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

Program Number and Title

19120114 - Gulf Watch Alaska Program: Long-term Monitoring of Marine Conditions and Injured Resources

Primary Investigator(s) and Affiliation(s)

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Katrina Hoffman, Prince William Sound Science Center

Date Proposal Submitted

25 August 2018

Program Abstract

The Gulf Watch Alaska (GWA) program directly addresses the *Exxon Valdez* Oil Spill Trustee Council's focus area, integrated long-term monitoring of marine conditions and injured resources services. The overarching goal of GWA is to provide sound scientific data and products that inform management agencies and the public of changes in the environment and the impacts of these changes on injured resources. GWA has a consortium of 13 projects organized in the following functional groups: three monitoring components (environmental drivers, pelagic, and nearshore), a program management team, a science review panel, a science coordinating committee, and an outreach steering committee.

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

To date in FY18, all field sampling projects have been completed as planned, PIs continued to leverage GWA funding and resources to enhance collaborative efforts in the Gulf of Alaska, and the program management team has completed reporting requirements, continued development of data products and outreach activities to engage stakeholders.

Overall, there are only minor changes to GWA program management, outreach, and sampling effort for FY19. We are requesting additional funding in four of the 13 work plans to replace agency-supported vessel charter costs that are no longer available, resume summer forage fish surveys and aerial survey validation in PWS, and partially fund a postdoc to support science synthesis efforts.

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

FY17	FY18	FY19	FY20	FY21	TOTAL
$2,278,750	$2,574,860	$2,540,070*	$2,691,280*	$2,531,360*	$12,616,330*

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

FY17	FY18	FY19	FY20	FY21	TOTAL
$3,168,700	$3,243,900	$3,044,100	$3,117,300	$3,046,800	$15,600,800

**The funding request for FY19-21 includes requests for increases to several projects. Please see Sections 2C and 6B for details.*

1. EXECUTIVE SUMMARY

This proposal requests continuation of the Gulf Watch Alaska (GWA) long-term monitoring (LTM) program for FY 2019, year 8 of the program. The *Exxon Valdez* Oil Spill (EVOS) Trustee Council (EVOSTC) initiated funding for the GWA LTM program in 2012 (McCammon et al. 2011) and recommended continuation for the next 5-year increment, years 6-10 (Lindeberg 2016). The Trustees plan to support an LTM program for 20 years. As requested by the EVOSTC, this program is designed to monitor key components that play important roles in the Gulf of Alaska (GOA) marine ecosystem. These components include environmental drivers such as temperature and nutrient availability; pelagic populations of predators and prey; and the nearshore ecosystem. Through this effort, scientists and resource managers will be able to continue to monitor injured resources from the EVOS and have a better understanding of potential impacts to these resources from natural and anthropogenic changes in the environment.

GWA is a consortium of 13 projects, ten of which started before 2012 and several with data sets extending prior to the EVOS. A wide array of information and tools have been effectively coordinated and synthesized by the GWA program to date (GWA 3 Year Science Synthesis Report, 2015; GWA final reports, submitted in 2016 and accepted by EVOSTC in 2018; special issue publication of Deep-Sea Research II – Topical Studies in Oceanography, 2018). The program has fostered partnerships that include: professional administrative support, advanced data housing, scientific collaboration and synthesis across projects and disciplines, and a significant outreach capacity through agency partners. Collectively, this group of 28 principal investigators (PIs) represents unsurpassed expertise and knowledge of the GOA ecosystem and spill-affected region. The overarching goals of the program are to:

A. *Collect long-term ecological monitoring information from the GOA EVOS affected region*
B. *Make monitoring data publicly available for use by stakeholders, managers, and facilitate synthesis efforts*
C. *Assess monitoring data holistically across projects, components, and programs (i.e., Herring Research and Monitoring [HRM] and Lingering Oil) to better understand the range of factors affecting individual species and the ecosystem*

For FY19, we are submitting a program proposal (this document), a program management proposal (combined for the PM I and PM II projects) and eleven monitoring project proposals. Individual project proposals and budget plans are provided, as requested, in the program's Research Workspace to EVOSTC staff members.

Our plans for the next fiscal year have a few minor changes from the original FY17-21 proposal package. GWA PIs identified important funding needs for FY19-21 to replace lost agency in-kind funds, leverage newly available external funds, and improve current sampling efforts. In an attempt to maintain a monitoring program that is adaptive to EVOSTC and agency needs, environmental variability, and sound scientific inquiry, we developed a strategy to prioritize requests for additional funding. This strategy included an equitable nomination and selection process to add the highest ranking requests to work plans (see section 4B and Appendix 1 for details). This pre-selection of requests was our attempt to minimize the total requests to the EVOSTC from GWA. This effort plus subsequent identification of needed assistance for science synthesis resulted in new funding requests for $189K per year in total from four of 13 work plans to replace agency-supported vessel charter costs that are no longer available, resume summer forage fish surveys and aerial survey validation in PWS, and partially fund a postdoc to work with the GWA Science Coordinator.

Brief summaries of each project under the GWA program have been compiled below. These are not meant to be comprehensive, but provide a quick means for reviewing key aspects of all projects (e.g., who, what, where, when, interim findings, and highlighted time series datasets where appropriate). For more details, please see individual project work plans. Fig. 1 shows the GWA "footprint" for the various monitoring projects.

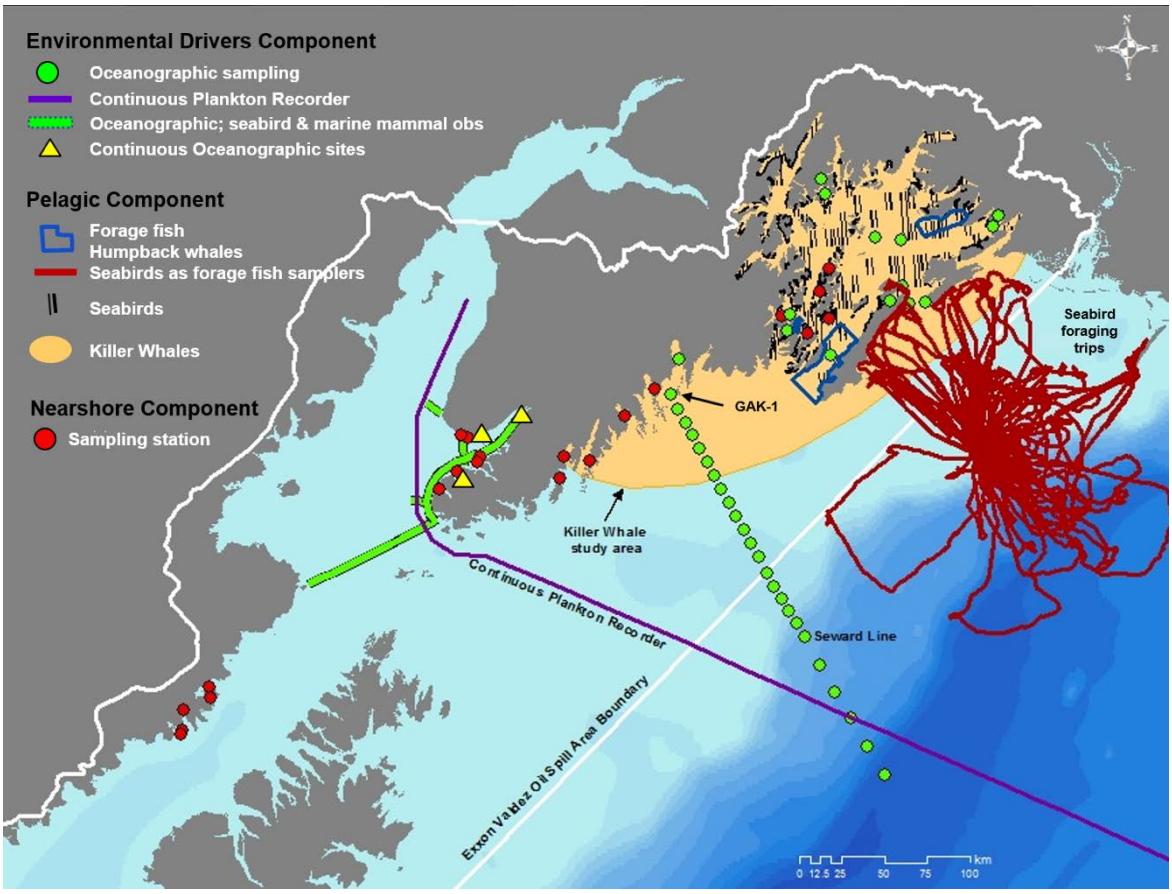

Figure 1. Gulf Watch Alaska monitoring "footprint" by ecosystem component and project focus.

