climate change. The PIs propose to expand the area surveyed in collaboration with the NSF NGOA-LTER program. The PIs are well-qualified to undertake the important long-term research they propose and have strong collaborations. The PIs have contributed to various peer-reviewed publications, but apparently have no first-authored journal papers reporting results of their GOA work to date. We encouraged the PIs to develop mechanistic, predictive hypotheses focused on change in abundance and/or distribution. We noted that this should be possible with the data already in hand and would show clearly that the PIs are thinking about how data can be used while providing insights into analytical/modeling approaches for their data. We also wondered how the data gathered during the NGOA-LTER project improved on data obtained on the Seward Line, which has a very long history.

The PIs indicated that they intend to produce a manuscript summarizing data collected in 1989-2018 upon completion of their current report to EVOSTC. The PIs noted that they are coauthors on the

two synthesis papers that were published this year—Arimitsu et al. (21 authors) and Suryan et al. (49 authors). The PIs further noted that they intend to produce "more directed synthesis products over the next 10 years" and that they are "working on a number of hypothesis-based papers and analyses" but did not provide examples of what those papers are. The two hypotheses they did propose in their revised proposal were elementary. They did offer reasonable hope that hypotheses will be formulated and tested during a recently initiated project funded by NPRB in 2021-2023 and gave some examples, which the SP found to be insufficient. Nevertheless, we believe the NPRB project will be of great benefit to the overall program. The response of the PIs to the question of how data from the NGOA-LTER project improved on data collected on the Seward Line and in PWS was not compelling. The NGOA-LTER program seeks to better understand upstream-downstream ecosystem dynamics across the shelf of the NGOA. Tying patterns of seabird distribution and abundance to those data might be interesting. It is not clear how much added value there would be compared to the value of data from just PWS and the Seward Line in tracking pelagic seabird dynamics in response to physical forcing, but it is reasonable to assume that after ten years additional insights would emerge. The total budget for the entire 10-y project is reasonable. The NGOA-LTER ship-of-opportunity is an economical platform for this project.

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC.

Project Number: **23120114-N**

Project Title: Long-term killer whale monitoring in Prince William Sound/Kenai Fjords

Primary Investigator(s): Craig Matkin, Dan Olsen, John Durban

PI Affiliation: North Gulf Oceanic Society **Project Manager:** NOAA/PWSSC

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$213,302	$140,163	$145,439	$99,757	$0	$598,661
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$76,000	$126,000	$106,000	$56,000	$0	$364,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $1,475,402

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,615,565

Total Non-EVOSTC Funding (FY12-22): $318,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021 (revised 09.27.21), budget updated 08.12.2021 (revised 09.27.21).*

The proposed project is a continuation of the photo-identification based long term killer whale monitoring program that was initiated in 1984 in Prince William Sound. A primary focus has been on resident killer whales and the recovery of resident (fish eating) AB pod and the threatened transient (mammal eating) AT1 population of killer whales. These groups of whales suffered serious losses at the time of the oil spill and have not recovered at projected rates. Furthermore, the positive recovery trajectory of the AB pod appears to have suffered a setback to post-spill levels following the recent marine heatwave. Monitoring of all major pods, their population dynamics, feeding ecology, movements, range, and contaminant levels now spans over 35 years; its continuation will assess their vulnerability to future perturbations and environmental change, including oil spills. To ensure continuity of existing data streams and better integrate the killer whale project with the Gulf

Watch Alaska - Long-Term Research and Monitoring Pelagic Component goals in the next funding cycle, we are adding a program led by Dr. John Durban to regularly monitor killer whale growth and body condition, including pregnancy status and subsequent calf mortality rates, using camera equipped drones. In combination, these techniques will continue to provide assessment of long-term trends in population numbers and dynamics and provide increased resolution on killer whale responses to environmental changes. Diet and distributional data will be used to suggest plausible environmental and trophic covariates, and the predictive ability of these mechanistic links will be investigated in a Bayesian modelling framework that will integrate changes in body size, body condition and population dynamics. Community based initiatives, educational programs, and programs for tour boat operators will continue to be integrated into the work to help foster restoration by improving public understanding and reducing harassment of the whales.

Funding Recommendations (Fall 2022):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Did not review	Fund	Reduced funding for FY23

Science Panel Comments

Date: Fall 2022

The PIs are requesting continued funding for three years, FY23-FY25, during the current 5-year funding cycle. They were previously funded for FY22 by the TC as a bridge year to allow them time to transition fully to other funding sources. Their total 3-year request is $385,359, or less than $130 K/year, representing a 60% reduction from their earlier request. They were able to achieve this by securing support from other sources. Their current request is a paltry amount for this project considering that it is of extremely high value to understanding the ecology of an injured, non-recovering resource; the only study of killer whales in Alaska, the apex marine predator in the N. Pacific Ocean pelagic domain; the role killer whales play in ecosystem function and their relationships to other upper-trophic level species in PWS and the Kenai Fjords; their value as an indicator of ecosystem change; and that they have highly significant social and cultural value to residents and visitors in the region. Moreover, the lessons learned about these killer whales will be valuable to achieving a broad understanding of killer whale biology and ecology across their range in the GOA, SE Alaska, and British Columbia, where one stock, the Southern Residents, is in notable decline for reasons that are not fully understood.

The primary, initial concern of the SP was that the original proposal did not emphasize studies to develop mechanistic explanations of observations they have obtained over the long course of this program. In their revised proposal of September 2021, and in the reduced request presently under consideration, the PIs have emphasized an expanded range of field studies, including acoustic monitoring of movements and behaviors; photogrammetry using drones to determine morphometric, growth and health status of individuals, and pregnancy status of females; and genetic barcoding of prey remains in fecal samples to refine estimates of diet. Further, and of particular note, they are developing sophisticated Bayesian modelling approaches to assess impacts of the marine heatwave and other environmental variables at the population level, e.g., departures from expected levels of survival based on age and sex composition; and departures from expected patterns of fecundity in females and covariance in survival and fecundity. This addresses well the

SP's principal concern about a lack of emphasis on developing mechanistic explanations of their long series of observations.

A second concern was the relative lack of first-author, peer-reviewed publications resulting from this long-term project. In response, the PIs pointed out two recent publications by Olsen et al. (2018, 2020), which examined core use areas by resident killer whales as well as the relationship between social behavior and multipod aggregations, respectively. A third paper on year-round patterns of distribution based on passive acoustic monitoring was published in 2021 by Myers, Olsen, Matkin, et al. in the prestigious journal Scientific Reports (H. Myers is a doctoral student at UAF working directly on the project). They offer an impressive, coherent plan of modeling/synthesis work linked to that already planned within the broader LTRM synthesis and modeling effort. The SP particularly appreciates recognition of the need for modeling to be a continuing effort throughout the project and not just the final step after data are gathered. This will be achieved by involvement in all years of Dr. John Durban, who has wide experience and a strong publication record in the proposed methodologies.

They further outlined seven anticipated publications focused on integration of information they have obtained and would have obtained over the course of a 10-y funding cycle. Those papers would address well the concerns of the SP about mechanistic explanations of their many field observations. The PIs are now requesting only three years of additional funding, and producing the seven papers in that time might seem ambitious. However, the PIs will undoubtedly pursue other sources of funding going forward from this 3-year request, and the SP is confident that they will produce the important papers they described—the expertise of the current team of researchers working on the project is very strong, and a post-doc was recently employed who will be of great value to the modeling and publication efforts.

The SP believes this project is very important in many ways to refining our understanding of killer whale ecology and ecosystem function in the northern GOA, and by extension other regions of the broader GOA and N. Pacific. The continuation of the 37-year time series for the true "poster children" of the spill needs to continue: it is integral to all of the monitoring in the GOA, as there is no other focus on apex predators within the LTRM. And, as noted above, killer whales have extremely high cultural and societal values. The SP strongly recommends that this project be funded for the additional three years requested.

PAC Comments

Date: August 2022
The PAC did not review as the revised budget was submitted after the September 7, 2022 PAC meeting.

Executive Director Comments

Date: October 2022
I concur with the Science Panel.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund FY22-26 Fund contingent FY27-31	Fund FY22-26 Fund contingent FY27-31	Fund	Fund FY22*

*The Council amended their October 13, 2021 Do Not Fund decision to Fund for FY22 at their January 18, 2022 meeting.

Science Panel Comments

Date: May 2021

This proposed continuing project is a component in the multidisciplinary Gulf Watch Alaska Long-Term Monitoring Program: Pelagic Ecosystem Monitoring Component, with the other projects focusing on forage fish, seabirds (2), and humpback whales. This project would continue 35 years of monitoring killer whales in PWS. $600,000 in matching funds is secured for the next 10 years.

The primary objective and core objectives 1 and 2 would extend long-term time series of information on killer whales in the study areas using methods well-established there by the proposers. Core objective 3 is new to their work in the GOA, and provides additional strength to the project. Although drones have not been used in Alaska for this purpose, they have been used extensively elsewhere in studies of killer whales, notably the endangered Southern Resident population in Washington State and British Columbia. The proposers are pioneers in the use of drone techniques, and are experts in the field. An additional strength of the new drone objective is that data obtained from it would be useful for comparison to other killer whale populations in the Pacific Northwest, such as the Southern Residents, to better understand possible drivers of population dynamics.

Thus, in those respects the proposal is strong. But we noted that it does not appear to seek mechanistic explanations of some observations they have obtained to date. For example, why do the killer whales go where they go during the year? Following the trails of prey? Are there physical or biological correlates to interannual variability in numbers and/or distribution of killer whales in PWS, the Kenai Fjords, and elsewhere in the GOA? If so, how might they be related? It seems shortsighted not to propose work aimed at better understanding the mechanisms for their observations, given the amount of historic data and the proposed 10-year timeline. One example can be seen in Figure 1, which shows a sharp drop in numbers of AB Pod during the Pacific Marine Heat Wave, with a steady recovery during the following years. Did the AB animals simply leave the area, but are now returning? If so, where might they have gone? They must not have died, with numbers now recovering through recruitment or immigration?

PI Response:
We believe the combined suite of proposed investigations will provide the foundations for further analysis to examine and identify physical and biological correlates for behavioral, health, and population responses of killer whales. Specifically, we will seek mechanistic explanations of previous observations through new aerial body condition assessment, dietary assessment through fecal sampling, and acoustic monitoring for seasonal occurrence and distribution. All of these new methods will serve for a range of time scales. Short-term: data on changes in distribution and occurrence derived from passive acoustic monitoring will provide information on short-term responses to their dynamic environment. Medium term: body condition data from aerial photogrammetry will provide information on seasonal and inter-annual changes in health that can be

related to covariates that vary similarly across seasons and years; this will include monitoring changes in the incidence of pregnancies related to successful reproductions. Long term: data on individual growth and asymptotic sizes from photogrammetry will indicate non-lethal responses to multi-year trends in the physical environment and associated biological ecosystem and will combine with the higher diet resolution offered by fecal sampling. Detailed photo-identification monitoring will provide information on changes in mortalities and reproductive success. Further, our historic data from 35-years of photo-identification monitoring, added to the proposed 10-year timeframe, will allow for examination of trends across decades that can be examined against similar physical and ecosystem time series, where they exist. We have modified the proposal to emphasize the value of both our long-term data and the complementary power of our project components that will provide shorter-term measures of killer whale status (see the Abstract on page 1, Section 2, Relevance to the Invitation, on page 5, and Section 3, Project History, on page 6).

In combination, our data on killer whales at varied time scales will facilitate linkages to lower trophic level changes monitored by other GWA-LTRM projects and will help integrate our project more closely to other studies in the Pelagic Component and provide additional information for synthesis work (as now stated in Section 2, Relevance to the Invitation, on page 5). That said, performing extensive modelling work to identify physical and ecosystem correlates is beyond the scope and budget of our project proposal. Nonetheless, we have highlighted how this work may advance in Section 5, Coordination and Collaboration, pages 16 and 17. However, by combining the results of our prey sampling and body condition metrics, we may have the opportunity to advance some of this modeling, or at least evaluate plausible scenarios. Specifically, prey and distribution data will be used to hypothesize important salmon species/stocks as likely covariates for changes in body condition, and we will evaluate the significance of correlation with changes in body condition of the whales (if time series of abundance for those salmon species/stocks exist). We have added new text in Section 4, Project Design, C. Data Analysis and Statistical Methods, on page 14 (and a related edit on page 13). We also added text on page 11 (Section 4, Project Design, B. Procedural and Scientific Methods) and added Stewart at al. (2021) reference to Literature Cited as an example of a similar analysis we have conducted with Southern Resident killer whales.

In response to the specific comment about the dynamics of AB pod, our ongoing photo-identification census results is a complete enumeration of our core resident pods on an annual, or at least regular, basis (Matkin et al. 2014). As such, we have documented that the changes in abundance of AB pod is driven by births and deaths, not immigration or emigration (Matkin et al. 2008). Page 3 in the original proposal states that "in recent years following the Pacific marine heatwave the loss of older females and their older sons has driven numbers down to levels near those following the spill." The caption for Figure 1 has been modified to highlight this.

Matkin C.O., E.L. Saulitis, G.M. Ellis, P. Olesiuk, and R.D. Rice. 2008. Ongoing population level impacts on killer whales following the Exxon Valdez oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series 356:269-281.

Matkin, C.O., G.W. Testa, G.M. Ellis, and E.L. Saulitis. 2014. Life history and population dynamics of southern Alaska resident killer whales (Orcinus orca). Marine Mammal Science 30:460-479.
Stewart, J.D., J.W. Durban, H. Fearnbach H., L.G. Barrett-Lennard, P.K. Casler, E.J. Ward and D.R. Dapp. In Press. Survival of the Fattest: Linking body condition to prey availability and survivorship of killer whales. Ecosphere

While we recognize the importance of this valuable long-term study, we had a few additional questions: The proposers state that if biopsy samples are obtained, the samples will be analyzed for contaminants. Who will do the actual lab work, how will it be done, and why will it be done in the first place?

PI Response:
Lab work will continue to be conducted at NOAA's Northwest Fisheries Science center for continuity, building on previous work (as stated in Section 4, Project Design, B. Procedural and Scientific Methods, on page 9). We have cited a recent publication that describes the methods (Lawson et al. 2020, and other papers referred to therein). Periodic assessment of contaminants will enable updated comparisons to other killer whale populations (e.g., Krahn et al. 2007) and also monitor changes over time that might be indicative of changes in prey (text added to page 9), which may have health consequences (see A. Objectives and Hypotheses on page 6).
Krahn, M.M, D.P. Herman, C.O. Matkin, J.W. Durban, L. Barrett-Lennard, D.G. Burrows, M.D. Dahlheim, N. Black, R.G. Leduc, and P.R. Wade. 2007. Use of chemical tracers in assessing the diet and foraging regions of eastern North Pacific killer whales. Marine Environmental Research 63:91-114.

Lawson, T.M., G.M. Ylitalo, S.M. O'Neill, M.E. Dahlheim, P.R. Wade, C.O. Matkin, V. Burkanov and D.T. Boyd, 2020. Concentrations and profiles of organochlorine contaminants in North Pacific resident and transient killer whale (Orcinus orca) populations. Science of The Total Environment 722 p.137776.

PIs will use call diversity and calling rates obtained from the acoustic recorders to remotely estimate the number of killer whale pods and number of individuals present in the pods. Does this suggest that call diversity can be used to identify individual animals in the absence of focal follows of individuals? If so, is this not quite a significant development?

PI Response:
Call diversity and calling rates will be used to model the number of pods, with estimates ground truthed by field recordings in presence of a known quantity of pods and individuals. Call diversity cannot be used to identify individuals, and therefore will not be used for counting individuals, but rather serve as a marker of the number of pods present. Because call dialects are specific to pod groupings, presence of specific pods of known size is possible. Mean and median pod sizes were assessed in this project (Olsen et al. 2020) and can be used to extrapolate numbers of individuals. Of particularly strong value, however, is the ability to detect the timing of arrival and departure of specific pods, giving much improved resolution to presence/absence data, detection of timing shifts, and seasonal use. The proposal has been modified to reflect this in Section 4, Project Design, A. Objectives and Hypotheses, page 6.

Olsen, D.W., C.O. Matkin, F.J. Mueter, and S. Atkinson. 2020. Social behavior increases in multipod aggregations of southern Alaska resident killer whales (Orcinus orca). Marine Mammal Science 36:1150-1159.

Can this work inform studies of killer whales elsewhere in the NE Pacific, e.g., the Northern and Southern Residents?

PI Response:
Yes. Population dynamics can be directly compared to other killer whale populations. Our population model for resident killer whales will provide a quantitative framework for these comparisons, as will estimates of population parameters from our mark-recapture models for transient killer whales (as stated in Section 4, Project Design, A. Objectives and Hypotheses, page 6). Indeed, incomplete data on two Alaska resident pods was already used in a comparative study of resident killer whale population dynamics (Ward 2016) and our study will allow more complete data to better inform such comparisons. In the case of the endangered Southern Resident killer whales, population dynamics of relatively healthy and increasing Alaska resident pods can provide benchmarks for recovery (mentioned on page 6).

Data from our diet studies is directly comparable to similar studies being conducted for Northern Resident killer whales, particularly given that laboratory analysis of scale samples is being conducted by the Fisheries and Oceans Canada lab that also analyzes scales from fish kills by Northern and Southern Residents, and our fecal samples are being analyzed by the NOAA Fisheries laboratory that is performing similar work on these adjacent populations. This is elaborated on in Section 4, Project Design, B. Procedural and Scientific Methods, on pages 8-9.

In the same section (see pages 9-14) we have provided several figure examples and references to our parallel photogrammetry research on Southern and Northern Resident killer whales. Our work on Alaska killer whales will use the same flight team, equipment methods and analysis tools to provide directly comparable data. Our ability to directly compare identical sets of photogrammetry metrics on size-at-age, body condition and pregnancy rates is stated explicitly in Section 4, Project Design, A. Objectives and Hypotheses, page 6. Notably, in the case of the endangered Southern Resident killer whales, growth and body condition parameters for relatively healthy and increasing Alaska resident pods can provide benchmarks for recovery.

Ward, E.J., M.E. Dahlheim, J.M. Waite, C.K. Emmons, K.N. Marshall, B.E. Chasco, and K.C. Balcomb III. 2016. Long-distance migration of prey synchronizes demographic rates of top predators across broad spatial scales. Ecosphere 7, p.e01276.

There has been only one first author publication by the PIs since 2014, and we feel that this could be improved at this juncture of this long-term study. In addition, the Education and Outreach potential of this project is very high given that killer whales are charismatic predators that the public is naturally drawn to. Thus, we strongly suggest the PIs take advantage of this unique opportunity to promote EVOSTC-funded work through increased Education & Outreach activities with this project. One suggestion is collaboration with The Whale Museum in Friday Harbor for E&O activities.

PI Response:
We would highlight additional first-author papers by the PIs in recent years on spatial distribution (Olsen et al. 2018) and social dynamics (Olsen et al. 2020).

With the new proposed investigations, there are papers that will be produced relatively quickly, for example 1) length-at-age relationships compared to other killer whale populations in the NE Pacific and 2) body condition comparisons, both from photogrammetry. We are currently underway with a publication using 3) DNA analysis of fecal samples to describe feeding habits. Additionally, we plan

updated publications on population dynamics of 4) resident killer whales and 5) Gulf of Alaska transients that will result from continued photo-identification. Similarly, an important paper on inferring distribution and occurrence from passive acoustic monitoring has now been submitted (Myers et al. in review) and we have added this reference to Section 4, Project Design, B. Procedural and Scientific Methods, on page 9.

We agree that Education and Outreach potential is very high for this project. We already perform a high degree of outreach given our limited funding, including Captain and Naturalist presentations, collaborations with the Prince William Sound Regional Citizens' Advisory Council, University of Alaska Anchorage, U.S. Forest Service, and National Park Service; Facebook and Instagram updates; updated pod catalogues; an updated website; and educationally thematic emails to 170 naturalist recipients. Future collaborations are always welcome, and perhaps the best focus is to strengthen our current local relationships with the National Park Service, U.S. Forest Service, and local schools. Due to our own limited budget, we look forward to collaboration with the agencies that receive funding as part of EVOSTC's Education and Outreach focal area. Details of our outreach have been updated in the proposal in Section 6, Deliverables on pages 18 and 19.

Myers, H.J., D.W. Olsen, C.O. Matkin, L.A. Horstmann, and B. Konar. In review. Listening for killer whales (Orcinus orca): Passive acoustic monitoring reveals year-round distribution and residency patterns. Scientific Reports.

Olsen, D.W., C.O. Matkin, R.D. Andrews, and S. Atkinson. 2018. Seasonal and pod-specific differences in core use areas by resident killer whales in the Northern Gulf of Alaska. Deep Sea Research Part II 147:196-202.

Olsen, D.W., C.O. Matkin, F.J. Mueter, and S. Atkinson. 2020. Social behavior increases in multipod aggregations of southern Alaska resident killer whales (Orcinus orca). Marine Mammal Science 36:1150-1159.

Date: September 2021

This proposed continuing project is a component in the multidisciplinary Gulf Watch Alaska Long-Term Monitoring Program: Pelagic Ecosystem Monitoring Component, with the other projects focusing on forage fish, seabirds (2), and humpback whales. This project would continue 35 years of monitoring killer whales in PWS. The approach would extend a highly valuable time series of information on killer whales in the study areas using methods well-established by the PIs. The PIs would add a new component of photogrammetry using drones to document various characteristics of individual whales, such as growth, condition, and pregnancy status that would be important in its own right and for comparisons to similar data obtained on killer whales elsewhere. We are impressed by the time series of data collected by this project, the importance of the new component, and the qualifications of the PIs.

The principal concerns we have are an apparent lack of attention to developing mechanistic explanations for observations obtained over the course of this study, and a paucity of recent publications. The PIs responded that the proposed new studies, including health assessments, diet analysis, and pregnancy will provide a foundation for seeking such explanations of previous observations. While this is true, numerous physical, biological, and environmental indices exist that would have allowed the PIs to have already embarked on such analyses. The PIs further noted that

"extensive modelling work to identify physical and ecosystem correlates is beyond the scope and budget of our project proposal." Yet the valuable data sets they have acquired over the past 35 years are fertile ground for such work, and if the PIs do not undertake it, who will? The PIs identified two rather recent publications by members of the group, and a third that is in review. They further identified additional manuscripts they have in mind "that will be produced relatively quickly," which is vague. Our other questions and concerns posed were adequately addressed.

We strongly encourage the PIs to expand their project, beginning by proposing conceptual models of relationships between killer whales and their environments that would inform more rigorous modeling approaches. To facilitate this, if necessary to expand the expertise of their group, we recommend a revised proposal and budget to include an appropriate postdoctoral fellow upon whom this responsibility would fall. The comparatively low budget would increase accordingly, which should not materially reduce the financial competitiveness of the proposal, but would measurably increase its scientific competitiveness. Their progress in this direction would be assessed after five years (FY22-26) and a recommendation would be made concerning the future of the project (FY27-31).

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: October 2021

The PI submitted a revised proposal as suggested in response to the Science Panel's comments. As a cost-saving measure, the new PI (Dr. John Durban) will be responsible for the suggested modelling efforts instead of a postdoc (salary included for Dr. Durban for this work is lower than the estimated cost for 3-yr postdoc) and time associated with looking for a postdoc. Dr. Durban has extensive experience in modelling approaches for killer whales and publication record, which makes him a very suitable addition to this project. Without having to spend the time to search for and hire a postdoc, the modelling objective can be investigated without delay with the historical data available. I concur with the Science Panel and PAC and further recommend that this project be fully funded for the 10 years as the recommendations by the Science Panel have been adequately addressed.

Project Number: **22120114-O**

Project Title: Long-term monitoring of humpback whale predation on Pacific herring in PWS

Primary Investigator(s): John Moran, Jan Straley

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$204,709	$203,430	$199,754	$204,337	$203,411	$1,015,639
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$220,317	$212,893	$217,019	$224,018	$228,436	$1,102,683

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$140,000	$140,000	$140,000	$140,000	$140,000	$700,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$140,000	$140,000	$140,000	$140,000	$140,000	$700,000

Total Past EVOSTC Funding Authorized (FY12-22): $1,662,309

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,865,739

Total Non-EVOSTC Funding (FY12-23): $1,430,700

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

The humpback whale monitoring project is part of the Gulf Watch Alaska (GWA) Pelagic Component and the 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 from the *Exxon Valdez* oil spill (EVOS). 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. Following the Pacific marine heatwave of 2014-2016, humpback whale numbers declined dramatically and calf production fell within PWS. In 2020, we saw a decoupling of whale numbers from herring abundance and an increase in herring biomass while whale numbers remained low. The cause of the decline in PWS whales remains unknown, but the reduction of predators may provide some relief for struggling herring populations. 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 and quality. These data will be combined in an updated bioenergetic model that will allow 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 will contribute to a comprehensive understanding of bottom-up influences and top-down controls on the PWS herring population. This project is one of only two long-term humpback whale projects funded in Alaska, we will continue to inform the Herring Research and Monitoring component of the GWA Long-Term Research and Monitoring program as well as state and federal managers.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The goal of the project is to continue estimating the impacts of humpback whale predation on herring in Prince William Sound over the next 10 years. The objectives are to 1) estimate trends in humpback whale abundance, diet and distribution and identify the causes for the decline, 2) evaluate prey quality and trophic position through bomb calorimetry and stable isotopes and 3) estimate the impact of humpback whale predation on herring. The objectives, sampling protocol and personnel remain the same. 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 and quality. These data will be combined in an updated bioenergetic model to assess the impact of recovering humpback whale populations on the Prince William Sound ecosystem.

The PIs noted that whale numbers dropped dramatically following the recent heatwave while there was an uptick in herring in 2020. If whale numbers remain low, then it is more likely that whales are depressing herring populations than bottom-up environmental drivers are responsible for the declines. The PIs suggest that the decline in whales indicates that the whales either moved to different feeding grounds or died. We suggest a third possibility that herring were avoiding the high numbers of whales in Prince William Sound in 2020. The PIs should consider this hypothesis.

PI Response:
The PIs have considered this hypothesis and agree that whales can influence prey behavior but there needs to be sufficient predators and prey to evaluate this concept. The numbers of whales in PWS in 2020 was still low (see figure below) and not synchronized with herring. The PIs believe (speculate) that there was a change in herring biomass and behavior that made PWS herring less energetically profitable as prey for whales. This ties in with the 'whales moved somewhere else' hypothesis. The following two observations support this idea:

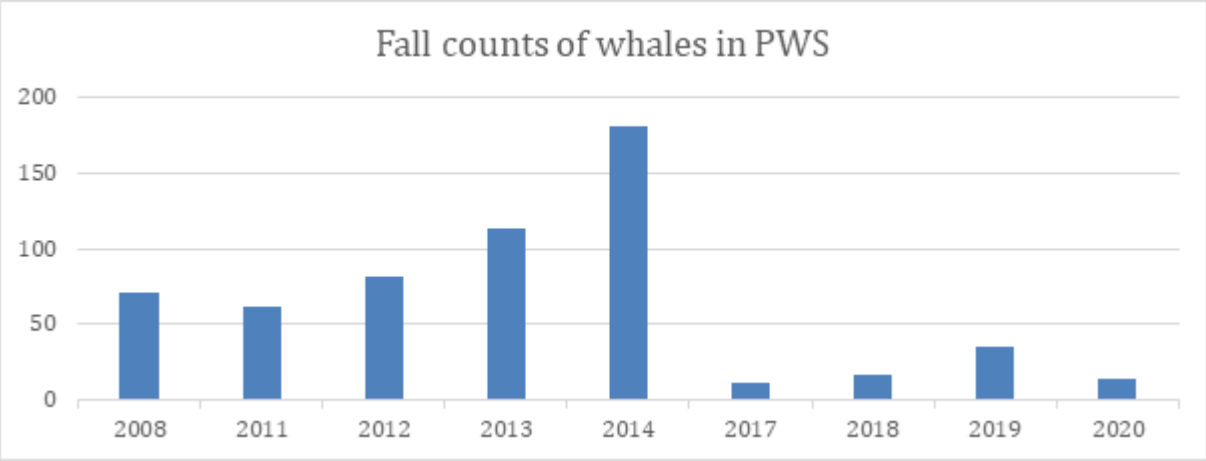
1) The absence of winter aggregations of herring that were present prior to the heatwave. These shoals were temporally and spatially predictable with energetically rich herring. Good prey for whales.

2) Herring staging in deeper water before spawning doesn't seem to be happening anymore. The acoustic surveys are having a hard time finding schools. It seems the herring move fast into shallow water, spawn, and leave. A good strategy for avoiding whales and boats.

It would be difficult to quantify the avoidance hypothesis suggested by the Science Panel. The PIs will look at changes in the density and distribution of whales in relation to herring which may shed light on this topic. For example, if whales were present in a small area, feeding on herring implies easy feeding (minimal search time). We could look at school size for prey species as well and maybe come up with a prey energy density map.

We are using the Happywhale algorithm to match individually identifiable fluke photographs from throughout their range and see if the missing PWS whales have turned up on the breeding grounds or other feeding areas.

Fall counts of humpback whales in Prince William Sound provide an index of whale abundance.



We recognize the value of monitoring the potential impact of humpback whales on herring. We also appreciate the outreach that the PIs have conducted by giving talks. We suggest that the PIs increase the presence of this project through online platforms to expand outreach opportunities.

PI Response:
We will work with our own agency's media teams, the GWA Outreach Coordinator, and any projects funded under the EVOSTC's Education and Outreach Focus Area to increase this project's online presence and outreach opportunities over the next 10 years.

Date: September 2021

The goal is to continue estimating the impacts of humpback whale predation on herring in Prince William Sound over the next 10 years. The objectives, sampling protocol and personnel remain the same. The PIs have been productive and agreed to increase their online presence and outreach. We recommend that the work be continued.

PAC Comments

Date: September 2021
It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: October 2021
I concur with the Science Panel and PAC. I also note that data from this project are being incorporated into the herring BASA model (project 22120111-C).

