Exxon Valdez Oil Spill Trustee Council

DRAFT FY22 – FY31 Work Plan

Fiscal Year 2022

This work plan contains funds approved for FY22 – FY31

Finalized February 15, 2023

This document includes decisions made at the October 13, 2021 and January 18, 2022 Trustee Council meetings.

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EVOSTC Projects
Draft **FY22** Work Plan
Prepared by:
Exxon Valdez Oil Spill Trustee Council

This work plan contains funds approved for FY22 – FY31

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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 FY2022 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

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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/

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

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 2022 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.
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FY22-31 Proposal Funding Recommendations

The funding described in this document is for the EVOSTC Annual Budget, EVOSTC Projects submitted in response to the FY22-26 and FY22-31 Invitations and the ASLC and PWSSC Facilities projects that were not submitted in response to the Invitations. 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

[a]includes funding for FY32-33. [b]PAC approved the FY22-26 budget at their September 2021 meeting. The budget has been updated to include FY27-33. [c]Funding for FY22 was approved at the January 18, 2022 Council meeting.

								FY22-33 Funding Amount Recommended			
Page	**Project Number**	**Principal Investigator**	**Project Title**	**# Years Proposed**	**FY22-26 Requested**	**FY27-33 Requested**	**Total Requested**	**Science Panel**	**PAC**	**Executive Director**	**Trustee Council Approved**
17	22220100	EVOSTC Admin	EVOSTC General Operating Budget	10	$7,553,192	$10,154,064[a]	$17,707,256	Not Applicable	$8,009,881[b]	Not Applicable	$1,497,845[c]

Long-Term Research and Monitoring (LTRM) Program

Page	**Project Number**	**Principal Investigator**	**Project Title**	**# Years Proposed**	**FY22-26 Requested**	**FY27-31 Requested**	**Total Requested**	**Science Panel**	**PAC**	**Executive Director**	**Trustee Council Approved**
20	22200127	Hetrick, Campbell, Baird, Evans	Ocean acidification sampling	3	$34,323	$0	$34,323	$34,323	$34,323	$34,323	$34,323
22	22110853	Kuletz, Kaler, Irons	Pigeon guillemot restoration	13	$95,921	$0	$95,921	$95,921	$95,921	$95,921	$95,921
24	22210128	Hollmen, Labunski et al.	Status and trends of EVOS injured seabirds	5	$1,014,574	$0	$1,014,574	$1,014,574	$1,014,574	$1,014,574	$1,014,574
26	2222LTRM	Lindeberg & Hoffman	Long-Term Research and Monitoring Program (LTRM) – see 2222LTRM table below	10	$25,423,352	$26,070,306	$51,493,658	$50,207,766	$50,207,766	$51,401,161	$32,337,456
140	22220200	Bishop et al.	Pacific sleeper sharks and recovery o EVOS-injured resources in PWS	10	$2,615,612	$2,455,964	$5,071,575	$0	$0	$0	$0
147	22220201	Branson & Hetrick-Price	Chugach Regional Ocean Monitoring Program	10	$2,866,899	$2,899,400	$5,766,299	$1,719,534	$1,719,534	$1,719,534	$5,766,271
154	22220202	Hauri	Continuation and expansion of ocean acidification monitoring	10	$665,100	$658,400	$1,323,500	$1,323,500	$1,323,500	$1,323,500	$1,323,500
158	22220203	Rhea-Fournier et al.	Walleye pollock-Pacific herring interactions	10	$1,946,331	$2,182,986	$4,129,317	$0	$0	$0	$4,129,317
162	22120113	Janzen	Data Management	10	$1,947,961	$1,720,740	$3,668,701	$3,656,295	$3,656,295	$3,656,295	$3,668,701
			LTRM TOTAL		**$36,764,564**	**$35,987,796**	**$72,752,359**	**$58,218,810**	**$58,051,913**	**$59,245,308**	**$48,370,063**

Mariculture

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
168	22220300	Hetrick-Price	PWS kelp mariculture development for habitat restoration and local economy	5	$2,761,472	$0	$2,761,472	$0	$2,761,472	$2,761,472	$2,761,472
181	22220301	Poe et al.	Social, cultural and economic assessment of kelp mariculture opportunities for coastal villages within the EVOS spill zone	5	$3,667,827	$0	$3,667,827	$3,667,827	$3,667,827	$3,667,827	$3,667,827
189	22220302	Hoffman et al.	Sustainable mariculture development for restoration and economic benefit in the EVOS spill area	10	$13,188,075	$13,187,030	$26,375,105	$19,861,664	$13,188,075	$13,188,075	$26,375,105
			MARICULTURE TOTAL		**$19,617,374**	**$13,187,030**	**$32,804,404**	**$23,529,491**	**$19,617,374**	**$19,617,374**	**$32,804,404**

Education and Outreach

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
215	22220400	Wong	Community Organized Restoration and Learning Network	10	$13,616,177	$13,613,642	$27,229,819	$27,229,819	$13,616,177	$27,229,819	$12,499,908
222	22220401	Popovici	EVOSTC Education and Outreach Projects FY22-31	10	$484,881	$398,136	$883,017	$0	$0	$0	$0
225	22220402	Holleman	Sustaining Our Sound: PWS outreach project	10	$204,554	$164,307	$368,860	$0	$0	$0	$0
228	22220403	Twardock	PWS natural history symposium	10	$101,452	$109,790	$211,242	$211,242	$211,242	$211,242	$211,242
230	22220404	Young, Bishop, Hauri	Inspiring Seascapes	10	$1,616,300	$1,848,600	$3,464,900	$3,464,900	$3,464,900	$3,464,900	$0
234	22220405	Johnson	Preservation of subsistence and cultural practices for the Alaska Native people of the Chugach region	10	$1,397,108	$945,848	$2,342,955	$2,342,955	$2,342,955	$2,342,955	$2,342,955
			EDUCATION & OUTREACH TOTAL		**$17,420,472**	**$17,080,323**	**$34,500,793**	**$33,248,916**	**$19,635,274**	**$33,248,916**	**$15,054,105**

General Restoration

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
239	22220500	Hetrick, Suhrbier, Hocking	EVOS spill area clam restoration	5	$729,533	$0	$729,533	$0	$0	$0	$0
249	22220501[a]	Russell	Chenega abandoned vessel removal	1	$114,450	$0	$114,450	NA	$114,450	$114,450	$0
252	22220502	Lomax	Clean Water Act assessment of beaches with lingering oil	4	$658,432	$0	$658,432	$0	$0	$0	$658,432
254	22220503	Counceller	Alutiiq museum & archaeological repository sustainability project	3	$8,000,000	$0	$8,000,000	NA	$8,000,000	$8,000,000	$8,000,000
256	22220504	Wells	Solomon Gulch hatchery coho building replacement	3	$2,274,647	$0	$2,274,647	NA	$2,274,647	$0	$0
258	22220505	Johnson	Chugach region archaeological repository and museum	5	$6,842,677	$0	$6,842,677	NA	$6,842,677	Defer to Council	$6,842,677
260	22220506	Bien	Headwaters to Ocean: Shoreline Stewards	5	$517,666	$0	$517,666	NA	$517,666	$517,666	$0
262	22220507	Moonin	Port Graham Corporation general restoration and habitat protection	5	$7,468,823	$0	7,468,823	NA	7,468,823	Defer to Council	$7,146,292
264	22220508	Thielke	Geospatial wetlands and hydrography data across the EVOS region	4	$3,746,540	$0	$3,746,540	NA	$3,746,540	Defer to Council	$3,746,540
			GENERAL RESTORATION TOTAL		**$30,352,768**	**$0**	**$30,352,768**	NA	**$28,964,803**	**$8,632,116**	**$26,393,941**

[a]Federal Trustees voted to fund this project using settlement funds received in response to the 1991 Exxon Criminal Plea Agreement.

Habitat Enhancement

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
267	22220600	Wells	Robe Lake habitat preservation and rehabilitation	1	$256,893	$0	$256,893	NA	$256,893	$0	$0
269	22220601	Miranda	Alaska State Parks habitat restoration and protection FY22-FY26	5	$5,585,356	$0	$5,585,356	NA	$5,585,356	$5,585,356	$0
271	22220602	Johnson & Mazzacavallo	Kenai Peninsula streambank rehabilitation and protection	1	$395,796	$0	$395,796	NA	$395,796	$395,796	$395,796
273	22220603[a]	Thamm	PWS marine debris remediation project	5	$102,242	$0	$102,242	NA	$102,242	$102,242	$0

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
275	22220604	Eskelin, Gates, Cross	Kenai River coho salmon habitat and fishery assessment	5	$4,525,087	$0	$4,525,087	$0	$4,525,087	$0	$0
278	22220605	Mazzacavallo, O'Doherty, Polum	American River restoration, Kodiak	3	$851,236	$0	$851,236	NA	$851,236	Fund reduced	$0
280	22220606	Olsen	Restoration of marbled murrelet nesting habitat	5	$0	$0	$0	WITHDRAWN BY PROPOSER			
283	22220607	Dekker et al.	Kodiak archipelago fish passage project	5	$8,426,401	$0	$8,426,401	NA	$8,426,401	Fund reduced	$0
285	22220608	Shepard et al.	Port Graham habitat enhancement	5	$7,400,200	$0	$7,400,200	NA	$7,400,200	Defer to Council	$6,679,087
287	22220609	Hanson & Morse	Copper River watershed enhancement - Phase II	5	$9,036,464	$0	$9,036,464	NA	$9,036,464	Fund reduced	$0
289	22220610	Bornemann	Kenai Peninsula stream watch	5	$495,784	$0	$495,784	NA	$495,784	$495,784	$495,784
291	22220611	Fogels	Big Eddy restoration and improvements	4	$4,329,567	$0	$4,329,567	NA	$4,329,567	$0	$4,329,567
293	22220612	Morse, Namitz, Stutzke	Eyak Lake weir restoration	4	$5,707,498	$0	$5,707,498	NA	$5,707,498	$0	$5,707,498
295	22220613	Hanson & Stutzke	Valdez area habitat restoration	5	$8,822,413	$0	$8,822,413	NA	$8,822,413	Fund reduced	$0
297	20200135*	Miranda	Eagle Rock Facility Improvements	5	$6,419,000	$0	$6,419,000	NA	$6,419,000	$6,419,000	$0
HABITAT ENHANCEMENT TOTAL					**$62,353,951**	**$0**	**$62,353,951**	**NA**	**$62,353,951**	**$12,998,178**	**$17,607,732**

*Reauthorization required. [a]Federal Trustees voted to fund this project using settlement funds received in response to the 1991 Exxon Criminal Plea Agreement.

Habitat Protection Projects

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
300	22220700[a]	Lankard	Land appraisal for the retirement of Bering River coal fields parcel	1	$98,100	$0	$98,100	NA	$98,100	$98,100	$0
302	22220701	Kazary & Mitchell	Natives of Kodiak Afognak Island project	4	$10,582,186	$0	$10,582,186	NA	$10,582,186	$10,582,186	$0
304	22220702	Kazary & Mitchell	The City of Kodiak Ram Site project at Fort Abercrombie State Historical Park	5	$7,868,492	$0	$7,868,492	NA	$7,868,492	$7,868,492	$0
306	22220703	Kazary & Mitchell	Koniag, Inc. Women's Bay project	5	$3,354,696	$0	$3,354,696	NA	$3,354,696	$3,354,696	$0
308	KEN 4018*	Kreel	Bookey Parcel	5	$2,300,000	$0	$2,300,000	NA	$2,300,000	$2,300,000	$2,300,000
HABITAT PROTECTION TOTAL					**$24,203,474**	**$0**	**$24,203,474**	NA	**$24,203,474**	**$24,203,474**	**$2,300,000**

*Reauthorization required. [a]Federal Trustees voted to fund this project using settlement funds received in response to the 1991 Exxon Criminal Plea Agreement.

Marine Science Facilities Projects

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
311	19190125	Hoffman	PWSSC Facilities Project	4	$12,113,000	$0	$12,113,000	NR	$12,113,000	$12,113,000	$5,950,000
313	20200131	Riemer	Alaska SeaLife Center Project	1	$2,000,000	$0	$2,000,000	NR	NR	NR	$2,000,000
MARINE SCIENCE FACILITIES PROJECTS TOTAL					**$14,113,000**	**$0**	**$14,113,000**	**NR**	**$12,113,000**	**$12,113,000**	**$7,950,000**

	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
GRAND TOTALS	$212,224,290	$76,409,213	$288,633,501	$114,830,320	$232,949,656	$170,058,366	$151,978,090

2222LTRM: Long-Term Research and Monitoring Program Projects

(Gulf Watch Alaska and Herring research proposals)

The funding described in this document is for EVOSTC Projects submitted in response to the FY22-26 and FY22-31 Invitations. 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.

The total for these projects can be found under 2222LTRM in the FY22-31 Proposal Funding Recommendations Table (pg. 1)

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
26	2222LTRM	Lindeberg et al.	GWA LTRM Program Integrated Management*	10	$3,703,555	$5,014,804	$8,718,359	$8,718,359	$8,718,359	$8,718,359	$708,752
32	22220114-A-B	*Costs shown above reflect the cost for 22220114-A-B integrated into 2222LTRM. FY22 was approved for funding at the January 18, 2022 Council meeting.						-	-	-	-
37	22160111-B	Cypher & Bishop	Annual herring migration cycle	5	$526,398	0	$526,398	$526,398	$526,398	$526,398	$0
41	22120111-C	Branch	Modeling and stock assessment of PWS herring	10	$765,536	$897,219	$1,662,756	$1,662,756	$1,662,756	$1,662,756	$1,662,756
47	22120111-E	Hershberger	Herring disease program	10	$1,750,655	$2,022,436	$3,773,091	$3,773,091	$3,773,091	$3,773,091	$3,773,091
52	22160111-F	Haught	Herring surveys and age, sex, and size collection and processing	10	$928,097	$980,203	$1,908,299	$1,908,299	$1,908,299	$1,908,299	$1,908,299
55	22120111-G	Rand	Adult herring acoustic surveys in PWS	10	$433,099	$431,300	$864,400	$864,400	$864,400	$864,400	$0
58	22170115	Whitehead & Hershberger	Genetic and physiological mechanisms of virus and oil interactions in herring	8	$1,071,812	$1,008,939	$2,080,751	$2,080,751	$2,080,751	$2,080,751	$0
62	22220111-H	Cypher	Herring larval growth in PWS	8	$504,585	$1,105,394	$1,609,979	$1,609,979	$1,609,979	$1,609,979	$0
69	22220111-I	Rand et al.	Ecological interactions between Pacific herring and Pacific salmon in Prince William Sound, Alaska	8	$1,737,212	$339,209	$2,076,422	$2,076,422	$2,076,422	$2,076,422	$2,076,422
74	22220111-J	Pegau	Herring workshops	6	$134,288	$109,927	$244,215	$134,288	$134,288	$134,288	$0
79	22220111-K	Pegau	Aerial forage fish surveys	10	$271,138	$308,034	$579,172	$157,505	$157,505	$157,505	$0
84	22220111-L	This proposal was integrated with 22220111-I.									

Page	Project Number	Principal Investigator	Project Title	# Years Proposed	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
87	22120114-C	Arimitsu & Piatt	Forage Fish Distribution, Abundance, and Body Condition	10	$1,688,950	$1,869,240	$3,558,190	$3,558,190	$3,558,190	$3,558,190	$3,558,190
93	22120114-D	Ostle & Batten	Continuous Plankton Recorders	10	$449,884	$508,988	$958,871	$958,871	$958,871	$958,871	$958,871
96	22120114-E	Bishop & Schaefer	Seabird Abundance in Fall and Winter	10	$706,010	$799,204	$1,505,215	$1,505,215	$1,505,215	$1,505,215	$0
101	22120114-G	Campbell	Oceanographic Conditions in PWS	10	$1,312,836	$1,485,336	$2,798,172	$2,798,172	$2,798,172	$2,798,172	$2,798,172
105	22120114-H	Coletti	Nearshore ecosystems the Gulf of AK	10	$3,312,453	$3,183,914	$6,496,367	$6,496,367	$6,496,367	$6,496,367	$6,496,367
108	22120114-I	Danielson	GAK1 Monitoring	10	$857,971	$840,722	$1,698,693	$1,698,693	$1,698,693	$1,698,693	$1,698,693
111	22120114-J	Holderied & Baird	Oceanographic Monitoring in Cook Inlet/Kachemak Bay	10	$927,274	$1,048,942	$1,976,216	$1,976,216	$1,976,216	$1,976,216	$0
115	22120114-L	Hopcroft	Seward Line Monitoring	10	$1,211,529	$926,886	$2,138,414	$2,138,414	$2,138,414	$2,138,414	$2,138,414
119	22120114-M	Kuletz & Kaler	PWS Marine Bird Surveys	10	$1,033,467	$1,024,843	$2,058,310	$2,058,310	$2,058,310	$2,058,310	$2,058,310
124	22120114-N	Matkin	Long-term killer whale monitoring	10	$1,159,253	$1,193,395	$2,352,648	$1,159,253	$1,159,253	$2,352,648	$213,302
132	22120114-O	Moran & Straley	Humpback Whale Predation on Herring	10	$1,015,639	$1,102,683	$2,118,322	$2,118,322	$2,118,322	$2,118,322	$2,118,322
136	22200114-P	Esler & Lindeberg	Lingering Oil Component Project	2	$124,042	$45,453	$169,495	$169,495	$169,495	$169,495	$169,495

	FY22-26 Requested	FY27-31 Requested	Total Requested	Science Panel	PAC	Executive Director	Trustee Council Approved
LTRM (GULF WATCH ALASKA AND HERRING RESEARCH AND MONITORING) TOTAL	$25,625,683	$26,247,071	$51,872,755	$50,147,766	$50,147,766	$51,341,161	$32,337,456

Program and Project Funding by Fiscal Year (2022 – 2026)

This table provides funding amounts <u>requested</u> for each fiscal year. The current fiscal year for this annual work plan is indicated below. The funding described in this document is for EVOSTC Projects submitted in response to the FY22-26 and FY22-31 Invitations. 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. Page numbers are incorrect and will be updated after the January 18, 2022 meeting.

Trustee Council Administration

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total <u>Requested</u>
17	22220100	EVOSTC Admin	EVOSTC General Operating Budget	$1,497,845	$1,486,546	$1,580,495	$1,448,037	$1,540,269	$7,553,192

Long-Term Research and Monitoring (LTRM) Program

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total <u>Requested</u>
20	22200127	Hetrick, Campbell, Baird, Evans	Ocean acidification sampling	$34,323	$0	$0	$0	$0	$34,323
22	22110853	Kuletz, Kaler, Irons	Pigeon guillemot restoration	$47,361	$48,560	$0	$0	$0	$95,921
24	22210128	Hollmen, Labunski et al.	Status and trends of EVOS injured seabirds	$289,810	$294,894	$252,595	$177,274	$0	$1,014,574
26	2222LTRM	Lindeberg & Hoffman	Long-Term Research and Monitoring Program (LTRM) – see 2222LTRM table below	$4,544,764	$5,213,091	$5,042,190	$5,324,140	$5,299,171	$25,423,352
140	22220200	Bishop et al.	Pacific sleeper sharks and recovery o EVOS-injured resources in PWS	$440,823	$504,284	$463,068	$606,643	$600,793	$2,615,611
147	22220201	Branson & Hetrick-Price	Chugach Regional Ocean Monitoring Program	$672,345	$529,451	$517,738	$558,054	$589,310	$2,866,898
154	22220202	Hauri	Continuation and expansion of ocean acidification monitoring	$157,100	$138,800	$120,900	$123,400	$124,900	$665,100
158	22220203	Rhea-Fournier et al.	Walleye pollock-Pacific herring interactions	$363,390	$439,448	$397,465	$294,421	$451,606	$1,946,330
162	22120113	Janzen	Data Management	$379,716	$381,426	$411,819	$401,524	$373,476	$1,947,961
			LTRM TOTAL REQUESTED	**$6,929,632**	**$7,549,954**	**$7,205,775**	**$7,485,456**	**$7,439,256**	**$36,610,073**

Mariculture

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total Requested
168	22220300	Hetrick-Price	PWS kelp mariculture development for habitat restoration and local economy	$808,445	$614,545	$588,385	$621,085	$129,013	$2,761,473
181	22220301	Poe et al.	Social, cultural and economic assessment of kelp mariculture opportunities for coastal villages within the EVOS spill zone	$829,772	$668,224	$727,174	$775,129	$667,528	$3,667,827
189	22220302	Hoffman et al.	Sustainable mariculture development for restoration and economic benefit in the EVOS spill area	$2,637,792	$2,637,726	$2,637,783	$2,637,489	$2,637,285	$13,188,075
			MARICULTURE TOTAL REQUESTED	**$4,276,009**	**$3,920,495**	**$3,953,342**	**$4,033,703**	**$3,433,826**	**$19,617,375**

Education and Outreach *revised proposal amounts in response to decisions made at the October 13, 2021 meeting

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total Requested
215	22220400	Wong	Community Organized Restoration and Learning Network*	$2,498,550	$2,508,119	$2,444,292	$2,445,434	$2,603,513	$12,499,908
222	22220401	Popovici	EVOSTC Education and Outreach Projects FY22-31	$67,408	$113,270	$115,800	$88,277	$100,125	$484,880
225	22220402	Holleman	Sustaining Our Sound: PWS outreach project	$59,242	$51,476	$30,908	$30,908	$32,020	$204,554
228	22220403	Twardock	PWS natural history symposium	$24,738	$19,179	$19,179	$19,179	$19,179	$101,454
230	22220404	Young, Bishop, Hauri	Inspiring Seascapes	$318,700	$303,200	$323,400	$331,400	$339,600	$1,616,300
234	22220405	Johnson	Preservation of subsistence and cultural practices for the Alaska Native people of the Chugach region	$640,430	$189,170	$189,170	$189,170	$189,170	$1,397,110
			EDUCATION & OUTREACH TOTAL REQUESTED	**$3,609,068**	**$3,184,414**	**$3,122,749**	**$3,104,368**	**$3,283,607**	**$16,304,206**

General Restoration *revised proposal amounts in response to decisions made at the October 13, 2021 meeting

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total Requested
239	22220500	Hetrick, Suhrbier, Hocking	EVOS spill area clam restoration	$223,084	$148,693	$114,516	$110,689	$132,552	$729,534
249	22220501	Russell	Chenega abandoned vessel removal	$114,450	$0	$0	$0	$0	$114,450
252	22220502	Lomax	Clean Water Act assessment of beaches with lingering oil	$0	$138,740	$215,778	$178,684	$125,230	$658,432
254	22220503	Counceller	Alutiiq museum & archaeological repository sustainability project	$4,666,847	$1,828,290	$1,504,863	$0	$0	$8,000,000
256	22220504	Wells	Solomon Gulch hatchery coho building replacement	$132,298	$179,194	$1,963,156	$0	$0	$2,274,648
258	22220505	Johnson	Chugach region archaeological repository and museum	$1,139,023	$2,914,360	$2,183,853	$468,346	$137,095	$6,842,677
260	22220506	Bien	Headwaters to Ocean: Shoreline Stewards	$106,076	$104,046	$98,351	$105,682	$103,511	$517,666
262	22220507	Moonin	Port Graham Corporation general restoration and habitat protection*	$2,652,396	$1,485,496	$925,504	$1,092,000	$990,895	$7,146,292
264	22220508	Thielke	Geospatial wetlands and hydrography data across the EVOS region	$3,647,776	$32,921	$32,921	$32,921	$0	$3,746,539
			GENERAL RESTORATION TOTAL REQUESTED	**$12,924,584**	**$6,860,625**	**$7,056,273**	**$1,988,322**	**$1,489,283**	**$30,030,238**

Habitat Enhancement *revised proposal amounts in response to decisions made at the October 13, 2021 meeting

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total Requested
267	22220600	Wells	Robe Lake habitat preservation and rehabilitation	$256,893	$0	$0	$0	$0	$256,893
269	22220601	Miranda	Alaska State Parks habitat restoration and protection FY22-FY26	$100,787	$176,688	$165,135	$175,405	$4,967,341	$5,585,356
271	22220602	Johnson & Mazzacavallo	Kenai Peninsula streambank rehabilitation and protection	$0	$395,796	$0	$0	$0	$395,796
273	22220603	Thamm	PWS marine debris remediation project	$21,146	$20,274	$20,274	$20,274	$20,274	$102,242

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total Requested
275	22220604	Eskelin, Gates, Cross	Kenai River coho salmon habitat and fishery assessment	$202,029	$548,121	$1,166,695	$1,310,462	$1,297,780	$4,525,087
278	22220605	Mazzacavallo, O'Doherty, Polum	American River restoration, Kodiak	$821,424	$22,073	$7,739	$0	$0	$851,236
280	22220606	Olsen	Restoration of marbled murrelet nesting habitat – WITHDRAWN BY PROPOSER	$0	$0	$0	$0	$0	$0
283	22220607	Dekker et al.	Kodiak archipelago fish passage project	$8,076,685	$102,396	$88,873	$76,570	$81,876	$8,426,400
285	22220608	Shepard et al.	Port Graham habitat enhancement*	$2,000,000	$1,500,000	$1,500,000	$1,000,000	$679,087	$6,679,087
287	22220609	Hanson & Morse	Copper River watershed enhancement - Phase II	$8,409,102	$168,525	$152,150	$153,965	$152,722	$9,036,464
289	22220610	Bornemann	Kenai Peninsula stream watch	$109,343	$102,067	$102,067	$94,791	$87,515	$495,783
291	22220611	Fogels	Big Eddy restoration and improvements	$3,434	$3,434	$2,161,350	$2,161,350	$0	$4,329,568
293	22220612	Morse, Namitz, Stutzke	Eyak Lake weir restoration	$768,889	$4,718,016	$113,745	$106,848	$0	$5,707,498
295	22220613	Hanson & Stutzke	Valdez area habitat restoration	$8,463,927	$103,516	$80,384	$81,437	$93,149	$8,822,413
297	20200135	Miranda	Eagle Rock Facility Improvements	$6,419,000	$0	$0	$0	$0	$6,419,000
HABITAT ENHANCEMENT TOTAL REQUESTED				**$35,652,659**	**$7,860,906**	**$5,558,412**	**$5,181,102**	**$7,379,744**	**$61,632,823**

Habitat Protection Projects

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total Requested
300	22220700	Lankard	Land appraisal for the retirement of Bering River coal fields parcel	$98,100	$0	$0	$0	$0	$98,100
302	22220701	Kazary & Mitchell	Natives of Kodiak Afognak Island project	$250,231	$148,316	$10,124,767	$58,871	$0	$10,582,185
304	22220702	Kazary & Mitchell	The City of Kodiak Ram Site project at Fort Abercrombie State Historical Park	$296,992	$141,122	$6,394,300	$937,040	$99,037	$7,868,491
306	22220703	Kazary & Mitchell	Koniag, Inc. Women's Bay project	$179,490	$2,135,127	$905,866	$87,930	$46,281	$3,354,694
308	KEN 4018	Kreel	Bookey Parcel	$2,300,000	$0	$0	$0	$0	$2,300,000
			HABITAT PROTECTION TOTAL REQUESTED	**$3,124,813**	**$2,424,565**	**$17,424,933**	**$1,083,841**	**$145,318**	**$24,203,470**

Marine Science Facilities Projects

Page	Project Number	Principal Investigator	Project Title	FY22	FY23	FY24	FY25	FY26	FY22-26 Total Requested
311	19190125	Hoffman	PWSSC Facilities Project	$12,113,000	$0	$0	$0	$0	$12,113,000
313	20200131	Riemer	Alaska SeaLife Center Project	$2,000,000	$0	$0	$0	$0	$2,000,000
			MARINE SCIENCE FACILITIES PROJECTS TOTAL REQUESTED	**$14,113,000**	**$0**	**$0**	**$0**	**$0**	**$14,113,000**

	FY22	FY23	FY24	FY25	FY26	FY22-26 Total Requested
GRAND TOTAL REQUESTED	**$84,097,867**	**$30,352,125**	**$42,880,364**	**$22,036,277**	**$22,717,149**	**$202,083,782**

Program and Project Funding by Fiscal Year (2027 – 2031)

This table provides funding amounts requested for each fiscal year. The current fiscal year for this annual work plan is indicated below. The funding described in this document is for EVOSTC Projects submitted in response to the FY22-26 and FY22-31 Invitations. 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. Page numbers are incorrect and will be updated after the January 18, 2022 meeting.