Integrated Program Management and Administration

Program coordination and science synthesis (GWA Program Management I) – Mandy Lindeberg, Rob Suryan, and Donna Aderhold, NOAA Auke Bay Laboratories – Project 19120114-A, and Program administration, logistics, and outreach (GWA Program Management II) – Katrina Hoffman, Prince William Sound Science Center (PWSSC) –Project 19120114-B

The Program Management I (PM I) project provides program coordination and science synthesis of data for the EVOSTC's integrated Long-term Monitoring of Marine Conditions and Injured Resources and Services program, referred to as GWA. The Program Management II (PM II) project is the administrative and outreach component of GWA. The Prince William Sound Science Center (PWSSC) serves as the fiscal agent for non-Trustee Agency recipients of GWA funds. The work plans for these two projects are combined because together they represent management of the GWA program and because the EVOSTC Science Panel requested combining the projects in 2017.

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

So far in FY18, the PMT has maintained all of the program administration and outreach activities noted above. In addition, we participated in community engagement events in Port Graham, Seldovia, and Homer, and completed a graphic illustration for the Pelagic Component, the second of three illustrations to represent the major components of GWA (Fig. 2). We produced 14 presentations/outreach products; and are continuing FY17-21 science synthesis efforts for four cross-component manuscripts and 6-10 new time series indicators (15-19 total from GWA) to assess ecosystem status in the GOA. The PMT is also drafting plans for the 5-yr science synthesis that includes four cross-component synthesis manuscripts and beginning discussions of strategic science planning for third 5-year funding cycle (FY22-26).

Nearshore Component **Pelagic Component**

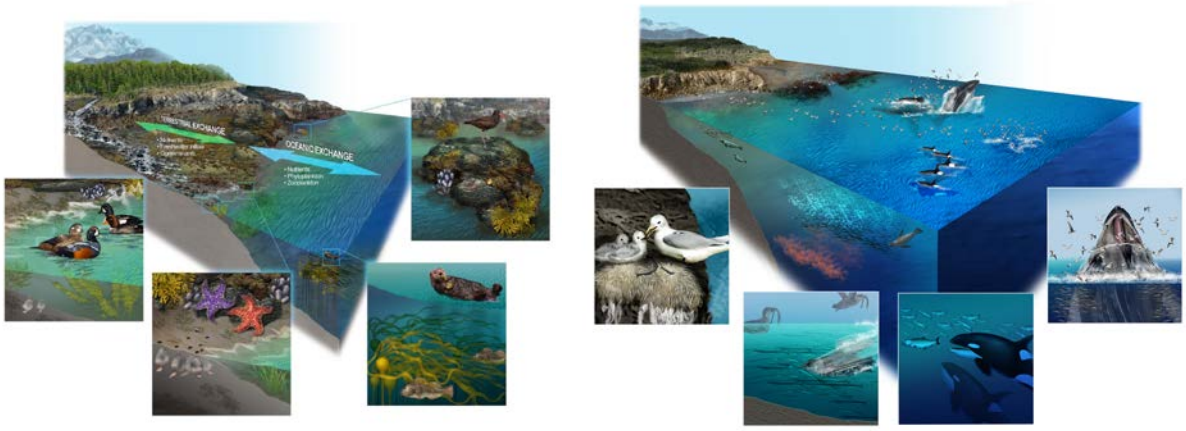

Figure 2. Graphic illustrations depicting the nearshore and pelagic ecosystems studied by GWA. A third illustration depicting the Environmental Drivers component will be completed in FY19.

Environmental Drivers Component

The Environmental Drivers component of the GWA program provides the spatial and temporal context for understanding change in the physical and chemical environment. As in the first five years of GWA, this observation network consists of five separate, but interconnected projects distributed across the spill-affected GOA and are key to improving our understanding of the intersection of the Alaska Coastal Current (ACC) with PWS, Resurrection Bay, and Lower Cook Inlet:

Gulf of Alaska mooring (GAK1) – Seth Danielson and Tom Weingartner, University of Alaska Fairbanks (UAF) – Project 19190114-I

This project continues a 45-year time-series of temperature and salinity measurements at hydrographic station GAK-1. The data set, which began in 1970, now consists of quasi-monthly conductivity-temperature versus depth casts and a mooring outfitted with seven temperature/conductivity recorders distributed throughout the water column and a fluorometer at 20 m depth. The project monitors five important ACC ecosystem parameters that quantify and help us understand hourly to seasonal, interannual, and multi-decadal period variability in: 1) temperature and salinity throughout the 250 m-deep water column, 2) near surface stratification, 3) surface pressure fluctuations, 4) fluorescence as an index of phytoplankton biomass, and 5) along-shelf transport in the ACC. All of these parameters are basic descriptors that characterize the workings of the inner shelf and the ACC, an important habitat and migratory corridor for organisms inhabiting the northern GOA, including PWS and resources injured by EVOS. We are aware of 69 publications utilizing data collected at station GAK-1, and since 2000 the citation list has grown by nearly three publications per year. Topics covered by these publications range from physical oceanography and climate through trophic (including commercial fisheries) level components and ecosystem analyses. Recent water temperatures have returned to average in the upper 100 m, but warmer than average water remains below 100 m (Fig. 3). A recently awarded National Science Foundation (NSF) Long-term Ecological Research (LTER) program (awarded to GWA PIs R. Hopcroft and S. Danielson) will leverage and compliment this and other environmental drivers sampling within GWA.

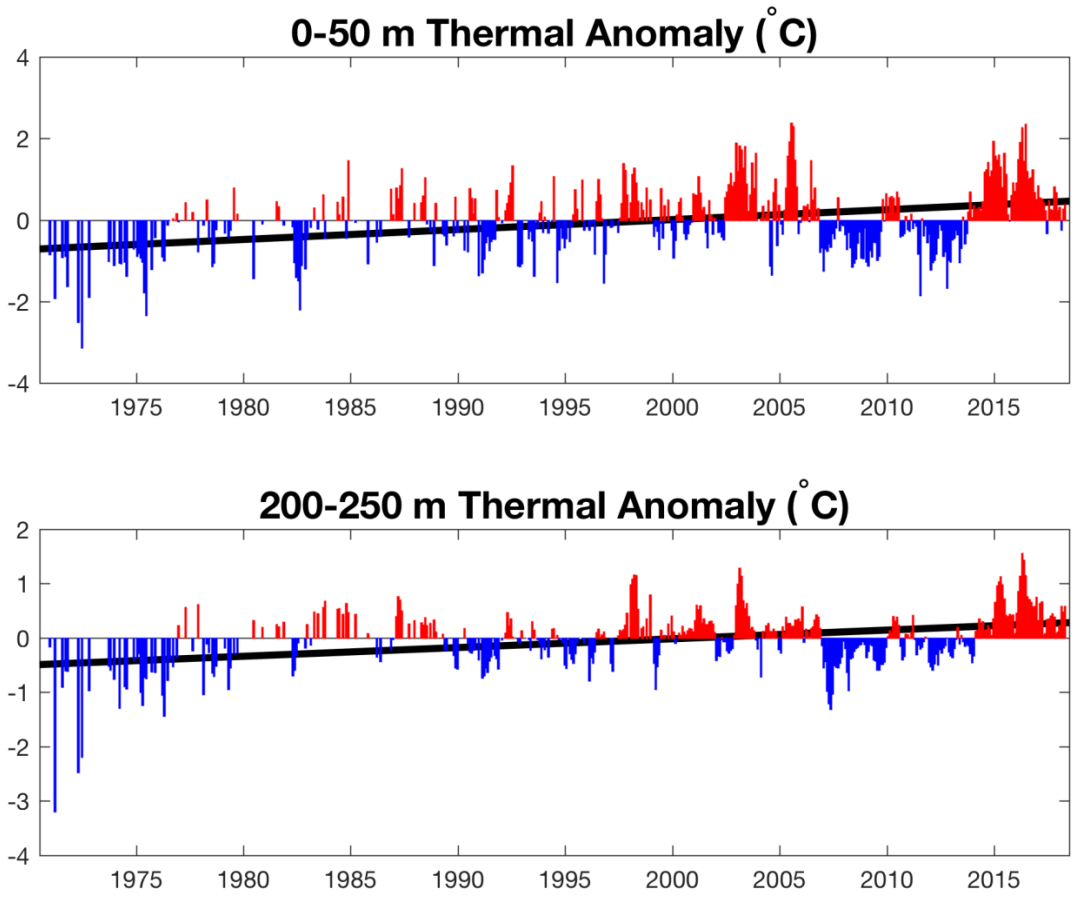

Figure 3. Time series 1970-2018. Temperature anomalies from the GAK-1 dataset over the upper 50 m depths (upper) and over 50 m close to the seafloor (lower) exhibit a long-term trend in warming along with signals associated with the cycles of El Nino and other phenomena. Black lines show the least squares best fit trend over the period of record.