Project Number: **22200114-P**

Project Title: Lingering Oil Component Project

Primary Investigator(s): Dan Esler, Mandy Lindeberg

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$124,042	$0	$124,042
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$45,453	$0	$45,453

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$25,500	$38,000	$0	$63,500
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$29,000	$42,500	$31,000	$102,500

Total Past EVOSTC Funding Authorized (FY12-23): $65,300

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $65,300

Total Non-EVOSTC Funding (FY12-23): $22,400

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.12.2021.*

Of the nearly 11 million gallons of crude oil released during the 1989 *Exxon Valdez* oil spill (EVOS), a small proportion is thought to remain sequestered within sediments of beaches with distinct characteristics throughout the spill area. This lingering oil, as it is known, has been a source of concern for federal and state governments and the public for more than 30 years. Significant efforts have been applied by the EVOS Trustee Council (EVOSTC) to document the extent of this issue, determine effects of lingering oil on natural resources, and identify potential mitigation or restoration options and their pros and cons. The most recent studies have indicated that the sequestered oil is not declining significantly in volume or occurrence, nor is it weathering quickly. Lingering oil also does not appear to be bioavailable, as indicators of exposure of living resources to hydrocarbons are at background levels in areas where oil persists. However, it remains important to monitor the locations and status of lingering oil both for improved scientific understanding of the timeline of persistence of spilled oil, as well as to determine potential for detrimental effects in the event lingering oil is disturbed. The EVOSTC has indicated their commitment to continuing lingering

oil monitoring and requested a plan to continue to document the occurrence and condition of lingering EVOS oil. This project proposes a low-cost presence/absence approach to intermittent monitoring, along with chemical analyses in FY25, that can be combined with previous EVOSTC-funded modeling efforts to provide managers with contemporary data on the status of lingering oil.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

This is a continuing project to follow the weathering and presence of lingering oil in regions where previous documentation has occurred. The PIs propose to sample oil collected during lingering oil surveys and will verify that the oil is Exxon Valdez and will evaluate its weathering state, based on composition of polycyclic aromatic hydrocarbons (PAHs). Chemical markers (not truly biomarkers) of weathering will be determined in order to assess weathering over time. The project has 3 primary objectives: 1) regular surveillance of lingering oil; 2) conduct PAH composition analysis of lingering oil; and 3) document contamination levels in mussels.

We are concerned about the lab analysis. The project states that oiled samples will be sent to a TBD analytical lab to determine PAHs and weathering state. Since the cost per sample is currently unknown by the PIs, they will determine the number of samples they will be able to analyze once costs are known. The PIs state that, if necessary, "they will secure additional funds". The lack of information regarding the lab analyses does not provide any assurance that the analyses will be completed. These are not novel analyses and the costs should be established before the project is funded. We expect to see this information in detail in the revised proposal.

PI Response:
While drafting this proposal in March we were unable to secure analyses due to the 10-year schedule of the Trustee's Invitation. Laboratories were reluctant to commit to analyses that would not arrive until FY2025. However, now we are pleased to provide a commitment from Dr. Apeti with NOAA through the NOS, NCOS, Monitoring & Assessment Branch, Stressor Detection & Impacts Division. Dr. Apeti is a senior chemist leading the NOAA Mussel Watch Program and has collaborated with the Nearshore Component to analyze and report on contaminants in mussel samples throughout the Gulf of Alaska over the last 10 years. We are pleased that the sediment samples from the lingering oil project will be analyzed from the same laboratory applying the same protocols and quality control standards. We have revised the proposal to reflect this along with estimated costs from Dr. Apeti's lab to process mussel and oiled sediment samples. Securing additional funds with other partners for extra analyses is a continued endeavor by investigators but not necessary here. This statement has been removed. Section 4, Project Design, B. Procedural and Scientific Methods, has been revised on page 6 to reflect this update.

Additionally, we have questions regarding objective 3, will mussels immediately adjacent to pits be the focus? The proximity to the buried oil is not described. Why are analyses focusing on total PAHs

(or breakdown products) instead of far more sensitive P450 or *CYP1A* analyses? Metabolites of PAHs in mussel tissue may not be detected (or even analyzed for), where the biomarkers will provide the answer for exposure. The PIs need to address these questions/concerns.

PI Response:
These are good questions; we have modified the proposal text to make collection and analysis plans clearer. Objective #3 constitutes a continuation of mussel contaminants sampling typically done under the Nearshore Component of Gulf Watch Alaska. For continuity and comparability, we will collect mussels at the Nearshore Component sampling sites across the northern Gulf of Alaska rather than in relation to the more restricted set of sites assessed for lingering oil. This will allow a broad regional perspective on contaminants, including PAHs, relative to levels in Prince William Sound where lingering oil will be sampled. This sampling design allows continuation of an existing data stream at the same spatial scale as previous collections, while also providing specific insights into differential PAH biocontamination in study blocks with a history of lingering oil.

In terms of analyses, we recognize that there are many potential approaches, including direct measurement of PAHs (which we have chosen), cytochrome P4501A (CYP1A) response, gene transcription, etc. We have chosen the metric that is consistent with the approach taken with mussels during previous Gulf Watch Alaska analyses, as well as many others dating back to the time of the Exxon Valdez oil spill, allowing the perspective and context provided by those previous samples. Also, the analyses are consistent with those used by the NOAA Mussel Watch program at a continental scale, allowing larger spatial comparisons. Finally, with the agreement of Dr. Apeti to conduct both sediment and mussel analyses, we eliminate any concern about laboratory or methodological differences that might inhibit comparisons of sediment and mussel PAH concentrations.

Date: September 2021

Since the lab identified will be committed to analyses of both sediments and mussel tissues, and does this routinely for NOAA Mussel Watch, we feel more comfortable with the proposed approach and budget. There is no text pointing out that if PAHs are detected in mussels or sediment, that these will be fingerprinted as an EVO source rather than a different source (diesel or fuel spills for example). It seems this should be able to be included as only using PAH levels does not link to lingering oil unless the ratios of different PAH components can be tied to EVO fingerprint. We would like to see this included in a final proposal. Please change the term “biomarkers” in describing the chemistry of oil to “chemical markers” as we requested in the first review. What is described are <u>not</u> biological markers.

The PIs should provide more fine-scale detail on the collection of mussels, the number of animals, the proximity to pits with oil, etc. This was requested in the first review of the proposal. The map with locations of sampling is at such a large scale, details cannot be ascertained. No protocols or extraction methods for mussel tissue are presented. Even though this will be routine as for Mussel Watch animals, a very brief description with references should be included, not just a broad Mussel Watch document.

Lastly, the long-established extraction of mussel tissue proposed here is fine as it is aligned with Mussel Watch. However, 10 years from now it is hard to imagine high throughput approaches using molecular techniques will not be used for tissues. These would be to determine *CYP1A* (P4501A) approaches. It was hoped that some subset of tissues would be analyzed in this way to advance the

approach that is the future of monitoring programs. Even if the PIs will not include preliminary screening, some text acknowledging that this is the future of tissue monitoring for oil would be appreciated.

PAC Comments

Date: September 2021
It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets.

Executive Director Comments

Date: Fall 2021
During the FY17-21 cycle, the Council requested a plan to continue to document the occurrence and condition of lingering EVOS oil. This is a low-cost project that will sample every 5 years to address the Council's request. I concur with the Science Panel and PAC.

Project Number: **22220201**

Project Title: Chugach Regional Ocean Monitoring Program (CROM): A Tribally led initiative to monitor baseline oceanic conditions and phytoplankton dynamics for safe shellfish harvest in Prince William Sound and Lower Cook Inlet, Alaska

Primary Investigator(s): Maile Branson, Willow Hetrick-Price

PI Affiliation: APMI/CRRC **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$672,345	$529,451	$517,738	$558,054	$589,310	$2,866,899
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$562,235	$556,803	$586,894	$576,943	$616,497	$2,899,400

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$0	$0	$0
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $672,345

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,201,796

Total Non-EVOSTC Funding (FY12-23): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.16.2021.*

Harmful Algal Blooms (HABs) are becoming a topic of increasing concern in coastal Alaskan ecosystems. These blooms produce dangerous biotoxins, which primarily accumulate in shellfish. Subsistence, recreational, and mariculture-based shellfish harvests are a significant source of both economic and food security across the spill-affected region, and there are currently no State operated HAB or biotoxin monitoring programs for shellfish safety in Alaska. Chugach Regional Resources Commission (CRRC) is a consortium representing seven Tribes in the prince William Sound and Lower Cook Inlet regions of Alaska. CRRC operates the Alutiiq Pride Marine Institute (APMI), located in Seward. CRRC/APMI presently conduct monitoring for harmful algae, shellfish biotoxins, and seawater carbonate chemistry across the spill-affected region through our Chugach Regional Ocean Monitoring (CROM) program. The current CROM program works with Tribal members in each

of the seven communities to conduct ecological and biochemical sampling on a weekly basis. Samples are sent to APMI for analyses and data dissemination to the public, with the ultimate goal of informing safe shellfish harvest in the region.

The proposed project will expand and improve CRRC/APMI's existing CROM program to include more comprehensive and quantitative methods of monitoring for harmful phytoplankton species, shellfish toxins, and total seawater chemistry through a long-term monitoring effort. Final data will be utilized to provide 1) weekly reports of these findings to both Tribal members and the general public to inform safe harvest opportunities, and 2) baseline phytoplankton abundance, shellfish biotoxin, and seawater chemistry profiles across the costal Gulf of Alaska region to understand precipitating factors for HAB events. The overall goal of this project is to build regional Tribal capacity through CRRC/APMI to monitor and study harmful algae and biotoxins in native shellfish in order to support safe and sustainable harvest opportunities for both local communities and the shellfish industry in southcentral Alaska.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund FY22-FY24 Fund contingent FY25-26	Fund FY22-FY24 Fund contingent FY25-26	Fund FY22-FY24 Fund contingent FY25-26	Fund

Science Panel Comments

Date: May 2021

This project represents a tribally-led monitoring effort aimed at providing information on the distribution of harmful algal bloom species and toxins to inform shellfish harvest. The Science Panel recognized that a major strength of the proposal is that it is tribally-led and would be capacity building, but noted that the proposers could augment that strength by providing more detail on the specific capabilities that would be developed and the plan for long-term continuity. Concerns raised included the lack of a science plan (including data analysis and archiving), no plan for long-term sustainability of the monitoring, and concerns about how the data provided would actually be used by stakeholders such as subsistence harvesters. The PIs need to address how they will comply with Data Submission requirements -all projects funded by EVOSTC must submit data annually to the Data Management project.

PI Response:
APMI has clarified its data archival and sharing policy throughout the proposal, particularly in section 4C (pages 10-13) and section 9 (page 25).

We would like a more thorough explanation and justification of the sampling scheme to ensure that it would provide adequate and actionable information. As we understood the proposal, sampling was only one sample per week per site-- what are the odds of missing potential HABs with a single sample? How are the samples distributed in space?

PI Response:
Sampling locations are at each of the communities detailed in the proposal. CRRC has proposed utilizing these communities as sampling locations to leverage their existing successful community sampling program. These communities are distributed across Prince William Sound and Lower Cook Inlet, and provide a cost-effective means of sample collection in these remote locations. While discrete sampling on a weekly basis might not provide the most thorough monitoring coverage, it is the most feasible option that accounts for sample preservation, shipment, and processing in a timely fashion.

More detail is needed on the qPCR methods as it was not clear to the extent to which these methods had already been established vs required development; either way we needed more to evaluate the proposal. Additionally, we had some questions about how cell counts and species identification (not speciation) will be accomplished in the field as described (will these data be too rudimentary to be useful?).

PI Response:
The qPCR methods are in development, this has been noted in the proposal in section 4B (pages 7-9), along with a detailed proposed methodology provided in Appendix 2. APMI participates in a HAB qPCR specific working group to develop methods with several academic and agency partners in the national HAB network.

Under the current funding from the Administration for Native Americans and the USGS Climate Adaptation Science Center, all Tribal field samplers have received specified training on microscopy and cell counts using a hemacytometer from collaborators at both NOAA and UAF. A microscope and hemacytometer are provided to each Tribe for samplers to use onsite. These data are currently being collected under both of these awards. APMI recognizes these data are rudimentary, and while this collection is helpful, the goal of the current proposal is to scale up from basic microscopy to more quantitative methods of detection.

Do the PIs undertake periodic intercalibrations of analyses with other laboratories to ensure accuracy and comparability, e.g., NPRB project 1801: Prevalence of Paralytic Shellfish Toxins in the Marine Food Webs of PWS and Kachemak Bay, Alaska?

PI Response:
All analyses will undergo interlaboratory calibrations with the agency and academic partners listed in the proposal. Interlaboratory calibrations are conducted for seawater chemistry with Dr. Burke Hales (OSU) and Dr. Wiley Evans (Hakai Institute), and for ELISAs with Dr. Shannon Atkinson (UAF). APMI has ranked in the top 10% in blind comparisons of interlaboratory accuracy and precision for DIC analyses. All other methods have been transferred to APMI by experts in the field, and are validated to a standard acceptable for peer-reviewed publication. Methodology for the remaining analyses is currently under development, and APMI participates in working groups to develop methods with several academic and agency partners in the national HAB network. This has been clarified in the proposal in section 4B (Pages 7-9).

We also ask that the PIs clarify how these data would augment current sampling for HABs elsewhere in Alaska and also potentially complement the oceanographic information (OA etc) provided by other entities. This does not mean that working with other entities is necessary to justify the

proposal, per se, but that we expect that PIs will recognize opportunities for outreach and leveraging other funded projects to help advance their goals and the goals of the overall program. We recognize the potential value of these data for the stated goal of informing harvest decisions, but also sees potential value of these data collected by the tribal community for the broader scientific community.

PI Response:
APMI is aware of other monitoring programs across the state, including those conducted by SEATOR, KBNERR, DEC, and others. Currently, KBNERR receives tow samples from PWSAC hatcheries, and the DEC commercial testing program operates exclusively on commercial shellfish samples for regulatory purposes. Furthermore, DEC testing results are often not timely, are not widely publicized for public access to inform both recreational and subsistence harvesters. Regular shellfish biotoxin testing is not part of any of the current publicly available southcentral Alaska monitoring programs. APMI would be the first and only entity to incorporate this testing into a regular monitoring program in the southcentral region. Although there are other public shellfish monitoring programs around the state, none of these programs cover Prince William Sound and Lower Cook Inlet. These regions are arguably among the most heavily utilized for recreational and subsistence harvest of both shellfish and other intertidal organisms. We feel that the state would benefit from a centralized monitoring and testing facility to serve southcentral Alaska. PIs recognize opportunities for outreach and leveraging other funded projects to help advance their goals and the goals of the overall program. APMI actively participates in collaborations through the AHAB, and have already applied for several grants collaboratively with a number of these institutions. This has been addressed in section 1 (pages 3-4)

Describing how data deposition requirements of the Invitation will be fulfilled will help here.

PI Response: APMI has clarified its data archival and sharing policy throughout the proposal, particularly in section 4C (pages 10-13) and section 9 (page 25).

Several other clarifications are requested. On Pg 9, “This project will compliment APMI’s existing Gulf Watch OA monitoring project as a continuation and extension of these monitoring activities.” This project, 21200127, is a 3-year project. The last year is scheduled for FY22. If this project proposal is funded, would the last year of project 21200127 be incorporated into this proposed project? Clarification is required to determine if proposed efforts are being duplicated.

PI response: These proposals encompass two separate projects, with completely separate sampling locations. This is clarified in section 11B (page 27) of the proposal with the following text: “While these proposals are similar with respect to ocean acidification monitoring efforts and an overlap in regional coverage, they do not share the same sampling locations. Instead, these two projects encompass entirely separate monitoring activities, each with distinctly unique sampling locations.” Our data is publicly available on both our website (www.alutiiqprideak.org) and the IPACOA website (http://www.ipacoa.org/Explorer), and may be accessed at any time by both the scientific community and the public.

We appreciate comments and foresight into GWA monitoring continuation. Efforts were made to partner with GWA on this proposal with the notion of continuation of regular monitoring in the spill-affected region. These efforts were unsuccessful. Furthermore, GWA partners did not contact APMI

for continuation of this proposal. We feel that the more data we can provide, the better we can contribute to monitoring efforts across the region.

We would like to see more justification of funds requested in the proposal. For example, why does new equipment need to be purchased in FY22 if there are existing resources? Why does the Autoanalyzer need to be replaced in FY26?

PI Response:
APMI is taking a tiered approach to capacity building for each analysis. A more detailed explanation of this capacity building approach as it relates to the items requested has been provided in section 4B (pages 9-10). This proposal takes a tiered approach to capacity development. APMI is currently conducting ELISA assays using an existing plate reader. This capacity began in FY21. APMI has also been conducting DIC analyses using the BOL since 2012, however, our current BOL is outdated and cannot handle the significant increase in throughput associated with planned projects. The BOL also requires frequent maintenance and troubleshooting to operate, as it is the second BOL ever produced. Dr. Hales has refined this system since project initiation in 2012, and the new BOL models have the ability to process with greater efficiency/accuracy. APMI is planning on bringing on PCR technology in FY22, and will finalize its analytical capacity with the addition of the Autoanalyzer in FY26. We believe this scaled approach is the most reasonable format with which to add these capacities. The only equipment APMI plans to replace is the BOL, and we are purchasing the autoanalyzer for the first time.

Over 50% of the funding requested is for salary for seven personnel; however, only two CVs are provided in the Project Personnel section of the proposal. Some additional information regarding personnel would be appreciated (e.g., who are they, what will their roles and responsibilities be on the project). Is there a longer-term plan for self-sustainability for this project as we assume there is a desire to continue monitoring after EVOSTC funding is no longer available?

PI Response: The proposal instructions only specified that "The CV's of all Principal Investigators and other senior personnel involved in the proposal must be provided". Therefore, CVs of junior personnel were not included. In response to reviewer comments, CVs of all personnel working on the project have been included, and a brief description of job duties has been added to the section 6 (pages 13-22).

The external peer reviews of the proposal were supportive but also felt that additional details and methods clarification were needed. They also expressed concerns about the technical expertise needed for the molecular analyses and wanted to see more detail in that part of the proposal.

PI Response:
Proposed protocols for all analyses have been added as Appendices 1-4. Language has also been added to clarify that method development is underway for some of these analyses in section 4B (pages 7-9). Also in section 4B (page 9), we have highlighted technical expertise who plan to partner with in case external staff needs assistance.

PI Branson conducted her PhD work on molecular detection, and has significant experience in molecular-based assays.

Finally, we agree with reviewers that the PIs are wise to be cautious about making specific harvest recommendations based on their data. However, we also noted that informing about safe harvest is the main justification for the proposal. We would like to see a clearer statement of how the specific information made available is going to be used by tribal stakeholders.

PI Response:
The use of the information generated by Tribal citizens has been clarified throughout section 1 (pages 3-4).

Date: September 2021

We were pleased with the PI responses and the resulting additions and clarifications in the proposal. We were persuaded by arguments about tiered capacity building and the lack of existing monitoring associated with subsistence harvest. The detailed protocols in the appendix gave the us confidence that the work would be carried out using accepted and vetted methodologies. However, we remain gravely concerned about the low number of samples taken at each site and time (only one). We appreciate the PI constraints but have serious concerns whether the sampling is sufficient to capture something useful and informative for stakeholders, and without that there is no justification for the proposal. This is a significant enough concern that we seriously considered a recommendation of Do Not Fund. However, given the merits of the proposal, we suggested an alternative that would allow the project to proceed if sampling concerns could be addressed. We suggest using the first year of the proposal to test what sampling intensity would be needed to detect events of interest, and how much variation there is among samples within a site. The PIs need to have confidence that lack of detection of HAB species is due to absence rather than limited sampling and patchiness in space or time. We note that given that the point of the project is not to make statistical comparisons among sites or times, the PIs may be able to address some concerns by still using a single sample, but sampling a larger volume of water, for example, and filtering it down prior to counting.

We do not wish to prescribe exactly how the PIs will design their sampling, but the justification should be scientific rather than logistical. This can be done through a combination of their own sampling and literature justification. This is a needed step to ensure confidence in the reported data by stakeholder groups. Given the Council's biennial review and five-year meeting cycle starting in FY22, our recommendation is to fund this project for FY22-FY24 and fund FY25-FY26 contingent on the sampling design justification and preliminary results from FY22-FY23. If successful, funding for FY27-31 may be determined in FY26.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

This is a great opportunity to support a Tribally-led initiative to inform shellfish harvests in spill-affected communities. The time and effort spent on revising this proposal and responding to reviewer comments is noted and appreciated. I concur with the Science Panel's concern regarding sampling design and verifying that information produced will be meaningful and valid to stakeholders. I look forward to seeing the progress and results for the first two years.

Project Number: **22220202**

Project Title: Continuation and expansion of ocean acidification monitoring in the *Exxon Valdez* Oil Spill area

Primary Investigator(s): Claudine Hauri

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$157,100	$138,800	$120,900	$123,400	$124,900	$665,100
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$127,500	$129,100	$131,900	$133,500	$136,400	$658,400

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$0	$0	$0
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $157,100

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $295,900

Total Non-EVOSTC Funding (FY12-23): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.18.201, budget updated 08.16.2021.*

Ocean acidification and warming are putting an additional strain on a marine ecosystem that is slowly recovering from the 1989 *Exxon Valdez* Oil Spill. The high latitude Gulf of Alaska ecosystem is especially vulnerable to ocean acidification and requires high-resolution in-situ observations to characterize the natural inorganic carbon variability, and monitor the progression of ocean acidification and climate change. High-resolution ocean acidification monitoring was conducted along the historic Seward Line between 2008 and 2017. Unfortunately, this effort was reduced to just 4-5 stations per cruise in 2018, terminating a time series that was starting to help us understand natural variability, local drivers, and define ocean acidification hotspots and potential impacts on the ecosystem. Here, we propose to reinstitute high-resolution ocean acidification monitoring along the Seward Line and in Prince William Sound in May, July, and September, and expand monitoring along an additional transect off Kodiak. This project will leverage already funded projects, such as the Northern Gulf of Alaska Long Term Ecological Research (NGA-LTER) program and the Gulf of Alaska

Ecosystem Observatory, funded through a consortium of agencies and institutions such as the National Science Foundation (NSF), EVOSTCs Gulf Watch Program, Alaska Ocean Observing System (AOOS), North Pacific Research Board (NPRB), and The M.J. Murdock Charitable Trust. In addition to extending the temporal and geographic coverage of a critical data set, the proposed sampling plan includes the new Kodiak Line, which passes by highly productive areas near current and planned future mariculture grounds suggested to be an ocean acidification hotspot. Thus, understanding the current chemical conditions and progression of ocean acidification is of high socio-economic importance to the region. Overall, the proposed project will help to distinguish the effects of the oil spill from the effects of ocean acidification on the ecosystem and manage sensitive or injured species and resources.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The Science Panel recognizes this project as one of the environmental drivers projects and its continuation and expansion is appreciated. With a new PI taking over, there were some concerns but the proposal and the PI's expertise were clear. In our reviews of the existing environmental drivers projects, we suggested better integration across these projects (see reviews for 22120114-D, J, I, J and L). We suggested that a postdoc within the LTRM integration and management proposal synthesize all oceanographic data. If this proposal is recommended for funding, we strongly recommend that the OA monitoring group closely collaborate with others on this effort. The budget is reasonable, for the amount of high value data that will be generated by this long-term project.

PI response:
We thank the reviewer for their comments and recommendation. We would be eager to collaborate on efforts, and with a postdoc, focused on synthesizing all oceanographic data across the EVOS area. We work closely with Dr. Seth Danielson (21120114-I, L) and Dr. Russ Hopcroft (21120114-L) and look forward to continued collaboration and further integration across projects. If funded, we will reach out to the PIs of 21120114-D and J to explore collaborations, noted on p. 17 "Nearshore Monitoring Component".

We agree with the external peer reviews and recommend that the PI follows the suggestions of one of the reviewers that include:

• Team members should consider using Millero et al. 2010 for the thermodynamic dissociation constants within CO2SYS due to the estuarine nature of their sampling. While Lueker et al. 2000 is the preferred dataset for typical oceanographic measurements, Millero et al. covers a salinity range from 1-50, and thus likely produces better results in estuarine environments.

PI response:
We appreciate the suggestion and look forward to investigating the internal consistency of the marine carbonate system in the EVOS area using our samples. We've updated the budget to reflect this and updated Section 3. Data Analysis and Statistical Methods to more directly address this.

• It may be worthwhile purchasing purified m-cresol purple indicator dye for the spectrophotometric pH measurements. Although somewhat expensive, it will lessen post-processing and improve confidence in the pH data. Additionally, take care with the dye perturbation correction of variable salinity data.

PI response:
We thank the reviewers for their insight and have adjusted the budget to reflect using purified m-Cresol Purple (mCP) indicator dye in our spectrophotometric pH measurements. We look forward to doing a detailed investigation to characterize and correct for the differences in pH measurements with the purified mCP (Dr. Byrne's lab in University of South Florida) and the previously used unpurified mCP indicator (-4-H JENA Engineering GmbH, S0045 from TCI lot number PKFSM-DQ), as recommended by Yao et al. (2007). To further reduce uncertainty of our pH data we will utilize the recent work of Li et al., 2020 to adjust for dye perturbations.

In addition, we have been in communication with Dr. Andrew Dickson to be part of a future inter-laboratory comparison to study correcting unpurified mCP pH measurements (Douglas and Bryne, 2017) to pH measurements obtained with purified mCP.
Please see Section 3. Data Analysis and Statistical Methods for further details.

• Lastly, it may be necessary to allow extra time and/or funding to sort alternate calibration methods for the instrumentation, as there is currently a shortage of standards (CRMs) available for purchase due to COVID. It is possible this will still be a hurdle when the work is scheduled to start (FY22). This is a manageable problem, but will likely take initial expense in the first year to create a stable substandard or to find alternative calibration solutions.

PI response:
We appreciate the suggestion and will look into the preparation of sodium carbonate solutions in our lab (Dickson et al., 2007) and storing the standard solutions and/or CRMs in gas-tight bags (e.g., Seelmann et al., 2020b; Cali-Bond bag, Calibrated Instruments, Inc.).

Dickson, A.G.; Sabine, C.L. and Christian, J.R. (eds) (2007) Guide to best practices for ocean CO2 measurement. Sidney, British Columbia, North Pacific Marine Science Organization, 191pp. (PICES Special Publication 3; IOCCP Report 8). /Guide_all_in_one.pdfhttp://hdl.handle.net/11329/249. Available: https://cdiac.ess-dive.lbl.gov/ftp/oceans/Handbook_2007

Douglas, N.K., Byrne, R.H. 2017. Achieving accurate spectrophotometric pH measurements using unpurified meta-cresol purple, Marine Chemistry, 190, 66-72,doi.org/10.1016/j.marchem.2017.02.004.

Li, X., García-Ibáñez, M.I., Carter, B.R., Chen, B., Li, Q., Easley, R.A., Cai, W.-J. (2020). Purified meta-cresol purple dye perturbation: how it influences spectrophotometric pH measurements. Mar. Chem., 225 p. 103849. doi: 10.1016/j.marchem.2020.103849

Seelmann, K., Tobias, S., Aßmann, S. and Körtzinger, A. 2020b. Enhance Ocean Carbon Observations: Successful Implementation of a Novel Autonomous Total Alkalinity Analyzer on a Ship of Opportunity, Frontiers in Marine Science 7, 1030, doi: 10.3389/fmars.2020.571301.

Yao, W.; Liu, X.; Byrne, R. H., 2007. Impurities in indicators used for spectrophotometric seawater pH measurements: assessment and remedies. Mar. Chem., 107 (2), 167–172.

Date: September 2021

This project focuses on an important environmental driver, and we support its continuation and expansion. The planned work would continue high-resolution ocean acidification (OA) monitoring in the Spill Area and add new methodology for analysis of water from estuarine and glaciated environments. There will be strong emphasis on identifying OA "hotspots", important for determining marine resources most vulnerable to OA. The external reviews were detailed and strong. The budget is reasonable, for the amount of high value data that will be generated by this long-term project. We recognize the strong publication record and high reputation of this new PI among researchers in ocean acidification (OA).

In response to the draft proposal and the external reviews, we emphasized the importance of cooperation with the other LTRM projects gathering data on environmental drivers and suggested that a postdoc within the LTRM integration and management proposal synthesize all oceanographic data. They responded very positively, describing existing collaborations with Council-supported projects and identified a further opportunity. The PI noted that she was already performing forecasting/hindcasting modeling and was enthusiastic about working with a postdoc. The PI also gave convincing responses to several technical questions and suggestions from the reviews relating to ensuring internal consistency of OA data from the Spill Area.

In summary, our review of the original proposal already identified this as a strong proposal meriting funding. The subsequent responses from the PI add strength to this recommendation. We further recommend that this project be integrated within the larger 2222LTRM Program Proposal.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC. I also note that the PI has made considerable efforts to coordinate with the ASLC and PWSSC to incorporate data from this project into the ASLC-led Education & Outreach proposal (22220400). Additionally, the PI plans to collaborate with the Tribally- led and organized ocean acidification community sampling networks in Southeast, Southcentral and Kodiak.

Project Number: **22220203** This project was terminated in FY23.

Project Title: Assessment of Prince William Sound walleye pollock with investigations into walleye pollock-Pacific herring interactions

Primary Investigator(s): Wyatt Rhea-Fournier, Pete Rand, Mike Byerly, Paul Hershberger, David Beauchamp, Andrew Whitehead

PI Affiliation: ADF&G, PWSSC, USGS, UC Davis

Project Manager: ADF&G, USGS, NOAA/PWSSC

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$363,390	$439,448	$397,465	$294,421	$451,606	$1,946,331
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$477,931	$322,325	$486,848	$491,285	$404,697	$2,182,986

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$59,000	$60,200	$61,400	$62,600	$63,900	$307,100
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$65,100	$66,400	$67,800	$69,100	$70,500	$338,900

Total Past EVOSTC Funding Authorized (FY12-22): $363,390

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $802,838

Total Non-EVOSTC Funding (FY12-23): $119,200

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.21, budget updated 08.16.21.*

This project will conduct research and monitoring activities to assess the pollock population in Prince William Sound (PWS) and investigate ecological interactions between pollock and herring. Available evidence suggests the population of pollock in PWS increased in the early and mid-1990s when the PWS herring population began to decline. Researchers have hypothesized pollock in PWS are limiting the recovery of herring due to their high abundance and the potential for mortality of herring from direct interactions. Although PWS pollock abundance estimates were generated in the past and interactions of herring and pollock have been reported previously, this proposed comprehensive project will gather new information and analyze data since the Exxon Valdez Oil Spill (EVOS) and since the recent Gulf of Alaska marine heatwave. Winter research surveys will quantify the PWS pollock spawning stock biomass and age structure and summer monitoring surveys will reestablish a

26-year index of abundance for pollock. This project will provide new information to assess herring mortality from interactions with pollock that have not been previously investigated or quantified, including the transmission of pathogens and predation. The winter survey will collect pollock eggs to assess the prevalence of a primary pathogen of herring, *Ichthyophonus,* and to investigate the transmission and ecological cycling of the pathogen. The summer survey will collect stomach contents of pollock and other dominant groundfish to identify previously undocumented herring predators. Pollock and other groundfish will have herring specific consumption rates quantified which will allow the significance of herring removals through PWS groundfish predation to be evaluated for the first time. The two surveys for this project will directly inform the management of the state-waters pollock fishery and the larger federal fishery and enable the continuation of the only long-term benthic community research survey time-series providing community composition observations in the EVOS affected area.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Do Not Fund	Do Not Fund	Do Not Fund	Fund

Science Panel Comments

Date: May 2021

The Science Panel was supportive of the surveys described under objectives 1 and 2, noting that groundfish interact with and may influence herring via known or suspected links via competition, predation and disease transmission. Regarding objective 1, see suggestions by external peer reviewers and the SP. Regarding objective 2, we note that there are 25 to 30 years of data in hand and the PIs should describe better what has already been learned from these data and why it should continue in the context of this proposal. We recognized the value of pollock data for fisheries models, but the section of the proposal concerning "monitoring groundfish and correlations with local climate indices" could be done with data in hand already. The external reviewers expressed some additional concerns that should be addressed for these objectives.