Trustee Council Administration

Page	Project Number	Principal Investigator	Project Title	FY27	FY28	FY29	FY30	FY31	FY27-31 Total Requested
17	22220100	EVOSTC Admin	EVOSTC General Operating Budget	$1,319,416	$1,350,769	$1,490,841	$1,415,013	$1,577,512	$7,153,551

Long-Term Research and Monitoring (LTRM) Program

Page	Project Number	Principal Investigator	Project Title	FY27	FY28	FY29	FY30	FY31	FY27-31 Total Requested
26	2222LTRM	Lindeberg & Hoffman	Long-Term Research and Monitoring Program (LTRM) – see 2222LTRM table	$5,922,623	$5,266,377	$5,394,835	$4,722,268	$4,764,203	$26,070,306
140	22220200	Bishop et al.	Pacific sleeper sharks and recovery o EVOS-injured resources in PWS	$555,774	$492,683	$526,564	$542,856	$338,088	$2,455,965
147	22220201	Branson & Hetrick-Price	Chugach Regional Ocean Monitoring Program	$562,235	$556,803	$586,894	$576,943	$616,497	$2,899,372
154	22220202	Hauri	Continuation and expansion of ocean acidification monitoring	$127,500	$129,100	$131,900	$133,500	$136,400	$658,400
158	22220203	Rhea-Fournier et al.	Walleye pollock-Pacific herring interactions	$477,831	$322,325	$486,848	$491,285	$404,697	$2,182,986
162	22120113	Janzen	Data Management	$328,449	$335,485	$344,195	$351,708	$360,903	$1,720,740
			LTRM TOTALS REQUESTED	**$7,974,412**	**$7,102,773**	**$7,471,236**	**$6,818,560**	**$6,620,788**	**$35,987,769**

Mariculture

Page	Project Number	Principal Investigator	Project Title	FY27	FY28	FY29	FY30	FY31	FY27-31 Total Requested
168	22220300	Hetrick-Price	PWS kelp mariculture development for habitat restoration and local economy	$0	$0	$0	$0	$0	$0
181	22220301	Poe et al.	Social, cultural, and economic assessment of kelp mariculture opportunities for coastal villages within the EVOS spill zone	$0	$0	$0	$0	$0	$0

Page	Project Number	Principal Investigator	Project Title	FY27	FY28	FY29	FY30	FY31	FY27-31 Total Requested
189	22220302	Hoffman et al.	Sustainable mariculture development for restoration and economic benefit in the EVOS spill area	$2,637,506	$2,637,530	$2,637,458	$2,637,634	$2,636,901	$13,187,029
			MARICULTURE TOTAL REQUESTED	**$2,637,506**	**$2,637,530**	**$2,637,458**	**$2,637,634**	**$2,636,901**	**$13,187,029**

Education and Outreach *revised proposal amounts in response to decisions made at the October 13, 2021 meeting

Page	Project Number	Principal Investigator	Project Title	FY27	FY28	FY29	FY30	FY31	FY27-31 Total Requested
215	22220400	Wong	Community Organized Restoration and Learning Network*	$0	$0	$0	$0	$0	$0
222	22220401	Popovici	EVOSTC Education and Outreach Projects FY22-31	$88,953	$77,200	$86,829	$84,126	$61,028	$398,136
225	22220402	Holleman	Sustaining Our Sound: PWS outreach project	$39,007	$34,243	$30,908	$29,796	$30,352	$164,306
228	22220403	Twardock	PWS natural history symposium	$26,405	$20,846	$20,846	$20,846	$20,846	$109,789
230	22220404	Young, Bishop, Hauri	Inspiring Seascapes	$336,800	$356,700	$365,700	$374,900	$384,500	$1,848,600
234	22220405	Johnson	Preservation of subsistence and cultural practices for the Alaska Native people of the Chugach region	$189,170	$189,170	$189,170	$189,170	$189,170	$945,850
			EDUCATION & OUTREACH TOTAL REQUESTED	**$680,335**	**$678,159**	**$693,453**	**$698,838**	**$685,896**	**$3,436,681**

	FY27	FY28	FY29	FY30	FY31	FY27-31 Total Requested
GRAND TOTAL REQUESTED	**$11,415,014**	**$10,544,931**	**$10,932,435**	**$10,289,253**	**$10,081,857**	**$53,263,490**

EVOSTC General Operating Budget Funding 2032 – 2033

This table provides funding amounts requested for each fiscal year. The current fiscal year for this annual work plan is indicated below. The funding described in this document is for EVOSTC Projects submitted in response to the FY22-26 and FY22-31 Invitations. 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

Page	Project Number	Principal Investigator	Project Title	FY32	FY33	FY32-33 Total Requested
17	22220100	EVOSTC Admin	EVOSTC General Operating Budget	$1,482,509	$1,518,004	$3,000,513

EVOSTC General Operating Budget Description

Project Number: **22220100**

Project Title: EVOSTC General Operating Budget

Primary Investigator(s): Shiway Wang, EVOSTC Acting Executive Director
Linda Kilbourne, EVOSTC Administrative Manager
Joy Maglaqui, EVOSTC Executive Assistant

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

EVOSTC Funding Requested:

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$1,497,845	$1,486,546	$1,580,495	$1,448,037	$1,540,269	$7,553,192
FY27	FY28	FY29	FY30	FY31	FY27-31 Total
$1,319,416	$1,350,769	$1,490,841	$1,415,013	$1,577,512	$7,153,551
FY32	*FY33*				FY32-33 Total
$1,482,509	$1,518,004				$3,000,513

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 in the upcoming two five-year cycles (FY22 – FY26, FY27 – 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 will be 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 the first five-year cycle 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 11 budget cycles (FY23 – 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 (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

Submitted in response to the FY22-31 Invitation for Proposals

Project Number: **22200127**

Project Title: Gulf Watch Ocean Acidification Sampling

Primary Investigator(s): Jeff Hetrick, Rob Campbell, Steve Baird, Wiley Evans

PI Affiliation: Alutiiq Pride Marine Institute, PWSSC, KBNERR, Hakai Institute

Project Manager: NOAA

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$34,323	$0	$0	$0	$0	$34,323

See FY21 Work Plan for FY17-21 funding history.

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $68,600

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $102,923

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 07.26.2021, budget updated 07.26.2021.*

The Chugach Regional Resources Commission (CRRC) operates the Alutiiq Pride Marine Institute (APMI), and its Ocean Acidification Research Laboratory (OAR Lab), in Seward Alaska. This project incorporates dissolved inorganic carbon (DIC) sampling for the purposes of quantifying ocean acidification into the Gulf Watch Program currently funded by *Exxon Valdez* Oil Spill Trustee Council (EVOSTC). The Gulf Watch program, through its routine sampling, has added the collection of DIC samples to several of its sampling sites. This has added to the current data sets from these locations and offers a broader understanding of ocean acidification in Prince William Sound and Lower Cook Inlet. The Prince William Sound Science Center (PWSSC) and the Kachemak Bay National Estuarine Research Reserve (KBNERR) are current partners in the Gulf Watch program and routinely conduct marine (vessel-based) sampling transects on a time series. The cost to sample and process DIC samples ($34,323 per year) is the only additional cost to the PWSSC and KBNERR existing programs and would go directly to CRRC.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund	Fund	Fund	Fund

Science Panel Comments

Date: September 2021

The request is for the remaining year of the project which contributes inorganic carbon (DIC) sampling for the Gulf Watch Program. During FY22, the project experienced delays due to COVID. There is no change to the methodology. We do not have concerns about the work to date.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC.

Project Number: **22110853**

Project Title: Pigeon Guillemot Restoration Research in Prince William Sound

Primary Investigator(s): Kathy Kuletz, Robb Kaler, David Irons

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

EVOSTC Funding Requested (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 (FY07-21): $2,676,700

Total EVOSTC Funding Authorized (FY07-21) and Requested (FY22): $2,724,061

Total Non-EVOSTC Funding (FY12-22): $2,448,900

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

No specific comments.

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:** NOAA, 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 (FY12-21): $278,600

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $568,457

Total Non-EVOSTC Funding (FY12-22): $187,525

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: **2222LTRM**

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$4,544,761	$5,213,091	$5,042,190	$5,324,140	$5,299,171	$25,423,352
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$5,922,623	$5,266,377	$5,394,835	$4,722,268	$4,764,203	$26,070,306

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$2,115,584	$2,136,812	$2,107,044	$2,138,910	$2,122,149	$10,620,499
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$2,095,906	$2,116,293	$2,162,371	$2197,372	$2,205,886	$10,777,827

Total Past EVOSTC Funding Authorized (FY12-21): $41,056,865

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $45,601,626

Total Non-EVOSTC Funding (FY12-22): $21,251,484

Abstract:

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

In response to the *Exxon Valdez* Oil Spill (EVOS) Trustee Council's (EVOSTC's) focus area, Long-Term Research and Monitoring (LTRM) of marine conditions and injured resources, we are proposing to combine the successful Gulf Watch Alaska (GWA) long-term monitoring program with the Herring Research and Monitoring program, known as GWA-LTRM. The overarching goal is to continue to provide sound scientific data and products that inform management agencies and the public of changes in the environment and the impacts of these changes on the recovery of injured resources. Science synthesis is now integrated in a new synthesis and modeling component to increase our understanding of Gulf of Alaska (GOA) ecosystem processes and function.
The program has five primary objectives:

1. Sustain and build upon existing time series in the EVOS-affected regions of the GOA.

2. Provide scientific data, data products, synthesis products, and outreach to management agencies and other users.
3. Provide information that can be used by the Education and Outreach and Mariculture programs.
4. Leverage partnerships with outside agencies and groups to integrate data and expand capacity through collaborative efforts.
5. Ensure data are properly archived so that they can be accessed beyond the life of this program.

These objectives are a continuation of the Trustee Council's long-term programs started in 2012. Monitoring projects will curate and extend legacy datasets while research projects investigate mechanistic drivers of injured resources (e.g., understanding factors limiting herring recovery). The EVOSTC Data Management program will continue its role of ensuring data are properly archived and publicly available. The GWA-LTRM team includes scientists, managers, and administrators of the previous programs and remain experts in their fields with decades of experience studying the EVOS and GOA ecosystems. This team has demonstrated their ability to work collaboratively, resulting in many successes and elevating the impact of EVOSTC funded research.

Funding Recommendations (Fall 2021):

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

* This program includes individual projects, some of which have been recommended for reduced funding and/or funding contingent. One project was requested to add funds for a postdoc. Please see funding tables and individual projects for details.

Funding Recommendations (January 2022):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Not applicable	Not applicable	Fund Reduced*

* Integrated program management was approved by the Council for FY22.

Science Panel Comments

Date: May 2021

The Science Panel is pleased that the Gulf Watch Alaska and Herring Research and Monitoring programs are now integrated into one proposal and that five postdocs will help address key objectives and hypotheses of ecosystem change, recovery of injured resources, and potential effects on commercial, recreational and subsistence resources as part of the scientific synthesis and modeling effort. We recognize the administrative complexity described in this proposal and appreciate the effort required for its preparation. We have several observations and comments. First, we recognize that these two 'management' proposals (2222LTRM-A and 2222LTRM-B) do not fit perfectly into the format used for most of the other project proposals concerned with research, outreach, and restoration. Further, once formally submitted, the relatively large cost (>$60 million

over ten years) may result in relatively more scrutiny than many of the other proposals. Therefore, we recommend careful and substantial revision of the presentation to explain the diversity of topics and linkages of projects that are presented within the administrative umbrella.

GWA-TLRM Management Team Response:
We concur with the Science Panel that combining Gulf Watch Alaska (GWA) and Herring Research and Monitoring (HRM) will make a well-integrated program under the Long-Term Research and Monitoring (LTRM) Focus Area.

Regarding the cost for the GWA-LTRM program: The 10-year cost of the program falls within the funding cap of the Invitation, "…up to $5,000,000 annually (not including 9% GA)..." and encompasses a significant consortium of researchers affiliated with an array of agencies and organizations. Our proposal package also leverages over $2M/year of non-EVOSTC funds for the program.

GWA-LTRM will operate under the existing management and science oversight structure of the GWA program, thereby consolidating and improving efficiency in program management and science integration. Program administrative costs are low (11% of the total budget) for a large, multi-organizational program with substantial reporting requirements. We have added text to help clarify administrative objectives and added Section 10, Budget, D. Key Budget Summaries (pages 43-44) for key budget summaries associated with integrated program management activities.

A major and firm recommendation is to combine both projects that were submitted as separate entities (2222LTRM-A and 2222LTRM-B). The rationale for presenting the two proposals as separate items was not immediately clear to the SP and probably would not be clear to others.

GWA-TLRM Management Team Response:
In March we submitted a GWA-LTRM Program proposal (2222LTRM) and an Integrated Program Management Project proposal (2222LTRM-A&B) following our existing structure. During FY17-21 there were originally two GWA oversight projects (17120114-A and 17120114-B) but they were combined in 2018 at the request of the Science Panel.

As recommended by the Science Panel, we have removed this project proposal and migrated relevant information held within to the program proposal (2222LTRM). To facilitate disbursement of EVOSTC funds to non-Trustee agencies and organizations, we have retained two separate budgets (NOAA and PWSSC) in the budget workbook and provided additional program management budget summaries in the program proposal under Section 10, Budget, C. Integrated Program Management Budget Forms, pages 41-42.

Another recommendation is to provide a justification for the continuance of the administrative program. While to many reviewers the wisdom of such continuity may appear as self-evident, it may help some readers to appreciate that research projects cannot occur within a vacuum and that there are efficiencies related to management of multiple programs. Further, there are opportunities to promote functional or operational linkages between concurrent field projects that result in additional cost-savings. On this point, however, some SP members wondered why there would not be any cost-reductions related to the linkage of the administrative functions of LTRM and GWA.

GWA-TLRM Management Team Response:
We appreciate the Science Panel highlighting the benefits of having leadership and a management team for the LTRM program. An integrated program management team is also specifically requested in the Invitation. We have made an effort in the revised proposal to explain the critical needs and complexities of leading and administering a large, integrated ecosystem monitoring and research program based on 10 years of prior experience. With the presence of a program management team (PMT), not only has GWA been very productive, but this has allowed many synergies occurring within and outside the program, increasing the impact of EVOSTC funding that would not have occurred otherwise. Examples of the value of having a management team for the program have been added to the proposal, primarily in Section 4, Program Administration, pages 21-26.

Regarding cost-reductions related to the linkage of the administrative functions of LTRM and GWA: We have maintained the same general administrative personnel and costs of GWA and HRM for the combined GWA-LTRM. While this does not reduce costs, it does increase administrative efficiency as the LTRM program has new projects, now larger than the two combined programs, and will have additional duties such as coordinating with the EVOSTC's two new Foci, Mariculture and Education and Outreach. A considerable portion of this increased effort will fall upon the Program Lead and Science Lead who provide their salaries as in-kind at no cost to the EVOSTC.

There are instances where the proposal should be clarified. For example, the second sentence of the abstract refers to an entity called the "PMT" ('project management team') of the "GWA LTRM". Presumably the PMT will be a new entity that would develop once this proposal is approved. Without more explanation some reviewers may wonder why this is necessary. If the intention is to provide for a new, coordinated administrative structure beginning in 2022, then perhaps some new, or original, nomenclature could be used that could reduce and simplify an otherwise acronym-rich text.

GWA-TLRM Management Team Response:
Overall, we have made an effort to reduce acronyms where possible. However, the example sentence is actually found in the now removed Integrated Program Management project proposal. But, to clarify, the program management team (PMT) is not a new entity and has been the term used by the GWA program for the past five years (FY17-21). We plan to continue the PMT as part of the GWA-LTRM program.

We noted that NOAA was listed as the administrative agency but as stated, this is misleading and could be controversial if not revised. It is personnel within NOAA that would provide the administrative functions, but not the NOAA per se.

GWA-TLRM Management Team Response:
Personnel within NOAA will provide program support (e.g., scientific, managerial, and administrative leadership). This has been clarified in the proposal.

We were disappointed that a plan for coordinating with Native and local communities was not yet developed given how long the GWA and HRM programs have been operating. The proposal merely states that the PIs will reach out to local communities and Native communities during the first year to ask them what engagement they would like. They would then develop an approach that involves PIs from each project. Consequently, each LTRM project suffers the same shortcoming.

GWA-LTRM Management Team Response:
The GWA-LTRM PMT appreciates the Science Panel's concerns regarding the development of a plan for coordinating with Native and local communities. We understand the value of information sharing and are committed to programmatic work to engage with communities in the spill-affected area. Prior to COVID-19, during the 2017-21 program cycle, successful engagement with local Native communities occurred. GWA PIs participated in a community exchange that was structured as a two-way listening session with the Chugachmiut Local Education Coordinators and Elders from Cordova, Tatitlek, Chenega Bay, Valdez, Seward, Nanwalek, and Port Graham communities. GWA PIs have also volunteered, when invited into these communities, for education events such as Sea Week or in schools when they are doing fieldwork in the area.

Efforts to coordinate with small and remote communities need to be strategic, well planned, and flexible. An Outreach Coordinator is key for maintaining communication avenues and relationships with local communities over time. A successful Native and local community outreach plan needs to be in a collaborative manner that will develop a meaningful exchange of knowledge. The first year of the upcoming funding cycle is needed to develop such a plan. Moving forward, we see great opportunities with the Trustee Council's new Education and Outreach Focus Area. The capacity that small Alaska Native villages have for engaging with outside entities (including internet services) can be very limited. Therefore, excellent coordination between GWA-LTRM, the eventual Education and Outreach entity, and local communities will reduce any unnecessary burdens or duplicative efforts. We also look forward to working with NOAA Alaska Fisheries Science Center's newly hired Tribal Research Coordinator to broaden community awareness of our program's activities and findings.

Date: September 2021

This proposal now combines all the research projects that, in previous years, were part of separate programs: Gulf Watch and Herring. We recognize and applaud the effort put into the combined proposals linking research projects that were once administratively distinct, but cooperative entities within the Gulf Watch program and the Herring program. We also appreciate the attention given the revisions following our comments on an earlier draft in March. The revised proposal shows that a considerable and thoughtful effort was made to accommodate the diverse requirements and research interests and capabilities of the research scientists engaged in research that is either directly, or indirectly related to the 1989 oil spill and subsequent environmental changes.
Can the reasons for the linkage of the GWA and Herring programs be made clearer? The linkage was made in the interest of administrative efficiency and perhaps this could be briefly elaborated in the proposal for clarity.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: Fall 2021

The program management team was envisioned and initiated by the Council in 2012 as a way to reduce the burden on the Council and Council staff through taking on responsibilities such as project collaboration, coordination, and logistics across all Council-funded program projects. This team has demonstrated their capabilities over the first 10 years of the programs which instills confidence that

these Gulf Watch Alaska and Herring Research & Monitoring projects, now under the umbrella of the Long-term Research and Monitoring Program, will continue to be efficiently managed.

Project Number: **22120114-A-B. This proposal has been integrated with 2222LTRM.**

Project Title: Integrated Program Management

Primary Investigator(s): Mandy Lindeberg, Rob Suryan, Katrina Hoffman

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

EVOSTC Funding Requested NOAA (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$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

EVOSTC Funding Requested 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

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 (FY12-21): see FY17-21 work plan

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): see FY17-21 work plan

Total Non-EVOSTC Funding (FY12-22): see FY17-21 work plan

Abstract:

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

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.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
This project has been integrated into the 2222LTRM proposal.			

Science Panel Comments

Date: May 2021

This proposal combines the administration of the Gulf Watch Alaska and Herring Research and Monitoring and Data Management EVOSTC legacy programs. The goal is to support the component scientific projects, facilitate the cooperation and synthesis among the projects, ensure data management compliance, coordinate program outreach and community engagement activities and ensure the quality of scientific reporting. They will continue the program management approach for another 10 years. NOAA personnel will provide oversight and science synthesis of the program components as well as compliance with data and reporting submissions. PWSSC personnel will administer the NOAA grant to non-Trustee agencies and organizations, day-to-day program coordination, coordination of the science review panel, logistics associated with principal investigators meetings, and coordination and oversight of outreach and community involvement activities. Two changes were made to personnel: 1) the former Science Coordinator (Rob Suryan) will become the Science Lead (his replacement has not yet been identified) and 2) the former Outreach Coordinator for the HRM program (H. Hoover, PWSSC) will become the Outreach Coordinator for the LTRM program. The Science Lead will 1) oversee the synthesis and modeling efforts by five postdoctoral researchers addressing key objectives and hypotheses of environmental drivers of ecosystem change, recovery of injured resources, and potential effects on commercial, recreational

and subsistence resources and 2) provide products to stakeholders. The Outreach Coordinator will 1) provide materials or the names of appropriate researchers to the Education and Outreach program and 2) serve as a liaison with local and Alaska Native communities.

We commend the Project Management Team (PMT) for their past efforts in overseeing the many scientific projects and facilitating the synthesis of results, ensuring data management compliance, coordinating outreach and ensuring the quality of scientific reporting. We are quite pleased that the administration of the Gulf Watch Alaska, Herring Research and Monitoring programs are now better integrated under one proposal and that five postdocs will help address key objectives and hypotheses of ecosystem change, recovery of injured resource, and potential effects on commercial, recreational and subsistence resources as part of the scientific synthesis and modeling effort. We remain pleased with the program management approach used over recent years and approve of the two personnel changes.

GWA-LTRM Management Team Response:
We thank the Science Panel for their positive feedback. Even as the natural next step of combining programs has commenced, the fundamental model of the PMT is designed well and will maintain efficiencies for managing and administering the program.

Now that the GWA and HRM components have been combined into the GWA LTRM proposal, we cannot see any justification for submitting a separate Integrated Program Management proposal. Combining the two proposals will remove duplication and more clearly articulate how the GWA LTRM program will be managed and administered and the cost of doing so in a single budget. It also will be more efficient for the PIs to prepare, and reviewing parties to evaluate, just one proposal instead of two over the next 10 years. Put more plainly, we want to see these two proposals (2222LTRM and 2222LTRM-A&B) rightfully combined into a single revised proposal.

GWA-LTRM Management Team Response:
In the past, having a separate program management project has helped with tracking responsibilities and budgets, but admittedly caused some redundancy with reporting. We appreciate the Science Panel's effort to simplify the process for all involved. Therefore, we have removed this project from the GWA-LTRM proposal package and migrated relevant content to the program proposal (2222LTRM). However, there is still a need to keep the NOAA and PWSSC budgets separate so they will remain this way in the program budget workbook (approved by the EVOSTC Executive Director).

We also recommend that the PMT take the next step in integration by synthesizing the five projects under the Environmental Driver Component: PWS oceanography, Cook Inlet/Kachemak oceanography, GAK1, Seward line and Continuous Plankton Recorder. This region-wide synthesis would provide a broader perspective, such as the 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.

GWA-LTRM Management Team 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.

Several points need clarification in the revised proposal: The proposal indicates that the public will be invited to attend the PI meetings. What is the plan for doing so? Will they participate throughout the meeting or a portion of the meeting? This is laudable in theory but may not be productive.

GWA-LTRM Management Team Response:
Over the past ten years we have not advertised our meetings, but we do have an open-door policy for the annual PI meetings. We have had requests in the past and tried to facilitate them depending on the venue and available space. The more intensive breakaway discussion groups for the PIs are closed-door. During our fall in-person meetings we also schedule evening presentations for public engagement.

1. Science Panel Comment - The Environmental Drivers, HRM and Nearshore Ecosystem Components will host their postdocs during the first 5-year period, and the Pelagic and Synthesis and Modeling Components will host their postdocs during the second 5-year period. We would like some explanation of why the Pelagic and Synthesis and Modeling Components have been deferred to the second five years instead of the one or two of the other components. Presumably, it would be best, in theory, for all components to begin in the first five years. Milestones, to the extent possible, are also expected for the postdocs.

GWA-LTRM Management Team Response:
We have strategically staggered postdoc involvement to sequentially build science synthesis efforts throughout the 10-year period, with the Science Lead and Science Coordinator providing continuity throughout. The Environmental Drivers and Nearshore components have some of the longest time series and provide some focus on lower trophic processes, whereas the Pelagic Component data are shorter in duration and focus on longer-lived, upper trophic-level species (e.g., seabirds, whales) and will benefit from additional years of data collection. The Science Coordinator will contribute to overall synthesis and modeling throughout, while having additional postdoc support to extract the greatest value of the longest time series in the last five years. This strategy is also driven by the requirement of producing science synthesis reports midway through each five-year period.

Milestones for postdocs at this point are general expectations of public and scientific presentations, contributions to the two required science synthesis reports, and peer reviewed publications by the

end of each three-year period. Milestones for postdocs publications have been added to the milestones and task table in the proposal.

2. Science Panel Comment - Why does the personnel cost roughly double in the last 5 years? This does not appear to be explained by the planned schedule for postdocs.

GWA-LTRM Management Team Response:
This increase is indeed solely a result of where the postdoc hires are included in the budget, in the last five years. Two of the postdocs are included in the NOAA personnel budget because one will be working directly with the Science Lead and Science Coordinator, both NOAA employees, and likely recruited as a NOAA National Research Council postdoc, whereas the second postdoc funding (for the Pelagic Component) is simply "parked" in this budget because it allows the most flexibility for future allocation to agencies or universities as analytical priorities are solidified for their effort in the final three years of GWA. We have provided clarification on the postdoc positions, focus, and schedules in the program proposal.

3. Science Panel Comment - Why wasn't the Science Coordinator identified already? The coordinator plays a key role in overseeing synthesis and modeling, given that the science lead is only allocating 10% effort. Has one been identified by now?

GWA-LTRM Management Team Response:
As in the previous five-year funding cycle, the Science Coordinator position was advertised and filled once the GWA program was funded by the EVOSTC. This is a full-time position that cannot be hired until we know the program and position are funded. We do not have a candidate at this time, but we are actively seeking one. We have started the process for advertising the position so we can fill the position as soon as possible but cannot until funding is approved. This will be an open search, however, there are potential candidates currently working as postdocs with GWA and NOAA.

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

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 (FY12-21): $2,016,800

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $2,147,693

Total Non-EVOSTC Funding (FY12-22): $538,730

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

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 (FY12-21): $1,588,900

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,730,617

Total Non-EVOSTC Funding (FY12-22): $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 (FY12-21): $2,029,600

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $2,373,850

Total Non-EVOSTC Funding (FY12-22): $529,845

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: ADFG **Project Manager:** ADFG

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 (FY12-21): $891,500

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,048,117

Total Non-EVOSTC Funding (FY12-22): $380,730

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

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 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, correct number is 22160111-F

Project Number: **22120111-G**

Project Title: Adult Pacific Herring Acoustic Surveys in PWS

Primary Investigator(s): Peter Rand

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$107,860	$77,820	$83,670	$82,354	$81,396	$433,099
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$85,373	$86,111	$85,246	$86,594	$87,976	$431,300

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 (FY12-21): $713,900

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $821,760

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

I propose to continue a long-term data set of biomass estimates of the adult population of Pacific herring in Prince William Sound and address hypotheses related to changes in distribution and aggregation behavior of pre-spawn herring observed over two decades (2000-2020). This work addresses the Herring Research and Monitoring Component Area of Interest (e1, "Continued monitoring of the distribution and abundance of the herring population using established metrics from continued long-term data sets (acoustic studies, age-weight-length sampling, mile days of spawning), as well as evaluating testable hypotheses about herring using these data"). Since 1993, the Prince William Sound Science Center has been carrying out acoustic surveys as a cost-effective approach to estimate the biomass of adult Pacific herring just prior to the spawning period. Here I propose to continue this sampling during 2022-2031. The main goal for this proposed project is to produce a reliable estimate of adult biomass of the population of Pacific herring during 2022-2031 in support of the age-structured assessment model. While overall removals of herring by predators (including marine mammals and seabirds) have been quantified in past studies, we still lack an

understanding of how herring have responded to changes in predation pressure along with other environmental changes occurring in the region during the critical, pre-spawn period in March and April. Through a retrospective analysis, I will test hypotheses related to how distribution (broad-scale shifts across Prince William Sound) and aggregation characteristics (mean depth, peak seasonal densities, and school morphology) are related to observed changes in predators and climate over this period. Understanding how distribution and schooling behavior has changed in recent decades can provide important insight into factors that may be preventing recovery of herring in Prince William Sound.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

The Science Panel appreciates the expanded scope of the proposed acoustic work that, relative to previous years, would examine other aspects of acoustic surveys, especially retrospective analyses that could include analyses of spatial and temporal variation. In its recent reviews of this project, we have thoughtfully considered the value of the data collected by this project relative to expense and effort. We understand that, in previous years, the PI understood that this work was conducted mainly to support other projects – essentially a data-gathering service. However, we see value in these data on their own and encourage the PI to publish this work in the peer-reviewed literature. At the same time, we also acknowledge and appreciate the role this project plays in the support of other work in PWS.

PI Response:
We appreciate the recognition of the role of this project.

As this work goes forward, we appreciate that the PI identified potential areas where scientific hypotheses might be explored, tested, and documented in the form of peer-reviewed publications. Specifically, we endorse the suggestion that the PI investigate the potential for spatial/temporal changes in herring distributions, and compare this with observed changes in spawn distributions over space and time. We note that the PI has committed to submitting only one peer-reviewed report in each of the two-5-year funding cycles. We encourage a more ambitious publication schedule, especially focusing on insightful peer-reviewed reports that comment on biological aspects of PWS herring or the merits and limitations of acoustic surveys in PWS.

PI Response:
I have proposed to complete two peer-reviewed manuscripts in each of the 5-year periods to fully examine spatial and temporal changes in herring distribution revealed through long term acoustic monitoring and contribute to future syntheses.

We appreciate the collaborations with others (22120114-C Arimitsu & Piatt) but would like the PI to discuss the implications of interfacing with the different acoustic systems mentioned in their

proposal. Finally, given the significance of past and recent utilization of acoustic data for several major EVOSTC-funded projects, we request that the PI consider preparing a synthesis report that would provide more information on acoustic abundance than is currently available. Such a report could comment on historical survey data, including times and dates, locations, track lines, equipment and vessels used, etc. and would be valuable to EVOSTC-funded projects and the broader scientific community.

PI Response:
The PI reached out to Dr. Arimitsu during the revision process. Inter-calibrating the two acoustic systems (she has upgraded to the Simrad EK80 system, I have been using Biosonics DT system) would be complicated and require a great deal of effort and expense. Her work is focused on different species in different regions in PWS and we both agreed there is no critical need to directly compare estimates of biomass estimated for the two survey efforts. The important point to emphasize here is that that sphere calibration will be conducted during each of my cruises so my survey results can be made comparable year to year, and this process will be made much easier with an upgrade in the analytical software I use for this survey (Echoview) which I budgeted for in this proposal.

I have outlined in the deliverables section of the proposal, and in my response above, that I intend to contribute to syntheses (reports and manuscripts) that would include documentation of important characteristics of the survey effort, including cruise tracks, vessel used, times and dates, and other information relevant to the survey.

Date: September 2021

We appreciate the checking and comparisons of the two different acoustic systems. We accept the conclusion that the differences preclude the potential for integrated use and analyses. We also acknowledge the commitment to increase the proposed reporting output to two peer-reviewed reports for the 2022-2027 reporting period. We recommend a continuation of full funding for this project.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: Fall 2021

I concur with the Science Panel and PAC.

Project Number: **22170115**

Project Title: Genetic and physiological mechanisms of virus and oil interactions in Pacific herring

Primary Investigator(s): Andrew Whitehead, Paul Hershberger

PI Affiliation: UC Davis, USGS **Project Manager:** USGS

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$92,160	$111,327	$276,770	$287,821	$303,734	$1,071,812
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$397,484	$350,533	$260,922	$0	$0	$1,008,939

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 (FY12-21): $1,761,100

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,853,260

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

The PIs seek to build upon our current collaboration that tests how oil exposure may interact with disease susceptibility in Pacific herring, and on how the genetic attributes of Alaska herring have recently changed over space and time. We leverage our progress made on understanding disease events in Prince William Sound (PWS) and the unprecedented genomic description of the population across a time period that spans both oil spill and disease challenges. Our proposed next research phase will further refine disease challenges by focusing on parental effects on early life stages. We will test the hypothesis that parental exposure to oil affects immune priming of offspring, thereby affecting offspring sensitivity to disease. We will also extend our genetic studies by testing the hypothesis that exposures to oil and to virus have fitness impacts that are genotype-dependent and predict that these sensitive genotypes have changed over space and time in wild populations. These critical studies will aid in determining the significance of disease challenges including the interactive effects of oil. Comparison of physiological, developmental, and genetic responses among

populations (including PWS, Sitka Sound and Puget Sound) will aid in interpreting how the unique history of PWS fish contributes to their current state; we seek to detect signals of adaptation that may predict future demographic recovery, or to discover whether their history may be disabling contemporary adaptation. The proposed series of exposure and response metrics will further refine our understanding of oil and disease impacts, and how those may shape the past and future of PWS herring.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

This project builds off of the previous disease and genetic proposal from 2017. The two PIs are excellent collaborators and are addressing how oil exposure may interact with disease susceptibility in herring and how genetic attributes of Alaskan herring have changed based on the location and timeline. The proposed next research phase will refine disease challenges by focusing on parental effects on early life stages. The PIs will test the hypothesis that parental exposure to oil affects immune priming of offspring, thereby affecting offspring sensitivity to disease. They will also extend genetic studies by testing the hypothesis that exposures to oil and to viruses have fitness impacts that are genotype-dependent and predict that these sensitive genotypes have changed over space and time in wild populations. Comparison of physiological, developmental, and genetic responses among populations (including PWS, Sitka Sound and Puget Sound) will aid in interpreting how the unique history of PWS fish contributes to their current state; the PIs seek to detect signals of adaptation that may predict future demographic recovery, or to discover whether their history may be disabling contemporary adaptation. The Science Panel appreciates that long term studies on adaptive genetic responses of fish to multiple stressors have been difficult to conduct and that the long-term funding from EVOSTC provides the platform for these types of important projects.