Seward line – Russ Hopcroft, UAF – Project 19120114-L

Long times-series are required for scientists to tease out pattern and causation in the presence of substantial year-to-year variability. For the 5-year period beginning in 2017, we are continuing multi-disciplinary oceanographic observations begun in fall 1997 in the northern GOA. Cruises occur in early May and early September to capture the typical spring bloom and summer conditions, respectively, along a 150-mile cross shelf transect to the south of Seward, Alaska. The line is augmented by stations in the entrances and deep passages of PWS. 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 (Figs. 4 and 5), and what may be anticipated under future climate scenarios. Beginning in 2018, funding as one of the NSF LTER sites is allowing expanded sampling on the shelf upstream of PWS, including near Middleton Island, to help better understand spatial variability on the shelf.

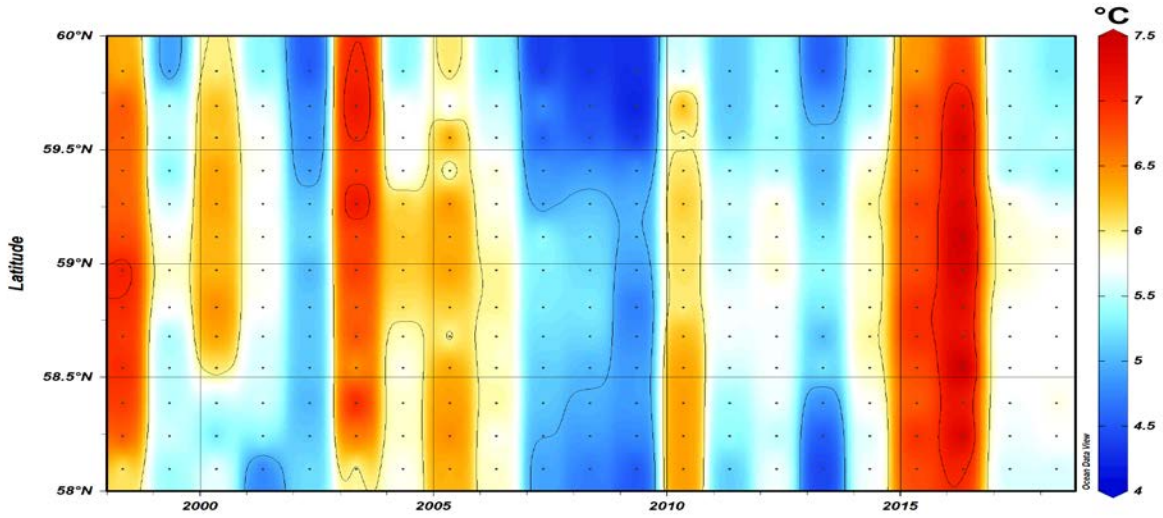

Figure 4. Early May temperature averages for the upper 100m along the Seward Line.

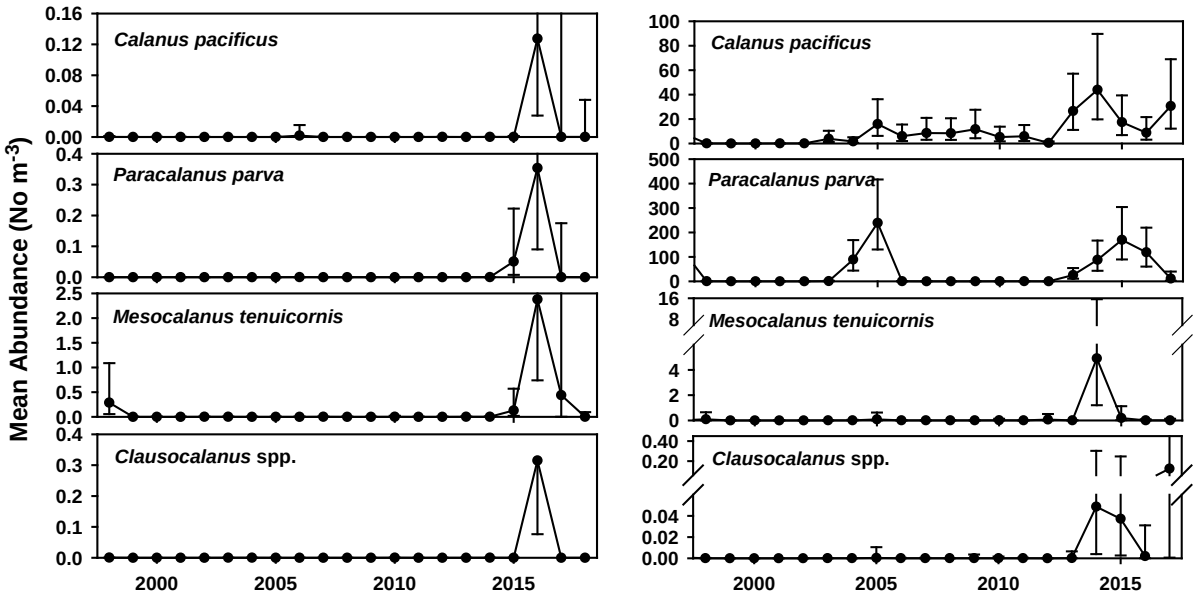

Figure 5. Abundance of the four most prevalent California Current copepods along the Seward Line, during May and late summer. Although these warm-water species have recently disappeared from May, some still remain during late summer.

Oceanographic conditions in Prince William Sound – Rob Campbell, PWSSC – Project 19120114-G

This project continues physical and biological measurements to assess trends in the marine environment and bottom-up impacts on the marine ecosystem of PWS. Regular (~6 per year) vessel-based surveys of PWS are conducted to maintain ongoing time series observations of physical (temperature, salinity, turbidity), biogeochemical (nitrate, phosphate, silicate, dissolved oxygen), and biological (chlorophyll-a concentration, zooplankton abundance and composition) parameters in several parts of PWS. Sampling sites include central PWS, the entrances (Hinchinbrook Entrance and Montague Strait), and four priority bays that were part of the EVOSTC-funded Sound Ecosystem Assessment project in the 1990s and the ongoing HRM program.

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

FY18 spring and early summer observations in PWS indicate the spring bloom was about on time, the surface layer water temperature was above average but trending towards the climatology (Fig. 6). Some warm water copepod (southern species) are still present (Fig. 7).