PI response:
The ADF&G historical summer bottom trawl survey data in Objective 2 has not been analyzed for correlations with groundfish (pollock) abundances and climate indices in the past. This trawl survey historically had a primary objective of assessing Tanner crab populations and thus ADF&G's analysis and reports have focused on Tanner crab fishery management goals.

Objective 3 is largely redundant of the separate proposal led by Hershberger on herring disease (22120111-E): these activities belonged clearly within the Hershberger proposal. We advise to remove this objective here or more clearly distinguish both here and in the Hershberger proposal how the two are distinct from each other. Activities here should be limited to collecting samples required by Hershberger. Regarding this collection, the proposal should clarify whether eggs will be collected from female adult pollock or embryos from the water column. This would seem to depend on whether the hypothesis is that disease is obtained from adult females or as free-floating embryos from the environment.

PI response:
Objective 3 offers a new collection platform for tissue samples to test for the presence and transmission of Ichthyophonus that is not available in the Hershberger proposal. Objective 3 proposes to evaluate whether Ichthyophonus is transmitted to Pacific herring through ovivory (page 3) and laboratory analysis will confirm that pollock eggs are infected by the disease prior to parturition. Tissue collection activities are specific to the requirements of Hershberger's work (page 11 and 12). The collection of eggs from gravid females caught on the winter A-T survey has been clarified in page 12 revisions.

There is some apparent redundancy between this study and the herring disease study (22120111-E), reflecting the collaborative nature of the two studies and the administrative structure of the EVOS programs. The herring disease study is part of the larger, integrated Gulf Watch Alaska (GWA) Program, but this pollock study is not. The GWA Program was limited to a finite funding request for the entire program, and this finite amount was apportioned among the team members. The scope of work and budget for the herring disease project were developed within these funding parameters. The serendipitous request to develop this pollock proposal (and include the Ichthyophonus ovivory studies) came after the budget for the Herring Disease Project was already maxed out within GWA. Therefore, the budget request for the pollock project includes a small amount of funding for a part time laboratory technician to process the pollock egg samples and run the egg exposure studies in the laboratory.

Eggs will be collected from the ovaries of adult females. We hypothesize that transmission occurs after eggs (with associated parasite) are released from the female and consumed by susceptible herring. At the current time, we have no indication that true vertical transmission occurs (i.e. penetration of the parasite to the inside of the egg); rather, it is more likely that the parasite is somehow associated with the outside of the chorion. For this reason, it is not completely necessary to obtain fertilized embryos from the water column. Additionally, plankton tows (where fertilized eggs might be encountered) are not a part of this study. However, the reviewer makes a good point. If we are not able to demonstrate transmission using ovary-sourced eggs, then we will make every effort to obtain naturally-spawned and fertilized eggs from the water column.

We had many concerns about objective 4. Based on the literature cited, predation / interactions between herring and pollock have been thoroughly investigated; thus, we are not convinced of the value of more limited surveys. The description of the calculations and extrapolations made regarding predation rates using the bioenergetic models was disturbingly vague, leaving the SP skeptical that they would actually be useful. The proposal mentions the Wisconsin model, but then suggests some parameters may be derived from parameters in the von Bertallanffy growth function (VBGF). A study by Essington et al. (Ca. J. Fish Aquat. Sci, 2001), with Kitchell as a co-author, noted high risk of bias in such estimates, and proposed that "biases and precision of these estimates must be made on a case by case basis". Any such estimates must have uncertainty estimates reported alongside, and we felt that the confidence intervals on such estimates could be very wide. We agreed with external peer reviewer comments about spatial and temporal variation in diet, and sampling scheme for quantification of diet in a quantitative way; these would add further uncertainty to the consumption rate estimates. Overall, we felt that the PIs needed considerably more information and justification to consider this component further.

PI response:
This project proposes to quantify consumption of herring by pollock from diet information collected during the winter and summer surveys which have considerable spatial overlap. Stomach contents will be collected from pollock during the first half of the winter acoustic-trawl survey in the eastern part of PWS where the summer bottom trawl survey occurs. Other groundfish consumption estimates will be limited to the summer season in the spatial extent of the bottom trawl survey. Text has been edited on page 12 and 15 of the proposal.

We also noted that it was not clearly stated which personnel are responsible for which deliverable.

PI response:
PIs have been assigned reports in the revised Deliverables section of the proposal.

On balance we were supportive of objectives 1 and 2, but viewed the other two less favorably.

Date: September 2021

Our concerns stated in our March review were largely unanswered by the PI responses. Rather than address why existing pollock data were insufficient to address the questions, the PIs merely stated that the data had been used for something else to date. We expected preliminary analysis of existing data to justify objectives 1 and 2. Objective 3 should be merged into proposal 22120111-E as its primary function is to collect eggs for that proposal; the PI responses indicated that it was placed here largely to circumvent a funding cap on the LTRM proposal, which we did not view as a sufficient justification. Our concerns about the Bioenergetic model approach in objective 4 were also largely unaddressed. In general, we were disappointed with the very limited responses, which mostly just reiterated their planned objectives, and thus we are unable to recommend funding.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC.

Project Number: 24120113

Project Title: Data Management Program

Primary Investigator(s): Carol Janzen, Rob Bochenek

PI Affiliation: AOOS, Axiom Data Science **Project Manager:** NOAA/PWSSC

EVOSTC Funding Requested for LTRM Program (includes 9% GA)

Actual funding amount is based on total proposals funded by TC

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$379,716	$394,207	$411,819	$401,524	$373,476	$1,960,742
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$328,449	$335,485	$344,195	$351,708	$360,903	$1,720,740

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$0	$0	$0
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $4,279,942

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $4,659,658

Total Non-EVOSTC Funding (FY12-23): $2,978,600

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 01.24.22, budget updated 11.07.22.*

The *Exxon Valdez* Oil Spill Trustee EVOSTC (EVOSTC) requires a data management approach composed of methods covering the entire data lifecycle, from immediately after data collection, to long-term preservation, to discovery and reuse. Since 2012, the Alaska Ocean Observing System (AOOS) and its technical partner, Axiom Data Science (Axiom), have provided data management services for both the "Long-Term Monitoring of Marine Conditions and Injured Resources and Services" Program (i.e., Gulf Watch Alaska (GWA)) and the "Herring Research and Monitoring" (HRM) Program. These two programs have leveraged the existing data management capacity of AOOS, and have also helped inform and improve the overall AOOS data management, access, and visualization tools. Beginning in FY20, AOOS and Axiom also began providing data management services for individual EVOSTC-funded Non-Program Projects (NPP) using the same approach and infrastructure that leverages the existing data management capacity of AOOS. Going forward in

2022-2031, the EVOSTC requested that a single program proposal be submitted for data management services to support the GWA and HRM Programs (now combined into a single program - the Gulf Watch of Alaska Long-term Research and Monitoring (GWA LTRM) Program), the continuing NPPs, and any newly-funded NPPs funded under the FY22-31 Invitation for Proposals. The AOOS-Axiom team and mature infrastructure remain best situated to continue providing data services to EVOSTC-funded programs and projects to maintain continuity and build upon the ongoing data management efforts. AOOS and Axiom Data Science propose to continue providing access to the tools and services for which the principal investigators (PIs) of the GWA LTRM Program and the continuing NPPs depend. Among these are the Research Workspace, a web-based data management platform; the AOOS Gulf of Alaska (GOA) Data Portal, where project data will be shared publicly; and the DataONE Member Node where final data sets will be archived for long-term preservation and broad access across multiple data repositories. Building upon these prior efforts, the AOOS-Axiom team is well poised to deliver continued success in facilitating the access and curation of EVOSTC data to support decision-making related to Spill affected ecosystems.

Funding Recommendations (January 2024):

Science Panel	PAC	Executive Director	Trustee Council
Did not review	Fund	Fund	Fund

Science Panel Comments

Date: January 2024

Did not review

PAC Comments

Date: January 2024

Excerpt from the Draft Meeting Notes: Stekoll asked if public comments were collected for this proposal, and Wang stated there were not, but the PAC could request Trustees take public comments. Docken asked if a third-party company manages EVOS data under the Council's data policy. Wang confirmed Axiom Data Services has provided data services for the Gulf Watch Alaska and herring research programs since 2012. In 2020, the Council asked them to manage data for all Council-funded projects to ensure they are publicly available. Under the contractual agreement, there is no requirement for an annual request for proposals. Proposal submissions are required when invitations are opened, and they must follow reporting policies and undergo review by the Science Panel, PAC, and Trustee Council. The intent of approving funding is to continue the ongoing relationship with the same entity and ensure the required data management services for all LTRM projects. Kopchak said he worked with Axiom Consulting and Design and was impressed with their work to aggregate and illustrate data. It was imperative that the same firm manages the data, and Kopchak was very much in favor of the funding allocation. Kopchak moved to recommend approving additional funding for data management services, and Docken seconded the motion. Stekoll stated he did not understand the proposal enough to vote on it. After no further discussion, PAC members took a roll call vote. Five members voted in favor, Stekoll abstained, and Skladal did not vote. The motion passed.

Executive Director Comments

Date: January 2024

No specific comments.

Funding Recommendations (Fall 2022):

Science Panel	PAC	Executive Director	Trustee Council
Did not review	Fund	Fund	Fund

Science Panel Comments

Date: November 2022

Did not review

PAC Comments

Date: November 2022

No specific comments.

Executive Director Comments

Date: November 2022

This funding request is for FY23 required data management services for the Project 23120114-N Killer Whale long-term monitoring project which was approved for reduced funding for FY23 at the October 5, 2022 Trustee Council meeting. Cost is $11,725, GA is $1,055, Total Cost with GA is $12,780.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The goal of the 2022-2031 data management project is to provide critical data management to support all EVOSTC-funded LTRM program and individual Non-Program projects in order to assist study teams in efficiently meeting their objectives and ensuring data collected or consolidated through the effort is organized, documented, and available for their use and for future use by the larger scientific community. Future EVOSTC-funded Non-Program projects outside of the LTRM program and current Non-Program projects being proposed can be added to the data management effort during the next 10-years upon request by the EVOSTC with modified appropriations. The AOOS-Axiom team proposes to be successful in meeting the goal of this project by leveraging the extensive cyberinfrastructure and data management capacities of both Axiom and AOOS, and utilizing the existing collaborative relationships with both GWA LTRM program and Non-Program PIs to ensure continuity in the data collected across all efforts. The Science Panel agrees with all of this.

However, some questions arose regarding the budget and the "new" 45% overhead charge by Axiom. There needs to be a clear agreement that the overhead rate will not change for the duration of the 10 year project. We also need assurance that data management for new education and outreach, and mariculture projects will be included in the Data Management proposal or in the individual new projects.

PI Response:
Regarding: "There needs to be a clear agreement that the overhead rate will not change for the duration of the 10-year project."
Effective 2019, Axiom Data Science moved to a federally approved indirect cost rate of 45%. This is a modified total direct cost rate that excludes direct costs, equipment, supplies, and subcontracts in excess of $25,000. Many of Axiom's services intricately overlap outside of the direct scope of work for our partners. Thus, Axiom's partners benefit from a much more comprehensive suite of services and systems than is written into our contracts. The indirect cost rate covers the cost of operating Axiom's data center and other utilities, as well as administration and indirect project personnel such as software engineers who may be responsible for a component in the Axiom suite that supports the project but is not directly included in the scope of work. Administration includes accounting services, audit services, grant services, office space, and human resources support. Indirect project personnel may include data analysts, data coordinators, data scientists, software engineers, and senior software engineers. Axiom agrees to a fixed indirect rate of 45% for the duration of the 10-year project. This agreement has been included in our letter of commitment that is enclosed with our revised proposal.

Regarding: "We also need assurance that data management for new education and outreach, and mariculture projects will be included in the Data Management proposal or in the individual new projects."
As per communications with Shiway Wang, Acting Executive Director EVOSTC, on June 29, 2021, Axiom Data Science is reviewing all new Non-Program project proposals (including new education and outreach, GWA-LTRM, habitat restoration, and mariculture projects) which have a relevant data collection component. Based on these reviews, Axiom will determine a cost estimate for data management services that leverages the existing Council data management infrastructure, as well as provide a detailed data management plan in support of the new project proposals. The data management cost estimates will be submitted by project PIs for review and consideration for funding. Below is a copy of the email sent to project PIs relative to data management plan requirements for EVOSTC proposals:

***From:** Wang, Shiway W (EVOSTC sponsored) <shiway.wang@alaska.gov>*
***Sent:** Tuesday, June 29, 2021 2:51 PM*
***To:** Wang, Shiway W (EVOSTC sponsored) <shiway.wang@alaska.gov>*
***Cc:** Carol Janzen <janzen@aoos.org>; Stacey Buckelew <stacey@axiomdatascience.com>; Kilbourne, Linda L (EVOSTC) <linda.kilbourne@alaska.gov>; Adams, Lauri (EVOSTC sponsored) <lauri.adams@alaska.gov>*
***Subject:** Data management plan requirement for EVOSTC proposals*

[External]
Good afternoon

This is a friendly reminder that your proposal review included information regarding the Council's data management policy with instructions to contact Carol Janzen (AOOS/Axiom) to determine a cost estimate for data management services by the Council's Data Management infrastructure, if you are submitting a revised proposal for Council review this fall.

Please email your proposal to Carol Janzen and Stacey Buckelew (cc'd on this email) by ***Monday, July 6, 2021*** *so they are able to determine a cost estimate for data management services for your project.*

A detailed data management plan that addresses the Council's Data Management Procedures and Data Policy is required in your proposal (see pg 24, FY22-31 Invitation rev12921 and pg 6, FY22-26 Invitation General Restoration rev12921) regardless of who you decide to manage your project data. This plan must be included for review and consideration for funding.

Please ignore this email if you have already reached out to Carol and Stacey.
And please don't hesitate to contact us if you have any questions.

Best,

~ ~

Shiway Wang, PhD
Acting Executive Director
Science Director
Exxon Valdez Oil Spill Trustee Council
4230 University Drive, Suite 220
Anchorage, AK 99508
Office: (907) 265-9328
shiway.wang@alaska.gov

Overall, we are pleased with the Axiom-AOOS team and the progress that has been made with the web data portal over the past 10 years.

PI Response:
Thank you! We are pleased to have the opportunity to continue to provide data management services to EVOSTC-funded programs and projects in order to assist study teams in efficiently meeting their objectives and ensuring data is organized, documented, and available for their use and for future use by the larger scientific community.

Date: September 2021

The Program Lead's response gives confidence that any data produced by new proposals will be correctly managed, archived and published according to the Council's data policy. We thank the Council for retaining the Data Management infrastructure as a separate program. This provides additional assurance that all data will be properly managed and made publicly available. Over the past 10 years, the existing Data Management program has evolved into an efficient, effective, and well-structured program, which has resulted in less oversight and maintenance for the Council and Council staff.

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets. It is also noted that a PAC member mentioned the good work being done by this program. Another member also noted that this effort is something that the Council should be extremely proud of.

Executive Director Comments

Date: Fall 2021

I concur with the Science Panel and PAC. I also note that this program has continually evolved through the leadership of skilled and experienced staff to adapt to current information needs and remains the best-situated to continue to provide data services to Council-funded programs and projects. Data Management through a stand-alone program funded by the Council ensures that the Council's Data Policy is adhered to and that Council data and metadata from a diverse collection of sources is professionally curated, archived, indexed, and made available in a consistent manner. These quality products will be a lasting legacy of the Council's science programs and projects. Concerns were brought forth by the Council to staff regarding the existing program's cost-effectiveness. To provide context, the National Science Foundation recommends 10-20% of the total research award to support data management activities. The EU Commission recommends 5% of overall research costs should go towards data stewardship (Nature, Feb 2020, https://doi.org/10.1038/d41586-020-00505-7). If all proposals submitted in response to both the 5- and 10-year Invitations that require data management were to be funded by the Council, only 4.3% of the total funding over 10 years would be dedicated toward the Data Management program. *This 4.3% is less than if not on par with the current national and international guidance on research funding to support data management.* This, along with the Science Panel and PAC's assessment of the Data Management program over the last 10 years should provide the Council and the public that this program is cost-effective, efficient, and valuable.

Mariculture Project Descriptions

Project Number: **22220300**

Project Title: Prince William Sound Kelp Mariculture Development for Habitat Restoration and Local Economy

Primary Investigator(s): Willow Hetrick-Price

PI Affiliation: CRRC **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$808,445	$614,545	$588,385	$621,085	$129,013	$2,761,472
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$500,000	$75,000	$75,000	$50,000	$0	$700,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $808,445

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,422,990

Total Non-EVOSTC Funding (FY12-23): $575,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.16.2021, budget updated 08.16.2021.*

The Chugach Regional Resources Commission (CRRC), in partnership with the Native Conservancy, is spearheading a five-year project to enable Native Alaskan and coastal communities to play a significant role in building a regenerative ocean farming economy in Prince William Sound (PWS). Our hypothesis is that careful and evidence-based kelp farming in oil-spill impacted areas of PWS will enhance localized water quality and habitat and sustain a profitable mariculture industry in the region through conservation-based kelp farming. Our overall goal is to establish this sustainable kelp farming industry in PWS based on best practices that fulfill long-term restorative economic development goals through specific objectives to:

- Objective 1: Scale the infrastructure to increase the production capacity of the Alutiiq Pride Marine Institute and Community Kelp Seed Nurseries to meet projected kelp seed string demands of the region.

- Objective 2: Develop effective, affordable, and sustainable practices for Native kelp farming through specific array designs, deployment methods, and seed cultivation strategies that will lead to the long-term restoration of oil-spill impacted areas of PWS.
- Objective 3: Conduct a comprehensive landscape analysis by deploying research kelp sites and kelp dropper lines to develop commercial farm capacity rating per region. Collect, analyze, and share data related to water quality, kelp tissue composition, sea life and other factors that may indicate the viability of a site for commercial kelp farms.

The project builds on three years of training coastal and Native Alaskan kelp farmers, kelp-nursery development at CRRC's Alutiiq Pride Marine Institute (APMI) in Seward, Alaska, the establishment of seven test-line sites, research into native species, and technology transfer of best-practices in kelp farming and conservation practices. The project will pave the for **2000 acres of a recovering ecosystem capable of producing 30 million pounds of kelp annually through 100 Native-owned kelp farms.** Leveraging a mix of Native farmer training, infrastructure and market development, and metrics-driven research, this initiative will lay the necessary groundwork for networks of Native-owned ocean farms and kelp seed nurseries, processing hubs and value-added kelp businesses throughout Alaska.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Do not fund	Fund FY22-26	Fund Contingent	Fund

Science Panel Comments

Date: May 2021

This 5-year project proposal strives to enable Native Alaskan and coastal communities to play a significant role in building an ocean farming economy in PWS. The premise for this proposal is that conservation-based kelp farming in oil-spill impacted areas of PWS will support fish habitat (herring and other fish spawning grounds), reduce ocean acidification, and sustain a profitable mariculture industry in the region. There are two main objectives, namely to: (1) develop conservation-promoting practices for Native kelp farming through specific array designs, deployment methods, and seed cultivation strategies that will lead to the long-term restoration of oil-spill impacted areas of PWS; and (2) collect, analyze, and share data related to water quality, habitat, and sea life at the research test sites to understand the restorative/regenerative possibilities of kelp farming. These are very meritorious objectives.

As suggested by one external peer reviewer, the proposal should clarify whether the PIs are submitting this proposal under the restoration and enhancement component of the Mariculture Focus Area goal or under research to support mariculture development.

PI Response:
This proposal falls under the mariculture development focus area.

In 2020 Chugach Regional Resources Commission (CRRC) built a kelp nursery at Alutiiq Pride Marine Institute (APMI) in Seward. Research capacity was expanded in 2021. The proposal reports that, to

date, the Community Kelp Seed Nursery (CKSN) has cultivated and delivered 80 spools and three species of native kelp (sugar kelp, ribbon kelp, and bull kelp) to seven research test sites in the PWS. This work sounds very promising and suggests that the 7sites are suitable for kelp production. Data showing those results should be included in the proposal to allow evaluation of claims made in the proposal.

PI Response:
Native Conservancy is currently developing a comprehensive report on the test lines after this first year of operation. This report will include profiles of the sites and performance of the kelp by species, noting seed string and parent stock specifications and regions as well. Once completed, this report can be made available to the Trustee Council and reviewers.

Proposed new work involves the conduct of ongoing research through seven test-line sites and in the kelp nursery. The kelp farm research test sites are located in Nelson Bay, Simpson Bay, Sheep Bay, Port Gravina, Tatitlek Village region (Port Fidalgo), Latouche Island, and Foxfarm Island. The proposal indicates that these test sites are contiguous with small to mid-sized Native village farm locations. As the proposal requests funding for kelp farming efforts at these 7 test sites that are already well underway, the proposal should clarify what portions of the work have already been covered by existing funds and which portions are being requested to be funded by new EVOSTC funding. The proposal should also indicate the plan for after EVOSTC funding is spent. Is the intention that these kelp farms be self-sustainable after 5 years?

PI Response: Funding

- *Existing funds cover: Current 7 research test site gear (buoys, lines, anchors) and small pilot nursery equipment (supporting 16 tanks with 9 spools each).*
- *New Funds requested for: Expanding test sites to new locations and larger arrays. Replacing lost or damaged gear. Replacing gear with better performing materials. Expanding the nursery capacity and purchasing new gear to experiment with more efficient seed cultivation methods.*
- *After EVOS funding is spent in 5 years, the test sites will be retired. We will turn our attention to advising new farmers on suitable locations to farm, supporting the permitting process, and advising farm arrays build/deploy/operation.*

Over the long term, the proposal indicates a goal to establish 2,000 acres of a recovering ecosystem capable of producing 30 million pounds of kelp annually through 100 Native-owned kelp farms. It is not clear how this goal aligns with the production goals of the Alaska Mariculture Development Plan and this should be clarified. It appears that the long-term goal stated exceeds production goals indicated in the plan.

PI Response:
Our long-term goal is to support the development of the mariculture industry, to be led by Native-owned farms. Our vision does not and does not have to align with the Mariculture Development Plan. Our long-term goal stated exceeds production goals indicated in the Mariculture Development Plan because this group of organizations has the hands-on experience to be able to make production numbers whereas the developers of the Mariculture Development Plan were conceptualizing. While we will not develop these farms directly, our work with the nursery and test sites under this proposal will allow us to confidently advise and support future farmers. [Page 2]

A revised proposal would benefit from a brief description of current and future markets for kelp (especially given the production goal mentioned in the previous paragraph). One reviewer indicated that there is currently very little commercial market for domestically-raised kelp, so economic benefits of the proposed work may not be realized. If the kelp are planned for subsistence, rather than (or in addition to) commercial harvest, this should be indicated. In such a case, the degree to which wild kelp harvests subsistence harvest needs should be indicated.

PI Response:
Native Conservancy has several pilot programs exploring and developing kelp market opportunities on behalf of future farmers. They have contracted Lift Economy for 1 year to conduct a market analysis to identify promising pathways and have been offered in-kind services from GreenWave's product development experts to develop specific products with predicted market growth. In addition, Native Conservancy is independently experimenting with processing methods and product creation, including soil amendments and food products. Native Conservancy is providing samples and data to Macro Oceans, who are piloting accessible bio-refinement systems so large amounts of kelp can be processed quickly and sold to pharmaceutical, cosmetic, and other larger industries.

While we expect communities to utilize this farmed kelp in subsistence practices, the primary goal is to develop commercial markets and reduce the stress and collection of wild kelp beds, leaving them pristine and available for sea life.

The proposal indicated that these 7 sites were chosen because they vary with regards to exposure, water quality, ocean floor topography, currents and more. While it is a good idea to conduct tests at a range of environmental conditions, data describing these conditions should be shown for each site. Features should be quantifiable so that any relationships to kelp production can be tested.

As the proposal strives to restore habitat, the proposal should describe the evidence that kelp habitats in PWS were damaged, and how kelp farms will restore those damaged habitats. As pointed out by one reviewer, kelp farms are typically located in areas without herring spawning, so it is not clear how much herring spawning habitat will be created by kelp farms. ADF&G specifies that no aquatic farm gear or product may be handled for up to 2-3 weeks until after the herring spawn to ensure eggs have hatched. So, locating kelp farms in areas of herring spawning would seem to conflict with aims to develop a farming economy. In addition, as the purpose of the kelp farm is to harvest kelp by removing it, it would seem that any habitats created would be temporary and they would be lost after harvest. Thus, it is not clear that this constitutes "restoration". Given this, it would seem that some other term, such as habitat "improvement" or "supplementation", is more fitting and some discussion of the consequence of fluctuating habitat availability due to harvest schedule is warranted.

PI Response:
This proposal does not seek to restore habitat and have adjusted the proposal to clarify this point. We believe that farming kelp will ease the stress and use of wild forests, especially as the kelp market continues to expand and demand rises. Kelp farming is a net benefit for water quality. If future wild forests are threatened, we can allow portions of the farms to go to seed and continue to propagate wild forests, however that has not been identified as a concern or allowed under current regulations. [Page 5]

Many of our community members would like to see herring populations restored in PWS. Herring spawning on kelp would be welcomed for our test sites and future farmers. Permit regulations would require us to wait several weeks after the herring has spawned before harvest and then that kelp can be used in non-food grade products such as compost. The restoration story is a Unique Selling Point, attractive to eco-minded consumers, and beneficial to brand development. We do not see this as a conflict with kelp production goals.

The ability to reduce ocean acidification would be a beneficial aspect of kelp farms and the proposal cites Vischa (2020) in this regard. However, a reviewer noted that ocean acidification was not part of Vischa's study. It is often touted that mariculture provides ecosystem benefits including habitat provisioning, reducing ocean acidification, pollution mitigation, and supporting fish populations, beneficially changing water chemistry through photosynthesis, respiration, and calcification. While some studies have found such results in other regions of the world, other studies have shown that ecosystem benefits of mariculture can be very site specific, temporary, or of limited spatial and temporal extent, and that the effects cannot always be assumed to be beneficial.

PI Response:
We will be removing the Ocean Acidification language from this proposal; however, we would like to note that Alutiiq Pride Marine Institute has begun incorporating kelp into their ongoing ocean acidification research, and plan to continue with these studies in the future. While we are narrowing the focus of this proposal to the practical development of the mariculture industry, we will be supplying Alutiiq Pride Marine Institute with samples of kelp from the test sites to continue their research.

There is a general need to explain methodology to be used in this proposal. For instance, the proposal indicates that sites will be used to "test new anchors or designs" and "train farmers in conservation-promoting practices." Methods are not provided nor any indication how differences will be evaluated. Water quality data collection and analysis is explained more thoroughly than the site design, while the GIS mapping is not explained very well. The GIS component should be explained more thoroughly or perhaps dropped from the proposal. The proposal also indicates that each site will include three 100-foot grow lines, each with a different species of kelp (sugar, bull, or ribbon kelp) aimed at determining whether and how well the kelp species will grow at that site. The proposal does not describe how many kelp plants will be affixed to each grow line. If it is one plant only, then it would appear that there are no replicates as needed for statistical analysis. A minimum of three plants per line would be needed to calculate mean and variance for statistical comparisons. We assume that many plants will be attached providing replicates so that this is not a problem, but this needs to be described in the study design.

PI Response:
The exact number of plants per test line will vary depending on how well and evenly the sorus settles on the seed spools in the nursery, however on a 100ft line there will assuredly be over 1000 plants per line, allowing for a variety of sampling to occur at each site. For the carbon and nitrogen sampling directed by Dr. Schery Umanzor we collect 5 tissue samples per line at different intervals.

Also, the method by which kelp are affixed to the grow lines should be described, as well as any tendency for kelp to become dislodged from the grow lines by tidal currents or storms.

PI Response:
A detailed account of the methodology that is followed by APMI can be found in the Flavin et al. ocean approved kelp farming manual. That manual is attached to the email submittal for reference. APMI, through training by Greenwave in 2020 and 2021, has been following this manual identically.

The proposal outlines three ways to measure success in terms of recovering ecosystems:

1. Demonstrated maintenance or improvement of water quality in terms of oxygen dissolution, ocean acidification and nitrogen levels in kelp-farmed areas during the December-May growing season.

2. Improved or maintained marine life diversity in terms of species and numbers observed in kelp-farmed areas over time.

3. Quantifying carbon capture of kelp grown on test sites through analysis in partner labs. Analyzing potential of farmed kelp for reducing ocean acidification at a regional level.