The only science-based concern is that the PIs are increasing the amount of oil and virus exposure to create 50% mortality and increase viral load, but how does that really compare to the actual concentrations they are exposed to in the field? It is understandable that for response detection, levels of stressors need to be higher initially, but because these data are being used to argue why the populations have failed to recover, how relevant are the doses and responses to the present condition in PWS? We have to assume that oil is no longer part of the stressor mixture. Are the PIs trying to re-create the conditions in the late 1980s to early 1990s? Please describe. Please justify the use of the amount of oil in the experimental design. There are some complicated experiments; repeated sampling of some of the tanks or mortality would change in density of fish and would this change alter the results and interpretation? Are there any complications from longitudinal changes in density?

PI Response:
Regarding oil and virus dosing (Objective 2a): Our main objective is to cause fitness impacts in our exposed populations that is sufficient to detect reproducible changes in allele frequency between the

control groups and the exposure groups. This objective is somewhat different from trying to re-create 1989-1990 PWS oil spill conditions. That being said, a concentration sufficient to cause 50% pacific herring embryo mortality is environmentally relevant. Though ~3.5 ppb (total PAH) is a relatively high concentration, it is within the bounds of water concentrations that were detected following the 1989 spill in PWS (e.g., J. Neff and W. Stubblefield, "Chemical and Toxicological Evaluation of Water Quality Following the Exxon Valdez Oil Spill," in Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters, ed. P. Wells, J. Butler, and J. Hughes (West Conshohocken, PA: ASTM International, 1995), 141-177). We could dial exposure concentrations down into a range that was more commonly detected in PWS in 1989-1990, and that cause sublethal toxicity such as cardiac developmental defects in pacific herring embryos. However, these sublethal impacts are very laborious to score, and doing so on thousands of individuals would not be feasible. We know that cardiac defects are mechanistically related to mortality induced at slightly higher concentrations, such that sensitive individuals revealed by more severe developmental abnormalities at a low doses are likely the same individuals that are more likely to die at a higher dose. We therefore consider our studies more efficient by exposing in the low ppb range to induce and score mortality, without compromising our research objectives. Furthermore, it is important to consider that population contrasts are an important component of our experimental design. We implicitly make the key assumption that prior to 1989 and the population collapse, PWS and Sitka populations were equally sensitive to oil and virus. Therefore, any differences between populations in the genetic response to challenges in our experiments should be detectable (given our replicated experimental design), and thereby offer insight into how exposure histories have shaped specific genetic trajectories over time, which we can verify with our existing catalog that tracks genome-wide genetic variation over space and time in these populations.

Regarding potential for complications from changes in density (Objective 2a): If we were measuring growth or behavior, then we would be concerned about the potential for complications caused by mortality-induced changes in density. However, since our key endpoint is 7-dph survival we do not think that this will be a complicating issue. That being said, perhaps there are complications that we have not considered, so we may reduce tank densities in the control treatments to match densities in the oil exposed treatments after the oil exposure and during the grow-out phase.

We also noted that this team is receiving considerable support from EVOSTC and is named in multiple projects with somewhat overlapping objectives. We would appreciate a clear delineation of the separate project and a statement of how much effort is devoted by the PIs to each project to ensure that the PIs are not overcommitting.

PI Response:
PI Whitehead is named in this proposal, in Dr. Hershberger's proposal, Dr. Rand's proposal, and Dr. Rhea-Fournier's proposal. In Dr. Rand's and Dr. Rhea-Fournier's proposal, the Whitehead lab may receive funds to run DNA diet analysis assays, and the work proposed in the Rand and Rhea-Fournier studies do not overlap with the work proposed in the oil/virus studies described here. Funds to the Whitehead lab from the Rand and Rhea-Fournier study will support graduate student salary and laboratory supplies and reagents. Our oil/virus proposal is mentioned in Dr. Hershberger's proposal, which describes how our oil/virus studies integrate into, and coordinate with, the larger herring disease program headed by Dr. Hershberger. Our oil/virus studies mentioned in Dr. Hershberger's proposal does not extend beyond any activities described in our oil/virus proposal.

Date: September 2021

We were pleased with the PI's responses to the initial review. It would be helpful if time commitment for the PI could be listed in person months for this project, other EVOSTC projects, and the PIs commitments to other extramural projects. There was some concern that there was over commitment.

Another question was what was the age and size structure of the populations that contributed to Figure 4 in the proposal. This is very exciting but there was a question if different geographical populations of herring were of similar age and size structure. If the PI can add a sentence or two, we would appreciate it.

PAC Comments

Date: September 2021

It is noted that the PAC requested that the Trustees prioritize the ongoing projects with long-term data sets. No specific comments.

Executive Director Comments

Date: Fall 2021

I concur with the Science Panel and PAC. Long-term studies on adaptive genetic responses in herring to multiple stressors may help elucidate why herring are not recovering in PWS. Methods that have been developed in this project have been applied to fish in other ecosystems, including paper that was recently published in the journal *Science*.

Project Number: **22220111-H**

Project Title: Pacific herring larval growth in Prince William Sound

Primary Investigator(s): Alysha Cypher

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$0	$0	$49,595	$140,778	$314,212	$504,585
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$2381,305	$345,275	$212,928	$83,405	$82,481	$1,105,394

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $0

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

The Pacific herring (*Clupea pallasii*) population of Prince William Sound (PWS) collapsed in 1993 and has not recovered. Historic research efforts identified the larval period as critical to strong year class formation, but the larval stage remains a data gap for PWS. To address these issues, this proposal includes a data synthesis of strong year class patterns in the North Pacific (FY26-28), a multi-year larval growth process study (FY24-31), and larval bioenergetic modeling (FY26-28). Recruitment data for North Pacific herring populations will be used to examine regional extreme (strong, weak) year class patterns for the hypothesis 1) *Extreme year class formation correlates with regional environmental trends in the North Pacific.* The larval process study will examine factors that promote rapid growth during the larval period for the hypotheses *2) Larval growth and prey field composition, abundance, and lipid content co-vary interannually* and *3) Rapid larval growth will occur in years with higher sea surface temperatures in combination with abundant, lipid-rich prey and weak selection for rapid growth.* Repeated intra- and inter-year sampling will generate herring larvae (otolith-determined growth rate, selection for rapid growth, energy content, standard length, gut

contents), zooplankton (abundance, lipid content), and oceanographic data for four rearing bays with variable zooplankton community structure and oceanographic conditions. These data will then be integrated with other Herring Research and Monitoring Component project data for bioenergetic models for the hypothesis, 4) *Zooplankton prey supply and predatory demand by pink salmon explain interannual variation in herring recruitment*, to address specific bottom-up and top-down processes relevant to PWS. This proposal provides an opportunity to evaluate poor recruitment patterns in PWS as a function of physical and biological factors on a regional and local scale and adds context for larval herring. Recruitment remains an important variable for fisheries management and therefore understanding the complex factors involved is necessary for guiding monitoring efforts.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund FY22-24 Fund Contingent FY25-26	Fund FY22-24 Fund Contingent FY25-26	Fund FY22-24 Fund Contingent FY25-26	Do Not Fund

Science Panel Comments

Date: May 2021

This is a large proposal, in terms of costs and 10-year duration. The Science Panel noted the many laudable research objectives in the proposal, but some were difficult to evaluate because the proposed methodologies were lacking sufficient explanation and detail. Therefore, our initial evaluation is that the 10-year proposed time frame is longer than necessary given the lack of details.

PI Response:
I appreciate the Science Panel's recognition of the need for larval work in PWS. I recognize that there were areas in need of more detail and have modified my proposal to address these issues, specifically data synthesis by a postdoctoral researcher (see Section 4, Project Design, A. Objectives and Hypotheses, Objective 1, page 6; B. Procedural and Scientific Methods, Objective 1, pages 7-9, and C. Data Analysis and Statistical Methods, Statistical Approach, H1, pages 16-17) and sources of error associated with larval sampling (see Section 4, Project Design, C. Data Analysis and Statistical Methods, Statistical Approach, H2 and H3, pages 17-20). I have also modified the timeline of this proposal so that the postdoctoral researcher will perform their data synthesis between FY26-28. This will shorten the project duration and allow for data generated during the LTRM program to be incorporated into data synthesis in the form of bioenergetic models (see Section 4, Project Design, C. Data Analysis and Statistical Methods, Statistical Approach, H4, pages 21-22) and collaboration between the postdoc and GWA PIs while projects are well underway. I have also added more details on how my collaborations with PIs Rand, Campbell, Gorman, and Heintz (22220111-I) will generate 3 years of preliminary data for this project and allow for establishment of protocols prior to the start of the larval process study in 2025 (see Section 4. Project Design, B. Procedural and Scientific Methods, Objective 2, pages 9-10). We will also share experimental data between our projects for bioenergetic modeling to evaluate zooplankton covariates on larval herring growth and pink salmon predatory demand on larval herring. The cost associated with this work reflects the need for repeated sampling to provide enough temporal resolution to resolve patterns in larval growth. The FY22-31 EVOSTC Invitation for the LTRM program provides a rare opportunity to conduct a relatively long-term larval process study in PWS and overcome known challenges associated with working with the larval period.

Overall, we support this project in principle but recommend a very cautious approach. Due to the learning curve associated with any new research effort, we strongly suggest that preliminary investigations are conducted from which a long-term strategy can be developed - especially with respect to larval sampling and specimen analyses. A two- or three-year duration might be sufficient, particularly to ensure that the proposed sampling methods are practical. Specifically, we suggest the PI may require a year, or more, to develop useful larval collection and sampling methodologies. We recognize that once sampling approaches and other methodologies are refined this investigation could be extended for a longer period of study.

PI Response:
I agree that preliminary investigation is needed to establish larval sampling protocols and demonstrate that this work can be successful in PWS. I have added more detail to my proposal to address how this will be approached (see Section 4, Project Design, B. Procedural and Scientific Methods, Objective 2, pages 9-10). Briefly, I will accompany PIs Rand, Campbell, Gorman, and Heintz on their nearshore trawl surveys of pink salmon prey field starting in 2022. Because the sampling for their project (22220111-I) relies primarily on enumeration, it will not pose a risk to their project data to evaluate the effect of tow duration, fixation method, and fixation duration between capture and processing on sample integrity and correction for larval shrinkage. This approach will allow for generation of preliminary herring larval data (shrinkage-corrected body lengths, otolith-determined growth rates, and gut contents) prior to funding of the larvae process study in 2025. I intend to provide the Science Panel with all preliminary data and analyses during annual reporting in 2024 and am amenable to other arrangements to establish confidence in methodology and integrity of generated data for this new project.

The literature citations supporting the proposal must be expanded substantially, especially with reference to sources of technical error related to catching and preserving larval samples. The proposal contends that larval size is an especially important metric that could explain some of the changes that have been observed in PWS herring. We advise that there are well-established relationships between herring female size, egg size, and larval size that can be found in the literature. Further, the literature reports that variation in herring larval size may occur as a function of hatching time and egg depth, but there was scant reference made to this in the proposal. There may be other factors that affect larval size and it is important that the PI be cognizant of such issues. We recognize the validity of the PIs hypotheses but remind the PI that there are many potential sources of error that must be acknowledged.

PI Response:
I recognize that the lack of detail in my proposal on sources of technical error was an oversight. I have expanded on this in my methodology and added the appropriate literature to guide how I will approach this issue (see Section 4, Project Design, B. Procedural and Scientific Methods, Objective 2, pages 9-10 and C. Data Analysis and Statistical Methods, Statistical Approach, H2, pages 17-18). This includes generating a time series for shrinkage rates of preserved (formalin, 70% ethanol) herring larvae during preliminary sampling (FY22-24) and making comparisons to Atlantic herring (Fox 1996, Fey 2002). These comparisons will assist with correcting for shrinkage rates in Pacific herring preserved in formalin vs. 70% ethanol and small vs. large larvae, known covariates for body length shrinkage.

I have also expanded on potential sources of variation, including maternal and environmental factors, that contribute to initial size variation of eggs and larvae-at-hatch (see Section 4, Project Design, C. Data Analysis and Statistical Methods, Statistical Approach, H3, page 20). I will have some capacity to account for this during sampling by collecting eggs at known spawning areas for egg size, size-at-hatch, clutch size, and developmental trajectory which can be used to calculate initial variation for comparison with size variation throughout the larval period. ADF&G ASL data for adult spawners can also be incorporated into analyses to estimate variation in maternal body size.

We note that the description of the data synthesis to be conducted by the postdoctoral researcher is lacking in the necessary detail for evaluation. It is stated that the data synthesis will consider strong year class patterns in the North Pacific. As many herring stocks in the North Pacific have been depleted for decades, the extent to which strong year classes overlap with oceanographic observations in the historical record is unclear. For instance, there were several strong year classes of PWS herring in the 1980s and early 1990s. Are there adequate environmental data from that time period? We expect to see more details describing specifically what sort of synthesis is being proposed and what sort of data analysis will be conducted in the revised proposal. Please include what observations will be considered for this analysis. For example, a comparison of conditions associated with strong versus weak year classes might be more meaningful rather than only conditions associated with strong year classes. The proposal points out many published studies of herring recruitment that have produced inconsistent results. How would the proposed synthesis in this proposal differ from those previous attempts?

PI Response:
I have added more detail for what questions the postdoctoral researcher will address during data synthesis, data sources that will be utilized, and a proposed modeling method (see Section 4, Project Design, B. Procedural and Scientific Methods, Objective 1, pages 7-9, and C. Data Analysis and Statistical Methods, Statistical Approach, H1, pages 16-17). The proposed examination of extreme year class formation amongst herring populations in the North Pacific will build off of a few previous examinations, utilize recent fisheries-independent data, and adapt current statistical modeling. While this would not be the first examination of extreme year class patterns in the North Pacific, the complexity of recruitment dynamics and environmental drivers of recruitment requires continued examination as modeling techniques become more sophisticated and tolerant of variation. A thorough understanding of recruitment is essential for evaluating the relevance of monitoring efforts and harvesting strategies of herring populations.

The proposed statistical analysis of field data leans heavily upon regression and ANOVA analyses. The PI is encouraged to consider the merits of conducting some of the analyses in the context of Generalized Linear Models (GLMs) and Generalized Additive Models (GAMs).

PI Response:
Thank you for this suggestion. I have modified my statistical methodology to address my hypotheses more appropriately (See Section 4, Project Design, Data Analysis and Statistical Methods, Statistical Approach, H2 and H3, pages 17-19).

Specific questions include: (1) Could the implementation of this project be an opportunity to collect larvae samples to help with other projects and specifically help address the issue of

transgenerational disease resistance, (2) Who would do this work and who would collect the samples? Is it the PI or is it a newly-hired postdoc? This requires clarification, (3) What type of collecting gear and vessel would be used? and (4) How will the PI deal with potential sources of error, especially the issue of larval shrinkage after collection in nets and other shrinkage in fixatives and preservatives? Regarding this last question, the proposal indicated that collected larval samples will be fixed in 3-5% formalin for later identification, sorting, and imaging. The PI should consider that larvae will shrink during fixation formalin or other preservatives so a correction factors need to be used to adjust for the effects of capture and fixation on estimates of live length. The proposal also indicates that larval otoliths will be collected from at least 50 larvae from each sampling time and rearing bay. The PI should be aware that formalin is not an ideal preservative for specimens from which otoliths are sampled. Preservation in alcohol should be considered for specimens from which otoliths will be collected. Differential shrinkage of larvae with type and time of preservation could affect this proposed larval growth study. See Fox, C.J. 1996. Length changes in herring (*Clupea harengus*) larvae: effects of capture and storage in formaldehyde and alcohol. Journal of Plankton Research 18(4): 483-493.

PI Response:
1) After conferring with PI Hershberger about the merit of larval samples for transgenerational disease resistance, we were not optimistic that this would be an easy thing to integrate to this project. However, we will continue to speak in the future about how sampling for this project could contribute to disease work. Larval data from this project will be shared with PIs Rand, Campbell, Gorman, and Heintz (project 22220111-I) for collaborative bioenergetic modeling that will be performed by the postdoctoral researcher funded by this project (see Section 4, Project Design, B. Procedural and Scientific Methods, Objective 5, page 14, and C. Data Analysis and Statistical Methods, Statistical Approach, H4, pages 21-22) and provide their project with larval data that indicates selection for rapid growth, an indicator of predation.

2) The postdoctoral researcher will be responsible for the data compilation and modeling for extreme year class patterns (H1) and bioenergetic model development (H4). The PI will oversee the larval process study (H2, H3) and will hire a technician to assist with field sampling and sample analysis. Zooplankton identification would be carried out at the PWSSC by trained staff and fatty acid analysis would be contracted to an appropriate facility. Based on my previous experience working with herring larvae, I anticipate that sampling each year will take approximately 2.5 months of full-time processing by two people to generate raw data.

3) I have added text to my proposal to emphasize vessel (R/V New Wave or contracting of a similar vessel) and fishing gear usage (see Section 4, Project Design, B. Procedural and Scientific Methods, Objective 2, pages 11-12). I have made modifications to this section including the use of a Methot net for larval sampling, tandem bongo net towing for simultaneous zooplankton capture, and decreased tow duration to account for shrinkage rates and gut expulsion of captured larvae.

4) I have added significant changes to address the issue of potential sources of error (see Section 4, Project Design, C. Data Analysis and Statistical Methods, Statistical Approach, H2 and H3, pages 17-18 and 20-21). Briefly, I will follow protocols from previous work (Hay 1981, Fox 1995) that have demonstrated best practices for preserving larval samples to correct for larval shrinkage and expulsion of gut contents during capture (see Section 4, Project Design, B. Procedural and Scientific Methods, Objective 2, pages 10-12). Larval samples for otolith processing will be stored in alcohol as

described in Fox (1996). Lastly, to mitigate the effects of larval shrinkage and loss of gut contents, I have shortened the proposed tow duration. These methods will be further assessed during preliminary data collection in collaboration with PIs Rand, Campbell, Gorman, and Heintz on their nearshore trawl surveys beginning in 2022 (project 22220111-I). This will provide 3 years of larval samples to establish methodology, quantify variability in larval sampling, and assess the integrity of preserved samples, particularly for otolith analysis.

Due to the concerns stated above, we have reservations about supporting this proposal at this time. The lack of many key details does not provide the necessary confidence that this will be a successful project. We acknowledge that there is much that we do not understand about the herring larval periods, in PWS and elsewhere. For this reason, the main merit of this proposal is not necessarily in the hypotheses or proposed methodology: rather it is the investigation of a life stage that may have been partially ignored in recent years.

PI Response:
I appreciate the Science Panel's comments and have made significant improvements to this proposal based on their input. I recognize that there are risks associated with larval sampling and that this has been a deterrent in the past for conducting this type of work for both researchers and funding agencies. The EVOSTC FY22-31 Invitation for the LTRM focus area provides an opportunity to address this data gap for PWS herring and allows for enough temporal resolution to adequately address environmental and bottom-up drivers during the larval period. Previous research funded by the EVOSTC has revealed numerous, valuable insights into why the PWS herring population has not recovered from the 1993 collapse. Egg and larval collection from this study, in combination with long-term data on later life stages, would provide a comprehensive picture of herring year classes between 2025 and 2029. This would provide a unique data set that may provide insights for other regions with low recruitment herring populations. I intend to provide preliminary data to the Science Panel in FY24, prior to funding of the larval process study, to establish confidence in methodology and data integrity and demonstrate that this project can be successful in PWS.

Date: September 2021

We welcome the revised proposal, with substantially expanded literature citations and a clarification that the PI is fully aware of the challenges related to studying the larval herring stages in PWS. Our candid assessment, nevertheless, is that we have misgivings about some aspects of the proposal. But, at the same time, we are impressed with the initiative shown in the preparation of the revised proposal. We also conclude that the PI is now aware of the sampling difficulties related to larval fish collections – including important factors such as the mesh size used for sampling and the impacts of different types of fixatives and preservatives. Also, we are pleased with the increased literature citation used to support this proposal. We are especially appreciative of this statement: *" I intend to provide preliminary data to the Science Panel in FY24, prior to funding of the larval process study, to establish confidence in methodology and data integrity and demonstrate that this project can be successful in PWS.*" We heartily agree with this approach but discussed whether this subject area warrants funding for the full 10 years. We recommend full funding for FY22-24, funding contingent for FY25-26 on progress made during the first two years. If successful, funding for FY27-31 may be considered in FY26.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC.

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

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $251,826

Total Non-EVOSTC Funding (FY12-22): $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: **22220111-J**

Project Title: Herring Workshops

Primary Investigator(s): Scott Pegau

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$34,902	$40,712	$29,158	$0	$29,517	$134,288
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$109,927	$0	$0	$0	$0	$109,927

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $34,902

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

No other region in the world has conducted as large of a suite of ecosystem studies, that include herring as a focal point, as the research supported by the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC). Research on herring historically has been driven by needs to support commercial fisheries, but this has expanded, largely by the continued support of EVOSTC, to now include a focus on the role, significance, and value of herring for ecosystem support. The research includes analyses and assessment methodologies that can inform fisheries management not only within Prince William Sound but across the state. The Herring Research and Monitoring program has contributed significant research expertise on many topics related to herring that can be of value to researchers and fisheries management agency staff, and likewise the expertise of the fishery management agency staff is important to guiding our research. The goal of this project is to provide an opportunity for researchers and fisheries management staff (contingent on their availability) to meet and address gaps in our understanding of issues of importance. We plan four small workshops followed by a larger symposium designed to gather and describe the findings from the herring

research conducted over the past twenty years. Expected workshop topics include the following: methods for assessing spawn deposition, herring aging, population modeling approaches, and survey measurement errors. In FY27 we plan a Wakefield symposium designed to provide an international perspective on research conducted since the last herring conference in 2008 and provide an update to the 2000 symposium proceedings *Herring: expectations for a new millennium*. The symposium provides an opportunity to highlight the rich body of ecological research on herring and quantitative herring population monitoring that has been supported by EVOSTC and put our findings in context with other herring populations.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

The Science Panel found merit in the idea of workshops that evaluate the methods and approaches in a critical fashion. However, there was insufficient detail presented on the goals, approach, and implementation of recommendations from workshops and some SP members questioned the timing and utility of the approach. For example, what is the plan if results from the workshops conclude that current methods (those used for 10+ years) are not ideal and should be replaced? We request an action plan in the revised proposal detailing how alternative (presumably better) methods could and would be successfully incorporated into the existing projects. Will non-LTRM experts be invited to attend the workshops? If not, then clarify why the goals of this project cannot be accomplished at the regularly scheduled PI meetings? We were particularly encouraging of workshops focused on estimating spawning deposition, as we had previously had discussions about the adequacy of the mile-days of milt approach that is currently used. However, we were not enthusiastic about the idea of funding the refurbishment of an ROV, as it made it seem as if it had already been decided on what the outcome of the workshop would be. It would seem that field work necessary to test methods resulting from the workshop might best be funded in the appropriate herring survey project.

PI Response:
We agree that the workshops may conclude that there are better approaches. The program has always worked to adapt new methods and technologies either within the existing budget or by seeking outside funding. We view the value of the workshops as providing guidance for the future and acknowledge that some recommendations may not be possible within the existing funding. In Section 4, Project Design, B. Procedural and Scientific Methods, page 7, we added the following statement about how we would try to accommodate workshop recommendations:

All of the workshops have the potential to identify changes to the existing methodology being used. In each case, our plan is to evaluate the costs and benefits of changing a design and to determine if the changes can be made within the existing budgets or if additional funding would have to be sought to implement the changes. We anticipate that some changes will have to be implemented outside of the EVOSTC funded LTRM program. If we identify changes that are critical in the short term, we will examine if the existing budgets or project objectives can be modified to implement

those changes. Any changes to the existing budgets or objectives will then be proposed to the EVOSTC for their approval. We acknowledge that the workshops may make recommendations that we are not able to accommodate within the existing program but look at the workshop recommendations as guidance for future efforts.

Non-LTRM experts will be invited to the workshops. The goal is to connect researchers and fisheries managers. We anticipate, and budgeted for, not only fisheries managers but also researchers outside of the LTRM program. In Section 4, Project Design, B. Procedural and Scientific Methods, page 5, we modified the sentence that lists the people to be invited as follows to make it clear that researchers outside the LTRM program will be invited as well as the fisheries managers:

Ten to fifteen participants including fisheries managers, GWA-LTRM researchers, and researchers from outside the program will be invited to attend each workshop.

We moved the $30,300 associated with the ROV refurbishment and testing an egg deposition method to the ADF&G herring surveys proposal.

We are generally supportive of workshop proposals concerning assessment models and survey measurement errors. However, the intent and focus of the assessment workshop may need further refinement. While there is value in comparing the different (Bayesian and Excel-based maximum likelihood) models used to assess herring in PWS and Sitka, we feel that the Bayesian age-structured assessment (BASA) model is clearly the most advanced of the two. Moreover, we feel that it is imperative that the BASA model PI(s) provide training to ADF&G (and others, as appropriate) biometricians in the development and operation of the BASA herring model so that the state management agency has the proper training to use BASA for future fishery management. It is not clear if this training and hand-off would be undertaken as a workshop or more focused training of the select few biometricians who are involved in stock assessments. See the SP comments about this to the BASA model PIs (proposal 22120111-C).

PI Response:
We agree that all of the workshop objectives may be refined. We proposed an organizing committee for each workshop that would be tasked with making those changes. ADF&G and the modeling group led by Dr. Branch have already met and began discussions associated with the value of the BASA modeling approach. ADF&G agrees that they would like to migrate to a Bayesian model. This workshop would provide the opportunity to work out the mechanism to make that happen. If the organizing committee feels that the process is mature enough then the funding for this workshop will be shifted to support training of ADF&G personnel on the operation of a BASA model.

With regards to herring aging, we strongly recommend that the proposers coordinate with the Committee of Age Reading Experts (CARE, http://care.psmfc.org/), a cooperative effort between international and state and federal agencies dedicated to standardizing and improving age determination techniques and activities for Pacific Ocean fish species. CARE primarily focuses on interagency calibration and the validation and standardization of age reading criteria. As the geographic distribution of Pacific herring spans four US states and one Canadian province, it may be very advantageous to coordinate efforts so that experience in those jurisdictions can shed light on best practices for PWS herring.

PI Response:
We will pass this recommendation to the organizing committee. Since Kevin McNeel is the chair of the committee and employed in the Age Determination Unit of ADF&G we anticipate that there will be a natural connection between our efforts and those of CARE. We intend to contact CARE to determine if there is interest in having our workshop be added to their meeting.

In order to conduct a more thorough evaluation, we request more detail in each of these workshops including proposed participant lists, objectives, and deliverables. We are supportive of the concept of a larger herring symposium, but less certain whether the Wakefield model was the best option. We noted that these symposia are now peer-reviewed and published electronically. However, users need to buy the whole proceedings or each paper individually, which can be an obstacle for dissemination. If Wakefield is pursued, we recommend that the PI consider exploring with Alaska Sea Grant the possibility of publishing the whole symposium proceedings as "open access" to broaden its accessibility to the scientific community and clarify the cost (if any) associated. It was not clear if these costs were already included in the budget. Regardless, it should be made clearer what the deliverables for this symposium would be and that any products would be available via Open Access.

PI Response:
We greatly increased the text associated with each of the workshops in Section 4, Project Design, B. Procedural and Scientific Methods, pages 5-7. A bulleted list of objectives and expected deliverables has been added to the methods in each workshop/symposium description. In each case, we propose to have an organizing committee that determines the participant list. The organizing committee will be able to best identify the fisheries managers and outside researchers that should be involved to address the objectives of the workshop. We added the following in the workshop methods section to clarify that process:

An organizing committee made up of the ADF&G herring coordinator, the most appropriate LTRM scientist, and at least one researcher from outside the LTRM program will be responsible for determining the participant list and specific questions to be addressed.

An organizing committee was already described within the Symposium methods section. We feel that it is important that the participant invitation process be driven by the fisheries managers as they are the target audience. The following sentence was added to clarify that the target audience is the fisheries managers:

Our target audience is the ADF&G fisheries managers.

We have confirmed with Alaska Sea Grant that the electronic copy of the proceedings of the Wakefield Symposium can be made open access. We note that the proceedings previous Symposia are available for free at https://alaskaseagrant.org/events/wakefield-fisheries-symposium/past-symposia/. We modified the text in Section 4, Project Design, B. Procedural and Scientific Methods, page 7, as follows to specify that the electronic form of the proceedings will be made open access:

Alaska Sea Grant will be contracted to organize the symposium and the development of a final symposium proceedings in a book form and make available as open access the electronic version of the symposium.

Date: September 2021

We appreciated the PI providing additional detail on the workshops and their organization and was satisfied with this response and recommends funding for the first five years of the proposal. However, we felt that funding of a Wakefield Symposium > 5 years before it would happen was premature and that this should be removed from the present proposal. We did think such a proposal would be of value but would prefer to see a fuller proposal for this, complete with additional sponsors and a statement of support from Sea Grant prior to recommending funding for this portion of the work. We recommend funding this project without the Wakefield symposium part of the proposal and budget.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

I concur with the Science Panel and PAC. This is a relatively low budget project ($134,288 for FY22-26) with the potential for larger, more widespread information exchange on a national and international level.