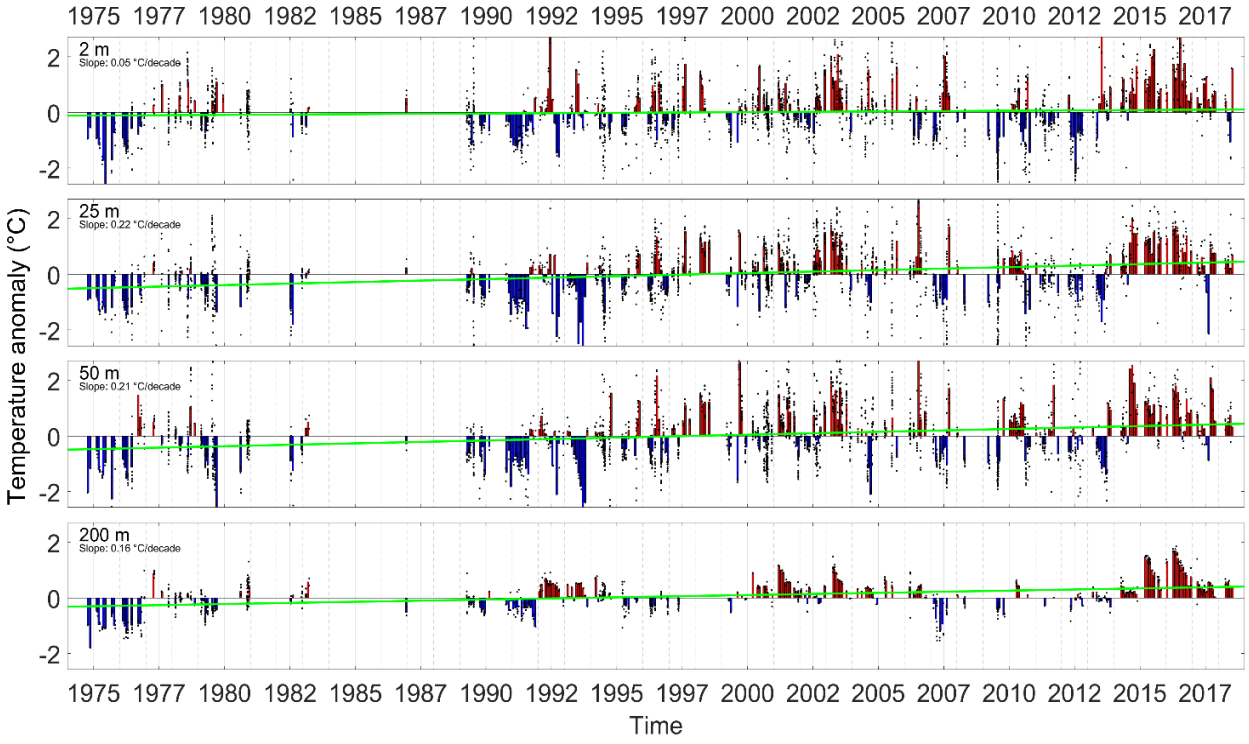

Figure 6. Temperature anomalies at four selected depths in central PWS. Anomalies were calculated as the residual to a second order cosine curve fit to all years data (to remove seasonality). Black points are observations, bars are quarterly averages, and the green line indicates the linear trend. Slopes with text in black are significantly different from zero ($p<0.05$).

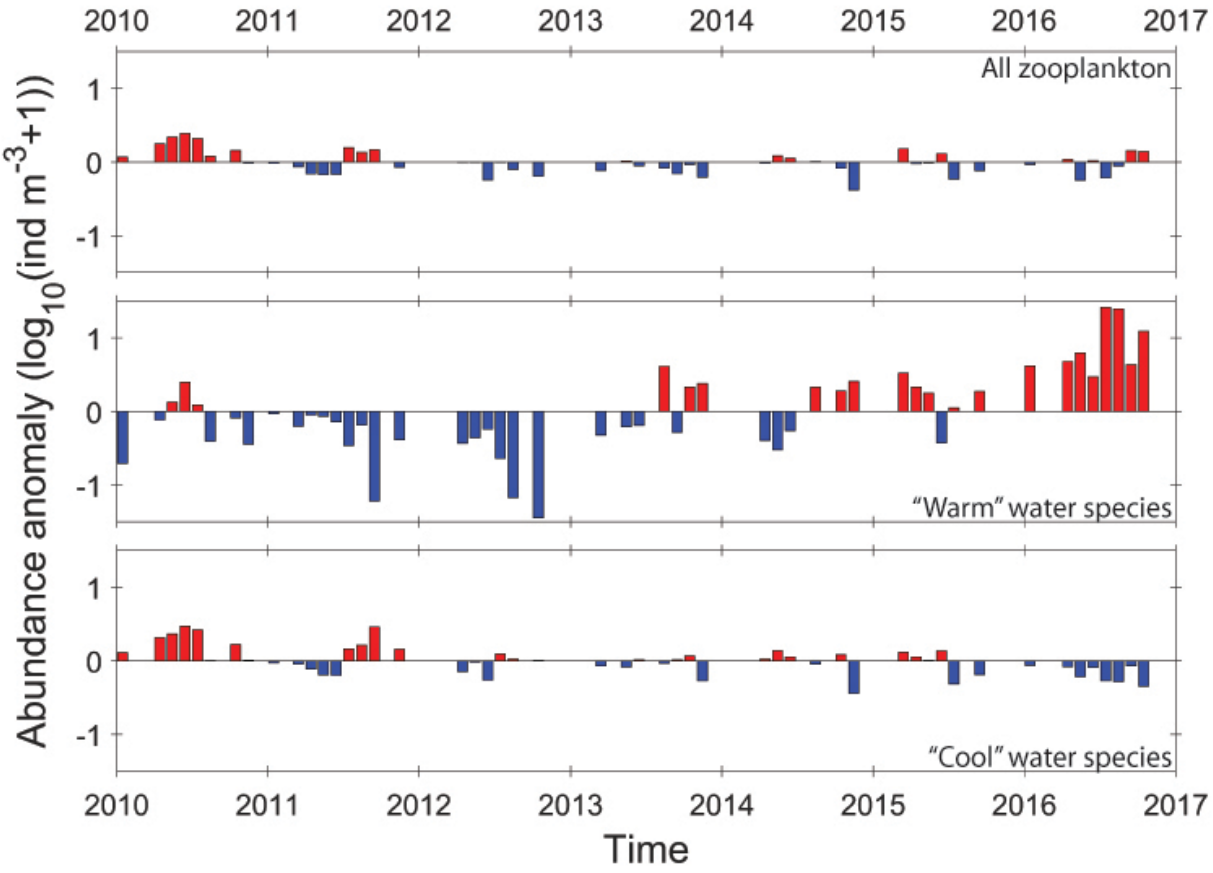

Figure 7. Time series of zooplankton anomalies in PWS, 2010-2016. Zooplankton were divided into "warm" and "cool" water copepod species.

Oceanographic conditions in Lower Cook Inlet/ Kachemak Bay – Holderied & Baird, National Oceanographic and Atmospheric Administration (NOAA) Kasistna Bay Laboratory & University of Alaska Anchorage (UAA) Kachemak Bay National Estuarine Research Reserve (KBNERR) – Project 19120114-J

The Cook Inlet/Kachemak Bay monitoring project provides year-round, high temporal resolution oceanographic and plankton community data to assess the effects of seasonal and inter-annual oceanographic variability on nearshore and pelagic species affected by EVOS. We continue a 7-year time-series of shipboard oceanography surveys along the estuarine gradient from Kachemak Bay into southeast Cook Inlet, as well as a 17-year time series of continuous nearshore water quality station observations in Kachemak Bay. Shipboard sampling includes conductivity-temperature-vs-depth casts, and phytoplankton and zooplankton net tows. Outputs from the project include seasonally-resolved oceanographic patterns, plankton abundance and community composition, and cycles for harmful algal species. The project provides oceanographic data to support GWA Nearshore Component monitoring in Kachemak Bay. It also provides year-round information on estuary-shelf oceanographic gradients for the GWA Environmental Drivers component to help evaluate local (within estuary) and remote (shelf, North Pacific) climate forcing effects on nearshore and pelagic ecosystems. Results show that: 1) water temperatures in 2017 were cooler than during the 2014-2016 marine heat wave but still above long-term averages (Fig. 8); 2) zooplankton response to environmental variability in Kachemak Bay was higher between years than among locations; and 3) summer abundances of the toxic phytoplankton species that causes

paralytic shellfish poisoning were sensitive to warm temperatures and higher in Kachemak Bay than lower Cook Inlet.