Sampling methods, laboratory procedures and statistical analyses are not adequately described to allow a determination of the ability of this proposal to measure success. With regard to the first metric, the proposal indicates that water quality data at each test site will be collected throughout the growing period from December to May. Data on water quality indicators (salinity, temperature, oxygen dissolution, nutrient availability, pH) will be collected 120, 90, 60, and 30 days prior to harvest and at harvest. We note that natural changes in water quality, unrelated to kelp production, are expected to dominate the water column between December and May owing to seasonal water column mixing, stratification, spring bloom, and depletion of nutrients in the photic zone subsequent to the bloom. While the proposed sampling schedule would allow comparisons across sites, in order to ascribe changes in water quality to the kelp farms, a scientifically valid design incorporating controls and treatments should be considered. If kelp do affect water quality, it is likely that water quality would differ upstream, within, and downstream of the kelp farm. Orientation of “upstream” and “downstream” would be expected to vary with the tidal cycle. It is important that the environmental monitoring is designed and executed using scientifically valid methods otherwise it should be dropped from the proposal. If environmental monitoring is to be included in the proposal, it is important to describe these sampling methods in sufficient detail. The PIs convey the impression that this will be deferred to some experts in this field. If so, these experts in the collection and analysis of water quality samples should be involved in the preparation of the proposal so that the sampling plan and analytical methods can be described.

PI Response:
Upon recommendations from reviewers and our scientific partners, we have decided that we cannot accomplish a defensible research design given the numerous environmental factors and inability to conduct controlled experiments. We have removed this component from the proposal and altered our goals to reflect the infrastructure development and applied research focus more accurately. We will continue to collect and analyze water and tissue samples to further develop our test site datasets with the aim of informing practical application for future farmers. Carbon levels in tissue samples could inform farmers about the capacity of their farm site and the stage of development of the plants when sampled. Nitrogen testing of the water and tissue could inform farmers of nutrient dense

locations and areas that can support larger farms. Temperature readings in the spring could inform farmers about when to expect biofouling to begin and ideal harvest times. Salinity readings can let farmers know if there are significant fresh water mixing at their sites and if they should sink their arrays deeper to prevent blistering of their kelp.

Regarding sea life diversity, it is not clear how the impact of kelp on sea life will be determined. The description of diversity sampling is vague. The proposal indicates that aquaculture specialists and collaborating Native fishermen will monitor marine life species in the kelp beds both underwater and from a boat. Specifically, what observations of marine life within the kelp will be monitored from a boat? Presumably, most effects on biota will occur below the sea surface. A standardized sampling design for underwater observations of marine life is needed to document and test for any statistically significant changes in diversity. What will be recorded? Do observations include fish and invertebrates and/or other taxa? Sampling seems to be directed at the kelp farms only, which would allow comparisons across farms. However, as all farms have kelp, it is not clear how kelp effects on sea life will be determined. Here, too, it seems that it would be necessary to include a study design involving treatments (with kelp farms) and controls (without kelp farms). Lacking controls, conclusions of cause and effect will be very difficult to establish.

PI Response:
Our permit requires us to monitor each site 2x per month. During each site visit we will record water quality indicators and anecdotal specific sea life observations. We will also report on any entanglement issues. The primary goal of developing conservation promoting array is to limit any negative environmental impacts of kelp arrays.

It is not clear from the proposal how carbon sequestration will be quantified. The proposal suggests carbon capture by kelp blades, but it is not clear how carbon sequestration for each kelp farm will be estimated from blade samples. It would seem that the amount of carbon captured by kelp plants might be best represented by the carbon in the entire kelp plant, not just the blades. It would be helpful if the proposal could provide more detail about this.

PI Response:
Ribbon and Sugar kelp plants are primary "blades" with small stipes and holdfasts at the bottom. Blade tissue sampling of these species is considered representative of the plant (weight and size measurements are also provided at the time of sampling). Bull kelp has a long stipe, pneumatocyst, and blade. Testing this species is in the early phases and we will defer to best practices laid out by Dr. Umanzor. Carbon stored in the plants is low during much of the life cycle as it is being used for its astonishingly fast development. It is not until the peak growing period tapers off that excess carbon begins to be stored in the tissue. These samples are most useful in determining whether the kelp has past that peak and is ready for harvest.

The proposal outlines four methods to evaluate success in terms of growing a sustainable kelp industry:

1. Success rate of nursery seedlines used in Native kelp cultivation, from the current 30-percent successful cultivation of seedline spools and two native species cultivated to more than 60-percent successful cultivation of seedline spools and three native species successfully cultivated.

2. Improved capacity to support sustainable kelp farming in the spill-affected PWS regions as measured by the amount of seedlines produced and the number of Native or fisherman-owned farms established.

3. Sustainable, site specific low-impact kelp farm arrays designed for the seven research test sites, ensuring arrays and anchors cause little to no impact on sea life and community use. Developing site specific designs to account for heavy currents and weather, steep slopes, low nutrients and more. Developing species-specific designs, particularly for bull kelp, experimenting with increasing the depth of submerged grow lines to reduce temperature and light for bull kelp seedlings.

4. Increased kelp production of three species on the research test sites, successfully growing 5lbs/ft of sugar kelp, bull kelp, and ribbon kelp.

While these would seem to be metrics that can be readily quantified to document the desired success, these four metrics do not seem to appear anywhere else in the proposal aside from this list. How is success rate in nursery seedlines quantified? How will improved capacity to support sustainable kelp farming be estimated? Will development of site-specific designs be ad hoc or will it involve systematic testing? Please explain. Finally, sampling procedures to measure kelp production have not been described.

PI Response:

We finished our first harvest after submitting this proposal and have learned much more about the gaps in knowledge and what information would be most useful to future farmers. We are developing a full report on the research sites and can make this report available to the Trustee Council and reviewers once completed.

Testing Designs: Designs will be implemented ad hoc and in response to experience gained in preceding years. This first year has provided valuable insight into what designs need further testing for PWS waters and species. For instance, bull kelp is notoriously difficult to farm, while we had a successful first year, the bull kelp remained small (similar results reported at other farms). Several theories exist on how to encourage bull kelp to grow large, sturdy stipes ideal for pickling, yet we have been unable to find any farm or organization having tested these theories successfully. While not a defensible research project, we can acquire significantly useful information from experimenting with new designs – such as sinking the bull kelp lines much deeper to mimic wild environments. We will be able to determine not only if it works to encourage larger bull kelp plants, but also if it is feasible to farm and monitor. Deeper lines may require more consistent dive monitoring and may create challenges with harvest.

Another key aspect of farming we are experimenting with is how to reduce costs for future farmers. This initial year we used 2000lbs concrete blocks as anchors. While they were individually inexpensive, they required chartering a larger vessel able to lift and deploy anchors of that size. This ultimately made the costs prohibitive for farmers to deploy and retrieve arrays. In our next season, we would like to purchase different types of anchors to determine the most inexpensive, practical, and effective equipment to use. Anchors we suggest using (depending on approval of permit modifications) are: 600lbs Danforth anchors, 500lbs railroad ties, duckbill anchors, and helical rods. Additionally, we have one site on a steep slope (Nelson Bay) and one site in a major current

(Latouche Passage), both of which presented unique problems with moving arrays or twisting lines. This year we are making minor adjustments to account for these environmental conditions and provide insight to farmers with similar challenges.

Sorus is inoculated on 2" twine-wrapped PVC spools in the nursery. Once ready for out planting (at 6-8 weeks) at the test site, we unspool the pipe around the grow line, wrapping as tightly as possible while handling the spool gently. Every 10ft we tie a small piece of twine around the seed string and grow line for extra security. As each kelp plant grows larger, the holdfast begins to grip onto the grow line directly, negating any further need for artificial adhesion. We only had one instance of kelp being stripped off the line at our test site at Latouche, which had the highest currents and the largest bull kelp which had a tendency of wrapping around the other grow lines. We believe we can easily solve this issue simply by moving the parallel grow lines further apart (from 10ft to 15-20ft).

Nursery Metrics: Success in the nursery will be measured by 1. Number of spools successfully inoculated. 2. Quality of growth on spools. Spools will be rated on a scale between 1-5, from no-growth to evenly and fully settled spools.

Successful increased capacity is threefold:

1. CKSN and APMI nurseries fully scaled with equipment, meaning the space is maximized with number of racks and tanks. This is 12 operation tanks for the CKSN and 30 for APMI.
2. Sufficient staff and interns are recruited and trained to operate both nurseries.
3. New nursery methods are tested (such as direct seeding) to begin developing alternatives to the labor-intensive seed spool and tank method. This is crucial to meet the predicted demand in the coming years.

Continued CKSN lessons and best practices will be recorded in future versions of the Best Practices Manual, attached.

Test line Metrics: Production results are measured by pounds per foot. This measurement is an average of three samples per line, at varying, visually representative sections. Kelp is also rated by quality (food grade, non-food grade, and unusable) which is primarily determined by level of biofouling. It is important to look at both indicators together. For instance, a line might be harvested earlier, resulting in a lower pound per foot due to less time in the water but in a higher quality rating due to less opportunity for biofouling.

The proposal indicates that test line crew will monitor the time from deployment to harvest. As deployment date and date of harvest would seem to be subjective judgements of the farm operator, it is not clear how out-growth performance will be objectively measured across sites and seasons.

PI Response:
We operate and own all the research test sites, therefore are not dictated by individual farmer preferences. Out planting timing will depend on nursery progress (which in turn depends on wild forest maturity cycles and sorus collection) and weather factors, however, it will likely only vary a couple weeks each season. Current best recommended out planting for Alaska is late October to early November.

Harvest timeline depends on the rate of warming waters and the intended use of the plant. Food grade kelp is recommended to harvest earlier in the season before any biofouling can occur. Non-food grade kelp can be kept in the water for several more weeks to increase pounds per foot of kelp. Based on this year, the anecdotal harvest time for Alaska is mid-April to mid-May. We have full control of the test sites and harvest timelines.

The proposal indicates that a best practices manual was developed (Lankard & Bobrycki 2021 Best Practices, Community Kelp Seed Nursery, Native Conservancy and Denali Commission). We were unable to locate a copy of the best practices manual at the websites of APMI, The Native Conservancy, and Denali Commission. It would be helpful if a copy could be made available (provide a hyperlink and/or submit as supplemental information). Also, the proposal should clarify if and how the proposed work will contribute to this manual. Presumably, improvements could be made subsequent to the findings of the proposed work.

PI Response:
The manual is attached and will be updated after each season.

The proposal is non-compliant with EVOSTC requirements for a data management plan. Data collected need to be provided to the central data repository. Data need to be made available to other users within one year of data collection.

PI Response:
Under the guidance of the TC, CRRC has obtained and incorporated a cost estimate to ensure these data are within council policies and incorporated into the research workspace portal. However, per EVOS staff guidance, applications were instructed to remove the Axiom data management cost from the proposal budget as the Trustees wish to consolidate all Data Management costs into one Data Management program budget. A consolidated DM program will continue to maintain the efficient and effective oversight of all applicable data for Council-funded projects and programs. Data and data products generated by this project will be posted on the Research Workspace together with standards-compliant metadata for access by the EVOSTC. A data management plan for this project was provided by Axiom and is included in the resubmittal The scientific community will be able to access data as a result of this project through the Research Workspace data archival and sharing platform.

The proposal does not propose a connection with the Alaska SeaLife Center or Prince William Sound Science Center. The proposal makes the case that these two Centers of Excellence are "not mariculture-focused nor are they as versed in the mariculture industry as CRRC's APMI and the Native Conservancy." The PIs also state that partnering with these two entities solely for administrative purposes is not needed, because their organization manages both federal and non-federal funding. Thus, they do not see any benefits of adding a fiscal layer to the project.

PI Response:
Chugach Regional Resources Commission acknowledges the Council's efforts to create Centers of Excellence to reduce the administrative burden on the Council's staff in administering grants. Just as the Alaska Sea Life Center and the Prince William Sound Science Center have been deemed 'centers of excellence' by the EVOS Trustee Council for their history in successful fiscal management of EVOS-funded projects, CRRC has been deemed a 'center of excellence' by federal grantors. Since its

inception, CRRC has grown over the years to become not only important regional facilities, but valuable statewide resources with reputations of excellence. In FY21 the organization's grant portfolio exceeded $5 million.

CRRC has an ISDEAA of 1975 (Public Law 93-638), a law that recognizes member Tribes inherent status as sovereign nations, which is distinguished by their relationship with the federal government. Chugach Regional Resources Commission serves as the ISDEAA-sponsored natural resource management agency on behalf of the following sovereign Tribal governments– Chenega, Eyak (Cordova), Nanwalek, Port Graham, Qutekcak (Seward), Tatitlek, and Valdez. The signing and passage of the ISDEAA meant Congress understood the inherent right tribes possess to set their destiny through tribally run programs for natural resources operated by the federal government to the benefit of tribal nations. It allows Tribes to manage and control their own assets.

Chugach Regional Resources Commission recognizes that the call for proposals specifically requires consultation with Alaska Natives and to consult with the Centers of Excellence; the Prince William Sound Science Center and/or the Alaska SeaLife Center. This requires an additional and unnecessary % on top of the existing budget that could be better spent on meaningful projects in the Spill Area. What we propose is that the costs associated with including a center of excellence be given to the Chugach Regional Resources Commission. This could bring new revenue to the organization to allow for further development of staff, management capacity, and internal infrastructure instead of these overhead funds going to existing, well-established, and top-heavy organizations such as the centers of excellence. There is no better way to ensure the long-term sustainability of the projects proposed as part of this solicitation than investing in Alaska Native organizations that have worked and will work in the Spill Area for decades benefiting the People who have lived off the land since time immemorial. Should the Trustee Council determine that this project requires administration through a center of excellence, Chugach Regional Resources Commission will expeditiously work with the Alaska Sea Life Center due to its proximity to our organization's operations.

Five helpful external peer reviews were received for this proposal. While a few of their comments have been incorporated in our comments above, we strongly encourage the PIs to carefully consider the full reviewers' comments in their revised proposal. As written, the proposal has commendable goals, but the connection to habitat restoration appears weak. Given these extensive comments above, we recommend major improvements (e.g., focus on the organization's strengths, consider eliminating environmental monitoring) to be able to evaluate this project more fully.

PI Response: Objectives Restructuring

- *We have restructured the objectives of this proposal to reflect the applied nature of this proposal more accurately, distinguishing the APMI kelp nursery infrastructure development from the kelp test sites landscape analysis portion.*
- *Additionally, we discovered after this initial year of operations that conducting further regional and local profiles on ideal farming regions is essential for future farmers. A reliable and cost-effective method of developing a nutrient (nitrate and ammonium) profile of an area is deploy test sites and seed string. How the kelp performs in terms of size, color, morphology can provide valued insight on the potential of the site for commercial kelp farming. While we will continue to test array designs, we would like to expand the test site portion of this proposal to expand our dataset on poor and high performing sites, thereby informing future farmers on the ideal places to permit.*

Date: September 2021

This 5-year proposed project strives to enable Native Alaskan coastal communities to play a significant role in building an ocean farming economy in PWS. The two main objectives are to: (1) develop conservation-promoting practices for Native kelp farming through specific array designs, deployment methods, and seed cultivation strategies that will lead to the long-term restoration of oil-spill impacted areas of PWS; and (2) collect, analyze, and share data related to water quality, habitat, and sea life at the research test sites to understand the restorative/regenerative possibilities of kelp farming.

The project intends to deliver cultured seed to seven test sites, and more than a dozen kelp farms composed of independent farmers and Native Alaskan Tribes who are starting family-owned and commercial kelp farms over the next five years in PWS. The project would train these farmers in conservation-promoting practices and provide them with ongoing monitoring assistance and data collection.

The proposal indicates that CRRC, in partnership with The Native Conservancy, initiated the Community Kelp Seed Nursery (CKSN) in 2020 and built a stationary kelp nursery at CRRC's APMI in Seward, Alaska. The proposal states that the CKSN cultivated and delivered 80 spools and three species of native kelp (sugar kelp, ribbon kelp, and bull kelp) to seven research test sites. Unfortunately, no information about the initial results were provided. Detailed information about this study would have been useful to evaluate the current proposal, but a comprehensive report is not yet available.

We and multiple reviewers thought that the proposal strives to restore habitat and it was unclear whether PWS kelp habitats were damaged and how kelp farms would restore those habitats. The PI clarified that this proposal does not seek to restore habitat. Rather, the PI contended that farming kelp will ease the stress and use of wild forests. Information on levels and trends of wild kelp harvests were not provided.

The PI made a number of revisions to improve the proposal in response to Science Panel comments and peer reviewer comments. A major comment was that sampling methods, laboratory procedures and statistical analyses were not adequately described to allow evaluation of whether this proposal can meet its goals. This comment was not addressed. Instead, the PI determined that they cannot accomplish a defensible research design. So, research methods were removed from the proposal. Nevertheless, the PIs indicated that they will continue to collect and analyze water (temperature, salinity, pH, turbidity, dissolved oxygen, flow rates, nutrients) and tissue (Carbon, Nitrogen) samples. Likewise, in response to comments by us and a reviewer, the PI removed reference to ocean acidification (OA) in the proposal, however the proposal still includes the collection of kelp samples for OA analysis. Additionally, the proposal indicates that aquaculture specialists and collaborating Native fishermen will monitor marine species in the kelp beds, however methods for monitoring biota are also not described. We feel strongly that projects involving data collection and analysis must include sufficient information on study design, sampling procedures, laboratory methods, and statistical analysis to allow evaluation.

We feel that this proposal has a very meritorious goal to promote the development of kelp farming on Native owned farms and CRCC is the appropriate organization to undertake this project.

However, a major shortcoming of the project is that it lacks a study design and description of methods. Rather, an ad hoc approach seems to be planned whereby anecdotal observations will be made and plans will be figured out by trial and error along the way. As a result, we did not see that the proposal could rigorously meet its objectives and therefore do not recommend funding.

PAC Comments

Date: September 2021

It is noted that the PAC recognizes the importance of including all groups (i.e., communities and tribes) within the mariculture project areas.

Executive Director Comments

Date: October 2021

I concur with the Science Panel with their concern regarding study design and description of methods. But I also recognize the value of supporting the development of kelp farming on Native owned farms. My initial recommendation was to delay the start of this project until the 0301 had been completed so the results from 0301 could inform 0300 and 0302 but I understand that this was not the Council's vision at the time this Invitation was released. My recommendation is to fund this project contingent on addressing the Science Panel's concerns regarding study design and methods and also contingent on being incorporated into 0302 to increase collaboration and increase efficiencies where possible.

Project Number: **22220301**

Project Title: Social, cultural and economic assessment of kelp mariculture opportunities for coastal villages within the EVOS spill zone

Primary Investigator(s): Aaron Poe et al.

PI Affiliation: Alaska Conservation Foundation **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$829,772	$668,224	$727,174	$775,129	$667,528	$3,667,827
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	40	$0	$0

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$125,000	$0	$0	$0	$0	$125,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $829,772

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $1,497,996

Total Non-EVOSTC Funding (FY12-23): $125,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.20.2021, budget updated 08.20.2021.*

This is a 5-year project to assess how Indigenous kelp mariculture operations within the spill zone would be socially beneficial, economically viable and compatible with local cultural values of coastal communities. In the 30 years since the Exxon Valdez Oil Spill (EVOS), substantial research has been conducted to understand the status of injured species and habitats, yet less work has been directed to evaluate potential strategies that address continued social, cultural and economic impacts (i.e., *injured services*) to coastal communities in the spill zone. Alaska generally, and the spill zone specifically, now stand at the forefront of an emerging kelp mariculture industry that has demonstrated restorative effects such as improving water quality for ecosystems in other locations. Kelp mariculture has also shown promise to create temporary habitat at key times to buffer important species like herring and salmon from some of the rapid changes now being observed in nearshore habitats (e.g., increased acidity and warmer water temperatures). These broad ecosystem

stressors are also challenging the stability of the commercial fishing industry and subsistence harvest of local communities. There is growing recognition of the thoughtful inclusion of kelp mariculture as a critical component to ensure the socioeconomic sustainability of communities in the spill zone. Understanding and establishing the potential benefits of kelp farms in the spill zone relies on baseline data collection including local, Indigenous, traditional ecological knowledge, and a focused analysis of consumer willingness to pay for kelp products from remote coastal communities. Best practices for the kelp mariculture industry will be investigated through the lens of historical ecological and subsistence food knowledge and practices, local Indigenous stakeholders, newly established and future kelp mariculture practitioners, scientists, and fishermen.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The PIs propose a five-year project in the spill area, primarily in Prince William Sound, lower Cook Inlet, and the Kodiak Island Archipelago. The proposal responds to the Trustee Council's interest in "funding research to support the development of mariculture in the Spill Area." The proposed research endeavors to understand how kelp mariculture development activities within the EVOS spill zone are likely to be received by communities based on social, cultural, and economic considerations. The PIs make the case that it is important to understand how this new development can best complement recovery objectives established by the EVOS Trustees relative to injured human services. The idea is to ensure that human services injured by the spill, namely Subsistence and Commercial Fishing, can benefit from new efforts associated with kelp mariculture in the region.

The proposal addresses three hypotheses, which, stated briefly, are: (H1) it is necessary to evaluate historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities in order to effectively select future mariculture sites, (H2) new kelp mariculture activity led by Indigenous communities will have additional benefits relative to subsistence harvest and commercial fishing activities, and (H3) kelp mariculture led by Indigenous communities is a viable economic activity that can help reduce continued impacts on commercial fishing in the spill zone. The Science Panel notes that hypotheses 2 and 3 appear to be quite similar and hypothesis 3 seems to be part of hypothesis 2, as currently stated. We suggest that these two hypotheses be merged or their differences clarified.

PI Response:
We appreciate hearing this feedback and if this is absolutely necessary, we can make this change, however our preference at this time would be to keep the structure that we have proposed. We see key differences between H2 and H3 with the latter being focused on economic aspects of kelp mariculture. This includes a DCE experiment with consumers from markets outside of Alaska relative to potential products as well as willingness to pay analysis on the feasibility of integrating mariculture operations into environmental research. Further, this effort proposes a focused look at economic strategies for kelp that include understanding markets, processing challenges and business

structures. H2 is more focused on understanding the broader social implications (positive and negative) of these types of operations in the spill zone, including to local subsistence and fisheries economies. Certainly, both speak to the longer term viability of this type of industry but feel like distinct enough courses of inquiry to our project team.

The proposal provides a general overview of the procedures by which these hypotheses will be tested. Research into H1 would begin with a focus on PWS place names, including how Indigenous place name distributions correlate with biodiversity, cultural keystone species, and community subsistence patterns. The PIs propose two mapping activities brought together in GIS: (1) historical ecological mapping, and (2) contemporary use and ecosystem services mapping. An Indigenous Listening Tour aims to engage 21-30 Alaska Native tribes in and around the EVOS spill zone to document historic and contemporary Native traditions and values associated with kelp harvesting and utilization. Through a series of repeat visits to ten communities, hundreds of participants will use hard copy maps of the coastline and will be invited to draw shapes to represent areas where they and their ancestors used kelps, seaweeds, and mussels/clams. This will inform second-stage interviews and additional mapping of contemporary mariculture development issues in communities. This mapping effort will also be informed by existing scientific and historical ecological layers identifying abundance and distribution of key types of kelps in the vicinity of each community over time, as well as known commercial, cultural, and other uses, and ecosystem service values.

With respect to H2, the PIs will identify up to 10 communities with near-term prospective kelp mariculture operations, and will conduct a 5-year study evaluating the impact of kelp mariculture on food security and food sovereignty status. In the first or second year of the study, prior to the expected establishment of farms, the PIs will conduct incentivized household surveys and semi-structured interviews in communities to establish a baseline of use, cultural practices and values around seaweed, shellfish and other relevant subsistence and commercial harvests. Then, toward the end of the study, follow-up household surveys and focus group assessments will be undertaken to assess whether subsistence resource use and cultural practices have changed, how perceptions about kelp mariculture have changed, and whether participants feel as though these kelp farms have improved their food security status.

Regarding H3, an economic analysis will focus on the willingness-to-pay of potential consumers for kelp products produced sustainably in Indigenous communities. This work will inform markets for mariculture products and an understanding of consumers' willingness to pay a premium for products produced by Indigenous people that contribute to ecosystem recovery and sustainable development.

We appreciate the approach outlined in this proposal intended to foster well-planned development of kelp farm sites based on ecology, historical use, and cultural values. Careful planning is important to minimize potential conflicts with new commercial operations.

Two very helpful peer reviews have been received and we leaned heavily on the comments of these experts. We highlight the following comments, but strongly encourage the PIs to consider all of the comments of both reviewers in a revised proposal:

1. The environmental benefits of kelp farms seem overstated. While several studies have identified various environmental benefits within other regions of the world, other studies have shown that

ecosystem benefits of mariculture can be extremely site specific and that they cannot be assumed to be always beneficial. For instance, it is often touted that farming will help mitigate ocean acidification. However, it is very difficult to find support for this claim in the peer-reviewed literature. Benefits of farmed kelp on herring and salmon habitats appear to be speculative. Typically, kelp farms are sited in areas to avoid herring spawning areas. If herring spawn on farmed kelp, that kelp cannot be harvested. Moreover, any creation of fish habitats would seem to be temporary, as the purpose of the kelp farms is to harvest kelp. It would seem that kelp harvests would remove new fish habitat with adverse effects on the biota living in the farmed kelp.

PI Response:
We agree that there seems to be an emerging sentiment that kelp mariculture could be a solution to a variety of challenges being experienced by coastal communities in Alaska and elsewhere. Our reference to some examples of perceived benefits, from water quality and ocean acidification attenuation, to habitat provisioning made in the opening paragraph of our executive summary was only intended to help convey some of the reasons why there is increasing interest in this industry as form of sustainable development with potential social, economic, and environmental co-benefits. We didn't intend to suggest that these are all viable "win-win" strategies or expectations for Alaska: from our perspective the science (both social and ecological) remains unclear at this point and have added additional qualifying language on page 2 to clarify this. We are confident, however, that our study design will enable us to further advance the ecological and social science to be able to better understand the potential environmental, social, economic and cultural costs, benefits and tradeoffs of this evolving enterprise in an appropriate social-ecological context.

2. The Native Alaska Kelp Initiative aims to establish 100 regenerative kelp farms along Alaska's coasts over ten years. However, it is not clear how many kelp farms will actually be established. The before-and-after study depends entirely on the construction and full implementation of new farms during the 5-year study plan. The proposal should describe more fully the evidence that a sufficient number of new farms will be installed during this time window for the proposed research. This is a critical aspect affecting the merits of this part of the proposal. The follow-up household surveys in year 5 presume that the farms have been operational for at least one year (two years or more would be better) so that they have the potential to have some sort of detectable effect that can be evaluated. The proposal should outline a contingency plan if there are few or no farms to evaluate the impact. This aspect of the proposal seems to be out of the hands of the PIs but absolutely critical to address hypothesis 2.

PI Response:
The Indigenous partners leading this proposal have made substantial investments into building capacity for the development of kelp farms in the spill region in support of the Native Alaskan Kelp Initiative (NAKI). Though these efforts are independent of the proposed work, we understand how sharing about these efforts strengthens the proposal and offer additional information on how three of the proposal partners are currently building substantial kelp mariculture infrastructure in the spill region beginning on page 12. Additionally, there is a concurrent proposal to the EVOSTC that would expand aspects of the work both Native Conservancy and CRRC are currently doing with funding from the Economic Development Administration. This includes piloting kelp test sites in Native communities in the spill area to better understand the growing capacities of ecosystems close to those communities.

Additionally, Native Conservancy and GreenWave have started outreach for an Indigenous Listening Tour and have hired 3 regional coordinators to help us identify 100--200 native people from 36 communities across the spill zone and some in southeast Alaska interested in starting kelp farms. These efforts are making connections with tribes in lower Cook Inlet and the Kodiak region as well. NAKI partners have also been proactively seeking funding from federal grants and private donors to expand the current capacity of Native Conservancy and CRRC to help fund communities interested in developing farms. It's also important to note that while NAKI efforts are underway, at the same time the 2020 Coronavirus Aid, Relief, and Economic Security Act (CARES Act), and the more recent American Rescue Plan Act (ARPA) have invested substantial funding into Alaska Native Tribes for their use in economic development and food security for their communities. The recent rapid growth in interest in our Listening Tour is in many cases being driven by the availability of these new funds.

From our team's perspectives at the center of mariculture expansion over the past two years, it seems unlikely that 10 tribal communities will not be supporting farms by 2023, although we certainly understand the reviewers' perspectives and appreciate their caution and advice. In response, we have inserted contingency planning language into page 13.

3. While the proposal did a sufficient job to broadly characterize the procedures to be implemented, there is scope to include some additional methodological details. As an example, the Discrete Choice Experiment (DCE) is very short on details. As another example, the proposal describes a large mapping effort. However, methodology on the construction of GIS maps is lacking. Additionally, it was not clear who will perform the GIS work.

PI Response:
This was an oversight on our part, and we have added specific methodology content and citations for the DCE effort on page 14 and 15. Additional methodology details about GIS ecological mapping efforts by Dr. Bell were added to page 9 and 10 and for cultural GIS mapping by Dr. Rose on page 10.

4. The economic aspects of the proposal to investigate markets for kelp products is a strong aspect of the project. We are of the impression that there is currently very little commercial market for domestically-raised kelp. Demand for kelp mariculture products, particularly products that command high prices, is an important question critical to future development of this industry.

PI Response:
Our team is excited about the potential to collect this information as we feel it will directly inform the EVOSTC and others about the viability of a kelp mariculture market for commercial fishing communities impacted by the spill. We are also excited to be able to have those results be considered in the important context of potential cultural implications (particularly subsistence) - as these are critical when evaluating the ultimate social licensing of new economic endeavors.

5. One reviewer raised some concerns about the potential for inadvertent release of place names or harvest information that may be proprietary or culturally sensitive. Please see and consider those comments raising those concerns. There are two sides to this. Confidential information should not be released, but on the other hand, if data are protected, how can the success of this project be evaluated and results implemented? The production of comprehensive maps may be compromised if many community members are hesitant to share their local knowledge. How will the PIs handle the situation if two households utilize resources in one local area, if one household is willing to release

that knowledge and the other household wants the locations to remain confidential. We would like to see a more comprehensive description of this issue, how it will be handled, and how it may affect the representativeness of results and their public dissemination, including the extent to which it will affect the EVOSTC requirement for data archiving and public accessibility.