Project Number: **22220111-K**

Project Title: Aerial Forage Fish Surveys

Primary Investigator(s): Scott Pegau

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$50,794	$53,519	$53,192	$57,171	$56,462	$271,138
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$61,585	$59,732	$60,005	$63,329	$63,384	$308,034

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $50,794

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 03.29.2021, budget updated 04.14.2021.*

Forage fish, including Pacific herring, are a critical link between zooplankton and higher trophic levels such as fish, birds, marine mammals, and people. There remain major gaps in our understanding of how the populations of these fishes fluctuate, and addressing these gaps requires data on how the populations change through time. The work proposed here extends a nearly ten-year-long time series of aerial surveys of forage fish in Prince William Sound (PWS), including age-1 herring, age-2+ herring, sand lance, and capelin. The aerial surveys complement the vessel-based forage fish surveys described in the Gulf Watch Alaska Long-Term Research and Monitoring Pelagic Component by providing information about the fish within shallow coastal waters while the vessel surveys focus on deeper waters. While we are interested in tracking changes in all the observed forage fish within the Herring Research and Monitoring Component, we are particularly interested in providing an index of age-1 herring populations that can be used to estimate future herring recruitment. Predicting year-class strength is important because the size of herring year classes fluctuates by nearly two orders of magnitude and the strength of the recruiting year class is

considered when estimating the available biomass. We desire to test the hypotheses that an index of year-class strength in PWS will improve herring forecasts and that because of synchronicity in recruitment in the Gulf of Alaska, the PWS index is relevant to other populations in the Gulf of Alaska. Aerial surveys of age-1 herring are the only available index of year-class strength before the herring join the spawning stock at age-3 and this index was recently incorporated into the age-structured-assessment model, which allows us to assess the ability of the index to improve recruitment estimates.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Fund FY22-24 Fund contingent FY25-31	Fund FY22-24 Fund contingent FY25-31	Fund FY22-24 Fund contingent FY25-31	Do Not Fund

Science Panel Comments

Date: May 2021

The Science Panel thought the concept of this proposal was interesting and potentially useful. However, the presentation of this proposal was weak in places and lacked a thorough literature search on this topic. Specifically, the hypothesis is that a quantitative measure of juvenile herring abundance, made in June when juveniles are approximately 14 months old, can be used to predict the relative magnitude of the same year class (or cohort) when they mature sexually and spawning at age 3, or about two years later. The general consensus in the scientific literature is that the relative size of a year-class, in herring and many other marine fish species, is determined in the first year of life. Therefore, if there were a way to estimate the size of the cohort at age 1, then this could be a valuable tool for management of PWS herring.

PI Response:
I appreciate the Science Panel's close review of this proposal. Based on this comment and the comments below I have strengthened the proposal throughout. Please see my responses to comments below and the revised proposal for specific edits.

Additionally, a substantial revision is required that includes more reference to the way that juvenile survey data are already utilized in PWS that is part of the stock assessment process (See the recent reports from the stock assessment work by Trevor Branch and colleagues). Also, the rationale for the proposal would benefit by making reference to the recent, and conceptually similar work by Jennifer Boldt at al. (2018). Boldt and colleagues found that, in the Strait of Georgia, the two years with lowest age-0 juvenile abundance (at an age of about 5-6 months) resulted in the two lowest years of recruits at age 3, roughly 2.5 years after the juvenile survey. The implication is that juvenile surveys can provide significantly useful predictors of POOR recruitment, *although not necessarily predictors of good recruitment*. Even so, such a predictive capacity of one or two years, can provide managers with a rough prediction about the prospects for the relative size of developing cohorts, especially poor ones and, if necessary, adjust harvest rates accordingly.

PI Response:
I added reference to the Branch et al. (2021) annual report to Section 1, Executive Summary, page 3, and Section 4, Project Design, A. Objectives and Hypotheses, page 7, with a discussion about the results included in that reference.

I added a reference to Boldt et al. (2018) to Section 1, Executive Summary, page 3, and Section 4, Project Design, A. Objectives and Hypotheses, page 6. I replaced Figure 1 on page 3 in Section 1, Executive Summary, with one showing the relationship between recruitment and the forage fish surveys that exist to show that our results are driven by the largest recruit class instead of the smallest as Boldt et al. (2018) found. I added text in Section 4, Project Design, A. Objectives and Hypotheses, page 6, that explains the regression results using the data in Figure 1. Our data only include one exceptionally poor and one exceptionally good year class and we expect there may be changes to these preliminary results as more large and small year classes are observed.

I pared down other text, particularly on previous validation efforts in Section 1, Executive Summary, to remain within the word limit of the section.

Boldt, J.L., Thompson, M., Rooper, C.N., Hay, D.E., Schweigert, J.F., Quinn II, T.J., Cleary, J.S., Neville, C.M., 2019. Bottom-up and top-down control of small pelagic forage fish: factors affecting age-0 herring in the Strait of Georgia, British Columbia. Marine Ecology Progress Series 617, 53-66.

Branch, T.A., Trochta, J., McGowan, D., Dias, B., 2021. Modeling and stock assessment of Prince William Sound herring, EVOSTC Restoration Project 20120111-C Annual Report.

We were puzzled over Figure 1 which shows the number of age-1 herring schools and the number of age-3 herring in Sitka. Why aren't the numbers of age-3 herring from PWS (from Branch et al.) plotted here with the age-1 herring observations?

PI Response:
I replaced Figure 1 in Section 1, Executive Summary, on page 3 with one that shows data from the PWS model and existing data.

The reporting of historical validation efforts is informative, and we strongly encourage future plans for further on-the-grounds validation of aerial observations. The proposal mentions a desire to work with other projects to provide additional validation. Please clarify specific options on how this would be accomplished, especially if these validations require additional costs to, or modifications by, those other projects.

PI Response:
I expanded Section 4, Project Design, B. Procedural and Scientific Methods, beginning at the bottom of page 11, to describe how we will address our objective to validate the aerial observations with vessel-based sampling. I added the following paragraph on page 11 to include a direct reference to the forage fish project that is conducting the sampling:

Validation accomplishes two tasks. It helps train the aerial observers to the characteristics of different forage fish schools and provides an error estimate associated with the school identification. To achieve the validation objective, we work with the forage fish project led by Dr. Arimitsu

(22120114-C). Either flights are conducted when that project is in PWS or they bring a small boat to Cordova and Whittier and work when we are flying in those areas. We have found that a small boat is less likely to spook the fish and can maneuver nearshore where most of the fish are observed. Approximately 10% (4-6 hours) of the flight time is dedicated to working with the validation vessel.

Aside from making better reference to the literature and past work in PWS, the proposal would be improved by providing more detail about the present understanding of how juvenile herring are distributed in PWS and adjacent areas. In particular, inclusion of the present understanding of how spatial distributions and depth distributions of age-1 juveniles may change with age and growth of herring juveniles and the extent to which some juveniles may migrate out of PWS. We also suggest that the PIs discuss how juvenile herring distribution would impact the proposed work.

PI Response:
Section 4, Project Design, beginning on page 5, was greatly expanded to provide more background on the survey design, why age-1 surveys are appropriate, and use of juvenile indices to predict recruitment. This expansion includes many new references and a discussion of the seasonal distributions (spatial and depth) of juvenile herring as it relates to the survey design. The existing evidence is that age-1 juveniles remain near their nursery grounds through our June survey window. We address the fact that the scale of the survey is designed to allow for changes in herring distribution within PWS.

Date: September 2021

In general, we endorse examination of juvenile herring distribution and biology. We also encourage the potential utilization of juvenile herring data as a contribution to the refinement of the herring stock assessment methodology. It is clear, however, from an examination of the data presented in the data portal and for the presentation of juvenile herring biology in the 2021 synthesis report, that there are many further questions and hypotheses about juvenile herring that might be examined.

Although we welcome and encourage further review and research on the juvenile herring life stage, we have concluded that the rationale for the work, as it was presented in this proposal, is lacking in detail and that the focus was too narrow.

There may be more utility to examination of juvenile herring data than is mentioned in this proposal. For example, interannual variation in juvenile size, distribution and abundance may be revealing about the access of food to juvenile herring. Also, analysis of intra-annual geographical variation could be important especially as previous Council-sponsored work is showing substantial differences in juvenile size according to the size of capture and the date of capture. So, in general, we believe that the available data on juvenile herring, especially data on distribution and abundance, warrants much more scrutiny than it has received to date, including detailed analyses and documentation in the form of peer reviewed reports. Therefore, we encourage the PI to step back from the relatively specific and narrow set up hypothesis mentioned in the proposal. Instead, we would like to see a detailed review of the assumptions using juvenile herring data that are presented to the assessment process. For example, the presentation made in the March 2021 synthesis document (which, in general is excellent) makes several unsubstantiated assumptions about how relative biomass is determined from aerial surveys. Specifically, the estimation of the relative number of juvenile herring based on aerial measurements of school size requires more validation. We are not saying that the present analysis is incorrect. Instead, we advise that the methodology, as presented in this

proposal and in the 2021 synthesis document, may be correct, but it requires substantially more description analysis and documentation.

The use of the scientific literature must be expanded and there is recent literature that should not be ignored. For instance, a paper by Brierly and Cox (2015) makes the case that as some fish populations decline, the effect is a reduction in the number of schools, not the mean size of schools. Clearly the data in the 2021 synthesis report indicates that there are sharp intra- and interannual variation in the number of schools and in the size-frequency of two-dimensional school 'diameters' but, to be credible, there also should be corroborating evidence that two-dimensional surface area can be pooled into a single "small school equivalents" number.

For 10 years the projected total cost would be almost $580,000 but the total scientific contribution would be one paper submitted to a peer-reviewed journal. Given the time and money used for this work, and given the potential utility of juvenile herring data, we would expect substantially more productivity. This is a lucrative subject area, both in terms of its biological value for managing PWS herring and for its inherent scientific worth.

The PI has indicated that this work will be collaborative and cooperative with other projects and share data and methods with others. We deeply appreciate and endorse that. We also acknowledge that the PI has produced an excellent synthesis report for EVOSTC (March 2021) and that the juvenile herring data have been carefully collected and presented in an accessible on-line website. We recommend funding for two years, the remaining years fund contingent on a re-submission of an updated proposal, that would incorporate any new results.

Brierley, AS and MJ Cox. 2015. Fewer but not smaller schools in declining fish and krill populations. *Current Biology* 2015 vol. 25 pp. 75-79

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: Fall 2021

I concur with the Science Panel and PAC.

Project Number: **22220111-L. This proposal has been integrated with 22220111-I.**

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

Primary Investigator(s): Peter Rand, Rob Campbell, Maya Groner

PI Affiliation: Prince William Sound Science Center **Project Manager:** NOAA

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$303,590	$264,567	$174,303	$177,990	$182,704	$1,103,153
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$310,216	$175,047	$0	$0	$0	$485,264

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $310,216

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

Studies have suggested that ecological interactions occur between Pacific herring and pink salmon in Prince William Sound (PWS) that may have consequences for recruitment in both species. We will apply a new field sampling approach that measures co-occurrence of these two species and apply new metrics related to predation and disease prevalence to test hypotheses related to the mechanisms of interaction. Our approach focuses on: 1) an early period when juvenile and adult herring co-occur with young pink salmon fry in nearshore, shallow waters, and 2) a later period when older, emigrating pink salmon encounter herring larvae over deeper waters. The former approach will determine how common herring co-occur with and are feeding on pink salmon fry, and determine prevalence of viral erythrocytic necrosis (VEN), a disease known to occur in both species. The latter approach will also measure prevalence of VEN and will determine whether pink salmon are feeding on larval herring and the potential impact that this predation has on herring

recruitment by applying bioenergetic model simulations coupled with estimates of larval herring densities. We will obtain additional field data on juvenile pink salmon and their prey collected in odd years as part of a planned Gulf of Alaska trawl survey conducted by the National Marine Fisheries Service. Through synthesis efforts at the end of the grant period, we will examine covariates to explain patterns in pink salmon survival and develop forecast models to predict pink salmon returns. We will determine whether these models perform better than the current model based on a running average of returns. This project will increase our understanding of potential mechanisms that affect recovery of herring and provide new insight into factors effecting survival and recruitment of wild- and hatchery-origin pink salmon to inform fishery management in PWS.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
This proposal has been integrated with proposal 22220111-I.			

Science Panel Comments

Date: May 2021

Like proposal 22220111-K, 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. The Science Panel reviewed the two proposals together and portions of this review duplicate the response to the parallel proposal. Both proposals respond 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*. We strongly recommend that the PIs of both herring-pink salmon interaction studies consider merging efforts into one, well-organized, comprehensive proposal.

PI Response:
We adopted the advice of the Science Panel and merged the two proposals into one. The merged proposal retains project number 2220111-I and this project number (22220111-L) is no longer used.

The PIs of this proposal intend to test hypotheses relating to: (1) herring predation on salmon fry; (2) salmon predation on larval herring; (3) disease prevalence in both species; (4) salmon survival covariates. These complement closely the aims for 22220111-K which were: to test hypotheses that: (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. Some, though not all, of the linkages between the objectives can be inferred from Figure 1 of 22220111-L. There are also obvious overlaps in specific areas, notably the uses of bioenergetic models of pink salmon predation on young herring. As noted in our review of 22220111-K, we suggest consideration of consumption differences in odd versus even years. Other areas of overlap should be addressed, as well.

PI Response:
In the merged proposal, we address the overlaps described by the Science Panel. For example, all the PIs decided to work together on the bioenergetic modeling component of the project to understand the potential impact of larval herring predation by pink salmon on herring recruitment. We also

expanded the purse-seine survey effort from two years to four years which will provide additional insight into consumption differences between even and odd years which was identified as important by the Science Panel. See proposal 22220111-I for revisions.

We request that the PIs include information about the expected magnitude of confidence intervals in estimated consumption rates using the bioenergetic model. The cited Cross et al. (2005) paper makes extensive use of literature data and at one point uses subadult sockeye as a surrogate for pinks. Analogous assumptions will inevitably be required for the proposed work; indeed, one strength of bioenergetic models is that it is commonly possible to plausibly make such cross-species connections. These assumptions need to be clearly stated in the revised proposal. Furthermore, metabolic rates will presumably be inferred from literature model fits, corrected using temperatures from CTD measurements.

PI Response:
In the model description we now refer to sensitivity analyses that we will carry out to understand the sensitivity of key metabolic parameters in the bioenergetic model, many of which have been borrowed from studies of other Pacific salmon. This will allow us to quantify confidence limits in our model output, particularly the consumption rate by juvenile pink salmon on larval herring. The PI has conducted these types of sensitivity analyses in earlier studies to understand how parameter uncertainty can be propagated in bioenergetic models. And, yes, we intend to use in-situ measures of water temperature to reflect conditions experienced by juvenile pink salmon in PWS.

To reemphasize, we strongly encourage merging of the two closely related proposals. 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:
The PIs have merged the two proposals as suggested by the Science Panel. Please see proposal number 22220111-I.

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 (FY12-21): $2,286,400

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $2,634,356

Total Non-EVOSTC Funding (FY12-22): $3,245,900

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.

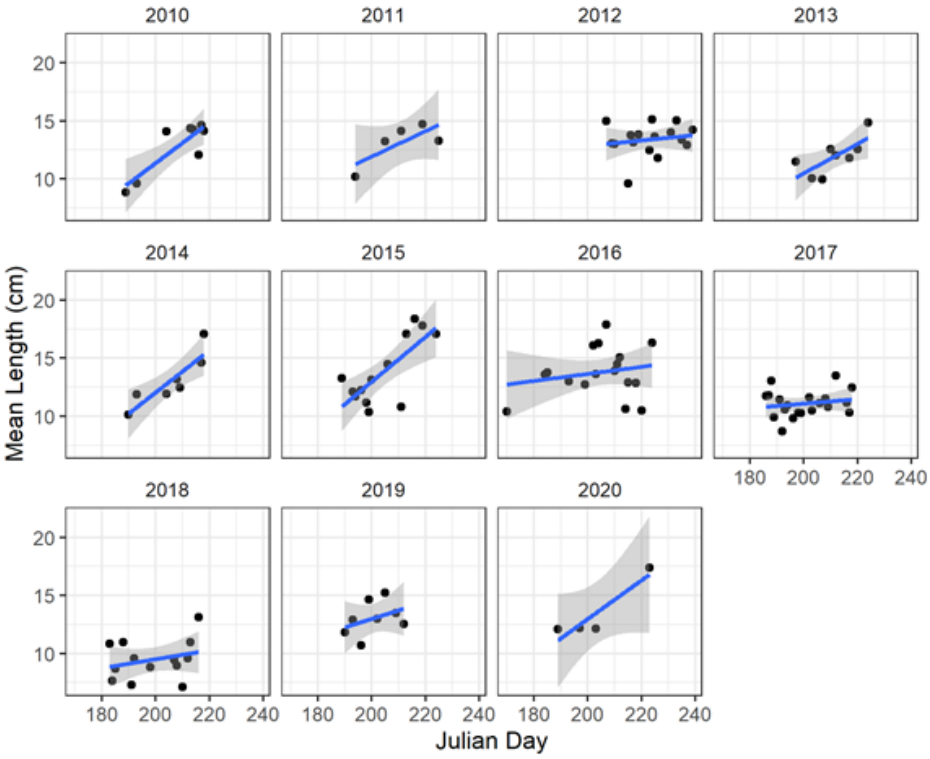
3) A similar question was raised about sample sizes for the juvenile pink and chum salmon collected from provisioning auklets at Middleton Island. Will 10 wild and 10 hatchery fish collected over a period of a month or so be sufficient to characterize the annual condition of these species? The example 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

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 (FY12-21): $1,699,900

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,785,467

Total Non-EVOSTC Funding (FY12-22): $1,653,351

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-E**

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

Primary Investigator(s): Mary Anne Bishop, Anne Schaefer

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$134,082	$137,788	$141,155	$144,665	$148,321	$706,010
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$152,021	$155,872	$159,752	$163,701	$167,859	$799,204

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$40,400	$41,700	$0	$0	$0	$82,100
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $938,300

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,072,382

Total Non-EVOSTC Funding (FY12-22): $431,900

Abstract:

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

Of the marine birds that overwinter in Prince William Sound (PWS), nine species were initially injured by the *Exxon Valdez* oil spill, including three species that have not recovered or recovery is unknown (pigeon guillemot, marbled murrelet, Kittlitz's murrelet). Fall through winter are critical periods for survival as food tends to be relatively scarce, light levels and day length reduced, and water temperatures colder. Our long-term monitoring has shown that the nonbreeding season marine bird community cannot be characterized by a single time period and suggests that multiple surveys are required to quantify wintering populations and understand drivers of distribution. The proposed fall and winter marine bird program will build upon previous years of monitoring (2007-2021) and will continue integration with companion studies of humpback whales and prey. The program will be augmented by an expanded March survey co-funded by the PWS Regional Citizens' Advisory Council (RCAC). For 2022-2031 we will conduct three marine bird cruises each winter: Gulf Watch Alaska (GWA) Integrated Predator Prey (IPP) Surveys (September), PWS Science Center

(PWSSC) Marine Bird Survey (November), and PWSSC-RCAC Expanded Marine Bird Surveys (March). Participation in the IPP survey will enable us to identify and estimate forage biomass at the same locations in which marine birds and humpback whales are feeding, providing information on both predator abundance and prey availability. Concomitant November and March surveys with the GWA Monitoring of Oceanographic Conditions in PWS project will allow us to relate marine bird distribution and abundance to *in-situ* and synoptically collected physical and biological measures. Continued monitoring of marine bird populations during fall and winter will improve our predictive models of species density and distribution across PWS in relation to biological and physical environmental factors and will help determine vulnerability of marine birds to future perturbations and environmental change.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

This proposal seeks to continue long-term studies of marine bird abundances in Prince William Sound (PWS). The PIs identify an additional $82,100 in matching funds. The proposers are competent, have been 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 useful to the current understanding of ecosystem variability in PWS and the Gulf of Alaska. The proposed continuing surveys are expected to produce comparable data to show long-term trends in the fall-winter abundance and distribution of a suite of seabird species from various foraging guilds.

We have some suggestions and questions about methodology that should be addressed. We ask the PIs to carefully edit this proposal in the next iteration. We found it difficult to clearly identify exactly what work is being proposed.

1) "Beginning in 2021, in collaboration with the PWS Regional Citizens' Advisory Council (RCAC), the March survey has been expanded to include transects in under-surveyed areas in and around the tanker escort zone and adjacent bays." Will there be any hydroacoustic, physical or other biological data acquired on these transects?

PI Response:
To clarify, the PWS RCAC transects are only funded to collect marine bird and mammal density and distribution observations in and around the tanker escort lane. For modeling efforts that include data from PWS RCAC transects, physical covariates will be the same as those used for all our surveys, such as weather state, sea state, sea surface temperature, bathymetry, slope, distance to land, and marine habitat type. Please see the flowchart in the figure below (the flowchart was added to the proposal as Fig. 1) for further clarification of how survey data will be used to test our monitoring hypotheses.

2) The stated hypotheses should be more specific based on the data the PIs have in-hand on variability in bird abundance and distribution, prey preferences and foraging type, and physical and biological correlates.

PI Response:
Based on what we have learned from our previous research, we have now expanded and specified our hypotheses. Please see Section 1, Executive Summary, page 5, for the revised hypotheses, which are also included here as follows:

> *1. Marine bird abundance and distribution varies with physical and environmental characteristics within the fall/winter season.*
>
> *a. Marine birds prefer nearshore, shallow, and protected areas within PWS.*
>
> *2. Marine bird distribution, abundance, and species composition vary with prey availability (quantity and/or quality) and predator dynamics.*
>
> *a. Marine bird community composition is dominated by surface feeding larids in fall and shifts to diving alcids by late winter.*
>
> *b. There is a positive correlation between marine bird density and distribution and measures of macrozooplankton and Pacific herring availability.*
>
> *c. Marine bird forage flocks signal the presence of prey aggregations to humpback whales.*

3) On page 11 it is stated: "Using data from all surveys, including the complementary PWS RCAC-funded surveys, we will model marine bird density and distribution in relation to physical and environmental factors and identify marine bird habitat characteristics in PWS within and across years since 2007… Covariates will include physical, spatial, temporal, and environmental variables expected to influence detection (e.g., observer, distance bin, glare) and marine bird distribution (e.g., winter, time period, sea and weather state, sea surface temperature, bathymetry, slope, distance to land, marine habitat type)." There is no mention of biological covariates. Please clarify if biological variables will be applied in the models.

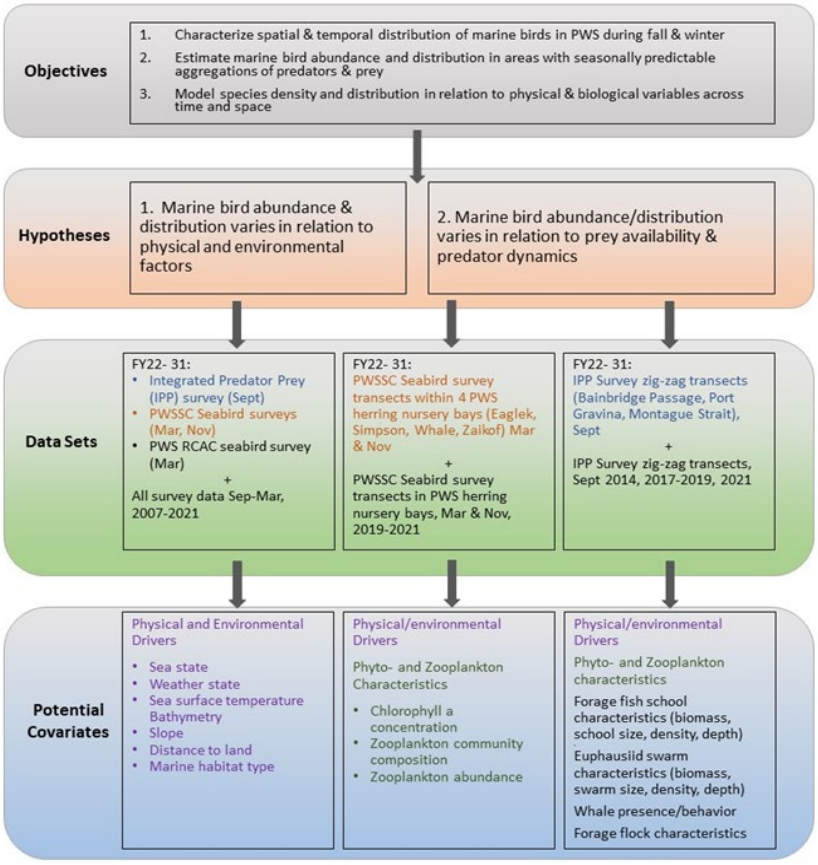
PI Response:
We developed the flowchart in the figure below (also added to the proposal as Fig. 1) to clarify and illustrate exactly how we plan to use our data to examine our hypotheses (See Section 1, Executive Summary, page 5, 2022-2031 Hypotheses) and meet research objectives (See Section 4, Project Design, B. Procedural and Scientific Methods, page 8).

Marine bird density and distribution data from all surveys (Sep – March 2007-2021, FY22-32) will be modeled in relation to ***physical and environmental*** *factors, including sea state, weather state, sea surface temperature, bathymetry, slope, distance to land, and marine habitat type. Unfortunately, not all surveys have been conducted concurrent with forage fish and/or macrozooplankton surveys.* ***Biological variables*** *(in addition to physical and environmental covariates) will be incorporated into models developed for the September integrated predator-prey (IPP) transect survey data (Montague Strait, Bainbridge Passage, Port Gravina) and the March/November PWS herring nursery bay transects (Eaglek, Simpson, Whale, Zaikof).*

Biological covariates in the September IPP transect models will include hydroacoustic measures of forage fish and euphausiids (PIs Arimitsu and Piatt, 22120114-C, Forage fish distribution, abundance, and body condition in PWS) and presence and behavior of humpback whales (PIs Moran and Straley, 22120114-O, Humpback whale monitoring in PWS).

For the November and March surveys conducted in PWS herring nursery bays, biological variables included in the models may include measures of zooplankton abundance and community composition and chlorophyll-a concentration (PI Campbell, 22120114-G, Monitoring Oceanographic Conditions in PWS).

Flowchart illustrating how FY22-31 marine bird survey data will be used in analyses to address project hypotheses and objectives. Color continuity of text within rows indicates continuity of the bullet point (e.g., same survey, same covariates).



4) The PIs indicate on the milestone chart that all data will be posted online by Q1 in FY31, but they show fieldwork in Q3 & 4 that year. Please reconcile.

PI Response:
Thank you for catching this! We have updated the chart to show that all data will be posted online by Q4 FY31.

Date: September 2021

This proposal seeks continued funding over an additional ten years for long-term studies of marine bird abundances in Prince William Sound (PWS). The results to date have been useful to the current understanding of ecosystem variability in PWS and the Gulf of Alaska. The proposed continuing surveys are expected to produce comparable data to show long-term trends in the fall-winter abundance and distribution of a suite of seabird species from a variety of foraging guilds. The proposers have been productive and have strong collaborations within the GWA LTRM Program and with other studies in the Gulf of Alaska.

The PIs answered and addressed our questions and comments reasonably well. The PIs clarified questions about data to be collected during the March RCAC surveys. They restated their hypotheses, which improved them somewhat, but we found some to still be rather simplistic. The PIs added a flowchart to help visualize connections between Objectives, Hypotheses, Data Sets (to be collected), and Potential Covariates (to patterns of seabird distribution): we believe the stated hypotheses could be more clearly linked to the flowchart beyond simply identifying the sources of data on potential covariables. A lack of consistency between panels of the flowchart, as well as unwarranted consistency, made it somewhat difficult to understand. In this regard, e.g., "Phyto- and Zooplankton Characteristics," "Forage Fish school characteristics…, etc., are not "Physical and Environmental Drivers" (or Physical/environmental Drivers), the headings for all three panels of "Potential Covariates." The PIs are encouraged to edit the flowchart before presenting it publicly.

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

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 (FY12-21): $2,183,800

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $2,433,562

Total Non-EVOSTC Funding (FY12-22): $1,999,900

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, Dan Esler, Katrin Iken, Brenda Konar, Brenda Ballachey, James Bodkin, George Esslinger, Kim Kloecker, Mandy Lindeberg, Dan Monson, Brian Robinson, Sarah Traiger, Ben Weitzman

PI Affiliation: NPS, USGS, UAF, NOAA

Project Manager: NPS, USGS, NOAA

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 (FY12-21): $3,678,200

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $4,366,912

Total Non-EVOSTC Funding (FY12-22): $4,075,200

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

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 (FY12-21): $1,260,000

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,396,337

Total Non-EVOSTC Funding (FY12-22): $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-J**

Project Title: Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay, Alaska

Primary Investigator(s): Kris Holderied, Steve Baird

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$176,434	$180,884	$185,361	$189,898	$194,699	$927,274
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$199,626	$204,549	$209,829	$214,787	$220,151	$1,048,942

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$105,000	$108,000	$110,000	$113,000	$116,000	$552,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$120,000	$120,000	$120,000	$120,000	$120,000	$600,000

Total Past EVOSTC Funding Authorized (FY12-21): $1,574,700

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,751,134

Total Non-EVOSTC Funding (FY12-22): $2,264,800

Abstract:

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

The Cook Inlet/Kachemak Bay monitoring project is providing year-round, high-temporal resolution oceanographic data to monitor and assess the effects of seasonal and inter-annual oceanographic variability on nearshore and pelagic species affected by the *Exxon Valdez* oil spill (EVOS). We propose to extend a 10-year time-series, under Gulf Watch Alaska - Long-Term Research and Monitoring (GWA-LTRM), of monthly shipboard oceanographic surveys along the estuarine gradient from Kachemak Bay into southeast Cook Inlet, as well as a 20-year time series of continuous water quality station observations in Kachemak Bay. Our sampling design captures along-estuary changes in water temperature, stratification, fresh water, Alaska Coastal Current intrusions into Cook Inlet, and nutrient variability at within-season, seasonal, and interannual scales that are important to understanding how food web dynamics affect fish, marine mammals, and birds in the EVOS-affected region. Shipboard sampling includes conductivity-temperature-vs-depth casts, zooplankton and phytoplankton net tows, and water collection for nutrient and chlorophyll analyses. Water quality

stations measure temperature, conductivity, pH, dissolved oxygen, turbidity, and depth every 15 minutes. Outputs from the project include spatially and seasonally-resolved patterns and interannual shifts in: physical water column metrics; zooplankton and phytoplankton abundance and community composition; and abundance of harmful algal species. The Cook Inlet project will continue to provide oceanographic data to support the GWA-LTRM Nearshore Component in Kachemak Bay and provide year-round data to help the GWA-LTRM program evaluate the effects of local (estuary) and remote (shelf, North Pacific) climate forcing on nearshore and pelagic ecosystems, including herring, other fish, salmon, birds, and marine mammals. Results have found rapid response of Cook Inlet waters to heatwaves and meteorological shifts; changes in zooplankton community species composition and phenology, but not abundance during a heatwave; and a variable association of temperature with increased harmful algal bloom events.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

The proposal is well constructed, guiding the reader through general hypotheses subsequently linked to a list of detailed actions. We discussed the broad justification for the study, given the geographic constraints, an issue raised in previous reviews of this study but were satisfied that this matter was now addressed. There is no substantive change in objectives or in sampling protocol in this continuing proposal. The proposed statistical methods are well established and reasonable.