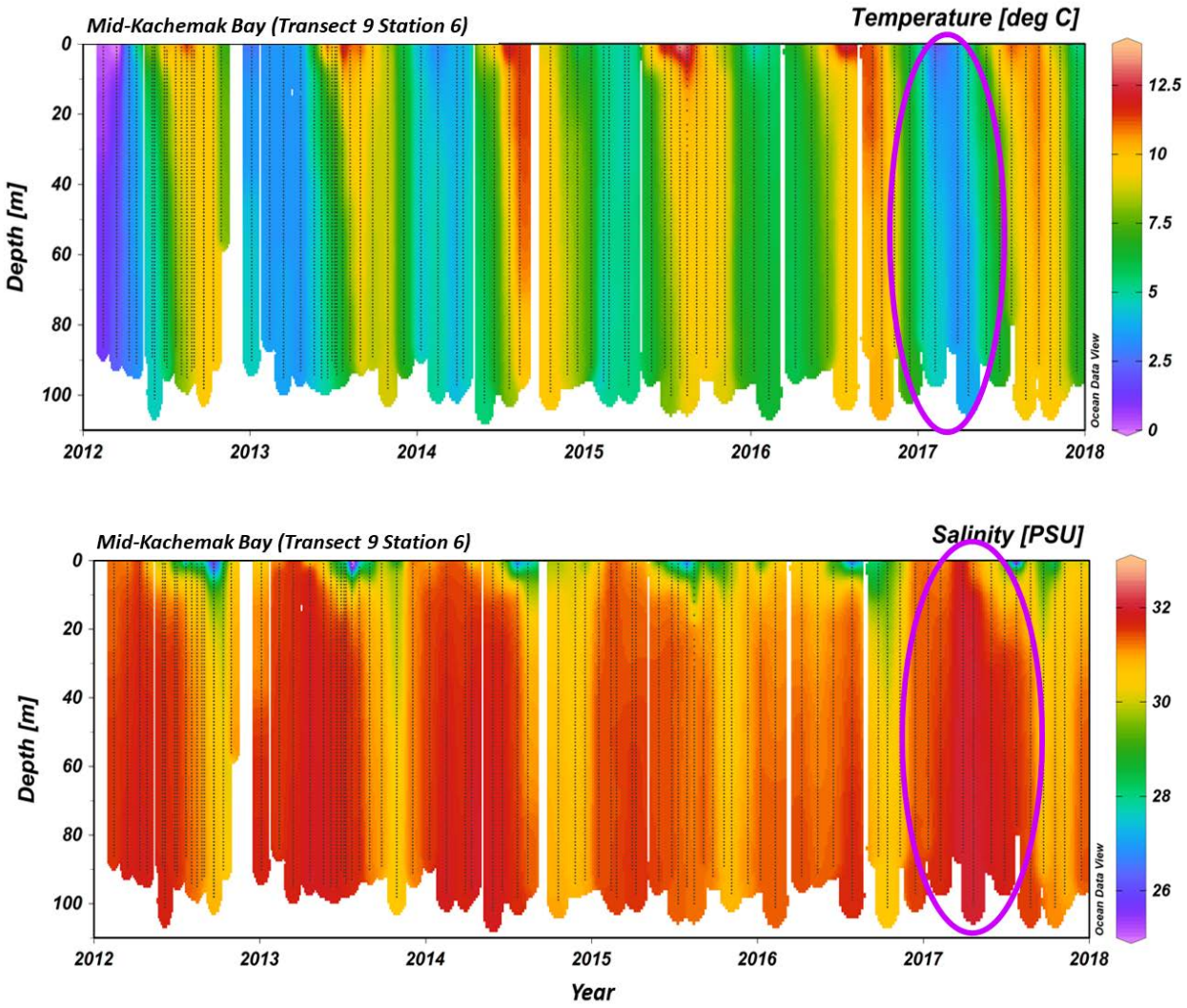

Figure 8. Time series of vertical profiles of water column temperature (top, °C) and salinity (bottom, practical salinity units (PSU)) from 2012-2016 collected from monthly CTD casts at a mid-Kachemak Bay station.

Continuous plankton recorder – Sonia Batten, Continuous Plankton Recorder Survey, Marine Biological Association, and Robin Brown, North Pacific Marine Science Organization – Project 19120114-D

The Continuous Plankton Recorder transect samples the Alaskan shelf from lower Cook Inlet across the slope into the open GOA, providing a now 18-year record of taxonomically resolved, seasonal, near-surface zooplankton and large phytoplankton abundance over a wide spatial scale. Sampling takes place approximately monthly, six times per year, usually between April and September. Outputs from the project include indices of plankton abundance (e.g., large diatom abundances, estimated zooplankton biomass), seasonal cycles (phenology of key groups) and community composition (e.g., appearance of warm water species, change in dominance by some groups). Variability in any, or all, of these indices might be expected to flow-through to higher trophic levels such as herring, salmon, birds and mammals that forage across the region, some of which have been impacted by EVOS. Results show that interannual variability in plankton dynamics is high and

plankton responded clearly and rapidly to the warm conditions of 2014-2016, with changes evident in abundance, composition and timing (Fig. 9).

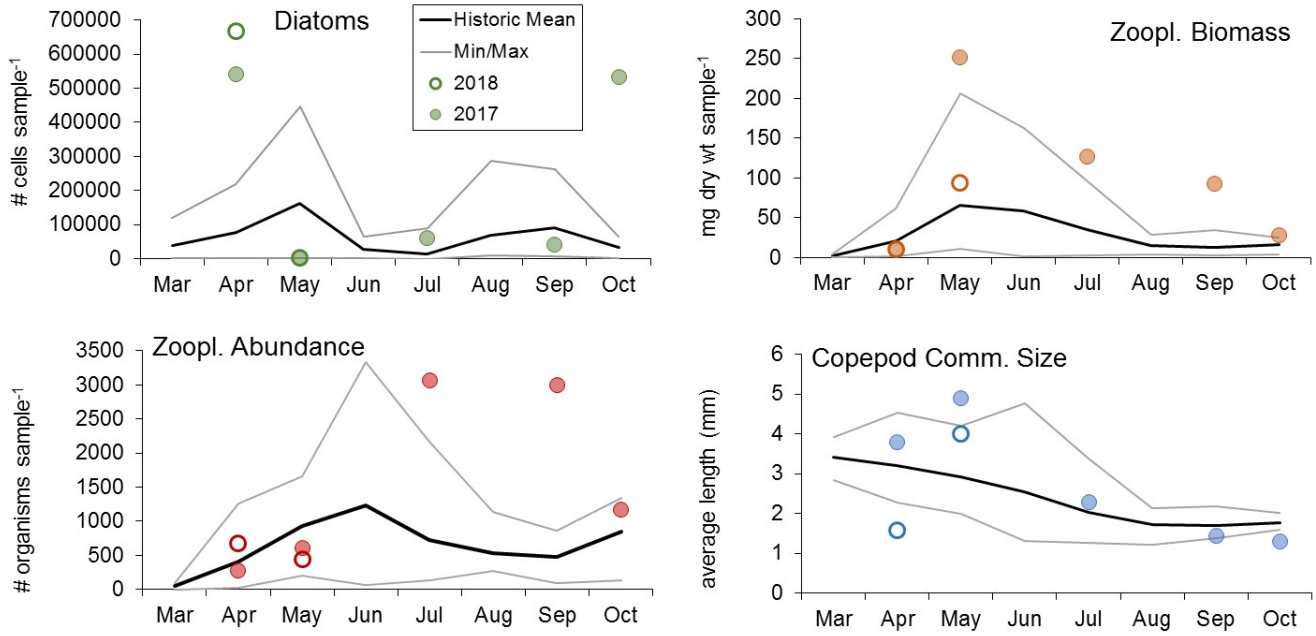

Figure 9. Mean monthly values of four plankton indices (circles), compared to the historic (2004-2016) values from the shelf region (mean shown by black line, min and max values shown by light grey lines). The filled circles are values from 2017 and the open circles values from 2018. Data from July 2017 onwards are provisional at this time.

Pelagic Component

The Pelagic Component research team monitors key pelagic species groups using five projects focused on killer whales, humpback whales, forage fish, and marine birds (two projects, summer and fall/winter). The two over-arching questions for the pelagic component to answer in the next five years are: 1) what are the population trends of key upper trophic level pelagic species groups in PWS – killer whales, humpback whales, and marine birds? and 2) how do predator-prey interactions, including interannual changes in prey availability, contribute to underlying changes in the populations of pelagic predators in PWS and Middleton Island?

Long-term killer whale surveys – Craig Matkin, North Gulf Oceanic Society – Project 19120114-N

This project is a continuation of the long-term photo-identification based program that has continuously monitored killer whale populations in PWS since 1984. A primary focus is on resident killer whales and the recovery of AB pod and the threatened AT1 population of transient killer whales. These two groups of whales suffered serious losses at the time of the oil spill and have not recovered at projected rates. Assessment of population dynamics, feeding ecology, movements, range, and contaminant levels for all major pods in the area will help determine their vulnerability to future perturbations and environmental change, including oil spills. In addition to population dynamics from annual photo-identification, this project uses other techniques to determine the health and trends of the population. These techniques include biopsy/skin sampling to compare genetics between populations; biopsy/blubber to investigate contaminants; fatty acid and stable isotope

profiles, prey sampling of flesh, fish scales, and whale scat to investigate diet, behavioral observation; and remote acoustic monitoring to determine important off-season habitat. During FY18, remote recording hydrophones have been recovered and redeployed in Montague Strait, Hinchinbrook Entrance, and Kenai Fjords. Initial investigation of these raw acoustic data suggests that strong fall activity in Montague Strait still occurs, but in 2016 and 2017 were 2-3 weeks later than in past years. If this timing continues, we may adjust the field effort dates to improve encounter rates. Between our surveys and contributed photos, we were able to confirm that all seven of the remaining Threatened AT1 transient population have survived to 2018 (Fig. 10).