PI Response:
The Native Conservancy is a leader in efforts to uphold the inherent sovereignty of Indigenous Knowledges and the safeguarding of this type of information has been central to their policy efforts for over a decade. The Native Conservancy will be implementing the cultural GIS work (led by Dr. Jen Rose, an Eyak Native from the spill region) and will use informed consent and confidentiality processes developed by Native Conservancy for work with Indigenous peoples that make clear to all participants how the information they contribute will be managed, how it will inform the mapping process and how it will ultimately be shared and not shared. Both Dr. Rose and Dr. Thornton have substantial experience synthesizing cumulative summaries of mapped information from Indigenous community participants such that specific places shared by individuals are spatially generalized for final data products. This treatment will allow us to share results where mariculture development may be suitable without revealing sensitive data or information. It is our understanding that EVOSTC does not require public access to interim data products of a sensitive nature like cultural use or harvest areas and the lead PI (Mr. Poe) has experience working with the data management team for this RFP (Axiom Data Science/AOOS) on ensuring appropriate controls over these types of data collected from Indigenous communities. This version of our proposal benefits from a Data Management Plan developed by Axiom that further explains our approach to protection of sensitive information. This plan has been submitted to the EVOSTC along with our revised proposal. Additional text has been added to page 10, 11 and page 22 of our proposal to clarify data controls and to address concerns about differing perspectives between households within communities. Further Axiom and AOOS have developed a data management program for this project that is attached at Appendix A in the revised proposal (starting on Page 68) .

6. The $3.6 million budget seems quite high for a project based mainly on the conduct of interviews. Please explain the basis for these costs. The roles of project personnel should be explained more thoroughly.

PI Response:
Our approach of training an integrated, intercultural, interdisciplinary team and utilizing multiple return visits to 10 remote communities across the spill zone over a period of 5 years is based on our experience with what it takes to make community-based social-ecological research of this nature successful. This team's time and travel expenditures (estimated by CRRC based on their work on the ground in our focal communities) are a key driver of costs in our proposal. However, we see this approach as essential for building the kind of trusted relationships we need with these communities to work within a true knowledge co-production framework. We've inserted some new language in the proposal on page 11 regarding the importance of taking this approach. In addition, this project involves two rounds of household visits to 10 communities by a second group of researchers from UC Berkeley over a period of years and these efforts also require significant travel support. We have made additional clarification on project personnel roles particularly relative to the cultural and ecological mapping efforts that were identified by other reviewers as lacking detail in PI Responses: 4, 6, and 11 as well as in those associated locations in the revised proposal.

7. The proposal should clarify which tasks are to be completed with existing (other) funds and which are intended to be completed with EVOSTC funding. For instance, where does the Seaweed Cultural Mapping for fall 2021 end and the new mapping under this proposal begin?

PI Response:
A pilot of the cultural GIS mapping will be completed in Cordova during the fall of 2021 and is being funded by the Native Conservancy. The mapping proposed to be covered by EVOSTC funding would begin during summer of 2022 based on insights learned from the 2021 pilot. We realize that in the current proposal we have referred to this effort as both "cultural GIS mapping" and "community mapping" and this may have also led to confusion. We have made changes throughout the proposal to use cultural GIS mapping. The Native Listening Tour funded by Native Conservancy and GreenWave, begins in Fall of 2021 and runs into March of 2021. The work will return insights for identifying focal communities for the proposed study as well as insights on specific questions to be asked in cultural GIS mapping and household surveys that begin in summer of 2022. Additional text to clarify has been added beginning on page 9.

Date: September 2021

The proposed research endeavors to understand how kelp mariculture development activities within the EVOS spill zone are likely to be received by communities based on social, cultural, and economic considerations. The PIs make the case that it is important to understand how this new development can best complement recovery objectives established by the EVOS Trustees relative to injured human services. The idea is to ensure that human services injured by the spill, namely subsistence and commercial fishing, can benefit from new efforts associated with kelp mariculture in the region.

This 5-year project intends to investigate three hypotheses, which are: (H1) it is necessary to evaluate historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities in order to effectively select future mariculture sites, (H2) new kelp mariculture activity led by Indigenous communities will have additional benefits relative to subsistence harvest and commercial fishing activities, and (H3) kelp mariculture led by Indigenous communities is a viable economic activity that can help reduce continued impacts on commercial fishing in the spill zone. Activities associated with each hypothesis are clearly stated.

Overall, we find that the PIs have done a very good job addressing comments by the Science Panel and peer reviewers. Major concerns have been satisfactorily addressed in the revision. The objectives, methods and costs are well justified.

The proposed work will provide an important baseline before development and will address how subsistence fisheries fit in with commercial aquaculture operations. The need for this type of study has been called for by state officials. We were also pleased to see that the Alaska Conservation Foundation will solicit bids to contract an outside evaluator, with experience working in Alaska's rural communities, who will complete an independent evaluation of the project.

We feel that this project will greatly aid in the selection of future mariculture sites by considering historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities. Moreover, it will evaluate perceptions about whether new kelp mariculture activity is a viable economic activity and its potential additional benefits to subsistence harvest and

commercial fishing activities in the spill zone. A highly qualified team and partnerships has been assembled to successfully accomplish the project.

PAC Comments

Date: September 2021

It is noted that the PAC recognizes the importance of including all groups (i.e., communities and tribes) within the mariculture project areas.

Executive Director Comments

Date: October 2021

This project will provide valuable information for the selection of future mariculture sites by considering historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities. It seems that this project should be conducted first before the initiation of projects 0300 and 0302 but I understand that this was not the Council's vision when the Invitations were released. This project is important to mariculture efforts in Alaska. I concur with the Science Panel and PAC. I also note that the proposers made a considerable effort to coordinate and collaborate with the ASLC and PWSSC and provided some details for potential interactions should this project is funded. Regarding Native and local community involvement, this project prioritizes Indigenous perspectives and as stated in their proposal, by virtue of the organizations and constituents, Alaska Native community involvement is inherent.

Project Number: **22220302**

Project Title: Sustainable mariculture development for restoration and economic benefit in the EVOS spill area

Primary Investigator(s): Katrina Hoffman et al.

PI Affiliation: PWSSC **Project Manager:** NOAA, ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$2,637,792	$2,637,726	$2,637,783	$2,637,489	$2,637,285	$13,188,075
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$2,637,506	$2,637,530	$2,637,458	$2,637,634	$2,636,901	$13,187,030

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$60,239	$62,333	$53,622	$67,787	$111,360	$355,341
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$37,689	$39,050	$40,607	$111,937	$128,381	$357,663

Total Past EVOSTC Funding Authorized (FY12-22): $2,637,792

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $5,275,518

Total Non-EVOSTC Funding (FY12-23): $122,572

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.13.2021.*

The overall objective of the Mariculture Research and Restoration Consortium (Mariculture ReCon) is to support restoration, habitat enhancement, and economic development through research and partnerships between scientists and seaweed and shellfish farmers. This suite of applied research components (Figure 1) takes a farm-centered approach to address EVOSTC restoration, economic development, outreach, administration, and data management interests that overlap top priorities identified by stakeholders and the Alaska Mariculture Development Plan developed by the Governor's Mariculture Task Force. Results will inform shellfish and seaweed production with farmers as full participants in the research, including the Native Village of Eyak, which has a permit in progress for the largest oyster and seaweed farm in Prince William Sound. Technology transfer and training for new and existing farmers will investigate farm designs and support industry growth, bringing green jobs and economic diversification to coastal communities in the EVOS-affected area. Ecosystem studies will evaluate the role of mariculture in restoration of injured resources, habitat

provisioning, reducing ocean acidification impacts, pollution mitigation, and supporting fish populations, while evaluating interactions with marine mammals and birds and developing mitigation strategies. Socioeconomic studies will investigate the economic sustainability of hatcheries, and product development will research new products for this nascent industry. We will host listening sessions in coastal communities and incorporate community feedback into research over the 10-year period to support mariculture development that is responsive to local concerns. Short videos will be created, streamed on social media, and shown in Education & Outreach kiosks to communicate about program activities and inform the public about mariculture. Training of graduate students and postdocs will build capacity, and research collaborations and annual meetings of scientists and farmers will build partnerships and trust that will support sustainable mariculture growth well into the future.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund reduced	Fund FY22-26	Fund FY22-26	Fund

Science Panel Comments

Date: May 2021

The Mariculture Research and Restoration Consortium (Mariculture ReCon) strives to support restoration, habitat enhancement, and economic development through research and partnerships between scientists and seaweed and shellfish farmers. The proposed project is complex and comprehensive, involving 12 components. As a result, this is a very expensive proposal with a total 10-year budget of $27.2 million, which meets the $25 million cap (without the 9% GA) that the Science Panel understands the Trustee Council has designated for all funded proposals combined under the entire mariculture category.

The Science Panel has leaned heavily upon expert peer reviews for this proposal. Below are comments that we wish to highlight, but the PIs are strongly encouraged to consider the full comments of all reviewers. We begin with more general overall comments and end with some specific comments on individual components. The 12 components are in different stages of development. We look forward to a fully developed proposal in the next iteration that includes sufficient levels of detail for each.

The background section of the proposal would benefit from a general description of kelp and oyster farms in Alaska. This could include descriptions of the provision of seed stock, how quickly kelp and oysters grow, how old are oysters at harvest, seasonality of harvest, and so on. Also, the juxtaposition of oyster and kelp farms to one another should be clarified. Do they require different habitat types or ocean conditions? Is there an interaction between the two types of mariculture activities that needs to be considered?

PI response:
We have added additional content in the rationale for Restoration Components 1-2 section (pp. 10-13) that briefly summarizes the state of kelp and oyster farming in Alaska and addresses the

questions raised by the science panel. This includes details on kelp, oysters, polyculture, how farms were selected, and a description of the selected farms.

We encourage the PIs to consider how climate change, including ocean acidification, may affect the future of the mariculture program. Upwelling of corrosive waters along the Pacific Northwest coast have been associated with die-offs of cultured oyster larvae at hatcheries. Lowered pH has also resulted in mortalities of oysters and scallops at hatcheries in British Columbia.

PI response:
We are excited for the potential of our proposed water column monitoring over 10 years to capture some of these changes and potential impacts to farms, including marine heat waves and progressively lowered pH levels. Monitoring of water column chemistry and temperatures is described in Component 1: Mariculture and the physicochemical environment (p. 15). We will then use these data and data from farms to better understand how water column conditions will impact farm productivity in the EVOS region and work with farmers to strategize how to mitigate for these changes (see Component 3: Enhancing farm production; p. 53).

There is a general understanding that oysters do not spawn in Alaska owing to cold temperatures. However, with rising sea temperatures, might that change in the future? If oysters would begin spawning in a warmer Gulf of Alaska, how would that affect yield estimates?

PI response: We have included a statement in the Farm types: Oysters section (pp. 11-12) that highlights this concern, and we note there that we are proposing to test how this will impact yield in our studies of triploid oysters. The added sentences read as follows: "The current dogma is that low ocean temperatures prevent oysters from reaching critical temperatures for spawning in Alaska; however, climate change may alter that balance. Farms in warmer low-latitude states often grow sterile triploid oysters; this proposal includes efforts to assess how yield may differ between fertile diploid and sterile triploid oysters under conditions experienced in Alaska (see Objective 3B.1)." At this stage of development in the Alaska mariculture industry, it is important that we gather Alaska specific data on the cultivation of triploid oysters. Anecdotal information suggests that diploid oysters may do better in Alaska than triploid.

In its entirety, the proposal is on a similar scale to the long-term research and monitoring (LTRM) program for the entire spill area, although it is focused on selected areas of mariculture development. Given the commonality of many of the proposed observations, the proposal may benefit from an interface with the LTRM program. In other words, the PIs should connect with the LTRM program researchers to verify that efforts are not being duplicated.

PI response:
We have communicated with PIs as well as the leadership team for the LTRM program. Multiple PIs on this proposal are also long-standing members of the LTRM program (Hoffman; Konar; Campbell; Schaefer; Cypher). Given the already tight linkages between the two, we can confirm that the efforts are complementary and will be collaborative, especially through the "crossover" PIs who would serve both programs if funded. There is no duplication between the two programs.

The proposal suggests that mariculture provides many positive ecosystem benefits including habitat provisioning, reduction of ocean acidification, pollution mitigation, supporting fish populations, and

beneficially changing water chemistry through photosynthesis, respiration, and calcification. Although some studies have found such results in other regions of the world, others studies have shown that ecosystem benefits of mariculture can be very site specific, and moreover that they cannot be assumed to be always beneficial. A review of this literature should be provided for a more balanced overview. This proposal should provide an objective evaluation of potential ecosystem impacts, be they positive, negative, or neutral, in the proposed areas of study.

PI Response:
We have added additional text and references to provide more background information in response to reviewer comments. In subcomponent 2C: Pelagic Fish, on p. 37, we state, "While there are hypothesized benefits to mariculture in terms of structural habitat and buffering capacity against ocean acidification (Visch et al. 2002, Xiao et al. 2021), increased vessel traffic, farm activity, and farm density could negatively affect fish habitat (Gentry et al. 2017, Gentry et al. 2020). It is also likely that the benefits and costs of mariculture activity in PWS will vary through time as farm density and productivity increases (Gentry et al. 2020)."

We agree with the reviewers that effects cannot be assumed to be beneficial and that they may vary by location, which is why we are excited to conduct these monitoring efforts and experiments in Alaska so we can better understand the interactions with ecosystems specifically in the EVOS region. While we hypothesize that effects will largely be positive, our proposed methods provide an objective approach to testing these hypotheses. Our results may support a null hypothesis (no effect or neutral), or they may support an alternative hypothesis that the presence of mariculture has a negative impact on the organisms or communities of focus.

The proposed project focuses on three sites in each of three regions with active and soon-to-be-permitted mariculture farms: Kodiak, Kachemak Bay, and Prince William Sound. While the PIs suggest that the turnaround time was too short to allow for identification of the 9 sites to be studied, these sites need to be named in a revised proposal. Characteristics of those sites should be reported. Are 9 sites necessary? Also, the proposal indicates that some components are not planned to be conducted at all nine sites. This should be clarified in the proposal. It would be helpful to include a map showing the nine sites and how the activities of each component are geographically distributed among them.

PI response:
We have used this revision period to solicit applications from interested farms to participate in this study. The high number of responses from farms despite the short application period with summer being a busy time for fishing and harvesting demonstrates the enthusiasm the industry feels about this research. Based on the criteria of the proposed components and the farms that applied, we have selected 8 farms: three each in the Kodiak and Prince William Sound areas and two in Kachemak Bay. Only two farms put in applications for Kachemak Bay and both met the needs of the research methods. We are very optimistic that an additional farm will be willing and able to participate in this project from Kachemak Bay. We were told that some farmers were away without connectivity would likely be interested and would have put in an application if the notice had come at a different time. There are also plans for additional farms to be established. We have outlined the methods for soliciting applications and selecting farms in the section, as well as relevant characteristics for each selected farm, to the "Farm background and site selection." We have also added a map (Fig. 2, p. 10)

to show where farms are located. Additional information was added to each component to clarify locations where work is planned.

The PIs indicate that, during the proposal revision and comment period (June and July 2021), they will recruit farmers from eight of the nine farms to participate in this research. Why not all nine?

PI response:
One of the nine farms has always been intended to be the Native Village of Eyak, which is a participating entity serving as the Community Lead in this proposal. However, do note that in the PI response immediately preceding this one, we clarify that from among the farms that did have to apply, we accepted and invited the ones that best meet our research needs and there remains space to add one more. We hope that an existing or future farm in Kachemak Bay may be that 9th partner so there are three participating farms in each geographic sub-region.

Farmers will be asked to measure temperature and salinity at additional sites to expand the geographic scale of sampling and engage farmers who are interested in lower-level commitment. How will those additional observations be used?

PI response:
How these data are incorporated will depend on the information provided by the farms. One goal of this proposed work is to engage with as many farms as possible to contribute to a community of researchers and farmers. Since these sites will be in addition to the core sites, we will use their data opportunistically, but it will not influence the evaluation of our project hypotheses. Some examples of uses of these data include:

- *incorporation into the production analyses, if the farmers decide to share farm yield information;*
- *incorporation into the ecosystem analyses, if the farmers decide to share marine mammal and bird observations;*
- *the use of temperature and salinity as a proxy for other water column parameters, such as nutrients or pH, to develop an approximate idea of region-wide oceanography (in combination with LTRM data collection efforts).*

As temperature and salinity of the spill area is monitored by the LTRM program, the proposal should indicate how this proposed new effort will contribute to the understanding of oceanography in the region.

PI response:
Our comprehensive water column monitoring both inside and outside of farms (Component 1: Mariculture and the physicochemical environment, p. 15) will contribute valuable information on nearshore carbonate chemistry (ocean acidification), nutrient levels, dissolved oxygen, temperature, and salinity, which will increase our understanding of fine-scale oceanography in the region.

The number and degree to which seaweed and shellfish farmers sign on (letters of commitment) to this activity will be an important indicator of constituent buy-in to this proposed project. Ideally, these farmers should represent a diverse set of industry stakeholders (e.g., large vs. small farms, Native vs. non-Native).

PI response:
We have included an appendix with letters of commitment from the selected participating farms across the region and have added relevant details about these farms to the "Farm Selection" section of the document (pp. 12-13).

Given the size of the proposal and the number of components, a revision should consider including a diagram illustrating how the various subprojects are interrelated. The proposal is currently organized by PI expertise. However, this organization makes it difficult to determine how large-scale questions about impacts of mariculture on the ecosystem will be evaluated.

PI response:
We appreciate this feedback and have reorganized the proposal to better convey hypotheses and objectives within common themes. We have added a summary figure (Figure 1, p. 5) that illustrates how the various components and objectives represent a holistic approach to studying mariculture impacts in the EVOS region. We have also added a summary table (Table 1, p. 7) that outlines each objective and the participating PI(s). Finally, we have added maps (Figures 2-3, pages 10 and 14) that display which farms will be included in the proposed work.

The organization of the proposal by PI skill set also has led to apparent redundancy of sampling design, which raises concerns about duplication of equipment purchases and other costs. For example, it appears that there is redundancy in the sampling of water properties in the farm component, pelagic component, and restoration component. The farm component intends to collect a host of environmental measurements to relate to mariculture productivity, and to assess spatial and temporal variability of environmental conditions among farms. The pelagic component intends to examine the effects of farms on environmental conditions, and the restoration component will also monitor many of the same environmental conditions. It may be that different objectives lead to the need for multiple collections of environmental measurements, as the farm component appears to be interested in the effects of environment on the farms, whereas the pelagic component appears to address the effects of the farm on the environment. However, differences in sampling design and purpose should be clarified and any shared data collection activities should be explained in a common section of the proposal. Sharing of equipment should be emphasized and any need for apparently duplicative purchases should be justified.

The 12 components are in different stages of development and we look forward to a fully developed, more integrated proposal in the next iteration that includes sufficient levels of detail. As indicated below, some aspects of the proposal were received with less enthusiasm than others, which could indicate areas for potential reductions. Our comments on specific components follow.

PI response:
We appreciate these observations. Although sampling redundancy did not exist, we have reorganized the entire proposal to clarify the sampling design and data sharing plans across components and objectives. We intend for this new structure to make clear that all projects are sharing environmental data and that we do not have any duplication of efforts.

<u>Farm component.</u> There is apparent redundancy between the farm objectives 1 and 2 and pelagic component and restoration component regarding water column properties. The PIs should consider

merging overlapping work into one central section, perhaps in the pelagic component, to the extent possible.

PI response:
We have completely reorganized the proposal to clarify the relationships across components. We hope this new structure makes it clear that work will be occurring collaboratively, rather than overlapping.

Also, as suggested by one reviewer, the PIs of this section are encouraged to revisit their plan for the second 5 year period as it seems to be largely a replication of the first 5 years. What new information will be gained in years 6-10? If the full 10 years is needed to achieve the stated objectives, the authors should provide a justification.

PI response:
As the reviewers mentioned, climate change is rapidly changing ocean conditions in Alaska. Therefore, the full 10 years will provide us with a critical perspective on how production is influenced by different and changing water conditions. We have added text to Objective 3A.1: Understand the influences of environmental conditions (temperature, salinity, water column stratification, dissolved oxygen, turbidity, chlorophyll, currents, photosynthetically active radiation) on productivity of farmed seaweeds and shellfish across growing areas. It now includes: "growing methods and selective breeding may change and improve over the course of the study, so monitoring the relationship between growth and changing environmental conditions during the full study period will give the most accurate and up-to-date information for the development of the industry." (p. 53)

We are also concerned about inclusion of objective 3 concerning performance of triploid versus diploid oysters. We note that there is a large body of scientific literature comparing performance of triploid and diploid oysters, including a recent meta-analysis involving 148 of these experiments (Wadsworth et al. 2019, Aquaculture 499: 9-16; https://doi.org/10.1016/j.aquaculture.2018.09.018). Research in coastal upwelling regions of the Pacific northwest would seem to encompass temperatures similar to those experienced in Alaska. It also appears that it would be difficult to analyze the effects of temperature on oyster growth in the field, given that in situ temperatures cannot be controlled. As a result, we question the need for additional experiments involving diploid and triploid oysters and recommend removing this portion of the proposal.

PI response:
We have included a statement in the "Farm Type" and "Farm selection" sections (pp. 11-13) that highlights this concern. We note there that we are proposing to test how this will impact yield in our studies of triploid oysters. The added sentences read as follows: "Currently, the low ocean temperatures prevent oyster spawning in Alaska, however climate change may alter that balance. Farms in lower-latitude states often grow sterile triploid oysters - this proposal includes efforts to assess how yield may differ between fertile diploid and sterile triploid oysters (see Objective 3B.1)." To date, no research has been conducted on the performance of diploid vs triploid oysters in Alaska. Anecdotal information from at least one farmer in Alaska suggests that diploid oysters may do better than triploid. At this stage of the industry, it is important that we gather Alaska specific data on the cultivation of triploid oysters to assess if there is a growth advantage using triploids.

We also question the value of objective 4, which will examine the spatial and temporal occurrence of heavy metals in farmed and wild seaweeds. We anticipate that variability in heavy metal contamination is due to local, site-specific conditions regardless of whether the kelp grows naturally or was planted on a farm. Whether the kelp meets regulatory standards for human consumption would seem to be a matter for the farmers to address at harvest.

PI response:
Our contaminant data for seaweeds in the EVOS region will inform the development of safe seafood operations and contribute to ensuring the safety and quality of cultured seafood products. Our results will inform seaweed growers, resource managers, agency personnel, and community groups of potential contaminant levels. Expected outcomes from testing seaweeds for contaminants include creating a better understanding of seasonal and year-to-year variation in seaweed contaminants, differences in contaminants among seaweed species, relationships between contaminant concentrations in farmed (growing mid-water away from shore) and wild-harvested seaweeds (growing on the benthos nearshore), and an understanding of the risk associated with seaweed consumption that could potentially have impacts on human health or have implications in accessing international markets. Currently neither the FDA or USDA regulates the sale of seaweed in its whole form as a food product. Without federal guidance on the food safety risks of seaweed in its whole form, states, including Alaska, are unsure how to proceed with their own laws and regulations, which impedes the growth of the industry. The data on seaweed contaminants will be important in informing future regulation to ensure safe food products.

Pelagic component. As mentioned elsewhere, overlaps should be addressed in some objectives involving environmental data collection with both the farm component and restoration component. In the farm component, it appears that environmental data are being collected to characterize the growing environment at each site, whereas in the pelagic component it appears that data are being collected to examine the effects, if any, of farms on environmental conditions, although it is not clear how a mariculture farm is expected to affect some of the measurements, such as salinity.

PI response:
Please see Component 1 rationale (p. 15). We've added the following text to clarify the collection of certain physical seawater characteristics (p. 16): "While variables such as salinity and temperature aren't expected to be substantially augmented through mariculture activities, these measurements are necessary to calculate other water column properties that are expected to change, including, pH, pCO_2, aragonite saturation state (Ω_{arag}) and apparent oxygen utilization. Additionally, variability in these parameters within a region may have impacts to mariculture production and thus are important to record. Our restructured proposal should also clarify that we are using the same instruments to collect data and analyzing these data in different ways. By having instrument arrays ("production arrays" in the proposal) inside and outside of farms across the three regions, are able to both measure the effect a farm has on water column parameters and regional variation in these parameters."

Clarification on sampling design would be helpful. Sampling appears focused "inside" and "outside" of the farm.

PI response:

We have clarified the definition of inside and outside by adding the following text (p. 16): ""Inside" refers to sensor array placement (centered) inside of a production farm. "Outside" refers to a site that is in similar water depth, roughly ~200-400 m from the farm, similarly distanced from shore."

Presumably, if there is an effect, water properties would vary upstream, within, and downstream of each farm. The orientation of upstream/downstream would be expected to vary with the tidal cycle. Please clarify how "inside" and "outside" will be defined for sampling. It would seem that flow through the farm would diminish effects, if any, on the measured water properties. Moreover, seasonal changes in water properties, unrelated to kelp production, are expected to dominate changes in the water column owing to seasonal mixing, stratification, spring bloom, and depletion of nutrients in the photic zone in summer subsequent to the bloom. The proposal should clarify how mariculture effects will be distinguished from natural changes in water properties.

PI response:
Please see the Component 1 data analysis section. We've added the following text to the document addressing the panel's concerns (p. 20): "To determine whether mariculture effects significantly differ from natural changes in water properties ("inside vs. "outside"), several statistical approaches will be applied to the annual high-frequency data. An autoregressive integrated moving average model (ARIMA) will be applied to each measurement parameter, and then an F test will be used to compare the model outputs from inside and outside of each farm. Anomaly plots for each parameter will be generated to visually compare inside-outside farm conditions, annually. Oxygen saturation at atmospheric pressure is derived following the methods of Garcia and Gordon (Garcia and Gordon 1992) using measured temperature and salinity values. Apparent oxygen utilization (AOU) will be calculated as the difference between measured in situ concentration and saturation, allowing for a comparison of the duration of net autotrophy/heterotrophy inside and outside each farm site (Miller and Kelley 2021a). To validate whether the inside and outside sites within each farm experience the same water masses (to ensure we are comparing "apples to apples"), temperature-salinity plots of annual time-series will be generated to visually compare water mass movement with time overlaid in color, similar to the sample figure below.

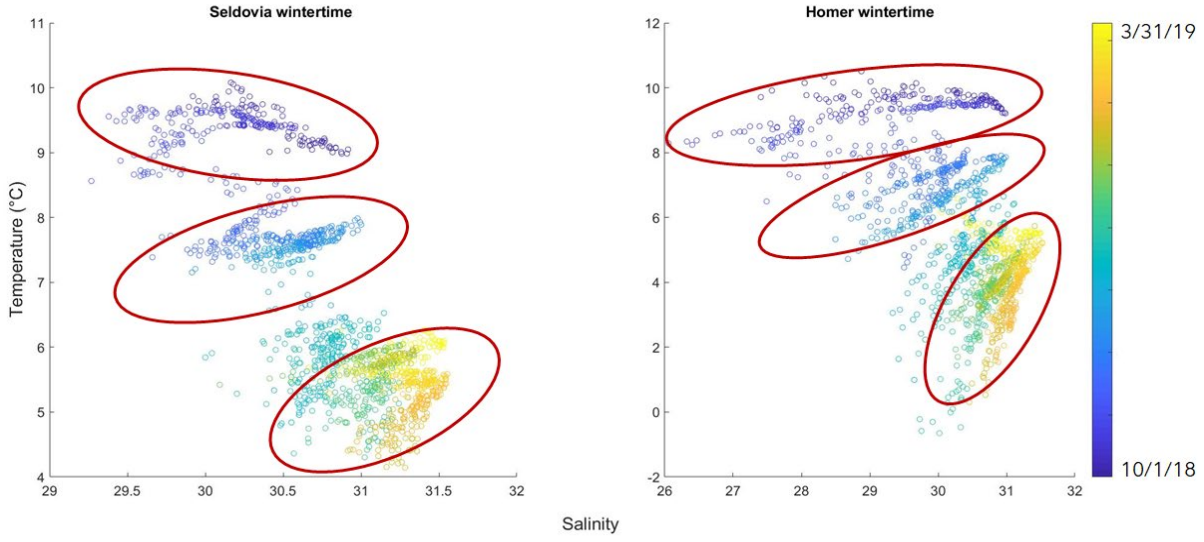


Figure X. Temperature-salinity plots of wintertime water column properties in Kachemak Bay, Alaska. Color bar indicates time.

Also, at least one hypothesis in the pelagic component seems very similar to one in the farm component – namely that growth will increase with warmer temperature. The proposal could clarify how a temperature effect will be estimated without ability to control for temperature. Also, please see our comments about oyster growth under the farm component. Duplication in hypotheses and objectives among components should be avoided unless explicitly justified.

PI response:
The proposal restructure has now eliminated apparent duplication and clarified where projects are sharing data and objectives. By focusing our work in the field, we will ensure that parameters realistically co-vary, and by testing across three regions, we will capture the range of environmental conditions that occur in the EVOS region. Our hypothesis is that production will be higher in warmer regions, and we propose to incorporate degree day as a variable in our growth analyses to control for temperature effects, but this may also be driven by co-varying factors (higher pH, different nutrient regimes, different food availability, etc.) that we will be able to capture with our multivariate analyses following the methods outlined in Brown & Harwick (1988). We've included this method in Objective 3B.3 (p. 59):

Brown, J. R., & Hartwick, E. B. (1988). Influences of temperature, salinity and available food upon suspended culture of the Pacific oyster, Crassostrea gigas: I. Absolute and allometric growth. Aquaculture, 70(3), 231-251.

Finally, as this component intends to estimate the effects, if any, of mariculture farms on water properties, zooplankton, and fish communities, it would seem important to conduct these comparisons early in the growing phase, late in the growth phase just prior to harvest, as well as post-harvest after the oysters and kelp have been harvested. It is important to understand whether effects are long-lasting or temporary and whether they diminish after kelp (or oyster) harvest. Sampling during harvest might also be considered. It would seem that harvest has the possibility to wipe out ecological benefits of the farms. Thus, the effects of harvest on these organisms (e.g., dislodging, displacement, mortality) would be critical to fully understanding the full net ecological effects of farms as positive, neutral, or negative.

PI response:
We thank the reviewer for this insightful comment and have adjusted and clarified the timing of sampling events. The plankton section (Objective 2A.1) now includes text (p. 25) stating "Additional tows will be conducted a week before and a week after kelp harvest. As oysters are harvested throughout the year, with most intensive harvest occurring in the summer, the bi-weekly tows will capture any community changes occurring due to harvest." The eDNA section (Objective 2A.2, p. 25) now includes "Sampling will occur four times per year, including during and outside of the kelp growing, season, and pre- and post-harvest."

Benthic component. The proposal states that, if the farm is big enough, three discrete areas will be sampled in each farm. Specifically, how will sample sites be positioned? In amongst the kelp or oysters or just outside the farm footprint? Likewise, how will control sites be cited? Given currents, any effects of the farm could be larger than the farm footprint, especially downstream.