We request further detail on the rationale (page 17 of proposal) for rejecting some alternative methodology due to cost. This cannot be evaluated without explicit elucidation of the deliverables from the current and alternative methods.

PI Response:
We have clarified the difference in deliverables between our current sampling design with small boat oceanographic surveys and an alternative sampling method we considered that would use an autonomous profiling oceanographic mooring, with fewer small boat surveys. The revised language is in Section 4, Project Design, B. Procedural and Scientific Methods, page 17 of our proposal, in the "Alternative Methods Considered" paragraph, and is also provided below.

<u>Alternative Methods Considered</u>
As an alternative sampling method, we considered deployment of an autonomous profiling oceanographic mooring in Kachemak Bay to provide daily temporal resolution of vertical oceanographic, chlorophyll and nutrient patterns in ice-free months (nominally April to November) at one location, similar to the time series data from the central PWS mooring deployed by Rob Campbell as part of the GWA PWS oceanography project (22120114-G). The mooring was considered to replace some, but not all, shipboard sampling, as monthly small boat oceanographic surveys would still be needed for winter observations and quarterly small boat surveys would be needed to monitor along-estuary gradients from the head of the bay to the Cook Inlet entrance. We did not consider

deploying a profiling mooring in Cook Inlet due to the high tidal currents in that area. Our current sampling methods in Kachemak Bay include continuous water quality monitoring at three locations and year-round, monthly small boat surveys to collect vertical oceanographic and chlorophyll profiles from CTD casts at 13 along-estuary and 10 cross-estuary locations, with zooplankton and nutrient sampling at five of these stations, to track both seasonal and along-estuary patterns in marine conditions and zooplankton communities. Through discussions with other Environmental Drivers component PIs, we assessed the expected staff and boat time needed for servicing the mooring (monthly), initial equipment cost for the mooring (>$200K, significant compared to our proposed project budget) and availability of equipment (the profiling mooring used in PWS is no longer manufactured). We determined that our proposed ship survey and continuous water quality station sampling methods still provide the most appropriate and cost-effective methods to monitor the spatial and temporal spatial variability of marine conditions in Cook Inlet at scales relevant for understanding biological and ecosystem changes. However, we will continue to monitor emerging observing technologies and additional funding sources to evaluate potential future use of moorings for supplemental data collection in this project.

The Education & Outreach (E&O) component for this research has been strong in the past and the SP supports the plans for coordination and collaboration with the future E&O activities now to be supported separately. The track record points to this being effective.

PI Response:
We appreciate the positive comments regarding our past and proposed education and outreach activities. We are excited about the potential for future collaborations with the separately funded EVOSTC Education and Outreach program, including working with local fishermen to routinely get forage species information from salmon and halibut diets and facilitate two-way exchange of information between scientists and community members on marine ecosystem changes.

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-EVOS world when funding may no longer be available. We understand why administratively these enterprises are kept separate in the present proposal but urges 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 3 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

At previous meetings and at the spring 2021 review of draft proposals, we discussed the limited geographic range of this continuing study. We are satisfied that these issues are now resolved and our reaction to the draft proposal was in large part very positive. There is no substantive change to current methodology, and consequently we were initially concerned by the lack of detail on the decision to reject some alternative methodology due to cost. The PI provided a detailed justification in response to this concern.

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-J) 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: October 2021

I concur with the Science Panel and PAC. I also note that this project has a significant amount of leveraged funds for the proposed 10 years.

Project Number: **22120114-L**

Project Title: Seward Line Monitoring

Primary Investigator(s): Russell Hopcroft, Seth Danielson

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

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 (FY12-21): $1,168,100

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,404,208

Total Non-EVOSTC Funding (FY12-22): $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): Kathy Kuletz, 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 (FY12-21): $1,237,800

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,333,801

Total Non-EVOSTC Funding (FY12-22): $404,753

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: **22120114-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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$213,302	$233,325	$238,601	$215,221	$258,804	$1,159,253
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$240,549	$219,147	$231,917	$225,262	$276,519	$1,193,395

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$76,000	$76,000	$56,000	$56,000	$56,000	$320,000
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$56,000	$56,000	$56,000	$56,000	$56,000	$280,000

Total Past EVOSTC Funding Authorized (FY12-21): $1,262,100

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,513,620

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 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

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 (FY12-21): $1,457,600

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,662,309

Total Non-EVOSTC Funding (FY12-22): $1,290,700

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:

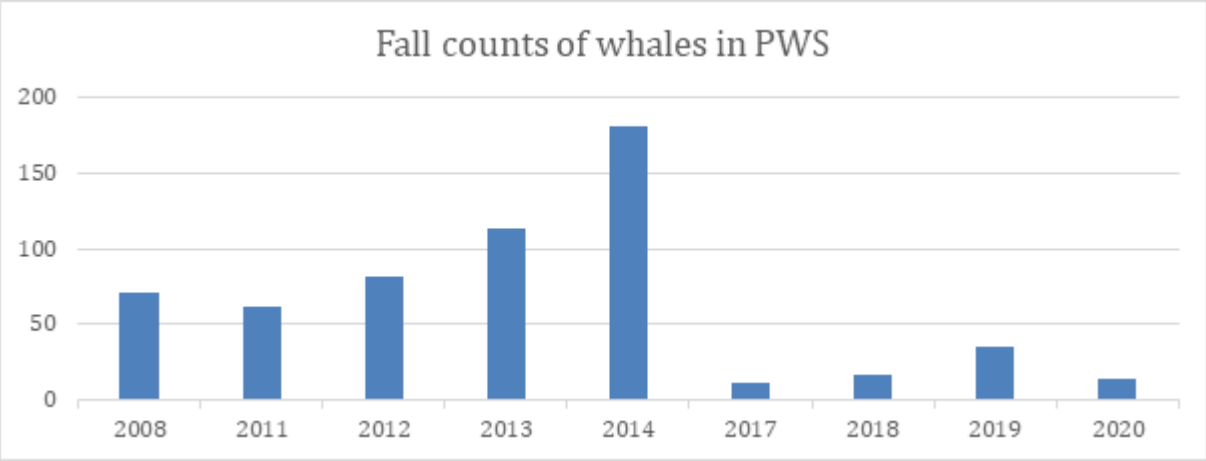
1) The absence of winter aggregations of herring that were present prior to the heatwave. These shoals were temporally and spatially predictable with energetically rich herring. Good prey for whales.

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 (FY12-21): $65,300

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $65,300

Total Non-EVOSTC Funding (FY12-22): $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 not 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: **22220200**

Project Title: Understanding connections between abundant but understudied Pacific sleeper sharks and the recovery of EVOS-injured resources in Prince William Sound, AK

Primary Investigator(s): Amy Bishop, Mary Anne Bishop, Markus Horning, Jacqueline Keating, Julie Nielsen, Andrew Seitz

PI Affiliation: UAF, PWSSC, Wildlife Technology Frontiers, ADFG, Kingfisher Marine Research

Project Manager: N/A

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$440,823	$504,284	$463,068	$606,643	$600,793	$2,615,612
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$555,774	$492,683	$526,564	$542,856	$338,088	$2,455,964

Non-EVOSTC Funding

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$270,839	$150,840	$150,501	$149,570	$149,050	$870,800
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$101,000	$101,000	$101,000	$101,000	$101,000	$505,000

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $440,823

Total Non-EVOSTC Funding (FY12-22): $270,839

Abstract:

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

An ecosystem-based approach to research and monitoring, that includes all components including upper-trophic level predators, is essential to understand the range of factors affecting individual species and the ecosystem as a whole following the Spill. Sharks are positioned at or near the apex of the trophic structures that support them, and as a result may function as keystone consumers central to dynamics of marine food webs. In the EVOS Spill Area, Pacific sleeper sharks (*Somniosus pacificus*) are likely long-lived, late-maturing active predators with diverse diets; however, very little is known about their role in marine food webs in Prince William Sound (PWS) or how changes in their

abundance and spatial distribution could directly or indirectly affect the recovery of EVOS injured resources. In this interdisciplinary study, we will use a combination of telemetry, spatial modeling, biomarkers, and traditional ecological knowledge (TEK) in order to address this critical knowledge gap and provide (1) a comprehensive evaluation of PSS habitat use, distribution, and trophic interactions in PWS food webs, (2) assess how these could change over time and in relation to environmental conditions, and (3) evaluate the implications for the recovery of EVOS injured resources. Our integrated approach will enhance opportunities to coordinate with other Long-term Research and Monitoring Projects (Focus Area 1), facilitate downstream synthesis of how changes in the environment may impact injured resources, and provide managers with information that is relevant to stock assessments and ecosystem-based management of fisheries resources in the region.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

This new proposal is for a ten year study of the natural history of Pacific sleeper sharks (PSS), arguing that very little is known about their role in marine food webs in PWS or how changes in their abundance and spatial distribution could directly or indirectly affect the recovery of EVOS injured resources. Their argument hinges on suspicions that PSS are voracious, long-lived predators that prey on harbor seals and herring, both injured by EVOS; and that by preying on species such as salmon and pollock, as well as other important forage species, PSS might be affecting food web dynamics in PWS. The aims would be to elucidate the role of PSS in marine food webs in PWS, specifically in predator-prey dynamics in relation to EVOS injured resources; characterize space use by PSS and explore how this may be related to physical and biological aspects of the environment, especially spatio-temporal distribution patterns of EVOS injured resources; and monitor trends in PSS space use and foraging ecology, and the implications for the recovery of EVOS injured resources. The methods they would employ include capturing, tagging, and monitoring movements and behaviors of PSS, estimating diet using stable isotopes, and conducting TEK interviews with residents of PWS in the last year of the study.

The proposers are highly qualified to undertake this novel research. They have extensive experience tagging fishes and mammals, and have conducted a pilot study on PSS in Resurrection Bay. Having an ADFG sociology specialist as a Co-PI will facilitate the incorporation of TEK into the project. Also, the veteran GWA and HRM PI on board involves the PWSSC and leverages the OTN sensors from established the HRM project.

Despite the potential of this study, the Science Panel has concerns, not the least of which is that PSS is not among the resources considered to have been injured by the EVOS. Moreover, the proposers failed to make a convincing case for their premise that PSS are, or likely are, keystone predators that are directly or indirectly inhibiting the recovery of injured resources. (And as a related aside, PSS is not an apex predator as characterized in the proposal) ….[*moved for clarity by PI see responses*

below] But most importantly, the PIs did not provide substantial evidence that PSS actually matter to injured species and ecosystem dynamics in PWS.

PI Response:
We thank the Science Panel for highlighting their concerns (further detailed in the sections below), and we agree that at present there is little information on Pacific sleeper sharks to definitively state that they are directly or indirectly impacting EVOS-affected species, but therein lies the main goal of this proposal: no data is not the same as not important. We aim to begin to fill in a considerable knowledge gap for a species that is likely ecologically important in Alaskan waters but that has, until very recently, been virtually ignored.

Until recently, sharks in the Somniosus genus were largely considered benthic scavengers, and studies exploring their movement or diet were limited by size-selective gear types and spatial and temporal biases (Sigler et al. 2006, Hulbert et al. 2006). For Pacific sleeper sharks in particular, basic population parameters and abundance estimates are limited or non-existent, resulting in their management in Federal fisheries as a Tier 6 stock. However, recent data on behavior, diet, and movements is providing increasing evidence that Somniosus are active predators throughout the water column and have diverse diets that shift from invertebrate (squids, cephalopods) to vertebrate (teleost fish, marine mammals) prey as they age (Sigler et al. 2006, Courtney and Foy 2012, Nielsen et al. 2019, and see discussion in Horning and Mellish 2014). While there is still a considerable lack of information, and no definitive direct or indirect linkages to EVOS-affected species, it is becoming clear that they are upper-trophic level predators in the Prince William Sound and Spill area.

In the 1994 Plan, the EVOS TC adopted an ecosystem based approach to restoration. This ecosystem-based approach that focuses on biological environmental factors that drive ecosystem-level changes including bottom-up and top-down forces has provided, and continues to provide, an abundance of information on marine resources. However, management of an ecosystem requires understanding of multiple players across trophic levels, and upper trophic level predators in particular can exert top-down control and should be considered in ecosystem models (Peer Reviewer 2). Currently, there is little to no information known about PSS, but preliminary evidence suggests their large size, diverse predation habits, and great longevity are factors that must have significant but unknown impacts on pelagic food webs. (Peer Reviewer 4). Having a better understanding of their ecology and foraging behavior could help further the understanding of several other EVOS injured resources (Peer Reviewer 3).

While at this time the direct and indirect impacts of Pacific sleeper sharks is, as the Science Panel rightly points out, unclear and lacking hard evidencee, information gained from this proposed project will be incredibly valuable for management and recovery of the ecosystem and species affected by EVOS. Furthermore, the foundational information gained through this project may provide insight to the hypothesized life stage movements (i.e., where are all of the adults), as well as stock structure which is critical for management and science of PSS within the Gulf of Alaska as a whole.

In this revised proposal, we have clarified the above points, specifically regarding the importance of PSS as a component of the EVOS Spill affected ecosystem for which little to no information is available at present and the significance of the data proposed in this study to restoration and management. Specific responses and revisions to Science Panel and Peer Reviewer questions and comments are provided below and incorporated into the proposal text.

We thank you for the opportunity to revise and resubmit this proposal to the EVOS-TC Long-Term Research and Monitoring funding opportunity.

Among their arguments is the claim that PSS prey on harbor seals and herring, and they cite several references in support of this. However, we investigated some of those references and found scant support for that claim. Bright (1959), found "portions of at least three harbor seals" in the stomach of an individual PSS in Kachemak Bay, along with some invertebrates. This is the most compelling evidence for predation on harbor seals. Sigler et al. (2006) examined stomachs from 198 PSS from the northern GOA, 165 of which contained food. They reported that "of the 25 prey identified as marine mammals, 21 were cetacean, one was a harbor seal and three were unknown..." They further noted that harbor seal remains were found in only one of 33 stomachs of PSS from PWS examined by L. B. Hulbert (unpubl. data). Herring was not among the identified teleost prey of any of the individuals in the study by Sigler et al. The proposers also cited Orlov and Moiseev (1999) as a source of herring consumption by PSS, but those authors simply stated that PSS ate herring in the western Bering Sea. They also cited Orlov (1999), but he found only a single individual herring in a single PSS, also in the western Bering Sea.

The PIs suggest that PSS may be an important predator, even a keystone predator, in PWS that may affect injured resources indirectly as well as directly. In support of this, they again cite Sigler et al. who found remains of salmon (only 1.0%-4.3% by number of prey) and pollock (only 1.2%-12.6% by number of prey) among the prey of PSS they sampled. Both taxa are important in various ways in food webs in PWS, including as predators of herring, but they appear to be consumed by PSS in very small numbers. In the Sigler et al. study, cephalopods (58.3%-80% by number of prey) were the dominant prey identified. And squid was by far the greatest component of the diet of the PSS reported by Orlov (1999).

PI Response:
Yes, squid and cephalopods are definitely a major component of the diet of the Pacific sleeper sharks sampled in these studies, but these studies have several sampling biases. Individuals sampled by Sigler et al. had Total Lengths (TL) ranging from 100-240 cm (mean size < 200cm). An ontogenetic shift from squid to teleost/marine mammal diet has been observed across the Somniosus genus: cephalopods were the predominant prey for Greenland sharks in the < 200cm size class but fish and marine mammals were predominant for individuals > 200 cm TL (Nielsen et al. 2019). This shift was also observed for Pacific sleeper sharks (Sigler et al. 2006, Courtney and Foy 2012). Recent size estimates for Pacific sleeper sharks suggest individuals in the Gulf of Alaska are relatively larger than those caught in the Bering Sea or Aleutian Islands (Tribuzio et al. 2020). In our pilot study, animals caught in Resurrection Bay (several of which were detected on acoustic arrays moving into Prince William Sound) were on average 283 cm TL.

These prior studies also provided snap-shots of diet from stomach content that are seasonally specific that suggest cephalopods and teleosts are equally important at different times of the year. In the Sigler et al. study, by <u>% relative importance</u>, cephalopods ranged from 61.2% in May to 31.5 % in August. An inverse pattern was observed for teleosts (34.5% relative importance in May and 64% in August), with the august teleosts primarily comprised of walleye pollock, and pink and chum salmon. Marine mammals were low importance in both seasons, but as stated above, this is expected based on the size of individuals sampled. Additionally, Steller sea lion (SSL) tissue or remains were never

identified in PSS stomachs, yet telemetry data from our own prior studies strongly suggests that PSS predation on weaned, juvenile SSL does occur and may account for ¼ of juvenile SSL mortalities or more (Horning and Mellish 2014), which in turn may have significant impacts on SSL population trajectories (Horning and Mellish 2012). This merely highlights that the absence or infrequency of detection in PSS stomachs does not translate to absence of predation, consumption, and even possible population level effects.

We have provided these clarifications and expanded details in the proposal text (Page 4 "Ecology and trophic interactions"), and highlight that our proposed approach of analyzing stable isotopes from two tissues with different turnover rates and opportunistic stomach content analysis will provide new information on how diet and foraging ecology changes seasonally and relative to size (Page 15).

Also, the proposal lacks any compelling information on the abundance of PSS in PWS, with estimates of biomass for the entire GOA spanning an order of magnitude—estimates from NMFS trawl surveys range between 6,561-70,933 t in the past 5 years. Some scenarios about ranges of possible numbers/biomass of PSS in PWS, ranges of their possible diets (and relative to estimates of the biomass of individual prey), and their daily energy requirements may help to better establish the notion that they might indeed be important predators, particularly in regard to species of interest to EVOSTC but even then, the expected range may not provide compelling evidence.

PI Response:
We have provided updated information on abundance estimates for Pacific sleeper sharks in PWS specifically from ADFG survey data, as well as further detailed AFSC and IPHC indices of biomass and relative population numbers respectively on Page 3. As to the scenarios of ranges of their possible diets this is one of the deliverables we aim to provide through the study, which in combination with work estimating daily energy requirements (ongoing NPRB-funded work) will enable future assessments of impacts due to environmental or anthropogenic change.

Estimating diet is a critical element of this proposal, as it is fundamental to establishing the role of PSS in the ecosystem. As the PIs acknowledge, the use of stable isotope analyses and models does not yield definitive identifications of prey consumed. Might they supplement the diet estimates by incorporating samples of opportunity from commercial fisheries bycatch or the sport fishery of PSS from which they could examine stomach contents? Could they possibly take enema samples from animals they bring aboard, and then use DNA (qPCR) for prey enumeration?

PI Response:
Thank you for this suggestion! We have identified in our proposal text on Page 16 that in addition to stable isotope analysis we will incorporate samples of opportunity from commercial fisheries bycatch or the sport fisheries of PSS. This will result in increased the sample size of the SIA bulk analysis to 30 per year (10 muscle + 10 blood from tagged animals, + up to 10 muscle samples from opportunistic collections; total = 20 animals/year). We have also noted that stomach content analysis will also be pursued from samples of opportunity to enhance our understanding of the temporally- and size-specific diet for this species. While we agree DNA is a valuable tool for prey enumeration, to our best knowledge due to the anatomy of these animals (e.g. spiral valves) enema samples would be challenging in the field.

We recognize that considerable effort will need to be put into collection of these supplemental samples. Out collaborative network of co-PIs, agency partners (AFSC), communities engaged with through the ADFG TEK work, industry partners, and outreach efforts will be leveraged to facilitate collection of opportunistic muscle samples for SIA as well as complimentary stomach content analysis. For example, a recently funded NPRB outreach proposal aims to bring together sport fisheries, researchers, and teachers to share information that can be incorporated into curriculum. This partnership could also be leveraged to identify and encourage opportunistic sample collection and sharing. This information has been added to the proposal on page 16 and the associated costs for supplies and personnel time for processing these additional samples are reflected in the UAF budget.

Overall, we did not see a rationale for a 10-year study to accomplish the goals of this project.

PI Response:
While individual questions on diet or movement may be partially addressed through a shorter study, one of our objectives (#8) is to "Monitor the seasonal and inter-annual variation in the distribution, habitat use, trophic niche, and diet of PSS in PWS, and identify trends across the 10+ years of data (2018-2031)." Since at present there is very little baseline data on PSS, characterizing patterns across the natural climate variability of a 10-year study will not only contribute to a more robust understanding of sharks' basic biology and ecology, but to also provide the opportunity to identify forcing mechanisms and to predict future shifts in response to increasingly variable environments. We have added text in the proposal to clarify this rationale (Pages 5, 16, 24).

We also wondered why the TEK interviews of residents would not take place earlier than the last year of the project in 2030.

PI Response: We have shifted the TEK interviews of residents to earlier in the project (Pages 5, 34-35). By engaging with these communities early, we will not only be able to address our objectives but additionally foster relationships that may be vital for opportunistic sample collection, data opportunities, and outreach.

Another concern is that personnel costs are very high.

PI Response: Our project is a collaborative effort between research scientists that rely entirely on external funding (Bishop, Bishop, Horning, Nielsen), agency and academic scientists (Seitz, Keating), and early-career mentored positions (graduate student, postdoctoral fellow). Personnel costs do account for a significant amount of our proposed budget but as Reviewer 2 noted, "This is a time intensive project and the personnel costs are commensurate with what is necessary to complete the project".

In response to comments on specific personnel costs, we feel this may have been due to the incorporation of salary and fringe (and in the case of Kingfisher Marine Research salary, fringe, and indirect rates) in the reported 'monthly personnel costs' column in the proposal budget forms. Since we cannot change the format of the budget spreadsheets to provide a breakdown, we have added information in the comments sections to clarify how costs were calculated.

The external peer reviewers raised a number of interesting points. Among them is that use of the term “abundant” in regard to PSS is not appropriate because so little is known about the population size; and that correlations between PSS movements and depth and direct measures of prey would not be legitimate. The importance of dietary information was noted and improvements to the approach of the PIs to estimate diet were suggested. Questions were raised about how the roles of the graduate students and postdoctoral fellows would generate independent research projects for them, and how they would fit into the anticipated publication schedule, which would not begin until five years into the project. And it was also noted that it is not realistic to expect a postdoc to work on a project for so long before publishing results.

PI Response: Specific responses to external peer reviewer comments are detailed below, with summary information noted below. [Staff note: External peer reviewer comments are not included in the Work Plan].

Date: September 2021

We appreciate the PI responses to reviewer comments. While it seemed clear that the proposed work would uncover new information about sleeper sharks, we remained unconvinced that there was a high probability that the work would conclusively tie Pacific sleeper sharks to recovery of injured resources. As a result, the proposal was viewed as a low priority, and we do not recommend funding.

PAC Comments

Date: Fall 2021

No specific comments.

Executive Director Comments

Date: Fall 2021

The proposers are highly qualified to do this work. The revised proposal is well-written. It is clear much time and effort were put into this proposal and addressing the Science Panel and external reviewer comments are greatly appreciated. Considering the Science Panel’s comments and that sleeper sharks are not an injured resource; 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:** ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $672,345

Total Non-EVOSTC Funding (FY12-22): $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

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $157,100

Total Non-EVOSTC Funding (FY12-22): $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**

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: ADFG, PWSSC, USGS, UC Davis **Project Manager:** NOAA, ADFG, USGS

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $363,390

Total Non-EVOSTC Funding (FY12-22): $59,000

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: **22120113**

Project Title: Data Management Program

Primary Investigator(s): Carol Janzen, Rob Bochenek

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

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	$381,426	$411,819	$401,524	$373,476	$1,947,961
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 (FY12-21): $4,279,942

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $4,659,658

Total Non-EVOSTC Funding (FY12-22): $2,978,600

Abstract:

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

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 (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

Submitted in response to the FY22-31 Invitation for Proposals

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:** ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $808,445

Total Non-EVOSTC Funding (FY12-22): $500,000

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, Kevin Berry, Willow Hetrick, Elizabeth Hoover, Dune Lankard, Bren Smith, Michael Stekoll, Thomas F. Thornton

PI Affiliation: Alaska Conservation Foundation, UAA, CRRC, UC Berkeley, Native Conservancy, GreenWave LLC, UAS

Project Manager: ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $829,772

Total Non-EVOSTC Funding (FY12-22): $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, Ginny Eckert, Julie Decker, John Whissel, Rob Bochenek, Rob Campbell, Alysha Cypher, Quentin Fong, Melissa Good, Jordan Hollarsmith, Amanda Kelley, Brenda Konar, Chris Long, Alexi Pinchuk, Michael Rehberg, Anne Schaefer, Schery Umanzor, Shellfish & Seaweed Farmers

PI Affiliation: PWSSC, UAF, NOAA, Native Village of Eyak, Axiom Data Science, AFDF, ADFG

Project Manager: NOAA, ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $2,637,792

Total Non-EVOSTC Funding (FY12-22): $60,239

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.

Farm component. 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.

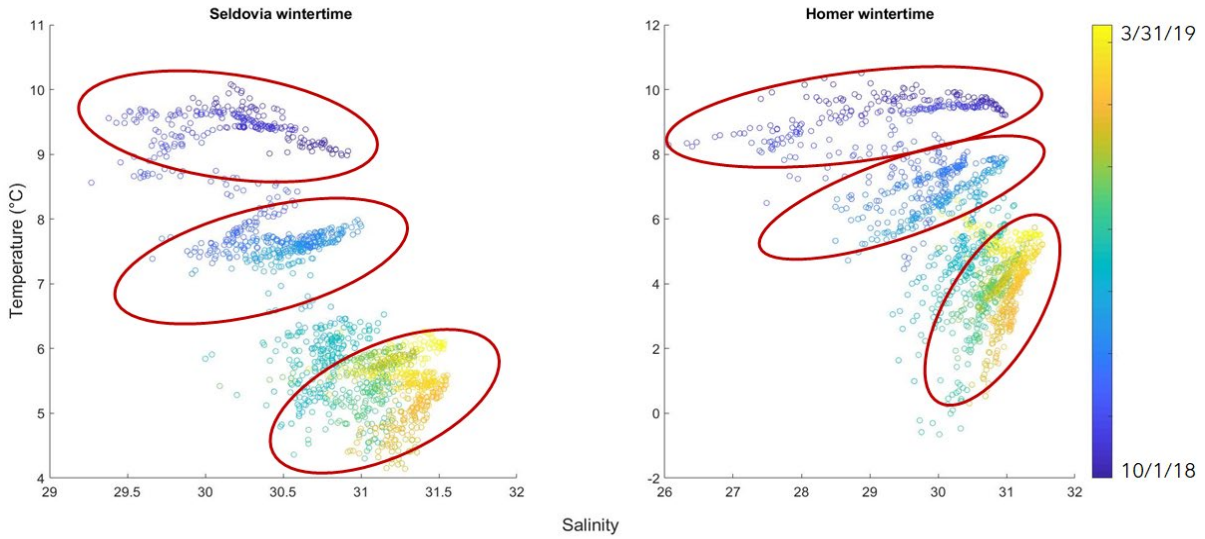


Figure X. Temperature-salinity plots of wintertime water column properties in Kachemak Bay, Alaska. Color bar indicates time.

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.

Marine mammal component. 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.

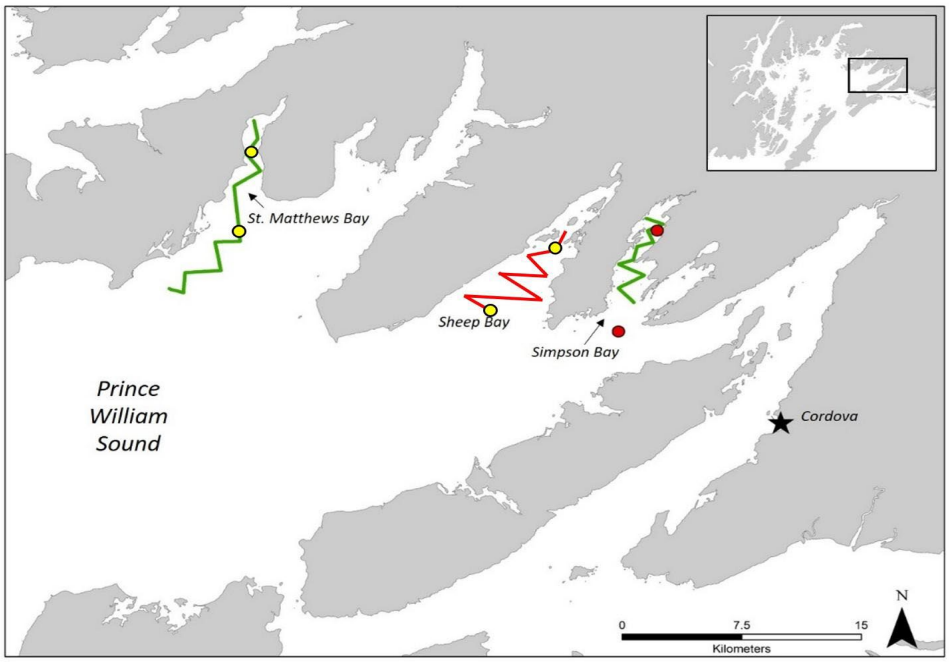


Figure 5. Proposed expansion of existing Gulf Watch Alaska (GWA) long-term research and monitoring (LTRM) programs in eastern PWS, Alaska for objectives 1.3, 2A.3, 2C.1, 2D, and 2E.1 to be inclusive of bays with varying levels of mariculture development (Simpson: existing farms/permits, Sheep: one test-site/several 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)

Economic component. 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

Submitted in response to the FY22-31 Invitation for Proposals

Project Number: **22220400**

Project Title: Community Organized Restoration and Learning [CORaL] Network

Primary Investigator(s): Wei Ying Wong

PI Affiliation: ASLC **Project Manager:** ADFG

EVOSTC Funding Requested (includes 9% GA)

This table reflects the original amounts requested for FY22-FY31. Please see Table 9 for revised amounts requested in response to Trustee Council decisions made at the October 13, 2021 meeting.

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$2,724,078	$2,724,110	$2,722,281	$2,720,772	$2,724,937	$13,616,177
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$2,722,904	$2,722,572	$2,724,775	$2,719,921	$2,723,469	$13,613,642

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $2,724,078

Total Non-EVOSTC Funding (FY12-22): $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: **22220401**

Project Title: ADPOR Education & Outreach Projects FY22-31

Primary Investigator(s): Shawna Popovici

PI Affiliation: ADNR/ADPOR **Project Manager:** ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$67,408	$113,270	$115,800	$88,277	$100,125	$484,881
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$88,953	$77,200	$86,829	$84,126	$61,028	$398,136

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $67,408

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

The goal of this project is to enhance EVOSTC's public outreach by educating the public about the *Exxon Valdez* oil spill event (EVOS, the Spill), its lasting impacts to the State of Alaska, and 40 years of achievements to mitigate those impacts on spill-affected habitats, species, and services. DPOR will achieve this goal in three distinct phases that include:

Phase I – Partner-Ready Projects*:* In the first three years, the Division of Parks and Outdoor Recreation's (DPOR) Interpretation and Education Unit has worked with tribal, local, state, and federal partners to identify "shovel-ready" projects that can be accomplished quickly. The EVOSTC staff will aid in the prioritization of projects and important sites. Outreach deliverables in this phase will primarily include static interpretive displays. Most Phase I projects will focus on and within the Kodiak region.