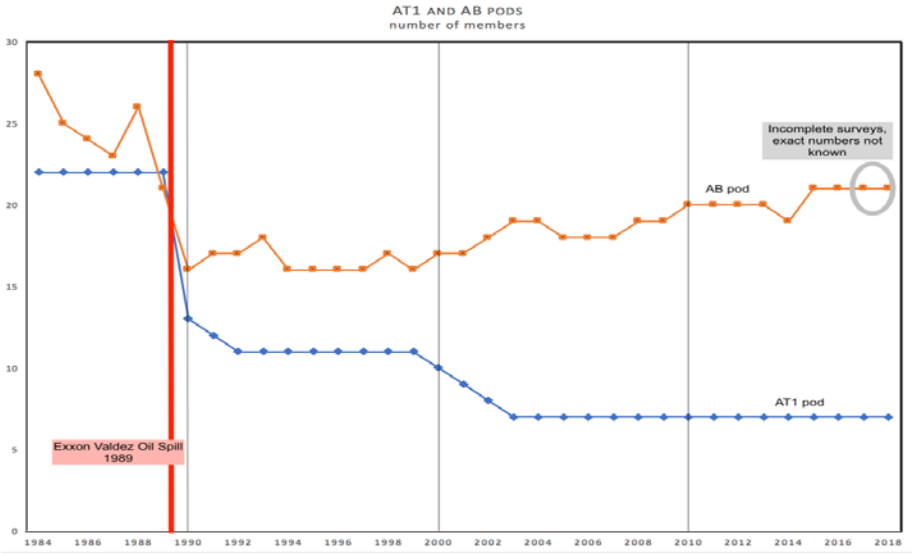

Figure 10. Number of killer whales in AB pod (1984-2016) and AT1 population (1984 to 2018). Only portions of the AB pod were seen in 2017 and 2018 (grey circle).

Prince William Sound marine bird surveys – Kathy Kuletz and Robert Kaler, U.S. Fish and Wildlife Service (USFWS) – Project 19120114-M

We conduct small boat surveys to monitor the abundance of marine birds in PWS, Alaska. The surveys are conducted every two, even numbered, years and therefore occur during July 2018 and 2020 during the current GWA funding cycle (FY17-21). Fifteen surveys over a 29-year period have monitored population trends of marine birds and mammals in PWS after EVOS. We use the data to examine trends from summer to determine whether populations in the oiled zone are increasing, decreasing, or stable. We also examine overall population trends for the Sound. Continued monitoring of marine birds and synthesis of the data are needed to determine whether populations injured by the spill are recovering. Data collected from 1989 to 2016 indicated that pigeon guillemots and marbled murrelets are declining in the oiled areas of PWS. We have found high inter-annual variation in numbers of some bird species and therefore recommend continuing to conduct surveys every two years. These surveys are the primary means to evaluate recovery of most of these injured marine bird species. Surveys also benefit the nearshore and forage fish projects of the GWA and projects in the HRM program. In FY18, we recently completed our July survey and have been working with other GWA PIs to integrate marine bird survey datasets for all of GWA to conduct analyses across-components and regions.

Forage fish distribution and relative abundance – Mayumi Arimitsu and John Piatt, U.S. Geological Survey (USGS) Alaska Science Center – Project 19120114-C

Identifying drivers of change in forage fish populations is key to understanding recovery potential for piscivorous species injured by EVOS. The goals of the GWA forage fish monitoring project are to provide information on the population trends of forage species in the GOA and to better understand how underlying predator-prey interactions influence recovering species and pelagic ecology within PWS and the GOA. Sampling in FY17 (FY18 sampling begins Sept 11, 2018) indicated predator and prey abundances in PWS were low and forage species such as capelin and sand lance continued a 4-year trend of low occurrence in seabird diets in the GOA (Fig. 11). Our continued sampling will provide insight into how forage fish populations respond to the persistence of or recovery from the recent Pacific marine heat wave. In FY19, we will continue acoustic-trawl sampling for the integrated predator-prey survey in PWS during fall (Sept/Oct), and seabird diet sampling at Middleton Island during spring/summer (Apr-Aug).

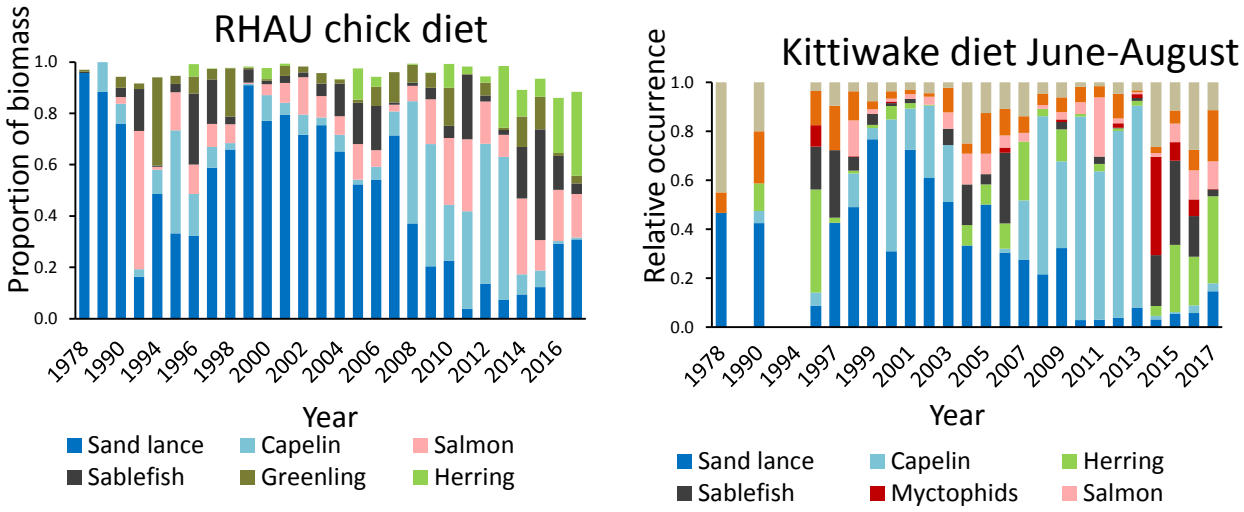

Figure 11. Interannual variation in diet composition of chick-rearing rhinoceros auklets (left) and black-legged kittiwakes (right) on Middleton Island, 1978 to 2017.

Humpback whale predation on herring – John Moran and Jan Straley, NOAA National Marine Fisheries Service (NMFS) Auke Bay Laboratory and University of Alaska Southeast (UAS) – Project 19120114-O

The humpback whale monitoring project is part of the GWA pelagic component's integrated predator-prey survey. Humpback whale predation has been identified as a significant source of mortality on over-wintering Pacific herring in PWS and a likely top-down force constraining their recovery. Humpback whales in PWS have a higher percentage of herring in their diet and forage longer on herring during non-summer months than their counterparts in Southeast Alaska. Currently, North Pacific humpback whales in the GOA may be experiencing nutritional stress and increased use of inland waters like PWS could result in increased predation on herring. We continue to evaluate the impact by humpback whales foraging on Pacific herring populations in PWS following protocols established during 2007/08 and 2008/09 (EVOSTC project PJ090804). Prey selection by humpback whales is determined through acoustic surveys, visual observation, scat analysis, and prey sampling. Chemical analyses of skin and blubber biopsy samples provide a longer term perspective on shifts in prey type (trophic

level from stable isotopes) and quality (energy content). These data are combined in an updated bioenergetic model that allows us to assess the impact of recovering humpback whale populations on the PWS ecosystem. By integrating with the forage fish and fall/winter marine bird components, we contribute to a comprehensive understanding of bottom-up influences and top-down controls on the PWS herring population (Fig. 12).