PI response:

Farms within a bay often contain multiple areas with net arrays. Each area with a net array would be considered a "discrete area" and would be our sampling site as mentioned in the proposal. These areas are typically separated by 100s of meters. Benthic sampling will occur directly under each net array. Control sites will be selected as having a similar depth and substrate and will be up-current of the farms and at least 100 m away.

It is unclear why data collection on the pelagic fish community is included in the benthic component.

PI response:
The reorganization helps to address this issue. Essentially, these community categories have been eliminated by our re-organization; however, fish and benthos will still both be sampled. Since many fish are benthic (i.e., sculpins, flatfish, snailfish, gunnels, poachers, etc.), the benthic component will sample fish along the benthic transect. We removed the pelagic transects from our study design.

It is also unclear why data on the fouling community in the water column will be compared with the benthic community on the seafloor. Presumably, the seafloor community would be most strongly affected by substrate type (e.g., rock, gravel, sand, mud). For example, why would organisms that foul the lines, ropes and anchors be expected to also occur on soft seafloor substrates?

PI response:
We appreciate the reviewer's comments about this comparison. We are primarily interested in the comparison when substrate is similar. When substrate is not similar, this survey will inform us as to which organisms would be in the area if adequate substrate were available. This will increase our understanding of whose propagules are available for settlement in the area and how the farms may be increasing local diversity.

The proposal indicates that farmers will use either visual surveys or photographs of randomly selected bags/lines for identifying fouling organisms and mobile species that may be living within the farming cages and lines in years 2-5. Will these observations constitute more than just anecdotal information? It is not clear whether laminated cards would provide adequate training to farmers for this activity.

PI response:
For the surveys of fouling communities, we will use easily identified organisms (Saccharina, Costaria, Mytilus, etc.) and also broader taxonomic categories (i.e., hydroids, tunicates, filamentous red algae, etc.). We feel that the laminated cards will be adequate for these identifications. If farmers choose to take photographs, the graduate student working on the project will process the images.

<u>Marine mammal component.</u> Currently, the proposal seems to lack a standardized survey plan for farmers to account for marine mammals at their farm. It is also not clear how control sites will be selected so that a farm effect can be tested. The proposal indicates that a plan will be developed in the second five years to mitigate interactions between marine mammals and farms. It is not clear what sort of interactions are viewed to be detrimental and in need of mitigation. Passive and positive interactions would seem to be likely. As mammals are unlikely to consume oysters or kelp, negative interactions are not obvious. Are the PIs thinking about potential entanglement of whales in anchor lines? These would seem to be rare events that are obvious and do not require surveys. Evidence should be provided that marine mammal interactions are an issue. The proposal should

include citations documenting interactions of marine mammals with oyster or kelp farms. Without better justification, we question the merits of including this component in this proposal.

PI response:
The bottom line on marine mammal – mariculture interactions is this: we don't know, in the US and certainly at the larger (some >100 acres) and widespread scale (2% of coastline goal) of new Alaskan mariculture, how marine mammals are affected: positively, negatively, or neutral. This is new territory, and Alaskans expect development site selection and management decisions to be backed up by published results which, by and large, do not yet exist. Without this knowledge, we risk denying a worthy farm proposal, or missing opportunities for worthwhile marine mammal mitigation steps. We think this EVOSTC proposal is a fantastic opportunity to transition from making farm siting and permitting decisions based on what managers, farmers, and the public think "might" happen, into decisions based on peer-reviewed research. Decision makers can be too permissive, and can be too cautious, and neither situation is good for anyone.

By statute (AS 16.40.105 (3)): "the proposed farm or hatchery may not significantly affect fisheries, wildlife, or their habitats in an adverse manner." Alaska law specifies that the aquatic farm or hatchery be compatible with area wildlife resources. We do not have a strong basis for these recommendations because we do not have research results available at the scale of Alaskan farming.

If we had abundant citations and evidence documenting marine mammals with oyster or kelp farms, we would not have proposed this basic research. Unfortunately, lack of evidence is not lack of effect, and we are pleased to have an opportunity to put numbers on paper and work toward solutions. Control sites will be selected as those identified by the other components of this Mariculture ReCon Proposal. We are pleased that reviewers concur with our proposed structure of initial 5-year study, followed by a following 5-years of work with mitigation that is informed by our initial work. The reviewers suggest a few potential effects and are on the right track – so here we will expand on those observations:

A 2017 NOAA report (Price et al. 2016) addressing potential impacts of aquatic farms on protected marine species, including marine mammals, was unable to determine if farms pose little risk or if harmful interactions have not yet been detected due to the low number and density of farms in the U.S. The key types of potential impact include competition for space, entanglement, underwater noise disturbance, and behavioral/food habituation (Clement 2013), along with mammal crop depredation or damage to farm gear. Some impacts are direct (e.g., marine mammal – and bird – depredation on and interaction with shellfish farms in the Pacific Northwest and Alaska). For example, in Alaska, sea otter depredation of an oyster crop was reported in 2021, and sea otters in captivity are capable of shucking and consuming oysters (Estes and VanBlaricom 1985). And should mussel or urchin farming take hold (one mussel farm exists now, and urchin permits have been held previously, Monson and DeGange 1998), there are additional direct food interaction and attraction opportunities. There is somewhat more bird literature available, which can help illustrate the types of interactions we intend to study: in British Columbia, shellfish farming was the best-supported predictor of sea scoter and Barrow's goldeneye densities (Zydelis et al. 2008), and they respond to this increased density. While mammals and birds may "benefit" somewhat by their interaction with farms, the attractive effect of mariculture needs to be quantified to better understand non-beneficial outcomes it may lead to – increased need for active harassment to protect crops and un-natural concentrations or distribution shifts of marine predators leading to unanticipated consequences.

While the science is in progress to determine whether and how marine mammals are affected, good or bad, by Alaskan mariculture, there is certainly management need to quantify these interactions for the purpose of decision making. In Alaska, new farm permit applications are circulated for agency review and public comment prior to permit issuance. One party to this management response is NOAA Fisheries, which directly states "NMFS recommends monitoring by the State of Alaska to assess changes in patterns of usage of [newly established or expanded farm] areas by marine mammals as development increases." (NOAA Fisheries – Alaska Region, Agency Review Notice response, 5 June 2021.) This is particularly timely, because since 2019, NOAA Fisheries – Protected Resources Division has taken renewed interest in mariculture farming and are now actively writing comments on applications. Public perception – through the commenting process – is another key audience for marine mammal-mariculture science as well. During recent public concerns raised over a farm expansion plan, there was precious little citable literature available to formulate a response or mitigation that could answer these concerns with knowledge. Finally, farm owners deserve timely and solid information to avoid unnecessary regulation and unwarranted opposition to their business, as well as effective mitigation suggestions.

Prior to 2014, defined distances from mariculture farms to natural resources, including pinniped haulouts, were included in the U.S. Army Corps of Engineers (USACE) general permit PAO-2006-1035, Aquatic Farm Structures Within the State of Alaska and included that farm siting avoid: 1) within one mile of harbor seal haulout concentration areas or pupping areas; 2) within three miles of Steller sea lion haulout concentration areas or pupping areas; 3) within one mile of walrus haulouts. After the USACE sunset in 2014, there were no longer any federal or state recommendations guiding farm-pinniped haulout distance buffers to avoid causing detrimental impacts to area wildlife. We aim to help plug this hole.

Alaska's waters are teeming with marine mammals, making the existing research from the Lower 48 and overseas less applicable. Monson and Degange (1988) point out that what keeps Alaskan and Pacific Northwest mariculture distinct from mariculture elsewhere in the world is the presence of sea otters. Several planned Alaskan farms are also large (some >100 acres), unlike smaller operations in the Lower 48. Also, as industry looks for mitigation measures to expand aquatic farming closer to seal haulouts than previously permitted under the USACE general permit (Alaska Governor's Mariculture Development Plan 2018), our expertise is sought by community members concerned for marine wildlife in areas witnessing mariculture growth. We want to bridge this knowledge gap by improving our understanding of how the growing mariculture industry in Alaska interacts with marine mammals.

Presently, the criteria used to determine whether, or not, proposed farms might be detrimental to marine mammals is not based on directed studies of how marine mammals interact with farms. One such criterion is the guideline whether farm development may affect nearby harbor seals. Presently, determination of distances allowed of farm-harbor seal haulouts is based only on the number of estimated seal abundance because behavioral responses of seals near operating aquatic farms is unknown for the region. Thus, any mitigation we propose lacks (a) solid data on the potential level and duration of impact and (b) foundation in known effective strategy to reduce interactions.

Clement D (2013) Effects on Marine Mammals. Chapter 4 in: Ministry for Primary Industries. Literature review of ecological effects of aquaculture. Report prepared by Cawthron Institute, Nelson, New Zealand.

Estes, J.A. and VanBlaricom, G.R., 1985. Sea otters and shellfisheries. In: J.R. Beddington, R.J.H. Beverton and D.M. Lavigne (Editors), Marine Mammals and Fisheries. George Allen and Unwin, London, pp.187-235.

Monson, D. and DeGange, A. 1988. Sea otters and Alaska's developing sea farming industry. US Fish and Wildlife Service, Alaska Fish and Wildlife Research Center, Anchorage, Alaska. 70 pp.

Price, C. S., E. Keane, D. Morin, C. Vaccaro, D. Bean, and J. A. Morris Jr. 2016. Protected species and longline mussel aquaculture interactions. NOAA Technical Memorandum NOS NCCOS 211. 85 pp.

Zydelis, R., Esler, D., Kirk, M. and Boyd, W. S. 2009. Effects of off-bottom shellfish aquaculture on winter habitat use by molluscivorous sea ducks. Aquat. Conserv.: Mar. Fresh. Ecosys. 19: 34-43.

Restoration component. Integration among pelagic, benthic, marine mammal and restoration components should be explained more thoroughly. There appears to be considerable overlap in the hypotheses and objectives of this component with some of the other components. For instance, environmental parameters will be monitored in the farm and pelagic components, effects of farms on fish is included in the pelagic component, and effects of mariculture on birds and mammals is included in the marine mammal component.

PI response:
With the restructuring of the ReCon proposal, the previously named 'restoration component' is better integrated into the proposal and we have added text and figures (Figure 3e, 5, and 6) to distinguish the PWS-specific proposed work (objectives 1.3, 2A.3, 2C, 2D, 2E.1). For objectives 1.3, 2A.3, 2C.1, 2D, and 2E.1, we propose to expand PWS-specific GWA LTRM surveys to include bays with varying degrees of mariculture development. These cruises will now include oceanographic and phytoplankton stations, marine bird and mammal surveys, and hydroacoustic surveys in Simpson (existing farms), Sheep (permitted leases), and St. Matthews Bays (no leases).

We have also delineated benthic fish and pelagic fish to make it clear that surveying will require different methodology and answer different questions. However, eDNA, which will only be collected/analyzed by Component 1 (formerly pelagic), will be available for the other components to corroborate presence of observed species. In addition, the fish-specific research proposed in the former restoration component can be found under Component 2C.

This restoration component proposes to monitor species historically injured by the EVOS that are currently designated as 'Not Recovered', 'Likely Recovered' or 'Unknown Recovery Status' to guide restoration activities. Please clarify, as the status of these resources is a function of regional status across the spill area, and the LTRM program addresses these concerns. If the proposal intends to examine local effects of mariculture on these species, please clarify how these observations will be scaled up. For instance, use of platforms by marine mammals and seabirds may represent a redistribution of animals rather than an increase in abundance.

PI response:
Mariculture development often spatially overlaps with the preferred habitats of many species initially injured by the spill (some of which have not recovered or have unknown recovery status); our research will provide insight as to the value of mariculture as a restoration activity.

The connection to the LTRM program should be explained and include a description.

PI response:
We are proposing to conduct collaborative oceanographic, hydroacoustic, and marine bird and mammal surveys in three PWS bays (Simpson, St. Matthews, Sheep) four times per year (late winter, spring, summer, late fall). Currently, as part of the LTRM program, collaborative oceanographic and marine bird/mammal surveys are conducted in Simpson Bay twice per year (late winter, late fall), oceanographic sampling occurs in Simpson Bay 6-8 times per year, and marine bird/mammal surveys are conducted in St. Matthews Bay twice per year (late winter, late fall). The proposed Mar ReCon research will expand upon the LTRM work by adding surveys in Sheep Bay, adding two more surveys/year (spring, summer), and add concurrent hydroacoustic surveys for a broader understanding of mariculture impacts to trophic dynamics and the marine ecosystem as a whole. Please refer to Figure 5 (included below) for a depiction of how the proposed project complements and expands LTRM projects in eastern PWS.

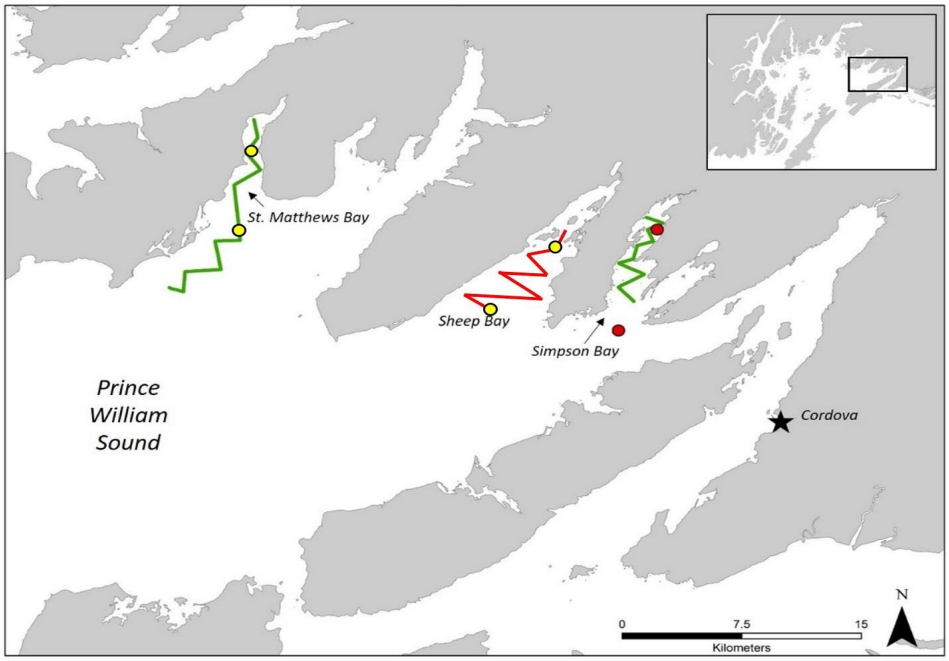


Figure 5. Proposed expansion of existing Gulf Watch Alaska (GWA) long-term research and monitoring (LTRM) programs in eastern PWS, Alaska for objectives 1.3, 2A.3, 2C.1, 2D, and 2E.1 to be inclusive of bays with varying levels of mariculture development (Simpson: existing farms/permits, Sheep: one test-site/several permits, St. Matthews: undeveloped). Current LTRM monitoring includes oceanographic and plankton sampling at stations (red circles; sampled 6-8 times per year; 22120114-G) and marine bird and mammal transects (green lines; sampled 2 times per year; 22120114-E) in Simpson Bay and St. Matthews Bays, respectively. Expansion will add a marine bird/mammal transect (red line) and oceanographic/plankton sampling station (yellow circles) in Sheep Bay, an oceanographic/plankton sampling station in St. Matthews Bay (yellow circles), and hydroacoustic

monitoring for pelagic fish (see 2C.1) to all transects. Surveys will occur annually in late winter, spring, summer, and fall.

Please provide a justification of the hydroacoustic system and compare it to systems used in the herring and forage fish surveys in the LTRM program.

PI response:
We have added the following text to objective 2C.1 (formerly within the restoration component) to address this comment.

"Acoustic monitoring has historically been used in PWS to estimate biomass of the Pacific herring population (PIs Thorne, Buckhorn, Rand; 13120111-E, 17120111-G). Our proposed methodology follows the same protocols with three exceptions: 1) biomass estimates will be calculated along a transect with varying distance to farming operations, 2) direct measures from fish capture will not be performed due to expense/logistics, and 3) surveys will be conducted during the day.

The addition of fish echo sounding to these surveys will provide estimates for overall fish biomass along fixed transects between the mouth and heads of Simpson, Sheep, and St. Matthews bays (Figure 5). This data will strictly be used for comparisons of fish biomass as a gradient with distance to varying densities of farms. Comparisons between bays with varying degrees of mariculture development (Simpson- existing farms, Sheep – planned farms, St. Matthews – no plans, functional control) will allow us to resolve whether farms are associated with increased overall fish biomass. Similar methods have been successfully used to identify differences in pelagic fish biomass between areas with seismic disturbances (Slotte et al. 2004).

Direct capture of acoustically detected fish is a means to obtain standard length data for calculating target strength (TSw), an estimate of area for sonar targets. While current estimates for Pacific herring biomass in PWS utilize direct measures of body length (17120111-G), previous estimates (13120111-E) were validated using ADFG age-sex-length measurements. Validation of fish body lengths is expected to increase the precision of acoustic monitoring, but the relationships between morphology and TSw is inexact (Boswell et al., 2008). Furthermore, the most significant source of error in acoustic biomass estimates is from mean volume backscattering strength which can inflate estimates by 10% (Boswell et al. 2008). Overall, we expect our estimates to have an error rate of ±30% which is similar to project 13120111-E (PI Buckhorn, Thorne) and that relying on estimates of the relationship between target strength and body length from previous work (Love 1977, Hazen and Horne 2004, Boswell et al. 2008) is adequate for estimating overall pelagic fish biomass along proposed transects (Figure 5).

Past acoustic biomass estimates in PWS for Pacific herring have conducted surveys during the day (13120111-E; PIs Buckhorn, Thorne), and they are currently conducted at night (17120111-G; PI Rand). Night surveys are generally more advantageous because fish orient higher in the water column and are more dispersed, leading to less acoustic shadowing. Because this work is taking advantage of already existing day-time surveys, acoustic monitoring for pelagic fish will be conducted simultaneously. While biomass estimates may be higher if conducted during nighttime surveys, consistent daytime surveys will allow for comparisons between transects and as a gradient in relation to farm sites."

This component intends to “extend existing 9- and 2-year data sets for hydroacoustic surveys for Simpson and St. Matthews bays respectively, including the addition of Sheep Bay, an area of expected mariculture development between FY22-31.” Are these surveys intended as pre-development baselines observations only? As written, it is not clear that there is a plan to study post-development conditions. Ability to do a before and after study depends on development of mariculture sites in these areas, which seems speculative.

PI response:
The existing 9- and 2-year hydroacoustic datasets are intended to serve as reference data for comparison with observations collected as part of the Mar ReCon program. We do intend to study post-development conditions. Our design is to conduct oceanographic, hydroacoustic, and marine bird and mammal surveys in three PWS bays with varying levels of mariculture development four times per year. Simpson Bay has been the site of mariculture development since the mid-1990s and is currently seeing an expansion in development as well as additional permits for future development. Sheep Bay has not previously been a mariculture location. However, one test site is currently in development, and multiple farms are permitted for upcoming development. St. Matthews Bay has not previously been a site of mariculture development and currently there are no known plans for development. Monitoring ecosystem impacts in these three areas with currently varying levels of mariculture development and as development expands over the next ten years will enable us to track changes to the trophic community and evaluate impacts to the bays in which these farms are located.

Specifically, how will these surveys be used to estimate the effects of mariculture? Given wide interannual variability in many lower trophic level species, are a system of control (no mariculture) and treatment (mariculture) sites planned for monitoring?

PI response:
The data collected by this project will be used to conduct a mensurative experiment (sensu Hurlbert 1984), the concept of “treatment” and “control” in this case is somewhat vague. The time series produced by prior work gives a temporal context, for instance we know that the region is warming (Campbell, 2018) and that zooplankton species assemblages change in response to temperature (McKinstry and Campbell, 2018) – the interannual variability has trends. By measuring the different sites more-or-less concurrently we “control” for the temporal effect (also discussed by Hurlbert 1984). The use of ongoing Gulf Watch Alaska data will also provide a larger spatial context. In this case we can be considered to have multiple “controls”, for instance the proposed observations in St. Matthews Bay, which has never had any mariculture activities, nor any planned; or the Gulf Watch Alaska station in central PWS that is far from any mariculture sites. The “treatments” are out of our control: Simpson Bay already has a long time series, but has had mariculture activities present the entire time, and more planned during the period of this project. Sheep Bay has had no mariculture but will be seeing new farms start at approximately the same time as this program. We expect that the observations made by this subcomponent at near- and far-field locations along with those made within the farms by the companion subcomponents will permit our estimating any mariculture “effects”.

Regarding phytoplankton, what are the mechanisms by which farms might result in increased plankton? Oysters feed on plankton, presumably drawing down phytoplankton in the water column.

Please include peer-reviewed citations for the purported effects and clarify how the effects will be tested here.

PI response:
We hope that the purpose of phytoplankton sampling, previously within the Restoration component, is now clearer (see objective 2A.3). This portion of the proposal aims to expand the existing GWA LTRM sampling for phytoplankton as a means to monitor community structure within mariculture bays. This data will be used for comparisons with historic data sets, comparisons between 12 sites across PWS, and for tracking changes in phytoplankton at the heads/mouths of PWS bays. While mariculture activities will be included as a factor into our analyses, the spatial resolution of this phytoplankton sampling will not directly compare phytoplankton within/outside of farms. Objectives 2A.1 and 2A.2, on the other hand, will conduct comparisons of phytoplankton community structure and abundance at production arrays inside and outside of farms. Due to the diversity and ephemeral nature of plankton communities, farms are likely to modulate local community structure rather than result in resolvable increases or decreases in phytoplankton (Jiang et al. 2020).

Jiang, Z., Liu, J., Li, S., Chen, Y., Du, P., Zhu, Y., ... & Chen, J. (2020). Kelp cultivation effectively improves water quality and regulates phytoplankton community in a turbid, highly eutrophic bay. Science of the Total Environment, 707, 135561.

Kelp component. This proposal is fairly straightforward and includes two well-defined objectives. The study seems to be well designed with appropriate statistical tests. For objective 2, what is the fate of the trimmed blades after biomass estimation?

PI response:
This section was changed minimally following the suggestions made by the reviewers and EVOSTC panel. For objective 2, after biomass determination, approximately 10 g of tissue will be stored for further analysis such as C and N determinations, while the rest will be returned to the farmer who will process it as desired.

Oyster component. Given the vast amount of work conducted on Pacific oyster production, how will the PIs build on that knowledge? The proposal should include a review of what research has already been conducted and a clear indication about how the proposed work will add to and not duplicate previous research. For instance, haven't the growth and survival of oysters from the Salish Sea and Oregon already been researched? How does the proposed work differ?

PI response:
We have added a succinct review of the successes of Pacific oyster breeding efforts to the Component 3, Objective 3B.2 and 3B.3 study methods, including highlighting some of the recent literature from the Molluscan Broodstock Program at the Hatfield Marine Science Center (p. 60). We also added text to clarify that our proposed work will build off of these efforts, which focused on optimizing yield for Pacific Northwest farms. Our stated goal is "By focusing selective breeding efforts on oysters that grow successfully in the environments found across the EVOS region, we hope to increase production on these farms while also building the expertise and infrastructure necessary to support Alaska-based hatchery operations."

A big issue with this component is that Pacific oysters are not allowed to be held in research facilities in the state of Alaska, but they can be held in hatcheries and on farms. A proposal to change this is pending Alaska Board of Fisheries review in 2022. If approved, the plan is that NOAA will apply to the state for permits to operate as a hatchery.

PI response:
We have added text (p. 60) that specifies that NOAA will pursue a hatchery permit while the proposed regulation change is pending. This will ensure that the work is able to continue regardless of the success of the proposal.

As stated by one reviewer, there has been a "long history of research projects at the Alutiiq Pride Shellfish Hatchery (APSH) and Oceans Alaska attempting to conduct this sort of research with little to no practical results." That reviewer recommends, before more funds are spent on work like this, that there needs to be a clear recognition of what has already been done by these other studies and why this needs more funding. Given this history, and uncertainty in whether this component will be allowed to move forward at the NOAA facility, it is unclear if this project component should be included in this proposal.

PI response:
We are confident that the work will be allowed to move forward at NOAA, either through a hatchery permit or a regulation change. Given how important optimized yield and hatchery capacity are for the success of the oyster industry in the EVOS area, we feel it is very important to include this work in the proposal. We have added text to the "Description of Study Area" for Component 3 to clarify why we have chosen NOAA facilities to house this experiment, including that "selective breeding is a time- and resource-intensive effort with delayed financial payoff. Considering the small size of the shellfish industry and the limited hatchery facilities present in the state, it would not be cost effective for a hatchery to undertake research and development while also producing seed for multiple species. Likewise, basing the work at NOAA ensures the availability of auxiliary research infrastructure, personnel, and expertise that will be necessary for the project's success." (p. 60)

<u>Economic component.</u> Peer reviews of this component were generally quite favorable. We feel that the economic component is critical to this research proposal. The proposed work should make a good contribution toward an understanding on how to solve the seed-supply bottleneck to Alaskan shellfish mariculture. The Panel supports the review comment to consider expanding work by evaluating potential financing pathways and possible policy action or legislative support that could promote development of reliable seed supply for the industry. That reviewer continues to say that, given the seed supply challenge, why not start the work in FY22 instead of FY25? The reviewer goes on to suggest that further thought should be given to developing a set of objectives for years 6-10 that will position the industry to solve this seed supply challenge.

PI Response:
Thank you very much for the panel and reviewers' comments. A section on financial pathway evaluation and possible policy action or legislative support has been added. Moreover, the proposed oyster hatchery economic feasibility work has been adjusted to start in FY22, and the project to be completed at the end of FY24. We have considered adding in additional economic feasibility studies but have decided these will fall under other funding sources due to budget constraints. Currently, Alaska Sea Grant is working with seaweed farmers to gather information and establish baseline

(estimates) of economic/financial data on kelp aquaculture for the desired long-term outcomes (profitability of the industry, financial literacy of existing and prospective farmers, levels of awareness among stakeholders) and Life Cycle Assessment (LCA) data. With new and emerging species expected to become of interest in the near future, Alaska Sea Grant will use the economic feasibility tactics used in this proposal to seek additional funding to support further analyses on species deemed of highest priority by the economics advisory committee. We will lean upon established outreach efforts from this project to get that information out to Alaska constituents.

PI Response:
Thank you very much again for the reviewer's helpful comments. The PIs apologize that the proposal seems nebulous in which no specific product or species categories are chosen for development, and how or whether the product development cycles would be linked. We feel that the types and/or species of products develop should be determined by the advisory committee, which will consist of industry members and experts from the field of food development. This is because the committee, particularly those from industry, are working with customers or potential customers on a daily basis and understand the needs and wants from the marketplace much better than the PIs do. The PIs also feel that since it is the industry participants that are incurring the risk, it would be best for them to take the lead to decide which products should be developed.

Outreach component. Outreach is critical to a proposal such as this. The outreach approaches for technology transfer, social license, and regulation and management appear to be appropriate.

PI response:
Thank you. We have not changed this section based upon these positive comments.

Data management component. The proposed data management component satisfies EVOSTC requirements for storage, access, and overall management of data collected by this proposed project.

PI response:
Thank you. We have not changed this section based upon this positive comment. However, we do note that immediately prior to resubmission of this proposal, the EVOS Trustee Council requested we remove data management from our budget, as it will be administered separately. Additionally, we were instructed to leave the data management plan in place. As such, the data management narrative remains in our proposal and if funded we will work with the awarded data management provider to carry out the tasks.

Administration component.
The proposed administration of this project is appropriate and satisfies EVOSTC requirements.

PI response:
Thank you. We have not changed this section based upon this positive comment.

One reviewer commented that this proposal represents a missed opportunity to include a social science component to study the implications of an expanding mariculture industry on coastal

communities. We do not disagree with this comment, but remain concerned about the total overall cost of the proposed program.

PI Response:
Thank you for this comment. We understand the importance of social science approaches. Economics is a social science, and it is a component of this proposal (and is a planned focus of future work that leverages what is accomplished by this program). We agree that social science approaches pertaining to the implications of mariculture activities for coastal communities will benefit from dedicated attention. Some of our outreach priorities include conducting listening sessions in the EVOS area communities to address how communities may be impacted by expanding mariculture operations and to provide information and tools on how communities and/or individuals can participate in this emerging industry. Community listening sessions will be done in a variety of formats, such as via teleconference, Zoom or other web-based video-conference system, and in person. The in-person listening sessions will be organized events where community leaders, Alaska Native Tribal members, elders, and the general public are invited. We will also spend time in communities in the spill area where mariculture is planned or occurring to formally meet with community leaders and informally meet with community members to hear their concerns. Concerns will be shared with the Mariculture ReCon team, who will incorporate this feedback into research considerations. Individuals in the region will also be invited to training opportunities that Alaska Sea Grant plans on hosting through other complementary projects.

Date: September 2021

The goal of this ambitious proposal is to support restoration, habitat enhancement, and economic development through research and partnerships between scientists and seaweed and shellfish farmers. It has 8 components. Component 1 addresses the impact of mariculture on the water column, and component 2 addresses impacts of mariculture on biological communities (zooplankton, benthic communities, pelagic fish, marine birds, and marine mammals). Components 3-5 investigate methods to increase production and yield on farms. In particular, Component 3 has three subcomponents including the influence of variability in water column parameters on kelp and oyster growth and survival, selective breeding of oysters to create Alaska-specific strains for optimized growth, and kelp farming and harvesting methods for enhanced yield. Component 4 involves an economic feasibility analysis of an oyster hatchery in Alaska to determine what resources and infrastructure are needed to produce economically viable oyster seed, whereas Component 5 develops proof-of-concept product forms for seaweed and shellfish that reflect consumer preferences. Finally, Component 6 is Outreach, Component 7 is administration, and Component 8 is data management.

This is a very large, comprehensive proposal with a budget on the same order of magnitude as the entire LTRM program. If funded, it would essentially utilize the entire EVOSTC budget allocation for mariculture proposals in the Call for Proposals. Portions of the proposal essentially create an extended GWA monitoring program with a focus on farms. The Science Panel and a reviewer asked the PIs to revisit their plan for a second 5-year period as it seemed to be largely a replication of the first 5 years. The PIs replied that the full 10 years will provide them with a critical perspective on how production is influenced by different and changing water conditions under climate change. We feel that this is insufficient justification.