Phase II – Partner-Planning Projects*:* The next four years include working with current and new partners in the greater Spill Area, identifying projects that require more planning and coordination to accomplish. The EVOSTC staff will aid in the prioritization of projects and important sites. These projects will also feature static interpretive displays, but could include outreach materials such as education programs, pamphlets, booklets, traveling displays, and video trail guides.

Phase III – EVOSTC 40th Anniversary Projects*:* The last three years of the project will focus on working with the EVOSTC to prepare for a 40th Anniversary outreach program which can include an update to the 30th Anniversary film about the work the EVOSTC has done over the past 40 years. This film and other outreach can highlight further scientific breakthroughs or EVOSTC supported projects over the last 10 years. The focus of this phase is leaving a legacy of mitigating impacts on the spill-affected resources and services.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

The Interpretation and Education Unit Manager of the Division of Parks and Outdoor Recreation (DPOR) is proposing to enhance EVOSTC's public outreach by informing and educating the public about the oil spill, its lasting impacts to the State of Alaska and 40 years of Council achievements mitigating impacts on spill-affected habitats, species, and services. The DPOR and the EVOSTC office have already collaborated on public outreach over the past few years, and they propose to continue working together to prioritize new projects and sites over the next 10 years. The objectives are to 1) identify new audiences for EVOSTC outreach throughout the spill area, 2) expand current outreach efforts about the spill, its impacts on the state, injured resources, or human services and EVOSTC restoration efforts and 3) expand awareness of the council and its 40 years of achievements mitigating EVOS impacts. Work will be conducted in three phases: 1) shovel-ready static interpretive displays In the Kodiak region during the first three years, 2) unspecified projects that require more planning and coordination with partners in the greater spill area to accomplish, again featuring static interpretive and possibly including education programs, pamphlets, booklets, traveling displays and video trail guides and 3) updating their 30th anniversary film about the work the EVOSTC has done over the past 40 years, focusing on the legacy of mitigating impacts on the spill-affected resources and services. Every project task will undergo a quality assurance plan before fabrication.

They are requesting that funds for the first two phases over the first seven years of the project be released in the first year to 1) eliminate the risk of not securing receipt authority over multiple budget cycles, given uncertainties with the state's budget process, and 2) allow uninterrupted progress if the project develops ahead of schedule. They are also asking that funds for the third phase being conducted over the last three years be released in FY27 for the same reasons.

The Science Panel recognizes the need for public outreach. We share the concerns of a critical external reviewer who thought that clear deliverables, personnel, and content of the fabrications

should have been included. Some of this was intentional to provide the opportunity for EVOSTC and partner input, but plans should have been made before submitting the proposal. The Panel also thought that metrics for evaluating the success of the outreach should have been included, both for the outreach the DPOR has already conducted for the EVOS Trustee Council as well as for the proposed outreach.

PI Response:
This set of comments reiterate comments from other reviewers seeking clarification on deliverables, key project personnel, and content of deliverables. PI responses follow each of the reviewer's comments. The proposal has also been revised to provide clarification on those three main items.

Additionally, under Section 4. B., Procedural Methods, bullet #8 Reporting, the proposal includes a revision within the project workflow. The revision states that "a sample Focus Group Project Evaluation form has been included in the attachments to this proposal to expand on evaluation criterion for each task," and the corresponding form was added to the proposal attachments.

Date: September 2021

We appreciate the contributions that the Alaska Division of Parks and Outdoor Recreation (ADPOR) has made over the past few years in enhancing EVOSTC's public outreach regarding the oil spill, its lasting impacts on the State of Alaska and their achievements in mitigating the impacts. ADPOR now proposes to continue developing such projects for 10 more years, and we see the value in continuing this work. However, five other new education and outreach proposals were submitted for consideration, and we felt that some of them were more competitive for funding. One issue was that the deliverables would largely consist of static displays and kiosks. Static displays are useful but are less engaging than more contemporary displays, such as video or interactive displays. A second issue was that deliverable projects were not described. In response to this criticism, the PIs provided nine possible projects that could be undertaken during the first three years of the project, but projects that might be undertaken during the last seven years of the project were intentionally not described to provide the opportunity for EVOSTC and partner input. However, potential projects during the last seven years of requested funding should also have been proposed to provide some idea of the work to be accomplished, and they could have been further developed in consultation with partners if the proposal were funded. As written, 70% of the work was not described other than to say that it would likely continue consisting largely of static displays. Hence, reviewers and the Science Panel could not evaluate the bulk of the work to be funded 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.

Project Number: **22220402**

Project Title: Sustaining Our Sound: PWS Outreach Project

Primary Investigator(s): Marybeth Holleman

PI Affiliation: PWSSF **Project Manager:** ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$59,242	$51,476	$30,908	$30,908	$32,020	$204,554
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$39,007	$34,243	$30,908	$29,796	$30,352	$164,307

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $59,242

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 03.29.2021, budget updated 04.16.2021.*

Sustaining Our Sound: PWS Outreach Project is designed to mitigate EVOS impacts by improving conditions for EVOS-affected and injured resources and resource services. Initial volunteer programs created by PWSSF in 2018 are the building blocks for the SOS Outreach project. Whittier and Western PWS is identified as an EVOS-affected geographic region.

Under the EVOSTC Education & Outreach grant, the current PWSSF outreach programs would expand to be a more comprehensive program. PWSSF will plan to hire a marketing firm to assist in the research, strategy and design of the materials to be used in the SOS outreach project, as well as to specifically define the various user groups within the scope of this project. Determining the different groups of PWS users will ensure that the material can be customized and created to address topics of importance to each group, their concerns and their values.

Materials will address Leave No Trace ethics, invasive species, ethical wildlife viewing, reducing noise and other disturbances, preserving freshwater quality, mitigating marine debris, and other topics highlighted by the PWSSF board of directors, business community, relevant agencies and the

marketing consultants. The work will tie directly to the education, restoration, and stewardship components of the PWSSF mission, and is aligned with the EVOSTC Restoration Plan.
This project will respond to the information collected with marketing research, and customize educational components regarding EVOS-injured resources and resource services of PWS. It will include topics like marine and terrestrial wildlife viewing ethics, best camping practices, invasive plant information, and data about the effects of increased boater traffic on otter populations, orcas, migratory birds, and more. The goal is to foster stewardship in the Sound by informing and inspiring the public, and empowering them with knowledge to become active stewards and citizen scientists.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

This proposal is a visitor education program focused on things like wildlife viewing ethics, invasive species awareness, general environmental principles. While laudable educational goals, the Science Panel did not see the specific activities and deliverables as tightly linked to recovery of EVOS injured resources. Overall, we were not particularly enthusiastic about the proposal as written. The objectives were unclear and there was a high reliance on an (unnamed) marketing research firm to direct the objectives and unnamed personnel to implement the goals and produce deliverables. We noted that many of the threats mentioned by the PIs in this proposal, while real, may not be primarily caused by visitors to the region. Two of the external reviews were detailed and critical of the proposal, expressing significant reservations. Rather than reiterate the suggestions made by the reviewers here, we direct the PIs to those for specific guidance as they consider whether and how to revise their proposal. We also note that the project was invited to join the broader CORAL program (project 22220400), but declined, and perhaps that decision might be reconsidered.

PI Response: No response submitted.

Date: September 2021

The Science Panel and external reviewers had serious concerns about the proposal that the PIs chose not to address. Therefore, we cannot 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: **22220403**

Project Title: PWS Natural History Symposium

Primary Investigator(s): Paul Twardock

PI Affiliation: PWS Stewardship Foundation **Project Manager:** ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $24,738

Total Non-EVOSTC Funding (FY12-22): $0

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: **22220404**

Project Title: Inspiring Seascapes: Growing the next generation of environmental scientists through experiential learning in Kenai Fjords and Kachemak Bay

Primary Investigator(s): Joanna Young, Amy Bishop, Claudine Hauri

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

EVOSTC Funding Requested (includes 9% GA)

FY22	***FY23***	***FY24***	***FY25***	***FY26***	***FY22-26 Total***
$318,700	$303,200	$393,400	$331,400	$339,600	$1,616,300
FY27	***FY28***	***FY29***	***FY30***	***FY31***	***FY27-31 Total***
$366,800	$356,700	$365,700	$374,900	$384,500	$1,848,600

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $318,700

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 08.20.2021.*

The Alaskan branch of *Inspiring Girls Expeditions* at the University of Alaska Fairbanks offers 12-day unique, tuition-free, backcountry expeditions that serve as once-in-a-lifetime experiential science, technology, engineering, art, and math (STEAM) learning experiences for high school girls. Our successful educational philosophy is built upon exploring the natural world through inquiry and observation in order to reveal the interconnectedness of physical, biological, and human dimensions of the marine ecosystem. In this new project to EVOSTC, we propose to leverage our proven expedition model as programmatic infrastructure that is well-poised to meet EVOSTC Education and Outreach goals. We propose to host our two sea kayaking expeditions per summer that take place within the Spill Area and are specifically designed to explore the Alaskan marine environment: the physical and chemical oceanography-focused *Girls in Icy Fjords* (Kenai Fjords; Unixkugmiut land) and the marine ecology-focused *Girls on Water* (Kachemak Bay; Seldovia land). To meet the Focus Area

goal of heightening public knowledge of the Spill, we will (1) adapt our flexible, place-based curricula to center EVOSTC LTRM and Mariculture research, (2) collaborate with EVOSTC LTRM scientists to facilitate research projects aligned with LTRM Focus Area goals, and (3) mentor participants in delivering post-expedition public presentations in the Spill-affected communities of Seward and Homer as well as their hometowns. To increase community involvement in Spill-related research, we will (1) reserve one-third of spots per expedition for participants from Spill-affected communities, and (2) engage local experts, Elders, and resource managers as guest instructors/presenters. Additionally, our project will provide professional development for our early-career scientist, artist, and outdoor guide instructors, and will include a detailed external evaluation. Ultimately, this project builds on the successful *Inspiring Girls Expeditions* foundation in order to meet EVOSTC Education and Outreach goals and forge new connections to EVOSTC Programs and Spill-affected communities.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

This proposal aims to continue experiential learning programs out of Seward and Homer targeted at high school girls. The PIs propose two 12-day sea kayaking expeditions per year, each with 9 students (3 from spill-affected communities), that take place within the spill area designed to explore the marine environment. They aim to center the curriculum on EVOSTC-supported long-term research and monitoring (LTRM) studies and to facilitate short projects related to LTRM goals. Participants will be mentored to give presentations in spill-affected communities and in their hometowns and mentorship of alumni will continue long after their immersive experience. The program will engage local experts, Elders, and other experts as guest instructors.

The Science Panel was greatly impressed with the plans, as were the reviewers. Major strengths included coverage of the students' costs, thereby opening access to underrepresented communities. Another strength was the rigorous evaluations throughout the funding period drawing on the lead investigators' prior experience with professional evaluations. By targeting the oil spill, the panel felt that the project offered more than the immersive experience for the participants, for example through the planned video.

The most challenging issue was the cost which works out at around $20k per student participant. This raises a fundamental issue of the tradeoff between the number of people impacted by a program versus depth of experience and long term impact on the relatively small number of students.

PI response:
While we have reduced the overall proposal budget, we would suggest that dividing the proposed total by the number of expedition participants is an over-simplification, as this does not account for the other proposed deliverables (e.g. community presentations, professional development for early

career and EVOS scientists, and a long-term program evaluation and formal study) and reached audiences (e.g. Spill-affected area community members, tourists, graduate students and early career professionals, and EVOS scientists). These additional elements are each described in the proposal text in Section 4B. We also better explain our proposed costs within our responses to reviewers below.

We concluded that the quality of the program was sufficient to justify the investment. Huge long-lasting impact on even a few of the participants can resonate through the community for a long period of time.

PI response:
We agree, and believe from experience that elements of Inspiring Girls Expeditions such as awe-inspiring landscapes and unbounded access to practicing scientists, artists, and outdoor guides for 12 days can have long-lasting impacts on participants. To better illustrate this, we have added reference to research demonstrating the value of 'significant life experiences,' i.e. formative experiences in the outdoors, that can lead to lifelong environmental sensitivity (Chawla, 1998). We included this in Section 4B, under the heading "Engage 180 16- and 17-year-old young women in 12-day field science expeditions in Kenai Fjords and Kachemak Bay (9 young women per expedition; 2 expeditions per year), with at least three spots per expedition reserved for participants living in Spill-affected communities."

When revising the proposal, we recommend attention to all reviewer comments. While not requiring specific budget cuts, there is a need for strong justification of the costs for each curriculum component. And related to costs, will the local community experts and Elders who will be engaged as guest presenters be strictly volunteers, or will they be compensated for their time?

PI response:
We have reduced our overall budget in this resubmission, primarily by adjusting hours for senior personnel and the professional evaluation, and by eliminating or reducing select other non-essential costs. We have also added text within the proposal to better explain particular program costs such as PI and senior personnel involvement, instructor salaries, instructor certifications, undergraduate summer employees, expedition expenses, and the external evaluation. We detail each of these in below, in response to specific questions from the Reviewers.
For the community experts and Elders who will be invited as guest instructors, we value the idea that these individuals should be compensated for their time, as a matter of equity. While we did have an amount included within the original budget for Meals and Incidental Expenditures (Per Diem) for guest instructors, we have instead eliminated that and added a more explicit payment of $250/guest instructor. This amount will cover both preparation and field time. Transportation to the field site is still included within our budget, as well. We have added text to reflect this in Section 4B under the heading "Engage local community experts, Elders, and investigators from other EVOSTC projects to deliver presentations and activities related to the history, impact, and research around the Spill as expedition guest instructors and presenters."

Date: September 2021

We previously responded very positively to this plan for programs of experiential learning out of Seward and Homer. Despite the high cost, we recognize the high potential for lasting impact on the students, a theme on which the PI's elaborated in their response to the Science Panel's review of the March 2021 proposal.

The program has strong external reviews. We and the external reviewers were particularly impressed by the evaluation component of the proposal, and an area in which the PIs have previous experience. In response to concerns about the costs, the PIs slightly reduced the budget, in part by reducing hours for senior personnel. The proposal includes plans "to engage local community experts, Elders and others “to deliver presentations and activities, relating to the history, impact and research around the Spill……”. They included in their budget explicit payment to guest presenters of $250 per day. We felt this was inadequate recognition of the importance of these contributors and suggested a more respectful stipend, perhaps $500 per day.

In summary, we were happy with the responses to the reviewer comments, and regard this as a very strong proposal for Education and Outreach support.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

This education model has been successful in providing STEAM experiences for high school girls. This project will apply this proven expedition model to support two sea kayaking expeditions per summer that take place within the Spill Area and are specifically designed to explore the Alaskan marine environment. I concur with the Science Panel and PAC; the potential for long-lasting impact on young individuals is high and valuable.

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:** ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $652,181

Total Non-EVOSTC Funding (FY12-22): $200,000

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.*
  - *o Section 2, Pages 5-8*
- *Chugach Region Cultural Camps Overview – Provides cultural camp details.*
  - *o Section 2, Pages 5-8*
- *Program Administration – Provides staff roles, duties, and experience for proposed personnel.*
  - *o Section 3, Pages 8-10*
  - *o Section 4, Pages 11-12*
- *Program Steering Committee – Provides organizational chart.*
  - *o 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*
  - *o Section 8, Pages 16-17*
- *Data Management Services – Details CHF's response from Axiom Data Management Services.*
  - *o Section 6, Page 13*
- *Contingency Plan – New section requested in reviewer comments.*
  - *o Section 2, Pages 5-8*
- *Compliance – New section requested in reviewer comments.*
  - *o 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.*
  - *o EVOSTC Funding Requested, Page 2*
  - *o 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

Submitted in response to the FY22-26 Invitation for Proposals

Project Number: **22220500**

Project Title: EVOS Spill Area Clam Restoration Project

Primary Investigator(s): Jeff Hetrick, Andy Suhrbier, Richard Hocking

PI Affiliation: APMI, Pacific Shellfish Institute, ASLC

Project Manager: ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$223,084	$148,693	$114,516	$110,689	$132,552	$729,533

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $223,084

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

This project proposal is for continuation of previous EVOSTC funded *Clam Restoration Project* (#99131; https://evostc.state.ak.us/media/2257/1999-99131-final.pdf). The Chugach Regional Resources Commission's (CRRC) Alutiiq Pride Marine Institute (APMI; previously the Alutiiq Pride Shellfish Hatchery) successfully completed the project and submitted a final report in August 2001 (Brooks et al., 2001). The project was valuable in providing baseline environmental data and beach characterization near the native communities of Tatitlek, Chenega, Port Graham, Nanwalek, and Ouzinkie. The project also experimented with out-stocking beaches of juvenile clams, which were monitored for growth and survival and demonstrated the efficacy of shellfish enhancement techniques and culminated in providing harvest opportunities for local residents in Tatitlek, Chenega, Port Graham, and Nanwalek. This project proposes to build on past and current knowledge utilizing hatchery-produced juvenile littleneck clams to enhance clam populations for local communities in the Spill Area.

The continuation of this project is being submitted in response to CRRC Board of Directors requesting additional intervention through new shellfish enhancement efforts focusing on the native littleneck clam (*Leukoma staminea)* repopulation to address the loss of harvest opportunities on intertidal areas near their communities. This project will revisit the same beaches surveyed and seeded under the

EVOSTC-funded project 99131 (Tatitlek, Chenega, Port Graham, Nanwalek, and Ouzinkie) to document their current status and provide insight to any changes over the past 25 years. Additionally, this project will support littleneck clam enhancement at four locations completed through the EVOS-funded project 99131: Tatitlek, Chenega, Port Graham, and Nanwalek. Ouzinkie will not be included in the current project due to limitations in hatchery space to maintain a separate area in compliance with ADFG requirements (Meyer 2014). This project will enable APMI to apply lessons learned in littleneck clam hatchery and nursery technology and enhancement techniques since 2001, which has resulted in consistent capacity to spawn broodstock, an increased survival of early life stages, and faster growth through improvements in feed and water temperature. The results will provide a foundation to expand enhancement and mariculture effort throughout the region impacted by the EVOS. The reintroduction and enhancement of native littleneck clams will allow for harvest opportunities for local residents and re-establish a cornerstone species of the intertidal environment for ecosystem services and confirm the potential use of similar techniques for commercial farming of littleneck.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

Clam populations in south-central Alaska have been declining in recent years. Causes of the decline are uncertain, but may be related to overharvest, predation, disease, ocean acidification, and increasing temperatures. This proposed 5-year project focuses on the endemic littleneck (or steamer) clams. It aims to reestablish clams on selected, subsistence beaches by using locally collected broodstock to produce juveniles for seeding. Project objectives include beach assessments, outplanting to evaluate clam growth and survival, and provision of harvest opportunities for local residents in four communities.

The Science Panel questions the prospects for a successful project. A similar restoration project, which had limited success, was conducted for five years in the late 1990s.

PI response:
The PIs consider EVOSTC project 99131 successful, which is reflected in the 2001 report; criteria for determining that it had limited success are not clear. It met objectives while demonstrating the potential for subsistence littleneck clam enhancement and identifying beach types that are most suitable for this activity. Beaches that have been enhanced on Powder Island near Seldovia and Murphy's Slough near Port Graham now have adult clams to harvest because of these efforts (pers communications with Michael Opheim, Environmental Coordinator at Seldovia Village Tribe). On three beaches, survival rates up to 65% for littleneck clams grown in bags were reached after 3.2 years. This work also demonstrated the importance of predator exclusion and protection at high-energy sites. This proposed project benefits from over two decades of additional work to study restoration techniques for clams to increase survival and recruitment and, importantly, will train and involve Native community members to ensure long-term success of out planting.

Additionally, this proposed project meets Best Practices for Shellfish Restoration, as defined by the Interstate Shellfish Sanitation Conference, The Nature Conservancy (TNC), and the NOAA Restoration Center (Leonard and Macfarlane, 2011) by 1) defining its objective to bolster subsistence harvests through Shellfish Sanctuaries, 2) expanding community-wide restoration efforts by engaging Native samplers and holding workshops, and 3) protecting public health by sampling for sanitary concerns and bolstering community faith in safe shellfish.

The current proposal lacks any citations, so it is difficult to judge how this work builds on any previous successful efforts. The proposal should include reference to previous EVOSTC-funded surveys of littleneck clams in PWS and their recovery, or lack thereof.

PI response:
In this revised proposal, citations of previous EVOSTC-funded work has been referenced, including Bodkin et al., 2009, Brooks et al., 2001, and Shigenaka et al., 2008. References are also included in regards to the impacts of EVOS on the Tribes of the Chugach Region. This body of work is used to inform the current understanding of littleneck abundance, the impact of EVOS, and how the proposed project can address gaps in knowledge while addressing ongoing concerns of Native villages.

Reference to successful restoration studies for littleneck, or other, clams elsewhere would be useful to provide evidence of the potential for success of the proposed project. Is there evidence that outplanting will promote self-sustaining recruitment of small clams to support future harvests?

PI response:
PIs have now cited work completed in California and along the East Coast that focused on shellfish restoration, which has not been extensively studied in Alaska. Small numbers of adult shellfish can limit recruitment, even when other negative factors are present (Wasson et al., 2016), and so bolstering this population can improve long-term recruitment. Indeed, seeding of clams has led to successful enhancement of recruitment for Mya arenaria. Seeded clams may help release populations from density limitations while netting provides protection from predators such as seastars (Beal and Kraus 2002; Beal et al., 2018). In a study where no wild spat was identified in control plots, recruitment was evident in seeded plots, with increased numbers of wild spat positively correlated with initial stocking density (Beal 2006). Beal and Kraus 2002 found that netting enhanced recruitment of wild spat by 3x compared to control plots, while Beal et al, 2018 found that clam recruit abundance increased by up to 118x with netting. While netting from this project will be removed at its conclusion, evidence of increased recruitment may help bolster abundance in the long-term against impacts of predation or other detrimental factors or support permitting for netting to remain on beaches for long-term enhancement potential. Furthermore, clam gardens (analogous to the bouldered Shellfish Sanctuaries proposed in this project) in British Columbia harbored increased biomass of littleneck clams, even without seeding, by creating a greater swath of favorable conditions (Jackley et al., 2016).

In 2000, at the end of a NOAA monitoring study, abundances of clams on oiled/washed beaches converged with abundances of clams on control beaches. In a 2006 update using multiple data sources, clams were judged to be recovering but not yet recovered. However, in a follow-up field study in 2007 (Shigenaka et al. 2008), it was found that there was a significant and consistent decline in littleneck clam abundance throughout PWS. Those researchers concluded that this widespread

decline did not appear to be related to the oil spill, but may have been related to disease and ocean acidification, two factors that may be difficult to mitigate through outplanting.

As written, the proposal does not demonstrate how the proposed work meets EVOSTC's definition of restoration. If a revised proposal is submitted, it should indicate why this project qualifies as restoration from the oil spill, especially if clams are no longer constrained by residual effects of the spill, as indicated in the proposal and in the recent assessment referenced above.

PI response:
The EVOSTC Recovery Objective for clams states: "Clams will have recovered when population and productivity measures at oiled and washed sites are comparable to populations and productivity measures at unwashed sites, when there is no oil exposure, and when abundances of large clams can provide adequate, uncontaminated food supplies for predators and subsistence users" (2014 Status of Injured Resources and Services: Clams; https://evostc.state.ak.us/status-of-restoration/clams/). The 2014 status states that the recovery objective has been met because "There are currently no differences in species richness, diversity and abundance between cleaned (oiled and treated) and untreated (oiled but untreated) beaches and no evidence of oil exposure in clam tissue samples." Yet, the last part of the restoration objective has yet to be met, as Native communities report that there are not adequate numbers of large clams for subsistence harvest. ADFG's 2020 report, Recovery of a Subsistence Way of Life: Assessments of Resource Harvests in Cordova, Chenega, Tatitlek, Port Graham, and Nanwalek, Alaska since the Exxon Valdez Oil Spill, notes that "residents also said that harvest of very small clams is the norm today with harvest of large-sized clams now very rare." While the absence of a sufficient number of littlenecks is not a consequence of a single event or factor, the decline due to EVOS may have precipitated subsequent vulnerability to other drivers, as is evidenced by sharper declines in abundance on oiled beaches in 2007 than on unoiled beaches after they had converged to similar levels in 2000 (Shigenaka et al. 2008).

Additionally, observational studies in the late 2000s did not all equivocally determine that oiled beaches had met the abundances found at unoiled beaches. While Bodkin et al. 2019 found similar mean abundances at oiled and reference sites, the variation among sites was substantial. The authors wrote, "The lack of differences in mean density of clams between oiled and reference sites we observed may be a reflection of low densities, high inter-site variability, and therefore low power to detect differences. Other more comprehensive sampling by Lees et al. (2007) suggests that there may indeed be lower densities at oiled sites that were treated using high pressure washes compared to unoiled reference sites" (Bodkin et al., 2009). Lees found that hard-shell clams were 66% less abundant at treated sites than at reference sites 13 years after the spill.

Lees et al., 2013 wrote in the report for EVOS project #10100574, "Coats et al. (1999), Skalski et al. (2001), and Shigenaka et al. (2008), using their concept of parallelism, have proposed that infaunal and bivalve populations in PWS had recovered by about 1992. Their interpretation is based on the fact that densities at Unoiled, Unwashed, and Washed sites were following basically parallel patterns from about 1992 through 2000. They concluded that hard-shell clams had recovered despite the fact that abundances at the Washed sites remained more than an order of magnitude lower than at the Unoiled and Unwashed sites until 1995 for Saxidomus and 1997 for Leukoma."…"An additional concern is that the analyses are based on very few sites (11, only four of which were washed), and these were sampled unevenly. Typically, one or more sites were not sampled during each sampling period. Only two Washed sites were sampled per year after 1996. In 1999, the average for Washed

sites was strongly influenced by a site where average abundance was more than three times higher than the other Washed site sampled that year. Moreover, the site with the higher abundance in 1999 was the only site measured in 2000; sites that routinely had much lower abundance historically were not sampled. The Washed site with highest average abundance was sampled in eight of 11 years whereas the sites with substantially lower average abundance were sampled intermittently in six of 11 years." Not all researchers have agreed with the methods or conclusions for work that indicated littleneck populations had recovered.

It is important to note that the abundance studies described above were not carried out at the beaches important for subsistence harvest for these Native communities. As the cause behind the decline at all beaches has not been determined, this proposed project has the benefits of better understanding littleneck abundance in relation to a number of abiotic and biotic factors while also enabling harvest opportunities for residents in Native communities that have been impacted by EVOS. As this work continues the approach of EVOSTC-funded Clam Restoration Project #99131, it offers an opportunity to examine temporal variance in drivers more than two decades later at beaches that are used for the purpose for which restoration is required.

These comments have been reflected in the proposal in the Objectives Section of the Project Design section (page 5, lines 235-270).

The current proposal does not appear to be compliant with EVOSTC policies requiring a data management plan. This is an important requirement. Data collected in EVOSTC-funded projects need to be organized in a database and made publicly available one year after collection. Also, the proposal mentions that "The North Pacific Rim Housing Authority has a Business Services Department that provides financial accounting and management expertise to CRRC". This also does not appear to be compliant with EVOSTC requirements to go through the Alaska Sea Life Center for administration.

PI response:
In compliance with EVOSTC's data management policy, this project will work with Axiom Data Science for data management. All data collected through the course of this project will be deposited for full and open access through this contract.

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.

From a scientific standpoint, project methodology is rather vaguely stated in the proposal and missing necessary details. For instance, the beach assessment and monitoring section does not provide sufficient information on methods.

PI response:
We have substantially elaborated on the methods to include additional information on how the site characteristics are measured and the purpose of each metric, both in Objective 1 (page 8, lines 349-420) and Objective 2 (page 12, lines 540-632) within Section C. Please see the text for further methodological details.

The study design is not very clear and there is no description of statistical analysis needed to make comparisons of the effects of the seeding operations. For example, how will growth and survival be estimated? To distinguish effects of seeding, it would seem to be important to sample controls (beaches with no seeding) and treatments (beaches with seeding). A control and treatment design does not appear to have been considered.

PI response:
The methods now explain that control plots at each elevation (n=3) will be established 100' away from the test plots and clam abundance and size will be assessed seeded plots. Growth and survival will be measured from seeded bags during the final visit to plots, which is noted in Section C6, using the methods described in Section C4. Statistical analyses, as described now on page 14, lines 616-621 of Objective 2 section D, will thus compare clam metrics among seeded and unseeded sites, as well as other factors, at the conclusion of the project.

APMI staff clearly have excellent experience in hatchery production. The proposal includes an overview of the hatchery methods and refers the reader to an "APMI Basic Management Plan" for detailed methods. The Science Panel attempted to find a copy of this plan without success.

PI response:
The extent of procedures for culturing littleneck clams outlined in the proposal are likely extensive enough for the Science Panel to evaluate methods. However, the APMI Basic Management Plan has now been included in the documents submitted; please see the extracted page from the 2012 plan regarding littleneck clams in particular.

A revised proposal should include sufficient description of hatchery methodology and/or a copy of the hatchery management plan. As ADF&G considers genetic regions for shellfish propagation, each beach will require their own brood source and those clams will need to be segregated in the hatchery system. Hatchery procedures to ensure this genetic separation should be described in the proposal.

PI response:
The stocks are kept separate in all aspects of the hatchery production. Brood are held and conditioned in their own systems; larvae are not mixed, nor are the subsequent juveniles. All tanks are covered to prevent cross contamination.

It is very commendable that the communities and their residents will be involved in every aspect of this project, however this involvement is not described in any detail. A description of how many people will be hired, how many will be volunteers, and their responsibilities would be helpful. Community involvement should be reflected in the budget, unless all participants will be volunteers.

PI response:
The support for the Native communities and the samplers are reflected in the budget under the "Contractual" and "Travel" sections. Funds will support the villages directly in the form of "Environmental Sampler Honoraria" at a rate of $150/day. Two samplers per community will be trained and participate in sampling and monitoring the plots. Additionally, IGAP already supports Environmental Coordinators in each community that oversee the sampling for CRRC's current Chugach Region Ocean Monitoring Program and will contribute to this project by continuing to take weekly ocean chemistry readings in the field of temperature, conductivity, pH, and salinity as well as collecting samples for ocean acidification measurements at APMI. Finally, there is additional economic benefit to each Village associated with skiff rental to reach the sites, utilization of local housing, and per diem expended in local eateries.