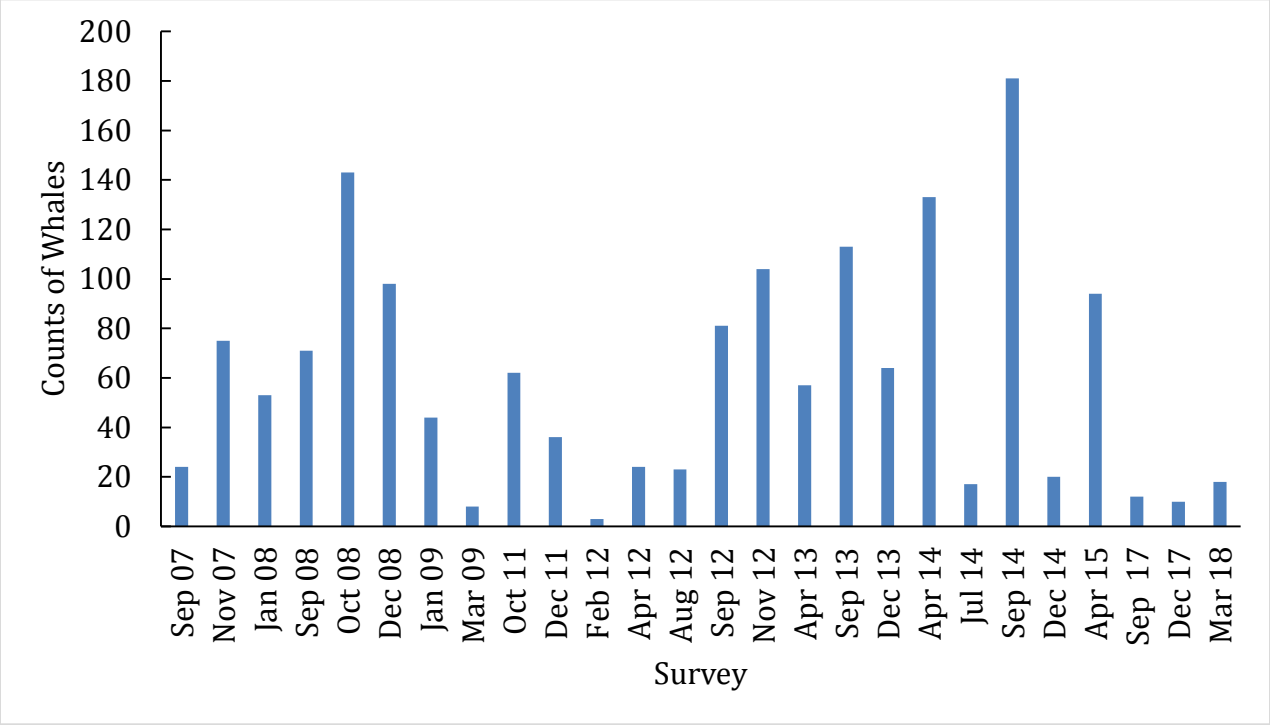

Figure 12. Counts of humpback whales in Prince William Sound provide an index of whale abundance, recent declines in whale numbers correspond to declines in herring biomass.

Fall and winter habitat use and distribution of seabirds in Prince William Sound – Mary Anne Bishop (PWSSC) – Project 19120114-E

The fall-winter marine bird surveys in PWS will continue to build upon an 11-year time series (2007-2018) of marine bird abundance and habitat associations. Marine bird surveys occur onboard research vessels conducting oceanographic, fisheries, or marine mammal surveys, thereby increasing opportunities for cross-project collaboration and reducing project costs. Our September marine bird surveys are integrated with GWA forage fish assessments of prey availability and humpback whale prey consumption and population monitoring with all three projects sharing logistics, timing, and location of sampling. These integrated surveys allow us to estimate forage biomass at the same locations in which marine birds and humpback whales are feeding, thereby providing comparable information on both predator density and prey availability. We use established protocols employed by all other GWA marine bird survey efforts (Kachemak Bay/Cook Inlet, Seward Line/GOA, PWS summer).

Of the marine birds that overwinter in PWS, nine species were initially injured by EVOS, including three species that have not yet recovered or their recovery status is unknown (pigeon guillemot, marbled murrelet, and Kittlitz's murrelet). Fall through winter are critical periods for survival as food tends to be relatively scarce or inaccessible, the climate more extreme, light levels and day length reduced, and water temperatures colder. By monitoring marine birds during fall and winter we will improve our predictive models of species abundance and

distribution across PWS in relation to biological and physical environmental factors. Our long-term monitoring has shown that the nonbreeding season cannot be characterized as a single time period when describing marine bird distribution and suggests that multiple surveys are required to quantify wintering populations and understand changes in marine bird distribution. We have also recently examined the use of ecosystem indicators to understand the influence of environmental variability on marine bird populations in PWS. Our previous modeling efforts found that murres and murrelets demonstrate relatively consistent temporal patterns in PWS within winter; murres tend to be present in low densities during fall and high densities during spring, whereas murrelets tend to occur in low densities in early fall increasing to higher densities in late fall, and then occur in low densities during spring. Both murre and murrelet densities appear to be highly variable within months and across winters (Figs. 13 and 14).

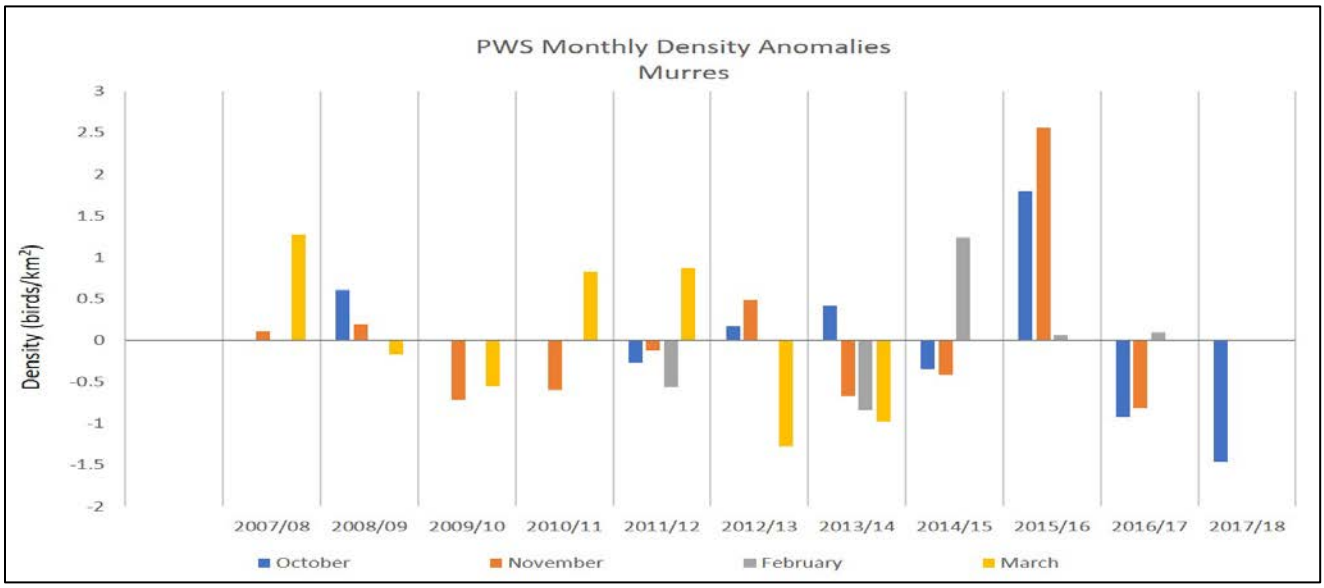

Figure 13. Monthly density anomalies for murres during fall and winter marine bird surveys in Prince William Sound, Alaska, 2007-2017.

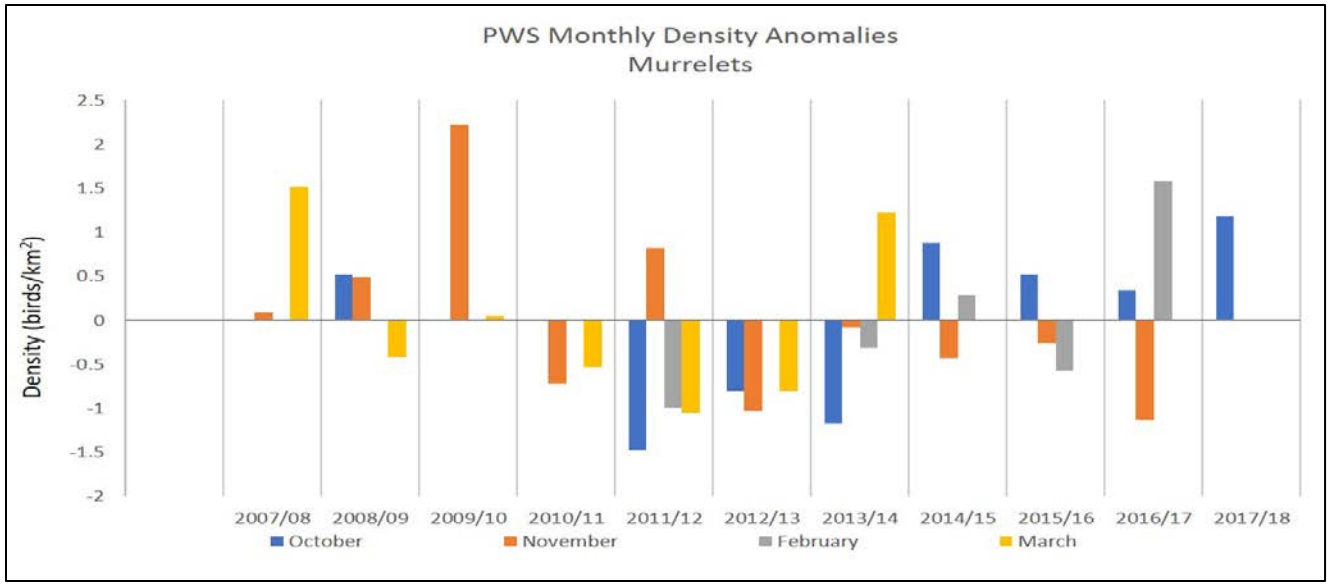

Figure 14. Monthly density anomalies for murres and murrelets during fall and winter marine bird surveys in Prince William Sound, Alaska, 2007-2017.