Component 1 seeks to test two hypotheses. The second hypothesis, concerning whether water biogeochemistry and nutrient concentrations differ throughout the region, can be tested with existing LTRM observations. Tests of the first hypothesis, whether mariculture impacts on water biogeochemistry and nutrient concentrations are context dependent, may produce some interesting results, however it is not clear how the findings would lead to actionable decisions by regulatory agencies concerning mariculture. We also were not completely satisfied with the explanation about the positioning of monitoring outside the farm to be compared with inside the farm. The PIs indicated that "outside" refers to a site that is in similar water depth to that "inside" the farm, roughly ~200-400 m from the farm, similarly distanced from shore. If the farm affects water properties in some measurable way, those effects may be expected to be carried downstream away from the farm in the direction of prevailing ocean currents. Thus, ability to detect differences inside vs. outside the farm may depend on whether the outside station is positioned downstream or upstream of the farm. Tidal currents are likely to be most important. Perhaps a case can be made that the outside site is far enough away from the mariculture site that any farm effect would be diluted by surrounding waters. However, this case was not made.

We had similar concerns with Component 2 as Component 1. Mariculture may or may not affect zooplankton communities, but again how would a change in some zooplankton species matter to mariculture regulators? For the benthic community subcomponent, it is unclear why fouling communities on mariculture structures would be compared to natural benthic communities on rocky substrates and how the findings would apply to management. Likewise, for the marine bird subcomponent, the third hypothesis concerning variability in marine bird density, distribution, and community composition can be tested with the existing GWA program. In summary, while some good science may result from successful completion of Components 1 and 2, their utility for mariculture management has not been made clear.

Component 3A considers drivers of regional variation in production and examines growth rates of cultivated kelp and oysters relative to environmental conditions. The proposed data summarizations and stated statistical analyses do not appear to be sufficient to determine the set of environmental conditions associated with higher growth rates. This component will also consider whether attributes of kelp and oysters will be improved by using polyculture.

Finally, Component 3A will also evaluate heavy metal contaminants in farmed and wild seaweeds, their variation, and whether they pose a risk to human health. We have concerns about the work on contaminants. As the FDA or USDA have not set acceptable levels of contaminants for the sale of seaweed, it is not clear how these levels will be put in context or lead to actionable recommendations k. The PIs indicated that their contaminant data for seaweeds will inform the development of safe seafood operations and contribute to ensuring the safety and quality of cultured seafood products. As setting safe levels of contaminants requires a study of human health, we are not convinced how measurements of contaminants in farmed products will inform what is safe or not safe for human consumption. The PIs should reconsider this aspect of the proposed work and its justification. This SP also found the statistical analysis of contaminants to be vague.

Component 3B involves an evaluation of diploid and triploid oysters and how performance varies with temperature, as well as selective breeding to develop strains of oysters with high growth and high survival. We had considerable discussion about this component and hoped to see more citation to previous work, given the amount of research conducted elsewhere, but agrees that performance

of oysters in the EVOS region is meritorious. We were uncertain about the fate of any new oyster strains, as neither of the proposed NOAA laboratories are a likely facility to maintain the brood stock over the long term. We wondered about the merits of partnering with a commercial entity that can keep the broodstock alive. As Alaska lacks facilities to produce oyster seed for local mariculture farms, it is also unclear how results from this component would be operationalized.

Component 3C explores a few very practical methods to improve kelp yields. First, to test the effects of spacing on yield, kelp will be seeded at two different densities (i.e., 500, 5000 –current seeding density). While the choice of two densities of different orders of magnitude are likely to demonstrate an effect, if one exists, it is not clear how optimal seeding density will be determined from just two divergent values. Second, pre-harvest trimming of distal-end portions of kelp blades will be tested to see if this practice increases farm yields. Third, the temperature and salinity tolerances of juvenile kelps sourced from different locations will be tested. Once the maximum and minimum limits are obtained, the PIs will conduct full factorial assessments consisting of three salinities and temperature treatments to measure their interactive effect in kelp development, which will inform decisions about sources of kelp for farming. We recognize that results from these three sets of experiments will lead to practical advice to farmers to help maximize their yields.

Component 4 will conduct an economic feasibility analysis of an oyster hatchery in Alaska to determine what components are needed to produce economically viable oyster seed. It will answer such questions as (1) what will it cost to raise oyster seed to market size?, (2) for what price can oyster seed be sold to provide an adequate return?, (3) what is the break-even price for culturing oyster seed?, and (4) what is the optimal size of a commercial oyster hatchery production facility to supply current and future needs in Alaska, with the possibility of exporting to other states? We view this as an important component of this proposal as it will produce information relative to potential local sourcing of oyster seed – a key hurdle to growth in this industry. We are pleased to see that an advisory committee from the mariculture industry and academia will be formed to provide critical advice for this project.

Component 5 intends to develop industry-driven proof-of-concept product forms for seaweed and shellfish that consumers may favor through five 2-year product development cycles over the 10-year research period. If successful, seaweed and shellfish prototype products will be adopted by industry to be further developed for large-scale commercial production. The PIs have considerable experience in conducting this type of work, which follows well-established market research and food product development procedures. The PIs will engage industry to gather preliminary information, use focus groups to define product attributes, and utilize consumer taste panels and surveys. We view the development of new, innovative product forms as a key ingredient to boost market demand for kelp and oysters farmed in Alaska.

Components 6, 7 and 8 involve outreach, administration, and data management. For outreach, the PIs plan to coordinate with the Community Organized Restoration and Learning (CORaL) Network to make current scientific information and activities publicly accessible and serve ongoing, community-identified needs. Project administration would be handled by the PWSSC and data management would be handled by Axiom Data Science. We felt that all three of these components were put together well. However, the outreach component would need to be revised, if the CORaL Network is not funded.

There were some aspects of siting mariculture farms that were not addressed by the proposal. For instance, the interactions of competing uses of the shoreline. Establishment of mariculture sites has the potential to conflict with existing subsistence uses, commercial fishing activity (e.g., setnet sites), and sewage outfalls. Some background information about this would have been helpful for context.

In summary, this proposal proposes a very large mariculture research program. Some components extend the already expansive Gulf Watch Alaska program into new bays likely to be sited for mariculture farms. We also had difficulty understanding how findings from Components 1 & 2 would translate to kelp and oyster farms and their regulation. Accordingly, we do not recommend funding of Components 1 & 2. Components 3 & 4 involve applied research with outcomes that will result in clear advice to farmers to boost the productivity of their kelp and oyster farms. Components 5 & 6 will result in an economic feasibility analysis for a potential shellfish hatchery, a key hurdle for growth of the oyster industry in Alaska, as well as development of new product forms, which are important to increase market demand for Alaskan kelp and oyster products. Reasonable plans were proposed for outreach, administration, and data management. If the CORaL Network is not funded by EVOSTC, then the outreach plans will need to be revisited.

PAC Comments

Date: September 2021

It is noted that the PAC recognizes the importance of including all groups (i.e., communities and tribes) within the mariculture project areas.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and also the PAC in their differing recommendations. After hearing public comment at the PAC meeting, including comments provided by ADFG regarding the importance of data collected from objectives 1 and 2 for mariculture permitting. I also heard concerns from the public and some members of the PAC that this program requests funding for the suggested allocation for the mariculture focus area in the Invitation, and that there would not be any funding left for projects 0300 and 0301 should the Trustees decide to fund this program in its entirety. I also heard concerns over making sure that all communities and tribes within the mariculture project areas are included. I recognize and appreciate the amount of work that was put into revising this proposal in response to reviewer comments and addressing reviewer comments. In an effort to address these concerns, my recommendation is to fund this proposal for FY22-26 as recommended by the PAC and to include proposal 0300 in this program (as recommended above for project 0300) to increase collaboration and coordination between these projects. I also strongly suggest that this program coordinate with 0301 for information that may improve upon this program proposal in future years (FY27-31).

Education and Outreach Program and Project Descriptions

Project Number: **22220400**

Project Title: Community Organized Restoration and Learning [CORaL] Network

Primary Investigator(s): Wei Ying Wong

PI Affiliation: ASLC **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$2,498,550	$2,508,119	$2,444,292	$2,445,434	$2,603,513	$12,499,908
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$0	$0	$0	$0
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $2,498,550

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $5,006,669

Total Non-EVOSTC Funding (FY12-23): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.13.2021.*

The vision of the proposed **Community Organized Restoration and Learning [CORaL] Network** is to create and maintain an ongoing framework that builds the capacity of existing resources within the *Exxon Valdez* Oil Spill impacted region to ensure that current scientific information, skills, and activities are publicly accessible and serve ongoing needs as identified by local communities. The Alaska SeaLife Center submits this proposal as the administrative PI on a program that will be conducted collaboratively with Alaska Sea Grant, Alutiiq Museum and Archaeological Repository, Center for Alaskan Coastal Studies, Chugach Regional Resources Commission, and Prince William Sound Science Center. This network design, with seven pathways for participation that can be entered in any phase of the program, is inclusive of existing and future EVOSTC-funded projects. Through the activities in each pathway, the CORaL Network will ensure that: science outreach is relevant, co-created, and culturally responsive to our regional communities, leading to increased public utilization of available knowledge related to the EVOS; the participation of regional youth in community-based science projects increases diversity in future science projects; EVOSTC-funded

Long-Term Research & Monitoring, Mariculture, and Restoration projects are integrated with community-identified needs; and increased understanding of Alaska Native knowledge and relations, cultural competency, and collaborative community research principles lead to active, community-informed restoration projects. By the end of 2031, the CORaL Network program intends to demonstrate that the impact of an active, collaborative, cross-sector network is greater than the sum of its parts and to maintain these ongoing collaborations as a legacy of the EVOSTC.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund FY22-26	Fund	Fund reduced

Science Panel Comments

Date: May 2021

The Science Panel is pleased to see substantial funding dedicated to Education and Outreach and was impressed by this comprehensive proposal. It was submitted by the Alaska SeaLife Center as the administrative lead on a program that is collaborative with Alaska Sea Grant, Alutiiq Museum and Archaeological Repository, Center for Alaskan Coastal Studies, Chugach Regional Resources Commission, and Prince William Sound Science Center. The scope is very broad but the proposal is well organized, starting with six clearly stated goals and quickly moving to a set of specific objectives (called Pathways to Collaboration) and plans for achieving these objectives that relate well to current and likely future EVOST-funded research. If fully funded it would represent a very large portion of the likely E&O funds allocated.

Much of our discussion covered points raised in four detailed peer reviews - all positive but with differing emphases. Reviewers pointed out the strength of this proposal, which include leveraging and expanding the capacity of existing resources, a well-qualified team with diverse and appropriate backgrounds, sound methodologies, strong on-going process and project evaluation with opportunities for the project to evolve, and milestones appear well developed and systematically conceived. Additionally, this proposal aims to exceed the goals of the E&O Invitation by providing additional outcomes in two critical and enriching areas - workforce development and developing/strengthening a pathway for community driven research. In regard to process and project evaluation, one reviewer pointed to a program with similar aims to the proposed COMPASS component whose experience might be immediately valuable.

Suggestions and questions from peer reviewers include: more attention to ecological outcomes and include details regarding the plan for science to be collected beyond the mini grants. Form MOUs between entities are required. Do existing scientific indicators sufficiently address cultural priorities? Regarding the internship program, removing the age limit is suggested. What are some examples of species/resources and associated research and how can support be woven across the different components? A reviewer also suggested adding additional information on how the 7 dimensions knit together.

PI Response:
We have responded to these questions and suggestions in the reviewers' direct comments below. [Note: external reviewer comments are not included in the work plan].

We thought all these points well worth consideration by the PIs with the exception of the criticism of the absence of a plan for science to be collected beyond the mini grants. This "missing" science is well covered by the many LTRM (and other) proposals currently under consideration, but presumably not available to the reviewer. We strongly support the ongoing evaluation plans that offer both possibilities for course correction and hopefully guidelines for the path to a sustainable post-EVOSTC future. In this context, will the external evaluator critique the overall program at the beginning to suggest possible modifications to the work plan prior to initiating all work?

PI Response:
Evaluation is a critical component of the CORaL Network's implementation plan in 2022, and our intention is to secure an external evaluation contract and hire a Senior Evaluation Manager immediately so that they are fully involved in formative discussions. As described on page 22 of the proposal, the Senior Evaluation Manager and the external evaluator will work closely with one another and with the CORaL Network's core team to design an evaluation plan while simultaneously conducting needs assessment activities that inform early program design. We anticipate their expertise, as well as their perspective on monitoring activities, to be beneficial to program and project planning.

We had two broad substantive concerns beyond those raised in the reviews. One was the absence of explicit products beyond scientists, educators, and collaborators. This is echoed in the reviewer question about whether the scientific indicators relate to cultural priorities.

PI Response:
The CORaL Network outreach framework is designed to focus on creating culturally-responsive processes rather than pre-determined and explicit products. Formative activities in the first three years of the program, as well as incorporated within the ongoing processes, will be critical for creating dialogue between the cultural and scientific priorities of the region's stakeholders. The process of co-creating priority inquiries, interpreting data within multiple contexts, and collaboratively applying information into local activities is, itself, a key product of the CORaL Network's activities. The products or outputs which will be most meaningful to the community or public domain in our network are yet to be described because these will become determined through the co-creation process.

That said, there are engagements currently planned specifically for the benefit of community members. Internships and community involvement in implementing local research projects are intended to increase the technical capacity of local residents and increase participation in STEM careers. Community Sharing activities are an opportunity for researchers to ask questions and learn more about local resources; however, these dialogues center on what communities and tribes want to learn about the resources that they steward and depend upon, as well as what they want the research community to understand about their priorities and understandings. Similarly, the Cultural & Communication Learning Opportunities may target audiences of non-Native researchers and outreach specialists, but the intention of these engagements is to reduce the burdens of explanation from tribal communities and enhance the impact of what they choose to share about themselves and

their priorities. In other words, the CORaL Network takes the perspective that it is not the responsibility of non-research, non-outreach, and/or minority communities to create inclusion of themselves within these conversations; that role is the responsibility of researchers, outreach specialists, and/or non-minority participants.

Creating demonstrable connection between scientific and cultural priorities, as well as facilitating co-creative engagement that results in community-relevant research and outreach products, is at the core of what the CORaL Network process intends to achieve through its activities and evaluation.

Related to this was lack of information on how PIs would ensure true involvement from and substantial financial benefit to communities, given that a high proportion of funding is going to standard institutions and agencies, e.g. 5 new employees at ALSC which contrast with lack of clarity on whether community sharing included money as well as knowledge. Specifically, it is not clear how Native communities will be brought in and will benefit.

PI Response:
The CoRAL Network program strategically includes two partners that are Alaska Native-run and staffed: the Alutiiq Museum and Archaeological Repository [AMAR] and the Chugach Regional Resources Commission [CRRC]. By virtue of the role these two organizations hold on the core team, CoRAL network partners will have direct lines of communication to multiple villages across the region, ensuring effective and consistent involvement from these communities. Although a high proportion of funding is going to standard institutions and agencies, there is sufficient financial benefit to these two Alaska Native organizations to ensure that smaller communities in the Spill Area are included. A particular goal of the mini-grant program proposed to be administered under CoRAL will include, through the involvement of Chugach Regional Resources Commission as a partner, technical assistance to Tribes to ensure they are included in the opportunity to receive substantial mini-grants.

The Chugach Regional Resources Commission was established by the seven Tribes of the Chugach Region, each of whom holds a seat on the CRRC Board of Directors. The CRRC Board serves at the pleasure of each Tribal Council and are chosen specifically because of their natural resource management inclinations. These Board members and their alternates report directly to their respective Tribal Council and community members. In addition, the Executive Director of Chugach Regional Resources Commission or designated staff attend each Tribal Council meeting to provide an update on the organization's natural resource management endeavors and partnerships. Specifically included in Council reports are ways for the community to be involved with projects and programs.

The Indian Self-Determination and Education Assistance Act [ISDEAA] of 1975 (Public Law 93-638) recognizes the inherent status of member Tribes as sovereign nations. Chugach Regional Resources Commission serves as the ISDEAA-sponsored natural resource management agency on behalf of the following sovereign Tribal governments: Chenega, Eyak (Cordova), Nanwalek, Port Graham, Qutekcak (Seward), Tatitlek, and Valdez. This contract represents a direct thread tying policy, Indian communities, and a tribally-run natural resource program.

This type of relationship helps with economic development and capacity building in the local communities through hiring local talent and keeping dollars re-circulating in Native communities many times over and by giving members of the Tribes opportunities to work within their communities

as professionals. For example, Chugach Regional Resources Commission will be hiring a full-time Tribal liaison to ensure that CoRAL outcomes and EVOS science projects are translated to communities in the Spill Area. In that same vein, the Tribal liaison will ensure that Alaska Native concerns or support are expeditiously translated, through the Chugach Regional Resources Commission's Board, to the EVOSTC-sponsored researchers. Additionally, Chugach Regional Resources Commission will also work closely and contract with Chugachmiut, the social services and cultural education ISDEAA organization of the Tribes in the Chugach Region. This subaward will allow Chugachmiut to secure funds for their Local Cultural Coordinators in each of the seven communities in the Chugach Region. The Local Cultural Coordinators are responsible for the coordination of local activities of Chugachmiut's Heritage Preservation Department (https://www.chugachmiut.org/heritage-preservation/). Through this partnership, the seven communities in the Chugach Region (Chenega, Eyak (Cordova), Nanwalek, Port Graham, Qutekcak (Seward), Tatitlek, and Valdez) will have natural resource and local culture coordinators on site to provide consultation and resources to the scientists and educators working in these areas. Community elders will also be financially supported for participating in Community Sharing activities.

While the Alutiiq Museum and Archaeological Repository does not fulfill an ISDEAA role on behalf of Tribal sovereignties, AMAR was founded and is sustained by the following eight Kodiak area Alutiiq organizations: the Kodiak Area Native Association, Koniag Inc., Afognak Native Corporation, Akhiok-Kaguyak Inc, Leisnoi Inc., Natives of Kodiak Inc., Old Harbor Native Corporation, and Ouzinkie Native Corporation. AMAR also employs local Tribal members on projects that serve their communities.

It is also important to note that the four non-Native organizations in the core CORaL Network partnership do not operate in a vacuum. These institutions serve as economic drivers in Homer, Seward, Cordova, and Kodiak, for the benefit of Native and non-Native residents in those communities. Hiring protocols are non-discriminatory and each organization actively works to foster qualified candidates from the local region. As nonprofits and agencies, we are mission-driven for the benefit of our community stakeholders.

We encourage EVOSTC to review the Letters of Support we have received from the following Native communities, corporations, and organizations regarding anticipated benefit to these entities. Note that the seven Chugach communities of Port Graham, Nanwalek, Tatitlek, Chenega, Seward (Qutekcak), Cordova (Eyak), and Valdez are represented by Chugach Alaska Corporation and Chugachmiut.

- *Alutiiq Tribe of Old Harbor*
- *Chugach Alaska Corporation*
- *Chugachmiut*
- *City of Kodiak*
- *Koniag*
- *Native Village of Afognak*
- *Native Village of Ouzinkie*
- *Native Village of Port Lions*
- *Seldovia Village Tribe*
- *Sun'aq Tribe of Kodiak*
- *Tangirnaq Native Village*

In summary, the proposal offers a grand vision for a well-funded program with great potential. The revised proposal needs to address our most substantive concerns as well as responding to the specific reviewer comments.

Date: September 2021

We are pleased to see substantial funding dedicated to Education and Outreach and was impressed by this comprehensive proposal. It was submitted by the Alaska SeaLife Center as the administrative lead on a program that is collaborative with Alaska Sea Grant, Alutiiq Museum and Archaeological Repository, Center for Alaskan Coastal Studies, Chugach Regional Resources Commission, and Prince William Sound Science Center. The scope is very broad but the proposal is well organized, starting with six clearly stated goals and quickly moving to a set of specific objectives (called Pathways to Collaboration) and plans for achieving these objectives that relate well to current and likely future Council-funded research.

We noted the strengths and leveraging of the proposal, and of the well-qualified team. The proposal had five, predominantly positive, external reviews that led to questions for the PIs from the March 2021 review. All external reviewers were impressed by the internal and external evaluation components of the proposal, with one suggesting shifting the balance between external and internal evaluation effort towards the form. The PIs convincingly suggested that the proposed balance is appropriate and we concur. In response to questions regarding absence of explicit products beyond the initial years, the PIs gave a particularly compelling response, noting that the CORal outreach framework is "designed to focus on creating culturally-responsive processes rather than predetermined and explicit products". They then elaborated on how they hoped to achieve this. We have confidence that this will be further developed as described. In response to concern on lack of assurance of involvement with local communities, the PI's gave a detailed response and concluded that there was sufficient financial benefit to two Alaska native organizations to ensure that smaller communities in the Spill Area were included. More details regarding quantitative estimates were not discussed.

There were many letters of support, including eleven from Native communities, corporations and organizations. Some of these had exceptional levels of detail. Such community support is a strong pointer to future success.

In summary, after considering the revised proposal, the thoughtful and detailed response of the PIs to the previous review, and the exceptional set of letters of support, we feel that this proposal offers a grand vision for an Education and Outreach program with great potential.

PAC Comments

Date: September 2021

It is noted that some PAC members expressed their concern that the high cost of this program would preclude other worthwhile Education and Outreach proposals from funding.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and also acknowledge the concerns expressed by some PAC members regarding the limited funding available. I do not have concerns with recommending funding this proposal for the full 10 years as requested. This is a comprehensive, well-organized

program led by a highly qualified team that will make significant contributions to the Education and Outreach goals for the Council.

Note: The Trustee Council at their October 13, 2021 meeting approved reduced funding for this project to include FY22-26 contingent on the removal of the mini-grants section in the proposal and budget

Project Number: **22220403**

Project Title: PWS Natural History Symposium

Primary Investigator(s): Paul Twardock

PI Affiliation: PWS Stewardship Foundation **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$24,738	$19,179	$19,179	$19,179	$19,179	$101,452
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$26,405	$20,846	$20,846	$20,846	$20,846	$109,789

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$5,000	$5,000	$5,000	$5,000	$5,000	$25,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$5,000	$5,000	$5,000	$5,000	$5,000	$25,000

Total Past EVOSTC Funding Authorized (FY12-22): $24,738

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $43,917

Total Non-EVOSTC Funding (FY12-23): $10,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.12.2021, budget updated 08.12.2021.*

The Natural History Symposium has been the keystone event of the Prince William Sound Stewardship Foundation (PWSSF) since it began in 2018. The Symposium, which is free to the public and held in mid-May, provides the latest science, research and heritage news by experts from throughout the PWS region. The program responds to a need expressed by tour companies, outfitters and guides, and other educational interests to provide consistent, accurate, and professional training for the guides and other educators that interact with thousands of PWS visitors every year.

Topics include climate change, ocean conditions, impacts of the 1989 Exxon Valdez oil spill, and other complex and evolving issues. It is also an opportunity for the general public to gain knowledge on important topics affecting the region. In these ways, PWSSF sees the symposium as an investment in responsible use of the Sound, public education, community resilience, and area-wide

stewardship, which all connect to the heart of the PWSSF mission. There is currently no other education or science center located in the Whittier harbor. The harbor has been experiencing a large increase in tourists, and recreational and commercial boaters. Hosting the NH Symposium in Whittier is a way for PWSSF to increase awareness of their various projects throughout the PWS and the community.

Educational programs like the Symposium can lead individuals to become citizen scientists; engaged, inspired and compelled. The presenters at the Symposium are selected to cover a wide range of topics, but the goal is to educate and advocate for reducing the negative impacts on the Prince William Sound. If the PWS is to continue recovering from the Exxon Valdez oil spill, the public need to be informed on ethical and sustainable ways of recreating. This program will explore and develop methods for encouraging low impact, responsible recreation.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The Science Panel supports the idea of a local natural history symposium and recognizes the need referred to by the PIs on the part of local tour operators and nature guides. However, we did not feel that the proposal made it clear how the budget would be spent, how success of the efforts would be evaluated, and how the topics would be kept fresh and updated each year. There was a mechanism described for deciding each year's topic, and we were pleased to see broad representation into the decisions but it was not clear how new and different it will be from year to year, nor was it clear what criteria would be used to select topics. The proposal did indicate that they will document each symposium for future reference; but we could not find whether this had been done for symposia thus far and how it would be done in the future (recorded and posted on a website?). External reviews offered some support, but also a critical view of the proposal, especially with regards to detail in how funds would be sent and how impact on the audience and broader regional outreach goals would be measured. We considered this a good idea in theory but needs justification in actual cost and content.

PI Response:
We appreciate the feedback and have revised our proposal adding a budget summary, goals and benchmarks, and details on our planning process. The 2021 Symposium recordings are available on our web site: https://www.princewilliamsound.org/2021-natural-history-symposium. The 2020 Symposium was also posted on our website shortly after the symposium and remains there today at: https://www.princewilliamsound.org/copy-of-natural-history-symposium. We have addressed these questions by heavily revising Section 2: Executive Summary.

Date: September 2021

We felt that the PIs did a good job addressing the concerns. The provision of previous symposia on the web helped us get a better sense of the diversity of topics covered and that considerable new material was present each year. EVOSTC-funded work is showcased in some of the talks. PIs have goals of expanding the reach and availability of their symposium to include broader audiences and more people.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC. This is low budget project that invites Council-funded PIs to present their research to an audience that represents a wide variety of interest groups (i.e., commercial recreation/tourism operators, educators, tourists, hunters, and fishers). The timing of the symposium and location is well thought out. The justification for the venue in Whittier is that it optimizes attendance by the larger number of companies and Alaska residents who access PWS from Whittier, Anchorage, and the Kenai Peninsula. Additionally, holding the symposium in Whittier also contributes to the local economy. In 2019, over 200 people attended the symposium. In 2020 and 2021, the symposium moved to an on-line platform due to the pandemic but garnered an audience of over 250 people in both years. This project seems like a worthwhile investment given the relatively low cost of the proposal and success over the last 3 years.

Project Number: **22220405**

Project Title: Preservation of Subsistence and Cultural Practices for the Alaska Native People of the Chugach Region - Proposal for FY2022-2031 Culture Camp Funding for the Chugach Region

Primary Investigator(s): Lauren Johnson

PI Affiliation: Chugach Heritage Foundation **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$640,430	$189,170	$189,170	$189,170	$189,170	$1,397,108
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$189,170	$189,170	$189,170	$189,170	$189,170	$945,848

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$200,000	$200,000	$200,000	$200,000	$200,000	$1,000,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$200,000	$200,000	$200,000	$200,000	$200,000	$1,000,000

Total Past EVOSTC Funding Authorized (FY12-22): $640,430

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $829,600

Total Non-EVOSTC Funding (FY12-23): $400,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.24.2021, budget updated 08.13.2021.*

The Chugach Heritage Foundation is working to strengthen and restore Chugach Region Cultural Camps that were disrupted as a result of the Exon Valdez Oil Spill. The goals of this program (cultural camps) are to help our people continue teaching the Alaska Native subsistence and cultural lifestyle in the Chugach Region, which is vital for future generations of Alaska Natives and the economy in the Chugach Region to come.

Subsistence hunting, gathering, and sharing this knowledge is a way of life for all residents that live in the Chugach Region. Alaska Native cultural camps have been taking place in the Chugach region since 1994 and have provided unique opportunities to unite youth, elders, and the Alutiiq (Sugpiaq),

Eyak (Athabascan), and Tlingit Alaskan Natives of the Chugach region to rediscover the history and culture of their ancestors.

This program will help to expand subsistence activities and the sharing of traditional knowledge around the Chugach region and in the Alaska Native communities. It will address the program goals and objectives by providing funding for the material and resources needed to market, develop, operate, and sustain the Chugach Region Cultural Camps. Currently there is not enough funding to expand, market, enhance, operate, and sustain Chugach Regional Cultural Camps for the following cultural camps:

1. Chenega - Chenega Fish Camp
2. Cordova - Native Village of Eyak
3. Hinchinbrook Island - Nuuciq Spirit Camp
4. Nanwalek - Nanwalek Summer Youth Worker Program
5. Port Graham - Port Graham Cultural Camp
6. Seward - Qutekcak Native Tribe
7. Tatitlek - Peksulineq Cultural Heritage Week
8. Valdez - Valdez Native Tribe

Funding for each camp will be used for personnel to administer the camp and subsistence programs; to purchase commodities and to purchase new subsistence related equipment. Travel expenses are built in for Nuuciq Spirit Camp.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

The Science Panel is very supportive of this proposal. The funding request supports camp operations (including personnel, travel, and commodity expenses) for subsistence activities at Nuuciq Spirit Camp and requests an annual fixed amount of funding for subsistence activities and commodity costs at other regional cultural camps that will be used based on individual unique camp needs. These funds will help to expand subsistence activities and the sharing of local traditional knowledge around the Region and in the Alaska Native communities including the cultural camps. These camps and their activities are of high impact for Native communities that were affected by the EVOS and we recognize the importance of the proposed project. One improvement to the proposal that could be made is to provide examples of the kinds of data that would be collected and measured for subsistence-related activities as referred to in the Program Data Management section.

Overall, the external reviews were positive, with helpful suggestions for this project. One review made a very good suggestion that a greater synergy between EVOSTC and CHF could be realized by including a marine science component (citizen science endeavor) where camp participants could measure plankton or simple oceanographic conditions. The concept of a safe place for youth to learn

about environmental monitoring, changes, and wildlife is an excellent one and should be seriously considered in the project.