One stated project deliverable is a comparison of beach status in 1996 versus the present. It is not clear what is meant by "beach status" and how these comparisons will be made. Does beach status refer to site characteristics on page 7? Or does beach status refer to clam density or something else? As the beaches were visited 25 years ago and conditions have not been monitored since then, the Science Panel questions the value of this comparison.

PI response:
Native Villages have expressed concern that the abundance of harvestable littlenecks has continued to decrease. This proposed project is testing that hypothesis and examining any changes among a suite of abiotic and biotic metrics that Brooke et al., 2001 measured. A lack of data in intervening years does not negate the value of a follow-up study. Beach monitoring over the last 25 years in this area could have been accomplished by established watch programs to provide regular temporal datapoints. In the absence of attention to these beaches that are important to Native communities,

this project will respond to the stated concerns of CRRC Tribes and characterize the current beach, biotic, and water conditions. Any changes—as well as indications of stable conditions--since the original work will be detailed in a final report.

As another product, the project will develop a management/harvest plan for each region. What will be included in this plan?

PI response:
The management plan contents, as described in more detail on page 14, lines 624-632, will help determine future stocking efforts, locations, the techniques to use, harvest schedule, and a shellfish consumption safety program.

The proposal claims that it is common that beaches can be harvested down to 60% where 30% of the clams are left as broodstock. These numbers do not seem to add up. Do the PIs mean that 70% of the clams can be harvested leaving 30% behind or that 60% can be harvested, leaving 40% behind? How soon before harvests will clams be assessed? Given recent declines in littleneck clams in PWS, it is expected that clam abundance will continue to decline before harvest. Apparently, at the end of the study, an estimate of the surviving clams will be calculated and a fraction of those will be proposed for harvest. Does the management plan include other features besides the numbers of clams that can be harvested?

PI response:
Thank you for asking for clarification on these values; 60% has been corrected to 70%, and a reference for the minimum density that supports this harvest rate for littleneck clams has been included. Yes, the endpoint of the monitoring will determine whether beaches should be harvested, and sampling prior to subsequent harvests can be accomplished by the community samplers who have been trained via the workshops in year 2 and subsequent field work. The management plan contents, as described in more detail on page 14, lines 624-632, will help determine future stocking efforts, locations, the techniques to use, harvest schedule, and a shellfish consumption safety program.

The proposal received two peer reviews and the PIs are strongly encouraged to address their review comments. One reviewer recommended development of a habitat suitability model as an outcome of the biophysical data, rather than just a static profile of a specific beach. This would help with future expansion of enhancement beaches.

PI response:
ADFG Division of Subsistence is developing a habitat suitability model in Chenega in support of the USFWS grant described as match. Data from the beach, biotic, and water conditions analyses, as well as traditional environmental knowledge held in Native communities will be made available to the ADFG Division of Subsistence to contribute to their development of a habitat suitability index. The habitat suitability index model for littleneck clams was published in 1983 (Rodnick and Li), so ADFG's work will provide an important update post-EVOS.

Given the limited success 25 years ago, it seemed to one reviewer that the development of four shellfish sanctuaries is overly ambitious. They recommended reducing the scope of the project to

demonstrate proof of concept. Toward this, they suggested considering one study site in PWS and one in LCI/Kachemak Bay.

PI response:
Again, it is unclear how project 99131 was deemed to have limited success. PIs have defined success as gaining additional scientific knowledge of littleneck life history, predator presence, and factors influencing spawn timing, larval recruitment, and survival at age steps. As other work can only hypothesize reasons for littleneck decline (Shigenaka et al., 2008; Lees et al., 2013), this research is clearly needed. Success has also been measured as tangible improvements in hatchery survival across all early-life stages since the original study (APMI Basic Management Plan). This proposed project will maintain the scope originally envisioned, as the goal of the work is to positively impact communities and beaches that were affected by the oil spill, of which there were more than two. Insight into how these sites have changed in 25 years is valuable to these communities. The additional cost of some activities, such as producing spat, from another two sites is not as substantial as the base cost of two sites, resulting in more cost-effective outputs from this project with four out planting sites. Furthermore, beach characterization from five sites and outplanting success data from four sites will provide a much more robust scientific analysis and strengthen the management plans while providing more inputs for ADFG's habitat suitability index model.

Date: September 2021

Littleneck clam populations have declined in south-central Alaska in recent years. This decline has been attributed to a variety of factors, including overharvest, predation, ocean acidification, warming temperatures, and a climate regime shift that may have resulted in changes in species composition. In 2000, a NOAA monitoring study found no differences in abundances of clams on oiled/washed beaches with those on control beaches. Shigenaka et al. (2008) found that there had been a significant decline in littleneck clam abundance throughout PWS, a decline that negatively affects Native communities that harvest clams as a subsistence resource. Given the similarity of clam abundances on both oiled and unoiled beaches, Shigenaka and colleagues concluded that this widespread decline did not appear to be related to the oil spill.

The objectives of this proposed 5-year project are to: (1) conduct an assessment at beaches known for the harvest of littleneck clams in the communities of Tatitlek and Chenega (PWS), Port Graham and Nanwalek (lower Cook Inlet), and Ouzinkie (Kodiak Archipelago), and to (2) outplant juvenile littleneck clams produced by Alutiiq Pride Marine Institute (APMI) to evaluate growth and survival and provide harvest opportunities for local residents in four of these communities (all except Ouzinkie). The project would employ residents supervised by the Village Councils and the Environmental Coordinators at each community who will be involved in all phases of the project.

While the proposal has several beneficial features, we feel that it is not an appropriate fit in the general restoration category for several reasons. First, some combination of factors (e.g., predation, ocean acidification, warm temperatures) may be responsible for the region-wide decline of clams and these factors will likely persist regardless of localized outplanting efforts. Second, even if predation is the primary factor such that clam stocks are stuck in a "predator pit", we are doubtful that 100,000 clams per community are sufficient to boost the brood stocks to levels whereby they can out-produce their predators. Third, given their dispersal by ocean currents over the 3-4 week larval stage, few clams are expected to self-recruit to these specific beaches. Settlement on study beaches is likely a product of spawning that takes place on beaches more broadly throughout the

region, where clam brood stocks remain low. Fourth, if restoration of clam populations is the project goal, then the proposed harvests toward the end of the 5-year project seem to directly conflict with this goal. Finally, as clams are not depressed due to lingering effects of the oil spill, it does not appear that this proposal is a good fit as a restoration project for injured resources. Rather, this proposal would have been a better fit for submission under the mariculture proposal focus area in the FY22-31 Invitation.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

This project has a commendable goal of providing clam stock for subsistence in this spill-affected region and would be led by a Tribally-led marine research facility with highly qualified staff. I also recognize the concerns of the Science Panel regarding the study design and concur that this proposal may be a better fit within the mariculture focus area.

Project Number: **22220501 – TO BE FUNDED WITH CRIMINAL SETTLEMENT FUNDS**

Project Title: Chenega Abandoned Vessel Removal Project

Primary Investigator(s): Buell Russell

PI Affiliation: Native Village of Chenega **Project Manager:** NA

EVOSTC Funding Requested (includes 9% GA)
(This project will be funded with criminal settlement funds)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$114,450	$0	$0	$0	$0	$114,450

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$2,500	$0	$0	$0	$0	$2,500

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $114,450

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 03.29.2021, budget updated 05.05.2021.*

The Native Village of Chenega seeks assistance through the Exxon-Valdez Oil Spill Trust Council funding opportunity in the amount of $114,450 to support the abandoned vessel removal project. This general restoration project, which will reduce marine pollution, promotes the restoration of key resources in the Prince William Sound within the Exxon Valdez Oil Spill area. The implementation of this project will require collaboration with state agencies, a pre-removal environmental assessment and contracting of services to safely remove the abandoned vessels and their debris from harbor waters and shorelines adjacent to the community's harbor area. The vessels will be transported from Chenega by barge for disposal in Whittier, Alaska. Through this collaboration of the Native Village of Chenega, state agencies and EVOS Trust Council funds, the community will achieve what has not been possible before.

Funding Recommendations (Fall 2021):

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

*At the October 13, 2021, meeting, Federal Trustees voted to fund this project using settlement funds received in response to the 1991 Exxon Criminal Plea Agreement.

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 low budget project that would provide significant benefits to spill-impacted resources and is located in the most heavily-oiled area of PWS. The project is well designed, and PIs have engaged experienced partners.

Project Number: **22220502**

Project Title: Clean Water Assessment of Beaches with Lingering Oil

Primary Investigator(s): Terri Lomax

PI Affiliation: ADEC Division of Water **Project Manager:** ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $0

Total Non-EVOSTC Funding (FY12-22): $0

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $4,666,847

Total Non-EVOSTC Funding (FY12-22): $1,000,000

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: **22220504**

Project Title: Solomon Gulch Hatchery Coho Building Replacement

Primary Investigator(s): Michael Wells

PI Affiliation: Valdez Fisheries Development Association (VFDA)

Project Manager: ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$132,298	$179,194	$1,963,156	$0	$0	$2,274,647

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$364,122	$493,193	$5,403,181	$0	$0	$6,260,496

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $132,298

Total Non-EVOSTC Funding (FY12-22): $364,122

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.11.2021, budget updated 03.31.2021.*

Valdez Fisheries Development Association Inc. (VFDA), a 501(c)3 organization, requests $2,274,647 in EVOSTC General Restoration Project funding for the Solomon Gulch Hatchery Coho Building Replacement project ($6,260,496 non-EVOSTC funds; $8,535,143 project total). EVOSTC funds will accompany a loan from the State of Alaska Department of Commerce, Community and Economic Development (DCCED) Fisheries Enhancement Revolving Loan Fund (FERLF). The project will construct a new hatchery facility at the Solomon Gulch Hatchery (SGH) site, including design engineering and selection of general contracting and construction management. VFDA will use the facility to propagate Coho Salmon (*Oncorhynchus kisutch)* for the enhancement of the fisheries in Prince William Sound (PWS), the Valdez community, and area Tribes. VFDA owns and operates an established hatchery program that provides for the economic and cultural needs of residents, Tribes, visitors, and communities in PWS for the last four decades. The aquaculture platform of the new building will accommodate VFDA's permitted coho salmon program of 2MM smolts annually, and will allow VFDA to realize unused *capacity of up to 300,000* Chinook Salmon (*Oncorhynchus tshawytscha) smolts annually. The addition of chinook salmon will provide significant fishing opportunity in early summer and increase economic opportunity for the Spill Area by establishing a new fishery to target these fish. VFDA has conducted a program evaluation of its current infrastructure to determine necessary steps to improve the efficiency of its coho program, completed*

a structural condition analysis, and developed 35% conceptual design drawings and third-party cost estimate. The benefits of this project are to both Recovered and Not Recovered terrestrial and marine life that depend on salmon as a feed source. In addition, the benefits of coho and chinook salmon production enabled by the project supports Recovering Injured Services of commercial fishing and recreation and tourism industries, including sport fishing.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Do Not Fund	Do Not 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 that the VFDA's mission is to provide sustainable salmon harvests to Southcentral Alaska and the communities located within the spill area. I struggle with the fact that coho salmon are not an injured species, nor are Chinook salmon which would also benefit from the building replacement. I do note that this project has a significant amount of leveraged funding for this project.

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,139,023

Total Non-EVOSTC Funding (FY12-22): $2,200,000

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: **22220506**

Project Title: Headwaters to Ocean: Shoreline Stewards

Primary Investigator(s): Lauren Bien

PI Affiliation: PWSSC **Project Manager:** ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$106,076	$104,046	$98,351	$105,682	$103,511	$517,666

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$26,000	$26,650	$27,316	$27,999	$28,699	$136,664

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $106,076

Total Non-EVOSTC Funding (FY12-22): $26,000

Abstract:

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

Marine debris* (MD) poses a threat to the health of Alaskan ecosystems recovering from the *Exxon Valdez* oil spill (EVOS). MD is a global issue that has no clear solution, which provides opportunities for students to design innovative solutions. The presence of MD on beaches in the EVOS affected area and in local harbors allows for meaningful stewardship and restoration opportunities that encourage public participation and reduce marine pollution. The movement, chemistry, and social issues associated with MD provide an avenue for participants to learn about restoration of marine ecosystems, ocean circulation, and marine debris prevention and policies. The Prince William Sound Science Center (PWSSC), in partnership with the Native Village of Eyak (NVE) and U.S. Forest Service (USFS), proposes to address some of the issues caused by marine debris in the EVOS affected area by implementing the *Headwaters to Ocean: Shoreline Stewards* program in Cordova, Alaska and surrounding areas. *Shoreline Stewards* will work with the community to create scientifically literate citizens that have the tools to tackle MD issues through hands-on clean-up efforts and innovative cleanup and prevention solutions. PWSSC currently reaches over 1,500 students and community members with the existing *Discovery Room* programs, summer camps, and community programs; however, none of these programs focus on MD, which is a persistent threat to ecosystems in the EVOS affected area. *Shoreline Stewards* will create a service-learning summer camp focused on MD cleanup, data collection, and removal. Additionally, it will implement an MD-focused curriculum into one elementary school grade and one high school grade, establish a community-wide MD

monitoring program, and reach a wide audience of community members throughout the spill affected area via effective outreach and partnerships.

*Marine Debris is defined by NOAA as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes.

Funding Recommendations (Fall 2021):

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

Funding would support a program based in Cordova to educate communities on marine debris issues through hands-on clean-up efforts and innovative cleanup and prevention solutions. The goal of this program is laudable and one of the objectives specifically states that participants will be given the opportunity to connect the impacts of marine debris to the recovery status of injured resources.

Project Number: **22220507**

Project Title: PGC General Restoration & Habitat Protection Project

Primary Investigator(s): Steve Colligan

PI Affiliation: Port Graham Corporation **Project Manager:** ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $2,895,030

Total Non-EVOSTC Funding (FY12-22): $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: **22220508**

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, ADFG, USGS

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 (FY12-21): $3,870,000

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $7,500,558

Total Non-EVOSTC Funding (FY12-22): $25,596

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 (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

Submitted in response to the FY22-26 Invitation for Proposals

Project Number: **22220600**

Project Title: Robe Lake Habitat Preservation and Rehabilitation

Primary Investigator(s): Michael Wells

PI Affiliation: Valdez Fisheries Development Association, Inc.

Project Manager: ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$256,893	$0	$0	$0	$0	$256,893

Non-EVOSTC Funding

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$20,000[a]	$0	$0	$0	$0	$20,000
$12,000[b]	$0	$0	$0	$0	$12,000

[a]City of Valdez, [b]Valdez Fisheries Development Association, Inc.

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $256,893

Total Non-EVOSTC Funding (FY12-22): $32,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.02.2021, budget updated 03.31.2021.*

Valdez Fisheries Development Association Inc. (VFDA), a 501(c)3 organization, requests $256,900 in EVOSTC General Restoration Project funding for the Robe Lake Habitat Preservation and Rehabilitation project ($288,900 project total). The project enables the acquisition of a new Aquarius Systems Model HM-420 Aquatic Plant Harvester. The aquatic plant harvester will bolster and sustain ongoing efforts by VFDA and local and state government partners in mitigating excessive *macrophytes* (aquatic vegetation) in Robe Lake, a consequence of manmade changes to the lake by diking Corbin Creek, a cold glacial stream that previously helped to regulate the lake's temperature. Robe Lake, located in Valdez, experiences rapid and dense macrophyte growth annually during the warmer June – September season. *Macrophytes* are noninvasive aquatic plant species, and they are slowly reducing the surface area of the lake and eliminating productive spawning habitat for three anadromous Pacific Salmon species – Pink (*Oncorhynchus gorbuscha*), (Coho (*Oncorhynchus kisutch*) and Sockeye (*Oncorhynchus nerka*) – that spawn and rear in the lake. Robe Lake and its outlet, Robe River, are also widely utilized by the community of Valdez and visitors for freshwater recreation, sport fishing, and are stopping points for migratory bird populations transiting to summer and winter habitats. Due to external influences on the lake's hydrology, indigenous *macrophytes* have

become a consistent and persistent problem, and threaten to permanently negatively alter the ecosystem without continual targeted intervention. The benefits of this project are to ensure the wellbeing and status of EVOS-recovered Sockeye and Pink salmon, and Dolly Varden; enhance Robe Lake's role as a critical habitat; and contribute to the recovery of commercial fishing and a diverse spectrum of recreation and tourism activities that serve as economic drivers in Prince William Sound. The new aquatic weed harvester ensures the viability of the Robe Lake watershed and the many populations that depend on it.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Do Not Fund	Do Not 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 proposers are highly qualified to lead this project and the goal of this project is commendable. The funds would be used to purchase a harvester to reduce to remove the overgrowth of macrophytes in Robe Lake. VDFA recognizes that the use of a harvester to control macrophyte overgrowth is not sustainable and provides justification for the immediate purchase and use of the harvester while working towards a more permanent solution. I struggle with the fact that the recovery objectives for pink and sockeye salmon and the decline in spawning habitat is not directly connected to the spill.

Project Number: **22220601**

Project Title: Alaska State Parks Habitat Restoration and Protection FY22-26

Primary Investigator(s): Rys Miranda

PI Affiliation: ADPOR **Project Manager:** ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$100,787	$176,688	$165,135	$175,405	$4,967,341	$5,585,356

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $100,787

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 06.10.2021, budget updated 06.10.2021.*

The Alaska Division of Parks and Outdoor Recreation (DPOR) is proposing to restore, protect, and enhance habitat at four state park units that continue to be adversely impacted by human activity, including recreational access. The four park units consist of Buskin River State Recreation Site located near the City of Kodiak; Diamond Creek State Recreation Site located near Homer, and Slikok Creek and Pipeline Crossing, both are within the Kenai River Special Management Area near Soldotna. All four park units are within the Exxon Valdez Oil Spill Impact Area. Habitat restoration work will consist of bioengineering strategies from the industry standard manual "Streambank Revegetation and Protection: A Guide for Alaska." Habitat protection and enhancement work will include construction of elevated, light-penetrating (ELP) walkways and designated trailhead for managed access that minimize human impact. Strategically constructed infrastructure is a proven strategy for managing recreational access to support natural resource protection. In addition to constructed elements, this project will also implement an interpretive and education program to help inform users of the importance of habitat protection and instill stewardship for the land.

This project, as a whole, will benefit the injured resources Dolly Varden, Sockeye Salmon, Pink Salmon, Cormorants, Bald Eagle, Harlequin Duck, Black Oystercatcher, Common Loon, Barrow's Goldeneye, Common Murre, Pigeon Guillemot, and Marbled Murrelet and the injured services Recreation and Tourism.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund	Do Not 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 has merit and is similar to successful habitat enhancement projects the Council has funded in the past and would help achieve Council's restoration goals. The PI is highly qualified and capable. This project will compliment past EVOSTC-funded projects 96180/99180, 17170116, 19190121, and 20200135. This project's scope of work is very similar to those past projects in that it will balance habitat protection with managed recreation access. It will use the same techniques which have been proven effective and long lasting.

Project Number: **22220602**

Project Title: Kenai Peninsula Streambank Rehabilitation & Protection

Primary Investigator(s): Jessica Johnson

PI Affiliation: ADFG/Sport Fish **Project Manager:** ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $0

Total Non-EVOSTC Funding (FY12-22): $0

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: **22220603—TO BE FUNDED WITH CRIMINAL SETTLEMENT FUNDS**

Project Title: PWS Marine Debris Remediation

Primary Investigator(s): Paul Twardock

PI Affiliation: PWS Stewardship Foundation **Project Manager:** NA

EVOSTC Funding Requested (includes 9% GA)
(This project will be funded with criminal settlement funds)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$21,146	$20,274	$20,274	$20,274	$20,274	$102,242

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$11,800	$11,800	$11,800	$11,800	$11,800	$59,000

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $21,146

Total Non-EVOSTC Funding (FY12-22): $11,800

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.12.2021, budget updated 04.01.2021.*

Using a three-year rotational schedule that targets known marine debris collection beaches, we will continue to implement and improve our community-driven marine debris removal project. The project consists of a minimum of two annual marine debris clean-up projects, annual monitoring of select beaches, and public outreach and education. The project will continue to engage other non-profits, land management agencies, commercial tour operators, private boaters, community governments, the commercial fishing community, and citizen volunteers.

In 2020 and 2021, PWSSF worked directly with Gulf of Alaska Keeper, Prince William Sound Aquaculture (AFK Salmon Hatchery), Port Ashton Lodge, the Chugach National Forest, Plastic Ocean Waste Solutions, State of Alaska, and others to collaboratively remove marine debris from PWS. While working in southwest PWS, we also reached out to the Chenega IRA Council and residents of Chenega Bay for additional coordination. We are unique in our ability to engage multiple stakeholders in community-driven marine debris removal.
In the Exxon Valdez spill area, ecosystems have been recovering gradually but marine debris and plastic pollution present new challenges. Our sorting and monitoring of marine debris at collection sites shows the most common items collected are foam and plastic fragments, followed by plastic

items such as thousands of water bottles. These items are known to cause harm to marine mammals, fish, seabirds and others through entanglement, ingestion, and other threats.

Injured and recovering species include herring, salmon, harbor seals, sea otters, and seabirds such pigeon guillemots and murres. These and other species are easily impacted by marine debris. Additionally, our efforts in western PWS include treating lands in the Nellie Juan-College Fiord Wilderness Study Area, which remains listed as an injured resource.
We continuously enhance the program and will continue to revise strategies based on need and input from stakeholders, many of whom depend on the ecological well-being of PWS to support subsistence and commercial harvest of marine and terrestrial species. With EVOSTC funding, we can contract a coordinator and continue growing the project and attaining broader community involvement.

Funding Recommendations (Fall 2021):

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

*At the October 13, 2021, meeting, Federal Trustees voted to fund this project using settlement funds received in response to the 1991 Exxon Criminal Plea Agreement.

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 would provide restoration benefits for marine debris removal for a relatively low cost and leveraging of volunteer and business efforts. This proposal is well written and will be assisted by many experienced partners and also includes a monitoring component. This funding will leverage a lot of other funds.

Project Number: **22220604**

Project Title: Kenai River Coho Salmon Habitat & Fishery Assessment

Primary Investigator(s): Anthony Eskelin, Kenneth Gates, Adam Cross

PI Affiliation: ADFG, USFWS, USDA **Project Manager:** ADFG, USFWS, USDA

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$202,029	$548,121	$1,166,695	$1,310,462	$1,297,780	$4,525,087

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$503,300	$589,800	$966,000	$727,000	$727,000	$3,513,100

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $202,029

Total Non-EVOSTC Funding (FY12-22): $503,300

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.13.2021, budget updated 04.12.21.*

This project is designed to continue to support and sustain salmon recovery, improve fishery resources, prioritize fish passage enhancement projects, manage human uses, prioritize strategic habitat protections, and prevent habitat fragmentation. The information garnered from this project will provide science-based decision support information to help inform future habitat conservation work in a more strategic science-based manner focusing on specific needs of the resources (e.g., key tributaries, spawning and rearing areas, etc.). In doing so, this project will reinforce past EVOS investments and focus future investments.

The long-term sustainability of salmon in the Kenai River is at risk and preventing further degradation of habitat and the resulting impact to injured services is critical to maintaining EVOS investments. Coho salmon have been selected due to the paucity of information and the expansive spatial utilization of the landscape often associated with this species. Changing flows, water temperatures, continued development, and the continuous desire to exploit salmon for subsistence, consumptive, commercial, cultural, traditional, and educational purposes are all common threats to the sustainability of salmon. Preferred lands along the mainstem Kenai River are also becoming increasingly unavailable as development continues which is pushing urban sprawl to peripheral areas within the watershed where salmon spawning and rearing is most prevalent and most susceptible to fragmentation.

Radio telemetry, water quality monitoring, genetics, and modeling will be used to identify and describe habitats critical for salmon migration, spawning, staging, and determining specific run timing and abundance for discrete spawning aggregates. This information will provide fishery managers and permitting agencies with the necessary information to improve injured services and maintain salmon as a keystone species to the local economy and ecosystem.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: May 2021

This new proposal seeks support over five years for studies of Kenai River coho salmon to improve knowledge of threats and natural history in order to better manage and conserve the resource. The PIs cite concerns by State and Federal management agencies over a lack of information on coho in the Kenai River. Threats considered to be most impactful to the Kenai River are overharvest and habitat degradation. They identify an additional $2,285,500 in matching funds.

The proposers appear to be highly qualified to undertake this research. They argue that: “This information will provide fishery managers and permitting agencies with the necessary information to improve injured services and maintain salmon as a keystone species to the local economy and ecosystem.” And that, “Stream bank restoration has been a high priority for the Kenai River and recovery of resources and injured services. This project will specifically provide science-based information to aid in the prioritization of current and future habitat restoration and protection activities within the Kenai River watershed.” Moreover, the restoration of habitat on the Kenai River would benefit the conservation of not only coho, but likely other species of salmon as well.

Despite the scientific merits of this proposal, coho has not been identified as a resource injured by the EVOS. Additionally, the link to sockeye salmon, that was an injured species, is weak; and in terms of science, there is no big-picture connection to coho in other regions for perspective. As an aside, the Panel also wonders why the identification of areas in need of habitat restoration could not be identified simply by walking the river edges.

Two external peer reviews were received for this proposal. One reviewer, who also noted that coho salmon was not impacted by the EVOS, wondered about the priority of this study over competing proposed studies. They commented that the proposers suggested that users of the coho resource take them somewhat interchangeably with sockeye and pink salmon, and thus might benefit from improved coho fisheries. A second reviewer was supportive of the proposal, based in part on their belief that it would support an EVOS-affected ecosystem. This reviewer believed the team was qualified to undertake the study, but noted a lack of peer-reviewed publications on their resumes, which was not meant as criticism, but they did hope that products of the research would include such a publication and/or report that would be made available to the public.

PI Response: [PI responded to external reviewer comments. These are not included in the work plan]

Date: September 2021

The overriding concern we had is that coho is not considered to be an injured resource. The PIs reiterated their position that cohos are important to resources that were injured, including killer whales; subsistence, commercial, and recreational fisheries; and to ecosystem function. They again emphasized the lack of information on areas in the Kenai River critical to coho spawning and rearing and the threat of ongoing degradation of habitat in and along the river important to cohos and other species of salmon. They point to interest by EVOSTC in broader aspects of conservation of ecosystem services and argue that, "Knowing the current status of Coho salmon and managing for productive self-sustaining populations benefits multiple species and services identified by the EVOSTC including resources and services found in both the freshwater and marine environment." We and external reviewers were not persuaded by these arguments that coho conservation and management in the Kenai River falls within the mandate of the EVOSTC.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

The PIs are highly qualified to execute this project. I concur with the Science Panel but also acknowledge the recommendation from the PAC.

Project Number: **22220605**

Project Title: American River Restoration, Kodiak

Primary Investigator(s): Michael Mazzacavallo, Gillian O'Doherty, Tyler Polum

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

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$821,424	$22,073	$7,739	$0	$0	$851,236

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$7,000	$0	$0	$0	$0	$7,000

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $821,424

Total Non-EVOSTC Funding (FY12-22): $7,000

Abstract:

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

This project aims to strengthen a stretch of damaged bank along the American River on Kodiak Island by implementing bioengineering techniques and revegetation of the banks. This project also intends to improve drainage along a short section of the Saltery Cove Road, which is an unimproved WWI era right of way primarily used as an ATV trail. In 2019 and 2020, two significant flood events led to the American River breaching its banks and a portion of the water in the American River flowed down the adjacent Saltery Cove Road for a period of months. These events resulted in a large breach in the stream bank, erosion of the unimproved gravel road surface, entrainment of fish on the road, damage to adjacent wetlands, and the restriction of access to two sport fisheries, one subsistence fishery, one fisheries enhancement project and three hunting opportunities. The goal of the pre-proposal submitted to this group in March was to repair the breach, thereby removing the flows from the trail and repair the scour damage to the trail. However, in June of 2021, emergency repairs were completed by local users of the Saltery Cove Road. The repairs included plugging the breach and repairing damage to the road surface and were successful in returning flow to the river channel. However, the formerly breached area remains un-vegetated and vulnerable to future high-water events. This project will use bioengineering techniques to further strengthen the repaired streambank and control and protect public access. It will also improve drainage at one other area where floodwater regularly cross the road in order to prevent fish entrainment and ATV users diverting through nearby wetlands. The project will provide benefits to the following EVOS impacted

species: coho, pink, and chum salmon as well as Dolly Varden. The project benefits salmon, other fish, recreationalists, subsistence users, and trail users.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund reduced	Do Not 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 completion of stream bank restoration through bioengineering and revegetation would have some benefit for the riverine habitat and spill-injured species. It appears that the majority of the funding would support road repairs. I recommend reducing the funding for this project to fund only the proposed stream bank improvements that will directly address habitat enhancement goals.

Project Number: **22220606—WITHDRAWN BY PI**

Project Title: Restoration of Second-Growth Forests on Afognak Island EVOSTC Purchased Conservation Lands for Accelerated Development of Marbled Murrelet Nesting Habitat: And Adaptive Management Experiment

Primary Investigator(s): Peter Olsen

PI Affiliation: Koniag, Inc. **Project Manager:** NA

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$1,595,556	$1,753,497	$2,645,389	$2,595,304	$2,365,725	$10,995,470

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$465,000	$465,000	$240,000	$240,000	$240,000	$1,650,000

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $1,595,556

Total Non-EVOSTC Funding (FY12-22): $465,000

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 03.29.2021, budget updated 05.10.2021.*

Koniag Inc. is proposing this 5 year, $11.9 million "Marbled Murrelet and Pacific Herring Restoration Project" on north Afognak Island. The project endeavors to restore murrelet nesting habitat lost to timber harvest through specialized silvicultural practices on 7,000 acres of second growth forests and enhance herring habitat by placing large rocks to act as algal substrate in areas currently naturally devoid of marine vegetation. Both the species are classified as "not recovered" by the Exxon Valdez Oil Spill Trustee Council.

In what is sure to become the premier marbled murrelet enhancement project anywhere within its range, these efforts will advance the knowledge base of how to manage for nesting habitat in a working forest. With 25% of the old growth on Afognak Island now in second growth status, the science behind this proposal can be applied to second growth on Afognak Island as well as Prince William Sound, Southeast Alaska and throughout its range.

This initiative is a logical and powerful next step for investment in the well-being of the murrelet by the Trustee Council. Land purchases by the Council on Afognak Island have exceeded 124,000 acres and $140 million dollars. These purchases were made in part for the preservation and restoration of

marbled murrelets which has suffered a 33% population reduction since the oil spill. With most of these lands now in State of Alaska ownership, there are over 13,000 acres of early second growth that currently provide no murrelet nesting habitat. Left to natural processes it will take 150 to 200 years for this non-productive nesting potential to develop the forest characteristics murrelets need to nest in. Through applied silvicultural practices and best murrelet science, this project is designed to induce murrelet nesting habitat formation within the next 30 to 40 years.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Withdrawn from Fall Review by PI			

Science Panel Comments

Date: May 2021

This new proposal submitted by Koniag, Inc., an ANCSA Native Regional Corporation; Peter Olsen, Lands and Natural Resource Manager, Project Manager, seeks funding over five years to: 1) restore and hasten the maturation of harvested timber tracks on Afognak Island toward conditions typical of old growth forests for the benefit of marbled murrelets, a species injured by the EVOS and one that is not recovering, and 2) amend the muddy floor of a bay on Afognak I. with solid substrate to provide habitat for kelp, and in turn spawning habitat for herring, another injured species that is not recovering. These activities would benefit marbled murrelets directly by increasing nesting habitat, as marbled murrelets nest primarily in trees in old growth forests. The activities also would benefit herring directly, and murrelets indirectly because herring are among the forage fish prey of murrelets. Additional justification is that the Kodiak Archipelago has previously been identified as one of the three most important breeding areas for marbled murrelets in Alaska, that murrelets are known to nest on Afognak Island, and that 25% of the forested area on Afognak Island has been harvested. No matching funds are identified. The PI notes that both the forest and substrate enhancement goals are scalable and can be either enlarged or reduced if desired by EVOSTC.

The Science Panel has concerns and questions about this project. The PI did not make a case that murrelet abundance is limited by a lack of suitable nesting habitat. Perhaps it is, at least in part, but this should be addressed. For example, if they were to do all of the planting and treatments on the 1000s of acres as proposed, based on murrelet densities in pristine forests elsewhere, including in the Kodiak Archipelago, about how many murrelets might these reclaimed forests support and presumably add to the overall population?

The PI notes that Koniag, Inc. has an existing project that uses Shareholder operated forestry equipment to conduct site preparation in second growth stands on hundreds of acres annually. They do not elaborate on what “site preparation” is, but we wonder if one implication is that they are preparing those stands to become functional forests again that includes providing murrelet nesting habitat. It is not mentioned if they have evaluated the efficacy of those treatments to restore murrelet nesting habitat; this needs to be clarified before launching into this massive program.

This proposed project to treat harvested forest stands spans five years. However, the PIs estimate that it will take 30-40 years for the treated stands to resemble old growth forests suitable as nesting

habitat for marbled murrelets. There is no stated provision about how progress will be monitored across such a long time span that likely would see personnel coming and going, and evolving priorities at Koniag, Inc. They say only that additional support would be necessary along the way. This vague open-endedness about costs and commitments is a major concern of the Science Panel.

In regard to the herring enhancement project, the PI provides no evidence that such an approach actually works. It is simply noted that a similar project was undertaken in 1995 in another bay on Afognak Island, and that the project has been documented photographically. It has now been about 25 years, a length of time that presumably would allow kelp to become established and herring to spawn there if it was successful.

The budgets for the two components, forest enhancement and herring enhancement, are combined and should be separated.

Five external peer reviewers raised substantial concerns. For example, the reviewers wonder if the silviculture practices the PI proposes are appropriate to enhance murrelet nesting habitat; if the use of drones to monitor progress and identify murrelet nests, and establishing flight corridors into recovering stands, might have harmful effects by attracting predators; why other methods for inventorying murrelet distribution and abundance do not include the use of radar and automated recording methods; what exactly would be monitored after the treatments are concluded; how many control and experimental plots would be established and how many would be required to achieve some desired power to detect differences; what landscape attributes would be compared and how would that be done; how would predation be assessed; if meaningful results can be obtained in just five years; and others. A lack of evidence that the herring enhancement project would work was noted and questions were raised about the possible need for State and/or Federal permits to undertake both the murrelet and herring enhancement activities.

Date: September 2021

No further review. Proposal withdrawn from fall review by PI.

PAC Comments

Date: Fall 2021

No further review. Proposal withdrawn from fall review by PI.

Executive Director Comments

Date: Fall 2021

No further review. Proposal withdrawn from fall review by PI.

Project Number: **22220607**

Project Title: Kodiak Archipelago Fish Passage Project

Primary Investigator(s): Franklin Dekker, Gillian O'Doherty, Erika Ammann, Blythe Brown

PI Affiliation: USFWS, ADFG, NOAA, KSWCD

Project Manager: ADFG, USFWS, NOAA

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$8,076,685	$102,396	$88,873	$76,570	$81,876	$8,426,401

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$45,000	$33,000	$0	$0	$0	$78,000

Total Past EVOSTC Funding Authorized (FY12-21): $4,535,533*
**Project 17170119, FY17*

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $12,612,218

Total Non-EVOSTC Funding (FY12-22): $1,645,000*
**Project 17170119, FY17*

Abstract:

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

The Kodiak Archipelago is an Exxon Valdez Oil Spill (EVOS) affected geographic area (Figure 1) and its injured resources and services have received past and ongoing EVOS Trustee Council (EVOSTC) habitat restoration support. In 2017 EVOSTC funded fish passage restoration and debris removal in the Buskin River (project number # 17170119) as well as conservation easements on Kodiak Island. The Alaska Department of Fish and Game (ADF&G), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Fish and Wildlife Service (USFWS) would like to offer an Archipelago scale restoration effort to continue benefits to Kodiak's habitat, species, and services affected by the spill. Restoration will focus on implementing 12 fish passage projects at priority sites as well as 72 culvert assessments, 10 conceptual design for future projects, and debris removal. We anticipate opening approximately 13 miles of upstream habitat for a total cost of $8.5 million. Fish passage projects not implemented in this proposal will be shovel ready projects set up to seek additional sources of funds to potentially open an additional 14.5 miles of upstream habitat.

The rivers of the Kodiak Archipelago are a high priority for restoration because they support a viable salmon fishery widely used for subsistence, recreation and commercial fisheries. The project represents the goals of the EVOS 1994 restoration plan and the current invitation as they provide ecological benefit, support tribal and community interest, landowner support, and cost-effective

implementation. By restoring access to upstream habitats for salmon and trout species and reconnecting fragmented natural processes, the productivity of the freshwater systems of the Kodiak Archipelago and greater nearshore marine areas will be improved. The proposed restoration addresses Kodiak Archipelago's injured resources and services by providing additional opportunity for impacted species populations to recover and improved opportunities for commercial, recreational and subsistence fishing.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund reduced	Do Not 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 restoration benefits to fish passages through culvert replacements. I struggle with recommending funding to support fish passage surveys and design work for future replacements if there isn't any funding or assurance in place to actually replace those culverts. My recommendation is to fund the replacement or removal of the 12 culverts as described in the current proposal.

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, ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $7,211,350

Total Non-EVOSTC Funding (FY12-22): $450,000

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: **22220609**

Project Title: Copper River Watershed (CRWS) Enhancement – Phase II

Primary Investigator(s): Heather Hanson, Kate Morse

PI Affiliation: USFWS, CRWS **Project Manager:** USFWS, ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$8,409,102	$168,525	$152,150	$153,965	$152,722	$9,036,464

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$3,408,532	$9,500	$4,500	$4,500	$4,500	$3,431,532

Total Past EVOSTC Funding Authorized (FY12-21): $1,846,612*
**Project 18180120 , FY18*

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $10,255,714

Total Non-EVOSTC Funding (FY12-22): $3,408,532

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.12.2021, budget updated 04.12.21.*

This project will address two broad aquatic connectivity conservation goals for the Copper River Watershed: 1) restore and maintain healthy fish populations and ecosystem functions that depend on connected river systems and 2) increase resilience and resistance of aquatic systems, infrastructure, and communities to changing hydrologic conditions (i.e., more frequent and extreme floods and droughts).

The Copper River watershed and its delta is complex and ever-changing mosaic of wetland and upland habitat supporting large populations of fish and wildlife, including five species of Pacific salmon and millions of coastal-dependent and migratory birds. The southern portion of the Copper River watershed, including the Copper River Delta, is identified as an Exxon Valdez Oil Spill (EVOS) affected geographic area and is a priority for EVOS Trustee Council (TC) restoration because it supports EVOS injured resources and services, including, but not limited to, Sockeye Salmon, Cutthroat Trout, intertidal communities, commercial fisheries, and recreation and tourism (EVOSTC 2014).

Acknowledging the high value habitat, project proponents have conducted fish passage assessment, prioritization, and improvement activities since 2002. For this proposal, we have identified high priority undersized and failing culverts in fish-bearing waters within the EVOS spill area that together

impede access to 79 miles of habitat. Replacing these structures at a cost of $9,036,464 will restore hydrologic function and unimpeded access to spawning and rearing habitat for all life stages of anadromous and resident fishes, while concurrently promoting natural water flows that maintain riverine and delta habitats and reducing the risk of infrastructure damage during flood events.

A broad-based partnership supports this aquatic connectivity restoration work, including U.S. Fish and Wildlife Service, U.S. Forest Service, National Oceanic and Atmospheric Administration, Alaska Department of Fish and Game, Copper River Watershed Project, Alaska Department of Transportation, Eyak Corporation, and Cordova District Fishermen United.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund reduced	Do Not 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 Phase 1 culvert replacements (project 18180120) for $8.4M in 2018 and this amount supported the replacement of 6 of the 11 culverts planned in the Phase 1 proposal. This proposed project, Phase 2 would fund ($9M) the replacement of the remaining 5 culverts from Phase 1 and an additional 4 culvert replacements and additional survey and concept design work on several more culverts. I struggle with recommending funding to support surveys and design work for future replacements if there isn't any funding or assurance in place to actually replace those culverts. My recommendation is to fund the replacement of the remaining 5 culverts as described in the current proposal from Phase 1.

Project Number: **22220610**

Project Title: Kenai Peninsula Stream Watch

Primary Investigator(s): Branden Bornemann

PI Affiliation: Kenai Watershed Forum **Project Manager:** ADFG

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 (FY12-21): $99,500*
**Project 18180117 , FY18*

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $208,873

Total Non-EVOSTC Funding (FY12-22): $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): Ed Fogels

PI Affiliation: Kenai River Sportfishing Association

Project Manager: ADFG

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $3,434

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

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 (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $768,889

Total Non-EVOSTC Funding (FY12-22): $21,180

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.

Project Number: **22220613**

Project Title: Valdez Area Habitat Restoration

Primary Investigator(s): Heather Hanson, Jeff Stutzke

PI Affiliation: USFWS, AKDOT **Project Manager:** USFWS, ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$8,463,927	$103,516	$80,384	$81,437	$93,149	$8,822,413

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$40,000	$40,000	$0	$0	$80,000

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $8,463,927

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.12.2021, budget updated 04.01.2021.*

This project will address two broad aquatic connectivity conservation goals for the Valdez area: 1) restore and maintain healthy fish populations and ecosystem functions that depend on connected river systems and 2) increase resilience and resistance of aquatic systems, infrastructure, and communities to changing hydrologic conditions (i.e., more frequent and extreme floods and droughts).

The Valdez area is a rich ecological resource, supporting large populations of Pacific salmon and coastal-dependent and migratory birds. Valdez is within the Exxon Valdez Oil Spill (EVOS) affected geographic area and is a priority for EVOS Trustee Council (TC) restoration because it supports EVOS injured resources and services, including, but not limited to, Pink Salmon, Sockeye Salmon, Dolly Varden, commercial fisheries, and recreation and tourism (EVOSTC 2014). The project will make progress toward the goals of the EVOS Restoration Plan (1994).

There are many known aquatic connectivity barriers in the Valdez area, however, little fish passage restoration work has occurred. Project proponents have identified high priority undersized and failing culverts in fish-bearing waters within the EVOS spill area that together impede access to 5.3 miles of habitat. Replacing these structures at a cost of $8,822,413 will restore hydrologic function and unimpeded access to spawning and rearing habitat for all life stages of anadromous and resident

fishes, while concurrently promoting natural water flows that maintain riverine habitats and reducing the risk of infrastructure damage during flood events.

A broad-based partnership supports this aquatic connectivity restoration work, including U.S. Fish and Wildlife Service, Alaska Department of Transportation and Public Facilities, Alaska Department of Fish and Game, Copper River Watershed Project, National Oceanic and Atmospheric Administration, and the City of Valdez.

Funding Recommendations (Fall 2021):

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

Similar to the other culvert replacement proposals, my recommendation is for reduce funds for the project to only include the replacement of 6 culverts along the Richardson Highway and access roads. I struggle with recommending funding to support surveys and design work for future replacements if there isn't any funding or assurance in place to actually replace those culverts.

Project Number: **20200135**

Project Title: Kenai River Special Management Area: Eagle Rock Facility Improvements - REAUTHORIZATION

Primary Investigator(s): Rys Miranda

PI Affiliation: ADNR **Project Manager:** ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
Reauth: $6,419,000	$0	$0	$0	$0	Reauth: $6,419,000

See FY21 Work Plan for FY17-21 funding history.

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $6,419,000

Total EVOSTC Funding Authorized (FY12-21) and Reauthorized (FY22): $6,419,000

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/20/19, budget updated 8/20/19.*

This project will develop the Bookey Parcel to augment the existing Eagle Rock Unit of the Kenai River Special Management Area. Improvements at the Bookey Parcel seeks to improve safety and habitat. The department is committed to providing safe access to recreational opportunities at its park units. Currently, parking at the existing Eagle Rock facility is very limited compared to the demand and overflows into a ditch line at the other side of the Kenai Spur Highway. Additionally, access into the facility is through a residential neighborhood. This project will remedy those two major issues by (1) constructing a 60-stall parking facility at the Bookey Parcel, suitable for truck with trailer design vehicle, and (2) constructing an access road directly off of Kenai Spur Highway, through the Bookey Parcel, and into Eagle Rock, completely bypassing the residential neighborhood.
In addition to the safety improvements, this project will also protect habitat and improve managed access to the parcel's Kenai River frontage. Habitat protection will come in the form of elevated light-penetrating walkways and stairs to keep foot traffic off of sensitive riparian vegetation while maintaining access. Floating docks will also be constructed to help shield the riverbank from erosive boat-induced wave action. This project will benefit the injured resources Dolly Varden, Sockeye Salmon, and Pink Salmon and the injured services Recreation and Tourism.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Reauthorize	Reauthorize	Reauthorize

Science Panel Comments

Date: May 2021

No comments.

Date: Fall 2021

No comments.

PAC Comments

Date: September 2021

No specific comments.

Executive Director Comments

Date: October 2021

The project is awaiting completion of purchase of the Bookey parcel (KEN 4018) where the new facilities will be constructed. The project was included and approved in the State's FY 2022 capital budget.

Habitat Protection Project Descriptions

Submitted in response to the FY22-26 Invitation for Proposals

Project Number: **22220700—TO BE FUNDED BY CRIMINAL SETTLEMENT FUNDS**

Project Title: Land Appraisal for the Retirement of Bering River Coal Fields Parcel

Primary Investigator(s): Dune Lankard

PI Affiliation: Native Conservancy **Project Manager:** NA

EVOSTC Funding Requested (includes 9% GA)
(This project will be funded with criminal settlement funds)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$98,100	$0	$0	$0	$0	$98,100

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $98,100

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 08.09.2021, budget updated 08.09.2021.*

The Native Conservancy requests $98,100 to conduct a Fair Market Value appraisal with the United States Forest Services towards the retirement of the Bering River Coalfield for EVOS Restoration/Habitat Program. The two goals are:

1. To provide a Fair Market Value appraisal conforming to US federal government standards for the proposed EVOS Habitat acquisition of the KADCO mineral rights – the amount of mineable coal in place, development and transportation costs, projected market value for the coal asset over the lifetime of the mine; and
2. To facilitate negotiation between the USFS and KADCO to agree to a deal to be presented to the full EVOS Trustee Council in the October 13, 2021 EVOS Meeting (or in 2022), with funds from the Trustee Council Habitat Sub-Account.

The coalfields are currently undeveloped. Left unprotected the coalfields pose a threat to preserving an entire intact roadless ecosystem that is critical to the restoration of the injured environment, in particular the Prince William Sound (PWS) region. Active coal mining would damage wilderness surface habitat quality in the region, release toxins, and necessitate extensive construction of port and other facilities on the land. In the watershed this would endanger marine species, wildlife, and water quality. Any unmitigated toxin release into the Bering River region from potential coal slurry

lines would flow with coastal currents into PWS (see: satellite maps). Purchasing the KADCO inholdings would also preserve equivalent pristine habitat within the spill restoration boundary for the spill impacted wildlife species and services to recover. Appraisal preparation for the habitat protection acquisition will include fair-market valuation of the asset, and then negotiation with the owner.

Funding Recommendations (Fall 2021):

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

*At the October 13, 2021, meeting, Federal Trustees voted to fund this project using settlement funds received in response to the 1991 Exxon Criminal Plea Agreement.

Science Panel Comments

Date: May 2021

No comments.

Date: September 2021

No comments.

PAC Comments

Date: September 2021

It is noted that the PAC approved a motion to recommend setting aside funding for the purchase of the Bering River coal rights should the Trustees fund this project. It is also noted that this motion was not unanimously supported by all PAC members present at the meeting.

Executive Director Comments

Date: October 2021

I appreciate that the PIs were responsive to reviewer comments and have agreed to do fair market value appraisal. The budget was also reduced in response to reviewer comments.

Project Number: **22220701**

Project Title: Natives of Kodiak Afognak Island Project

Primary Investigator(s): Ellen Kazary, David Mitchell

PI Affiliation: Great Land Trust **Project Manager:** NA

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$250,231	$148,316	$10,124,767	$58,871	$0	$10,582,186

Non-EVOSTC Funding

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $250,231

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

The Natives of Kodiak Afognak Island Project ($10,582,200 in EVOS TC funding requested) is a partnership between Natives of Kodiak, State of Alaska Department of Natural Resources and Koniag, Inc. to benefit the restoration of EVOS injured resources and services on Afognak Island. The project seeks to transfer land owned by Natives of Kodiak and subsurface rights owned by Koniag, Inc. to the State of Alaska Department of Natural Resources to be managed with Afognak Island State Park. This project will provide new opportunities for tourism and recreation through access to world renowned hunting, fishing, and wildlife viewing lands. This includes new, previously unavailable, public boat access to Afognak Island State Park from the south in Izhut Bay.

The project will benefit nearly 30 years and over $100 million of past investments by the EVOSTC when they created Afognak Island State Park by providing consistent management across Northern Afognak. This project is the keystone property connecting Afognak Island State Park with the past EVOS projects completed by Ouzinkie, Uyak, Natives of Kodiak and Afognak Joint Venture.

The project has direct benefits to the recovery of EVOS injured resources recreation and tourism, subsistence, and archeology, and habitat for injured species. The land is a mix of wetlands, streams and lakes with a mosaic of old growth and land in various stages of regrowth. Estimated costs include purchase price for the surface estate, purchase price for the subsurface estate, due diligence and initial management and enhancement costs.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund	Do Not 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-organized proposal that satisfies all EVOSTC criteria for a habitat purchase and would secure both surface and subsurface rights. This project has support of Native corporations and the broader community, including the Kodiak Island Borough, the State Parks Advisory Board. The proposers are highly qualified to carry out this project. Lands purchased would be accessible to the public and promote recreation and tourism. GLT and ASLC have discussed opportunities for collaborations for this project.

Project Number: **22220702**

Project Title: The City of Kodiak Ram Site Project at Fort Abercrombie State Historical Park

Primary Investigator(s): Ellen Kazary, Dave Mitchell

PI Affiliation: Great Land Trust **Project Manager:** NA

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$296,992	$141,122	$6,394,300	$937,040	$99,037	$7,868,492

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $296,992

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

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

The City of Kodiak Ram Site Project at Fort Abercrombie State Historical Park Project ($7,868,500 in EVOSTC funding requested) will restore EVOS injured species and resources through the strategic transfer of lands owned by the City of Kodiak and Kodiak Island Borough to the State of Alaska Department of Natural Resources, to be managed as part of Fort Abercrombie State Historical Park. The project site's coastline and forest provide one of the region's most valued recreation and tourism destinations. Its archeological sites indicate its importance since time immemorial and its boat launch is critical for subsistence and travel between Kodiak and surrounding villages. According to the Fort Abercrombie Management Plan, "Few other units of the Alaska State Park System … possess the cultural and natural resources that are found in Fort Abercrombie."

The park's robust recreational infrastructure supports extensive use by diverse groups, but only a portion of the site is owned by the State. The Ram Site, a 77.5 acre parcel, is owned by the City of Kodiak, and Kodiak Island Borough owns an adjacent 34.7 acre parcel. State Parks manages the City of Kodiak land under an agreement subject to renewal every five years. The State has invested extensively in the property, building and maintaining infrastructure on City land. The transfer of the Ram Site to the State will ensure that this investment in the area's tourism, recreation, and subsistence opportunities is secured for perpetuity, clear of the recurring need to renew five year management agreements.

Significant benefits to EVOS-injured resources and services will be achieved, including tourism, recreation, archaeology, and injured species habitat, likewise benefiting the local economy, the City of Kodiak, Kodiak Island Borough, and the Native Village of Ouzinkie. This project ranked in the 2014 EVOS prioritization's highest category and garners overwhelming public support.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund	Do Not 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-organized proposal that satisfies all EVOSTC criteria for a habitat purchase and the lands to be acquired are owned by the City of Kodiak and a portion of them are currently leased to the Division of Parks and Outdoor Recreation for public use as part of the Fort Abercrombie State Historic Park. The proposers are highly qualified to carry out this project. GLT and ASLC have discussed opportunities for collaborations for this project.

Project Number: **22220703**

Project Title: Koniag, Inc. Women's Bay Project

Primary Investigator(s): Ellen Kazary, Dave Mitchell

PI Affiliation: Great Land Trust **Project Manager:** NA

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$179,490	$2,135,127	$905,866	$87,930	$46,281	$3,354,696

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$18,000	$6,000	$6,000	$0	$0	$30,000

Total Past EVOSTC Funding Authorized (FY12-21): $0

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $179,490

Total Non-EVOSTC Funding (FY12-22): $18,000

Abstract:

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

Koniag, Inc. Women's Bay Project ($3,354,700 in EVOSTC Funding) will restore *Exxon Valdez* Oil Spill injured services and species through the permanent protection of 205 acres of surface and subsurface estate in partnership with Koniag, Inc and United States Fish and Wildlife Service (USFWS). The land is in Women's Bay near the City of Kodiak. Koniag, an ANCSA Regional Native Corporation, is the current landowner.

Purchased parcels will be conveyed to USFWS to be managed as part of the Kodiak National Wildlife Refuge. A conservation easement will be held by the State of Alaska. The property contains lands ranked in the highest category in the 2014 EVOSTC Habitat Land Prioritization.

Acquisition contributes to EVOSTC area-wide goals; the area is popular for recreation, tourism, and subsistence, and the project protects habitat for many injured species.

The landowner supports this project and multiple public planning processes endorse it. This project provides permanent legal public access for what is presently trespass use. Management and enhancements by USFWS will provide the public with easily accessible opportunities near Kodiak. This project includes lands proximal to past EVOSTC-funded projects, thus augmenting those efforts.

If protected, this parcel will provide fish and wildlife-oriented recreational and subsistence opportunities for visitors and residents. The purchase also contributes to the perpetual health of local Native populations and subsistence users.

This is a unique opportunity to acquire lands accessible by road and suitable for management consistent with USFWS uses. Many public lands on Kodiak currently require expensive boat or plane travel. This parcel provides wildlife viewing, fishing, and subsistence opportunities close to Kodiak on lands important for recreation and tourism. Their accessibility and proximity creates a high threat of conversion to other uses. Conservation eliminates the threat of habitat loss from construction, subdivision, development, or restricted access.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Fund	Fund	Do Not 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-designed proposal that satisfies all EVOSTC criteria for a habitat purchase. The lands in proposed for purchase are rated in the highest priority category of the EVOSTC habitat prioritization for multiple spill-affected species. The proposal has the support of the landowner, Koniag, Inc., the Kodiak Island Borough and the US Fish and Wildlife Service, which would manage the property, once acquired, as part of the Kodiak National Wildlife Refuge. GLT is an experienced EVOSTC partner with the skills to facilitate the work successfully to completion. GLT and ASLC have discussed opportunities for collaborations for this project.

Project Number: **KEN 4018**

Project Title: Bookey Parcel - REAUTHORIZATION

Primary Investigator(s): Sylvia Kreel

PI Affiliation: ADNR **Project Manager:** ADFG

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
Reauth: $2,300,000	$0	$0	$0	$0	Reauth: $2,300,000

See FY21 Work Plan for FY17-21 funding history.

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $2,300,000

Total EVOSTC Funding Authorized (FY12-21) and Reauthorized (FY22): $2,300,000

Total Non-EVOSTC Funding (FY12-22): $0

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 8/20/19, budget updated 8/20/19.*

This project will develop the Bookey Parcel to augment the existing Eagle Rock Unit of the Kenai River Special Management Area. Improvements at the Bookey Parcel seeks to improve safety and habitat. The department is committed to providing safe access to recreational opportunities at its park units. Currently, parking at the existing Eagle Rock facility is very limited compared to the demand and overflows into a ditch line at the other side of the Kenai Spur Highway. Additionally, access into the facility is through a residential neighborhood. This project will remedy those two major issues by (1) constructing a 60-stall parking facility at the Bookey Parcel, suitable for truck with trailer design vehicle, and (2) constructing an access road directly off of Kenai Spur Highway, through the Bookey Parcel, and into Eagle Rock, completely bypassing the residential neighborhood.
In addition to the safety improvements, this project will also protect habitat and improve managed access to the parcel's Kenai River frontage. Habitat protection will come in the form of elevated light-penetrating walkways and stairs to keep foot traffic off of sensitive riparian vegetation while maintaining access. Floating docks will also be constructed to help shield the riverbank from erosive boat-induced wave action. This project will benefit the injured resources Dolly Varden, Sockeye Salmon, and Pink Salmon and the injured services Recreation and Tourism.

Funding Recommendations (Fall 2021):

Science Panel	PAC	Executive Director	Trustee Council
Not applicable	Reauthorize	Reauthorize	Reauthorize

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

Reauthorization of funding by the Council is requested because of the additional time needed for the BIA's due diligence work.

Marine Science Facilities Project Descriptions

These projects were not submitted in response to the FY22-31 Invitation for Proposals or FY22-26 Invitation for Proposals

Project Number: **19190125**

Project Title: Prince William Sound Science Center Facilities Replacement

Primary Investigator(s): Katrina Hoffman

PI Affiliation: PWSSC **Project Manager:** DCCED

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$12,113,000	$0	$0	$0	$0	$12,113,000

See FY19 Work Plan for FY17-21 funding history.

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $18,000,000

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $30,113,000

Total Non-EVOSTC Funding (FY12-22): $1,602,951

Abstract:

**This abstract is excerpted from the PI's Request Letter, dated 09.08.2021.*

Per an invitation from the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC), the Prince William Sound Science & Technology Institute (dba Prince William Sound Science Center, also referred to as the Science Center or PWSSC) respectfully submits the enclosed request for an increase in funding for our facilities replacement and consolidation construction project, which is currently underway in Cordova, Alaska.

Due to unforeseen pre-pandemic price inflation & cost increases between 2018-2021 (after the initial round of project funding by the EVOSTC), as well as the unprecedented COVID-19 global pandemic and additional increases in materials, labor, and shipping costs, we learned in mid-December 2020 that the overall cost of our project had increased by a significant percent.

Therefore -- with unanimous EVOSTC approval -- in January 2021 we reduced the scope of the initial build and deferred portions of the original campus design. Those deferred elements include a residence building for visiting scholars and students and a seawater system that will advance important research into mariculture, fisheries, and more. Since then, additional challenges have arisen on our job site, and we are addressing them as they come.

The timing of the Trustee Council's interest in considering reinstating the full, original vision of the campus comes at an important time. Raising additional funds for these deferred elements will take years and delay critical research, including in the mariculture arena, which could benefit the spill-affected area in the near-term. Funding the full project now will avoid expensive re-mobilization costs, maximize efficiencies, deliver a debt-free new campus, stimulate our regional economy at a challenging time, and allow us to advance work to restore spill affected ecosystems. This is all in keeping with the goals and legacy of the EVOSTC. Thank you for the opportunity to submit this request. We look to partnering with you to bring the full original vision to fruition.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: September 2021

Not reviewed.

PAC Comments

Date: September 2021

It is noted that there is strong PAC support for this PWSSC and this additional request.

Executive Director Comments

Date: October 2021

This project was first awarded $18M in FY19. By December 2020, overall costs of the project had increased significantly due to unforeseen pre- and post-pandemic price inflation. In January 2021, the Council was approached with a plan to defer construction for the dormitory, seawater system, heat pump, seawater laboratory finish work, and interior finishings. The Council concluded that they were comfortable with those deferments. This request is for the completion of the work that was deferred in January 2021. While this amount is not insignificant (67% of the initial ask), this situation is not unique to this construction project. This project will stimulate the local economy in Cordova and the potential returns when the Council no longer exists is something to consider. Increased oversight and reporting may be considered by the Council should they decide to fund this request.

Project Number: **20200131**

Project Title: Alaska SeaLife Center (ASLC) Facility Improvements

Primary Investigator(s): Tara Riemer

PI Affiliation: ASLC **Project Manager:** DCCED

EVOSTC Funding Requested (includes 9% GA)

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$2,000,000	$0	$0	$0	$0	$2,000,000

See FY19 Work Plan for FY17-21 funding history.

Non-EVOSTC Funding

FY22	*FY23*	*FY24*	*FY25*	*FY26*	*FY22-26 Total*
$0	$0	$0	$0	$0	$0

Total Past EVOSTC Funding Authorized (FY12-21): $545,000

Total EVOSTC Funding Authorized (FY12-21) and Requested (FY22): $6,296,800

Total Non-EVOSTC Funding (FY12-22): $0 [to be updated]

Abstract:

**This abstract is excerpted from the PI's Proposal, dated 1/09/19, budget updated 1/09/19.*

The construction of the Alaska SeaLife Center in Seward, which opened in 1998 to conduct research, wildlife response, and public education, is the keystone legacy organization created as a result of the *Exxon Valdez* Oil Spill (EVOS). Nearly thirty years on, data continues to be produced indicating that habitat and ecosystem recovery remains constant, adaptations have been required, and more understanding is needed. To continue our research and restoration, ASLC must repair, replace, and improve our building infrastructure, life support, and research support systems. Provision from the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) for these projects is key to ASLC's mission to continue serving as a significant resource for generating and sharing knowledge that promotes understanding and stewardship of Alaska's marine ecosystems.

Funding Recommendations (Fall 2021):

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

Science Panel Comments

Date: September 2021

Not reviewed.

PAC Comments

Date: September 2021

Not reviewed.

Executive Director Comments

Date: October 2021

Not reviewed.