PI Response:
[Note that responses to external reviewer comments are not included in the work plan]
For the final proposal submission and to address the Peer Review comments CHF developed a Management, Operations & Evaluation Plan that builds upon the original proposal and provides more details in the following areas:

- *Resiliency & Adaptation – New section requested in reviewer comments.*
  - *Section 2, Pages 5-8*
- *Chugach Region Cultural Camps Overview – Provides cultural camp details.*
  - *Section 2, Pages 5-8*
- *Program Administration – Provides staff roles, duties, and experience for proposed personnel.*
  - *Section 3, Pages 8-10*
  - *Section 4, Pages 11-12*
- *Program Steering Committee – Provides organizational chart.*
  - *Section 5, Items A & B, Pages 12-13*
- *Program Schedule – The Operations & Evaluation Plan was developed to detail the proposed Milestones, Reporting, & Deliverables. o Section 5, Item C, Page 13*
  - *Section 8, Pages 16-17*
- *Data Management Services – Details CHF's response from Axiom Data Management Services.*
  - *Section 6, Page 13*
- *Contingency Plan – New section requested in reviewer comments.*
  - *Section 2, Pages 5-8*
- *Compliance – New section requested in reviewer comments.*
  - *Section 2, Pages 5-8*
- *Budget Workbook – The Budget plan was developed to detail in-kind contributions, and indirect, personnel, travel, commodities, new equipment, and inflation costs.*
  - *EVOSTC Funding Requested, Page 2*
  - *Section 9, Items A & B, Pages 16-19*

Date: September 2021

All revisions are acceptable. Collection of data as more of a public exercise rather than a rigorous scientific effort does make sense and we agree, there is no need to involve the Data Management program. While it is was a little disappointing that the PIs appear not to be interested in linking to science outreach people associated with EVOSTC, which in our view, could bring environmental monitoring approaches and basic ocean science to local coastal communities, it is understandable that the proposal's focus remains on EVOS damage and TEK at the culture camps.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC. I note that this project has substantial matching funds. Funding this project will support the important expansion of subsistence activities and the sharing of

local traditional knowledge around the Region and in the Alaska Native communities including the cultural camps, which are high impact for Native communities that were affected by the EVOS.

General Restoration Projects Descriptions

Project Number: **23230502**

Project Title: Clean Water Assessment of Beaches with Lingering Oil

Primary Investigator(s): Terri Lomax

PI Affiliation: ADEC Division of Water **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$138,740	$215,778	$178,684	$125,230	$658,432

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$6,684	$6,823	$7,027	$7,238	$27,712

Total Past EVOSTC Funding Authorized (FY12-22): $0

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $138,740

Total Non-EVOSTC Funding (FY12-23): $6,684

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 04.20.2021, budget updated 05.10.2021.*

In 1990 DEC classified 35 impacted beaches in the Exxon Valdez Oil Spill impact zone as impaired for petroleum exceedances under the Clean Water Act (CWA). Today, new information and technology exist that would allow for a re-evaluation of the condition of those impaired beaches. This project would allow DEC to evaluate the beaches and determine if the impairments still exist or if the beaches could be removed from the impaired list under the CWA. DEC will use a literature review, Gulf Watch data, SCAT surveys, and development of a lingering oil listing methodology to evaluate the status of the impaired beaches.

The impaired beaches are the only waters currently designated and listed by State as impaired from the Exxon Valdez spill. Initially, these beaches were listed as Category 5 (impaired waters) in accordance with section 303(d) of the CWA. In 1996, the beaches were reclassified off the 303(d) list as Category 4b (impaired waters with a recovery plan) because of the restoration efforts identified in the 1994 *Exxon Valdez* Oil Spill Plan (Restoration Plan).

Recent studies indicate that key injured resources are no longer negatively affected by the lingering oil that remains in the substrate of certain beaches. In 2015, passive samplers were deployed in the intertidal zone of one of the most contaminated beaches; no *Exxon Valdez* oil was detected leaching into the marine water. The study concludes that remaining lingering oil (still largely in an un-

weathered state) remains sequestered in the subsurface and is not biologically available. The population of target species, such as harlequin ducks and sea otters, between oiled and unoiled sites are now similar, indicating recovery from long-term effects of the spill. The recovery of injured resources and sequestered oil may justify the removal of the impaired status of some of the beaches.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Do not fund	Do not fund	Do not fund	Fund

Science Panel Comments

Date: May 2021

This project is necessary to collect data needed to determine if impairments remain, develop the tools necessary to manage the impaired beaches for the long term, and to solicit public input regarding the impacts of long term impairment status. The objectives of this study are to: 1) determine the current status of impaired beaches, 2) update the Clean Water Act status of impaired beaches, and 3) stakeholder involvement.

The PI proposes to look for water impairment in the literature. However, recent water quality data (post-spill years) are probably not available. The PI would have to show that classifications are established in order to even fully evaluate this proposal. Previous studies using passive samplers (SPMDs) in pits dug on beaches showed PAHs, but none were observed on the surface where no pits were dug. Perhaps once mussel exposure to oil is established in the Lingering Oil proposal (project 222200114-P), this proposal could be considered.

External reviews have serious concerns that this project is something that ADEC does as part of their normal function. EVOSTC cannot fund any projects that fall under normal activities of government agencies and as such, this project does not appear to qualify for funding.

PI response:
While reviewing waterbodies for attainment of water quality standards is within DEC's agency responsibility, reviewing decades of research spent overseeing the restoration of the EVOS injured ecosystem far exceeds DEC's normal responsibility. As a direct result of the spill state and federal agencies have been burdened by financial and regulatory requirements to address impacts without additional resources being provided. Recovery of EVOS impacts overwhelms the normal requirements for state and federal agencies and have been considered by EVOSTC for funding previously.

In 1990, EVOS impacted beaches were listed by DEC as water quality impaired for petroleum under the Clean Water Act Section 303(d). To remove or reclassify these waters DEC must address the original impairment identified. While we have the authority to develop new regulations and listing methodologies for sediment, but this will not address the original impairment to water quality. Reviewing and updating water quality impairments allows for the State of Alaska and EPA to formally acknowledge recovery. Which in turn recognizes that designated uses are being achieved

and allows for the full use of resources. Reclassification of waters will address a disconnect with EVOS recovered resources and State of Alaska impaired waters.

Integrated Reporting occurs on a biennial cycle, the lack of a publicly approved methodology has prevented DEC from considering EVOS impaired beaches each cycle. Work under this proposal would create a listing methodology that addresses where lingering oil is projected to remain, bioavailability of that oil, effects on subsistence and harvest of resources in line with state and federal requirements. DEC would then be able to utilize the listing methodology in future Integrated Report cycles more readily. The listing methodology and impairment determinations may serve as model to other coastal states that experience oil spills and similarly struggle with applying Clean Water Act requirements to determine the status of their waterbodies.

Date: September 2021

The PI did not adequately respond to the critical reviews of the proposal. All of the criticism initially put forth still exists and PI responses have not changed that. The proposal was not revised to address comments or concerns.

Developing current assessments of beach impairment cannot be accomplished using historical data from the EVOS from ~30 years ago. This approach would only be useful if up to date data existed on beach impairment in the spill zone. Since no oil is visible on beaches where lingering oil has been documented, it is not clear how recent information would even be obtained without detailed studies in the spill zone. This would not just be an analysis of sediments for EVO, but the health and tissue chemistry of organisms on these beaches. The lingering oil efforts supported by EVOSTC has been extremely limited to a handful of sites, the oil is buried, and there is no information that organisms at these sites are impacted. As such, an inventory of impaired beaches from EVO seems not possible; therefore, we do not recommend funding.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

The PIs are highly qualified to accomplish the work. However, I recognize and concur with the concerns of the Science Panel. If the Trustees fund this project, I suggest that the funding is contingent on revising the proposal and adequately addressing reviewer comments.

Project Number: **22220503**

Project Title: Alutiiq Museum & Archaeological Repository Sustainability Project

Primary Investigator(s): April Counceller

PI Affiliation: Alutiiq Museum & Repository (AMAR) **Project Manager:** DCCED

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$4,666,847	$1,828,290	$1,504,863	$0	$0	$8,000,000

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$1,000,000	$800,000	$1,096,453	$0	$0	$2,896,453

Total Past EVOSTC Funding Authorized (FY12-22): $4,666,847

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $6,495,137

Total Non-EVOSTC Funding (FY12-23): $1,800,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 03.29.2021, budget updated 04.15.2021.*

The Alutiiq Museum & Archaeological Repository (AMAR) requests $8,000,000 to purchase and renovate Kodiak's Alutiiq Center. This project will expand education and repository spaces and install energy-saving, environmentally superior technologies to support efficient, sustainable collections care and program operations. This facility project is proposed under the General Restoration's Management of Human Use focus area, seeking to protect and restore subsistence practices and resources of the Alutiiq people. It will ensure AMAR remains a permanent, valuable resource for the community and the State of Alaska. Founded in 1995 following EVOSTC funding through Kodiak Area Native Association, AMAR is a public, non-profit, organization. It is nationally and state accredited as a research and exhibit institution, collections repository, and community education center that preserves, restores, and shares Alutiiq heritage and culture. AMAR has overflowed its original footprint after 25 years of program evolution and collections growth, providing public education, documenting archaeological sites, and reducing site vandalism and cultural degradation. AMAR now leases additional space to advance its mission.

As promised in 1993 when EVOSTC funded AMAR construction to facilitate systemic documentation of spill injured sites and artifact collections, AMAR has become the focal point for research by universities, Native organizations, and government agencies, as well as a regional repository for artifacts and documentation on injured sites. The impetus to establish AMAR was to ensure Alutiiq

artifacts remain accessible to the Kodiak Alutiiq Nation and its ten federally-recognized tribes who have lived on Kodiak for over 7,000 years. This commitment continues. Additionally, AMAR has conducted extensive work to preserve the Traditional Ecological Knowledge (TEK) about Alutiiq subsistence practices—a resource EVOSTC recognizes has not recovered. AMAR facility development will better accommodate culture-bearers and empower the tribal community toward long-term sustainability of vital preservation, research, and education—rekindling TEK practices that otherwise may be lost.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

This is a well-written and organized proposal which would improve restoration and preservation of injured archaeological resources. This project would be led by a highly-qualified senior management team is excellent and the organization is sound. The Alutiiq Museum is nationally recognized and has documented and protected 688 archaeological sites in Kodiak.

Project Number: **22220505**

Project Title: Chugach Region Archaeological Repository and Museum

Primary Investigator(s): Lauren Johnson

PI Affiliation: Chugach Heritage Foundation **Project Manager:** DCCED

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$1,139,023	$2,914,360	$2,183,853	$468,346	$137,095	$6,842,677

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$2,200,000	$300,000	$300,000	$250,000	$250,000	$3,300,000

Total Past EVOSTC Funding Authorized (FY12-22): $1,139,023

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $4,053,383

Total Non-EVOSTC Funding (FY12-23): $2,500,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.16.2021.*

Chugach Heritage Foundation (CHF) is requesting $7.5 million in funding to administer and operate a consolidated repository (facility) located in Anchorage, Alaska to serve as a single consolidated repository for Chugach Artifacts from the EVOS Oil Spill Area. The facility will provide industry standard controls to be used for archival, display and educational purposes of these artifacts. Further, there will be a system to digitize and make information available as necessary to provide management of these critical resources. Currently these Native Artifacts are stored in boxes at a mid-town location in Anchorage. They are at risk of being damaged and are not able to be shared with CAC Shareholders or residents.

The CAC's shareholder community and the Prince William Sound region was the most devastated by the Exxon Valdez Oil Spill. Losses in the Oil Spill Affected Area include damage to our archaeological resources, a non-renewable resource that cannot be recovered as with most other resources.

The EVOSTC approved a resolution in 1997 to provide $2.8m in funds for archaeological repositories in the Chugach Region. The funds were used to build and operate display facilities in each community for 20 years. This original approach to archaeological resources did not consider a consolidated, collaborative approach to managing these artifacts and resources for the long-term benefit of the Chugach region or the greater public. Thirty-two years after the oil spill, and

archaeological repository and museum to properly archive and care for these cultural collections would provide the best possible case for the highest level of recovery of our archaeological resources that were damaged by the EVOS.

Following this project, the CAC intends to continue to seek funding to expand the facility to allow for other restoration and innovative services for the CAC Shareholders and community residents impacted by the oil spill.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Defer to Council	Fund

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I appreciate that the PI responded to the reviewer comments and provided additional information and updated plans. The revised proposal also included a reduction in the proposed budget.

Project Number: **22220507**

Project Title: PGC General Restoration & Habitat Protection Project

Primary Investigator(s): Steve Colligan

PI Affiliation: Port Graham Corporation **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$2,652,396	$1,485,496	$925,504	$1,092,000	$990,895	$7,146,292

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $2,895,030

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $4,380,526

Total Non-EVOSTC Funding (FY12-23): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.20.2021, budget updated 08.19.2021.*

Port Graham Corporation (PGC) is located on the tip of the Kenai peninsula at the sea-bound entry to Cook Inlet. PGC lands encompass high mountain vistas, tidewater and massive glaciers, deep fjords, protected bays and inlets, and an abundance of marine mammals, fish, shellfish, birds and plants, all vital to the people that live on these lands. Access from major population also makes this region a destination for many visitors and user groups. This project will create the tools and infrastructure necessary for PGC to protect subsistence areas, restore resources and services, and protect and enhance critical habitats injured by the 1989 Exxon Valdez Oil Spill (EVOS). As one of the largest landowners in the oil spill affected area, all of the approximately 200 miles of coastline habitat owned and managed by PGC was injured by the Spill. PGC is requesting $7.5M to work in partnership with 3GLP/E-Terra to preserve important land records located in village archives, audit and correct parcel ownership records, collect detailed data to support PGC infrastructure maintenance and development, compile a PGC region-wide base map and records system that meets or exceeds national map standards and invest in facilities that will redirect human use from impacted critical habitats and support other research or restoration activities. Establishing a baseline of data for impacted areas is essential in developing ecosystem wide management plans that continue to provide resources and services to not only PGC shareholders, but also other user groups. This project will benefit multiple species and services considered injured because of the spill. Over a 5 year period PGC and partners will train and utilize local workforce resources to implement tasks

associated with goals. This proposal includes funds necessary to develop data acquisition and management to monitor and enhance habitat on spill damaged PGC land.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Defer to Council	Fund Reduced

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

It is noted that there were questions by individual PAC members as to how this project will benefit injured resources and specific products that would be available. Steve Colligan (PI) was asked to clarify this during the meeting. Jon Shepard (PI) also contributed to the conversation. Emphasis by a PAC member that these data are managed by the Data Management Program. This was confirmed by the ED.

Executive Director Comments

Date: October 2021

I acknowledge the questions that were raised by individual PAC members. This project would occur on private lands but the PIs are committed to adhering to Council's data policy and data management services for this project are included in the Data Management Program which gives confidence that the appropriate data will be archived and publicly available. This is also a large funding request and it remains unclear how this work would necessarily restore habitat.

Note: At the October 13, 2021 meeting, the Trustees approved funding this project contingent on the removal of Objective 2 (cabin electrification work).

Project Number: 24220508

Project Title: Standardized, High-Resolution, Geospatial Wetlands and Hydrography Data Across the EVOS Region

Primary Investigator(s): Sydney Thielke, Leslie Jones, Brian Wright

PI Affiliation: USFWS, ADNR, USGS **Project Manager:** USFWS, ADNR, USGS

This project submitted a budget reallocation proposal for review, which requested to use $1,000,448 in unspent funds due to extremely competitive contract pricing, to update modeling of older data from hydrological units in the spill area.

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$3,647,776	$32,921	$32,921	$32,921	$0	$3,746,540

See FY21 Work Plan for FY17-21 funding history - Project 21210129.

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$25,596	$25,596	$25,596	$25,596	$0	$102,384

Total Past EVOSTC Funding Authorized (FY12-22): $7,517,776

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $7,550,697

Total Non-EVOSTC Funding (FY12-23): $51,192

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.13.2021.*

This is an extension of the project, Standardized High-Resolution Wetlands and Hydrography Data across the EVOS Region, funded by the EVOSTC for FY2021 to produce wetland and hydrologic data for EVOS region watersheds. Continuous coverage of high-resolution NWI and NHD products do not exist for the EVOS region, yet these data are critically important for continued management and recovery of injured resources and services. This proposal requests $3.7 million to update wetlands mapping across 17 million acres (including the lower Copper River and Bering Glacier watersheds), update hydrography mapping on 2.5 million acres of the Bering River watershed, and collect 670,000 acres of LiDAR data to enhance wetland mapping in the Copper River Delta. The final products will be integrated into statewide databases, compliant with national standards, and publicly available.

The NWI provides the location, characteristics and extent of wetlands, intertidal, and nearshore marine habitats. The NHD characterizes water drainage networks, including features such as rivers, streams, lakes, ponds, glaciers, and watersheds. The NWI and NHD are used, where available in

Alaska, for habitat management, species assessments (including anadromous waters), and to make informed decisions about development activities. The data serve as baseline geospatial information needed to monitor aquatic and wetland dependent species, including those that move between freshwater and marine habitats such as salmon and migratory birds. This includes providing information about coastal wetlands and the contribution of freshwater inputs to estuarine and nearshore habitats. This proposal will provide geospatial data that can be used to assess intertidal systems, from the headwater inputs to marine interface, that support habitat for injured species and injured subsistence and recreation activities.

Funding Recommendations (January 2024):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Defer to Council	Fund

Science Panel Comments

Date: January 2024

Did not review.

PAC Comments

Date: January 2024

Excerpt from Draft Meeting Notes: Vice Chair Stekoll asked how much would it cost for the additional 3DHP data to make all the data consistent? Varela answered that she did not have an estimate. The request is to have the funds available to request contract bids, and they could see pricing in the proposals received. If the funds are not enough to cover all three areas, they can try to improve the data in as many areas as possible. All three areas were included in the original geographic area and scope of the project. The new data would be more intricate and connect data features in a more detailed way, using elevation and three-dimensional landscape information. Trustee Sara Taylor added that the request is well within the scope of the original proposal, and it normally would not come back for approval, but it did so because of the large amount of the savings. She stated that the budget reallocation is an opportunity that fits within the original proposal and would be a bonus. Whissel moved to approve the hydrology budget reallocation, and Bauer seconded the motion. Whissel appreciated the explanation given and commented that it seems like a good idea to use the savings to considerably increase the value of work being done. He asked if the proposal met the criteria for projects that need to be scoped publicly? Wang stated that the Trustees did not think it was necessary to put the proposal out for public comment. Stekoll asked what is being reallocated and if it is a reallocation? Wang answered that there were extra funds due to savings from competitive contract bidding. They need approval to let the PIs use the savings for something else. Whissel asked for a breakdown of project budget modifications and where did the extra money come from? He commented that he would not be doing his job without having more information, but he would like to see the project gain value. Varela answered that the PI submitted that information in the proposal, and the $1 million came from a line item for contracting, which they propose to spend on contracting. They requested to carry over the funds from one year to another, and the magnitude of the amount required Trustee Council action. Whissel said he had no issue with that, and Wang clarified it was not an extension, but because the amount exceeded the

10% cutoff in their policies, the request is up for Council review to use the money for something that was not specified in the original proposal, but which does not change the original scope. Stekoll noted his concerns about the current budget shortfalls and that any funds that can be put back would be helpful. He asked if it would be more beneficial to return the $1 million to the research subaccount than to fund this particular item? After no further discussion, PAC members took a roll call vote. Five members voted yes, Stekoll voted no, and Skladal did not vote. The motion passed.

Executive Director Comments

Date: January 2024

While the proposed reallocation to update older modeling of data is worthwhile, the amount available is not insignificant and could be returned to the research subaccount to earn potential investment income and/or reallocated to long-term research and monitoring projects that will be affected by the upcoming shortfall in research funding.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Defer to Council	Fund

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

The Council funded the first 1/2 of this project for FY21 and suggested the PIs to submit a proposal for the second 1/2 of the project.

Habitat Enhancement Project Descriptions

Project Number: **23230602**

Project Title: Kenai Peninsula Streambank Rehabilitation & Protection

Primary Investigator(s): Jessica Johnson

PI Affiliation: ADF&G/Sport Fish **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$395,796	$0	$0	$0	$395,796

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$209,840	$0	$0	$0	$209,840

Total Past EVOSTC Funding Authorized (FY12-22): $0

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $395,796

Total Non-EVOSTC Funding (FY12-23): $209,840

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.12.2021, budget updated 08.12.2021.*

The Alaska Department of Fish and Game (ADF&G) will partner with the United States Fish and Wildlife Service (USFWS), Kenai Soil and Water Conservation District (KSWCD), Alaska State Parks, local governments, and private landowners to locate, assess, and prioritize sites and install restoration and rehabilitation projects over a three-year period. Projects on public lands will be funded with EVOS funds via ADF&G and projects on private land will be funded with a mix of EVOS and USFWS Partners for Fish and Wildlife Program funding via KSWCD. This structure is already in use on the Kenai Peninsula for streambank habitat projects. ADF&G and USFWS staff will provide technical and design assistance and on-the-ground project construction oversight. ADF&G and USFWS staff will also provide outreach and education to agencies and the public through presentations, consultations, site visits, and an annual 2-day hands-on workshop. KSWCD will provide administrative support including coordinating with partners, processing cost-share payments to landowners, and assisting with outreach and education. This project will benefit the EVOS impacted species sockeye salmon, pink salmon, and Dolly Varden as well as Chinook and coho salmon and will help maintain fish populations for recreational, commercial, and subsistence fisheries.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

This project proposes to expand the stream bank restoration program through a cost sharing program on privately owned lands on the Kenai Peninsula. If funded, this project would be used to leverage additional projects including some on public lands.

Project Number: **22220608**

Project Title: Port Graham Habitat Enhancement

Primary Investigator(s): Jon Shepard, Kyle Graham, Nathan Lojewski, Patrick Norman

PI Affiliation: PGC, USFWS, Chugachmiut, Native Village of Port Graham

Project Manager: USFWS, ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$2,000,000	$1,500,000	$1,500,000	$1,000,000	$679,087	$6,679,087

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$450,000	$1,767,376	$1,767,376	$0	$0	$3,984,752

Total Past EVOSTC Funding Authorized (FY12-22): $2,000,000

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $3,500,000

Total Non-EVOSTC Funding (FY12-23): $2,217,376

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 03.29.2021 budget updated 04.12.2021.*

Located on the western edge of the lower Kenai Peninsula is the community of Port Graham, the ancestral inhabitants of the Kenai Fjords and a thriving coastal culture. The Port Graham area boasts abundant marine mammals, fish, shellfish, birds and plants that remain vital to the residents of Port Graham and the surrounding villages. The focus of this proposal is an extensive road network that was constructed in the Port Graham, Windy, and Rocky River watersheds as part of logging projects from the 1960's to 2004. Many of the stream crossings were constructed with log stringer bridges that have failed and resulted in degraded habitat or with undersized culverts that have become barriers to EVOS-injured resident and anadromous fish species. This project will improve fish passage, restore degraded stream crossings and permanently protect stream crossings from future degradation.

In this proposal, partners including Port Graham Corporation, Native Village of Port Graham Chugachmiut, and the U.S. Fish and Wildlife Service (USFWS) propose addressing 24 stream crossings that impede fish passage or have resulted in degraded spawning and rearing habitat for EVOS-injured fish species. Additionally, repairing impassable stream crossings will provide critical access to subsistence resources in Windy and Rocky Bay for the residents of Port Graham, provide

access to road maintenance equipment to conduct regular road maintenance, protect the commercial fisheries in Rocky, Windy, and Port Graham River watersheds, and provide access to recreational opportunities in the area such as sport fishing, hunting, and wildlife viewing.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Defer to Council	Fund Reduced

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I recognize and appreciate the proposer's responses to all of the reviewers' comments. I also appreciate that the PIs reached out to the Alaska Sealife Center. This collaboration effort resulted in a productive discussion about how proposal 22220400 could support remote communities such as Port Graham. There are some details that still require some clarification such as the number or locations of culvert replacement work that should be clarified in order to assess the proposal more fully. I defer my recommendation to the Trustees.

Note: At the October 13, 2021 meeting, the Trustees approved funding for this project contingent on the removal of the culvert work in a revised proposal and budget.

Project Number: **22220610**

Project Title: Kenai Peninsula Stream Watch

Primary Investigator(s): Brandon Drzazgowski

PI Affiliation: Kenai Watershed Forum **Project Manager:** ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$109,343	$102,067	$102,067	$94,791	$87,515	$495,784

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $208,873*
**Includes $99,500 from Project 18180117, FY18*

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $310,910

Total Non-EVOSTC Funding (FY12-23): $125,500

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 03.29.2021, budget updated 04.12.2021.*

Kenai Watershed Forum (KWF) proposes to expand the highly successful, national award-winning Stream Watch volunteer program as a continuation of an Exxon Valdez Oil Spill Trustee Council (EVOSTC) investment in 2018. KWF expanded the program into the southern Kenai Peninsula initially in 2018 to implement Stream Watch volunteer driven river stewardship and education at extreme-high use recreational and fishing sites in the area. This proposal seeks to build on the initial success of the EVOSTC funded expansion for an additional five years. The proposed project will not only support existing efforts, but amplify prior investments, enable KWF to leverage additional funds, and ensure the long-term restoration of injured natural resources and services in the northern part of the Exxon Valdez oil spill (EVOS) affected area. The proposed project will support the personnel, travel, and supplies needed to implement five seasons of protecting, restoring, and enhancing critical riparian habitat on the Southern Kenai Peninsula, laying a foundation for future success of the program in the area. EVOSTC investment in Stream Watch would also provide meaningful service, leadership, and educational opportunities in local communities.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund	Fund

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

The proposed project will continue to accomplish significant restoration of key salmon streams, their mouths, and coastal beached on the Kenai. Costs are relatively low for what they will achieve. KWF will be able leverage additional funding with Council-support. The Council invested in the Stream Watch Program in 2018 and 2019 and was able to increase volunteer engagement by 20% from 2016 and 2017. More specifically, funds from the Council helped facilitate a 95% increase in the quantity of fish and wildlife endangering debris removed from riparian and coastal habitats from 5,523 pounds in 2016 and 2017 combined to 10,785 pounds in 2018 and 2019 combined. This project includes many laudable objectives including the support of at least 60 volunteers annually to participate in the program.

Project Number: **22220611**

Project Title: Big Eddy – Restoration and Improvements

Primary Investigator(s): Shannon Martin

PI Affiliation: Kenai River Sportfishing Association

Project Manager: ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$3,434	$3,434	$2,161,350	$2,161,350	$0	$4,329,567

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-22): $3,434

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $6,868

Total Non-EVOSTC Funding (FY12-23): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.20.2021, budget updated 05.04.2021.*

This project proposes to improve the 16.7 acre Big Eddy Day Use Area by restoring and protecting habitat and enhancing recreational and tourism opportunities. The scope of work is divided into three phases as shown in the attached concept site plan. This proposal will fund Phase II, Phase III, and Phase IV. Phase I has already been funded by other parties.

Phase II scope of work includes demolishing over 100 linear feet of existing elevated walkway, 350 square feet of viewing deck, and a set of river access stairs that have surpassed their intended design lives and are in a state of disrepair. 160 feet of next-generation elevated light-penetrating (ELP) walkway with river access stairs will be constructed for river access that protects riparian resources. 150 feet of deteriorating riverbank will be restored using bio-engineered techniques. Additionally, two interpretive signs will be updated under this phase.

Phase III scope of work expands riverbank protection and access opportunities to the greater Big Eddy facility. This phase will construct up to 850 linear feet of new ELP walkway and five sets of river access stairs to disperse use in a managed fashion. A 30-stall parking area will also be constructed away from the riverbank to meet user demand help prevent haphazard in sensitive riparian areas.

The work will also include three interpretive panels to facilitate redirecting human impact and to promote public participation in the long-term success of the project and project objectives.
Phase IV includes paving the 500-foot section of Big Eddy Road that goes through the park unit and the existing gravel parking area. An orientation kiosk will be constructed at the existing parking area to help with site messaging and wayfinding within the facility.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Do Not fund	Fund

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I recognize the habitat enhancement benefits of stream bank restoration. I also note that reviewer comments were not adequately addressed, and the budget increased by $1.5M in the revised proposal but justification was not provided, making it difficult to fully evaluate the proposal. Edit: the additional $1.5M in the revised proposal is due to inclusion of a 40% indirect and associated increase in GA on top of that indirect.

Project Number: **22220612**

Project Title: Eyak Lake Weir Restoration

Primary Investigator(s): Kate Morse, Steve Namitz, Jeff Stutzke

PI Affiliation: CRWP, USFS, AKDOT **Project Manager:** USFS, ADF&G

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$768,889	$4,718,016	$113,745	$106,848	$0	$5,707,498

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$21,180	$16,380	$11,580	$0	$0	$49,140

Total Past EVOSTC Funding Authorized (FY12-22): $768,889

Total EVOSTC Funding Authorized (FY12-22) and Requested (FY23): $5,486,905

Total Non-EVOSTC Funding (FY12-23): $37,560

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.13.2021.*

Eyak Lake is within the Exxon Valdez Oil Spill (EVOS) affected geographic area of concern, situated in the north east corner of the EVOS Area Boundary (Figure 1). It is recognized as ecologically significant by the Alaska Coastal Policy Council as an "Area Meriting Special Attention." The streambanks at the project site and about 17 miles of upstream lake shore are EVOS acquired lands managed by the Forest Service. The habitat of Eyak Lake and its watershed are used by injured resources that include, but are not limited to, Sockeye Salmon, Cutthroat Trout, Dolly Varden, and Pink Salmon. A fifth species, Coho Salmon also uses the habitat offered by the Eyak watershed and all five of these species are targeted by subsistence, commercial and/or recreational harvesters.

Resultant of the 1964 Good Friday earthquake, the surrounding area uplifted by approximately six feet and the lake-level subsided. In 1972 a sheet pile weir was installed at the outlet of Eyak Lake to re-establish the water surface to pre-earthquake levels. The weir is located at the head of the Eyak River, just upstream of the Copper River Highway (Figure 2 and 3). The weir impedes upstream passage of juvenile salmon and other aquatic organisms and has structural concerns with the potential for further adverse effects on the ecosystem if not addressed.

Since the weir was installed, damage to the integrity of the structure has occurred from environmental elements including freeze-thaw events. Additionally, there have been advances in understanding the importance of restoring ecological connectivity and aquatic restoration practices

have evolved since the weir was installed. This proposal seeks to restore upstream aquatic organism passage into the lake, and to preserve and improve the productivity of the salmon and Cutthroat Trout spawning and rearing that the Eyak Lake watershed supports.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Do Not Fund	Fund

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

The primary purpose of this project is to design and construct an improved outlet grade control structure at the outlet of Eyak Lake in Cordova. The project would have benefits for fish passage and maintaining the lake level in Eyak Lake up to 25.92 miles upstream, which is important for sockeye salmon (considered a resource that has met its recovery objectives) spawning and other migratory fish. Recreational access to Eyak Lake would also be enhanced. This project is well-thought out and the PIs are highly capable but it is unclear what the direct connection is to the spill as the project area is in the spill area but was affected by the 1964 earth quake and the weir that was installed in 1972.