Nearshore Monitoring Component

Nearshore systems in the Gulf of Alaska – Heather Coletti, Daniel Esler, Kim Kloecker, Dan Monson, Ben Weitzman, Brenda Konar, and Katrin Iken, National Park Service (NPS), USGS Alaska Science Center, and UAF – Project 19120114-H

Nearshore monitoring in the GOA provides ongoing evaluation of the status and trend of more than 200 species, including many of those injured by EVOS. The monitoring design includes spatial, temporal and ecological features that support inference regarding drivers of change. Application of this monitoring design to date includes assessment of change in sea otter populations in relation to EVOS recovery and density dependent factors, as well as the assessment of the relative roles of static versus dynamic environmental drivers in structuring benthic communities. Continued monitoring will lead to a better understanding of variation in the nearshore ecosystem across the GOA and a more thorough evaluation of the status of spill-injured resources. This information will be critical for anticipating and responding to ongoing and future perturbations in the region, as well as providing for global contrasts. In FY19, we propose to continue sampling in Kachemak Bay (KBAY), Katmai National Park and Preserve (KATM), Kenai Fjords National Park (KEFJ), and Western Prince William Sound (WPWS) following previously established methods. Monitoring metrics include marine invertebrates, macroalgae, birds, mammals, and physical parameters such as temperature. In addition to taxon-specific metrics, monitoring includes recognized important ecological relations such as predator-prey dynamics, measures of nearshore ecosystem productivity, and contamination. In FY18, sea star observations continue to include some recruitment and recovery in WPWS and KEFJ but not in KBAY or KATM. Recent survey results from Kachemak Bay indicate the sea otter population has increased rapidly, achieving high densities, with ramifications to the nearshore food web (Fig. 15).

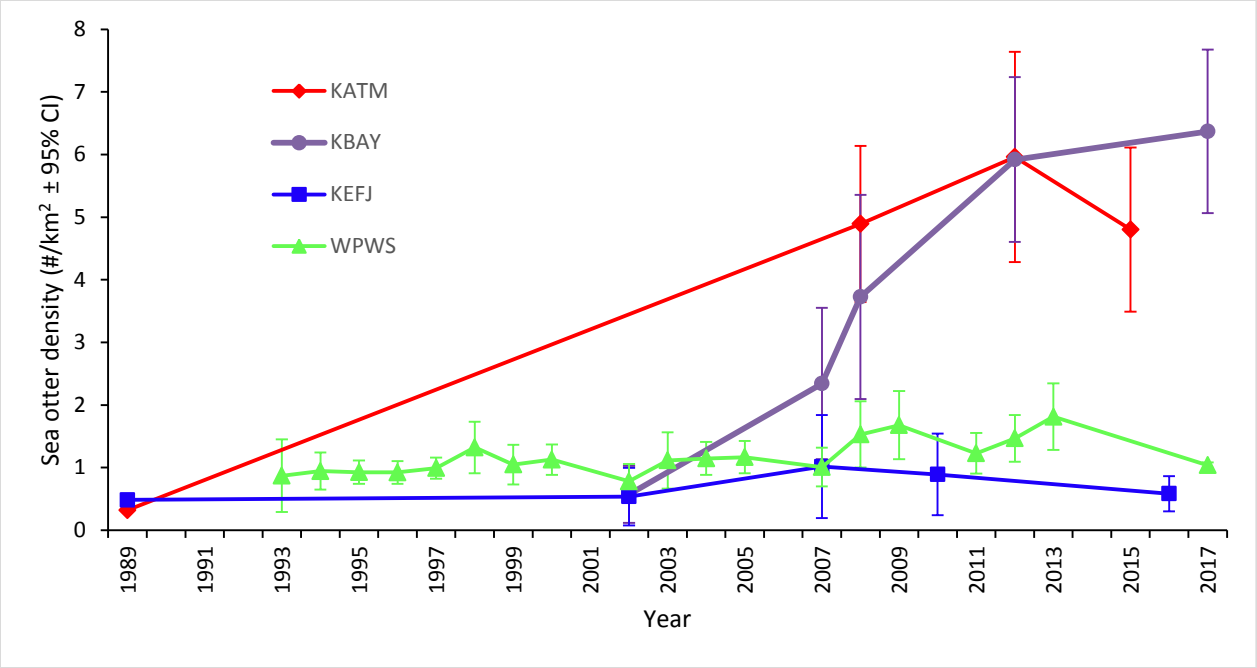

Figure 15. Sea otter densities in Katmai National Park and Preserve (KATM), Kachemak Bay (KBAY), Kenai Fjords National Park (KEFJ) and western Prince William Sound (WPWS). Error bars indicate 95% CI.

2. PROGRAM STATUS OF SCHEDULED ACCOMPLISHMENTS

A. Program Milestones and Tasks

Program milestone and task progress by fiscal year and quarter, beginning February 1, 2017.
C = completed, X = not completed or planned. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31.

	FY17				FY18				FY19				FY20				FY21			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Field sampling																				
Environmental drivers	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X
Pelagic	C		C	C	C		X	X	X		X	X	X		X	X	X		X	X
Nearshore	C	C			C	C			X	X			X	X			X	X		
Data																				
Data to workspace				C				X				X				X				X
Prior year data to public					C				X				X				X			
Meetings																				
PI meetings	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trustee Council/PAC			C				X				X				X				X	
AMSS				C				X				X				X				X
Community engagement			C			C					X				X				X	
Year 3 joint workshop													X							
Reporting																				
Annual reports					C				X				X				X			
FY work plan (DPD)			C				C				X				X					
Year 3 synthesis report												X								
FY12-21 final report																				X

B. Explanation for not completing any planned milestones and tasks

We have completed all planned milestones and tasks on schedule.

C. Justification for new milestones and tasks

While there are no changes to program level milestones, one project (19120114-C) added several new milestones/tasks pending new funding request and two projects (19120114-E&O) are at risk of not completing a couple current milestones/tasks if new funding requests are not granted. See section 4B, 5, and 6B and individual project work plans for details.

3. COORDINATION AND COLLABORATION

A. Within an EVOTC-Funded Program

Please see individual project work plans for coordination and collaborations being carried out at the PI level.

COORDINATION AND COLLABORATION WITHIN GWA

The following outlines how the GWA leadership personnel continue to achieve coordination and collaboration activities within the GWA program (see also organizational chart, Fig. 13):

Program Lead - oversees coordination of individual program components, science synthesis and integration, and ensuring a coordinated monitoring program that meets project milestones and deliverables. These duties include:

- Oversight of project synthesis efforts and coordinate preparation of scientific reports/papers for the EVOSTC and the public
- Coordinating efforts of the GWA program with the data management program, the HRM program, Lingering Oil program, external programs, and resource agencies.
- Working with Outreach Coordinator and PIs to support outreach efforts

Science Coordinator - provides program technical writing, review, and science coordination, including:

- Author and lead production of program synthesis products and promote integration of GWA projects
- Lead development of ecosystem indicators from GWA datasets
- Review and collation of reports and work plans
- Integrate GWA data and platforms with external programs such as HRM, NOAA's GOA Survey, University of Alaska Fairbanks and National Science Foundation's Northern Gulf of Alaska Long-term Ecological Research site.
- Editorial review, website development/updates, and assistance with coordination of outreach events for each project
- Attendance and presentation of program information at scientific meetings and public events.

Program Coordinator - facilitates meetings, reporting, outreach, sharing, and publication of information from the various monitoring projects, including:

- Planning and documenting all quarterly teleconferences and meetings
- Tracking and assisting with data and metadata publication in the GWA Data Portal
- Tracking progress towards deadlines and program products
- Assisting with maintenance and updates for program website for purposes of conveying important program goals and information to the group
- Participate on Outreach Steering Committee and assist with outreach events

Administrative Lead - works closely with all other members of the PMT on a regular basis to ensure within-program coordination and collaboration, including:

- Providing logistics for teleconferences and in-person meetings
- Acting as the fiscal agent for non-Trustee agencies and organizations

- Coordinating outreach activities and the Outreach Steering Committee; overseeing the Outreach Coordinator
- Facilitating and funding participation by the SRP
- Completes audit to demonstrate compliance with federal grants management standards
- Ensuring collaboration, where appropriate, with HRM and Data Management

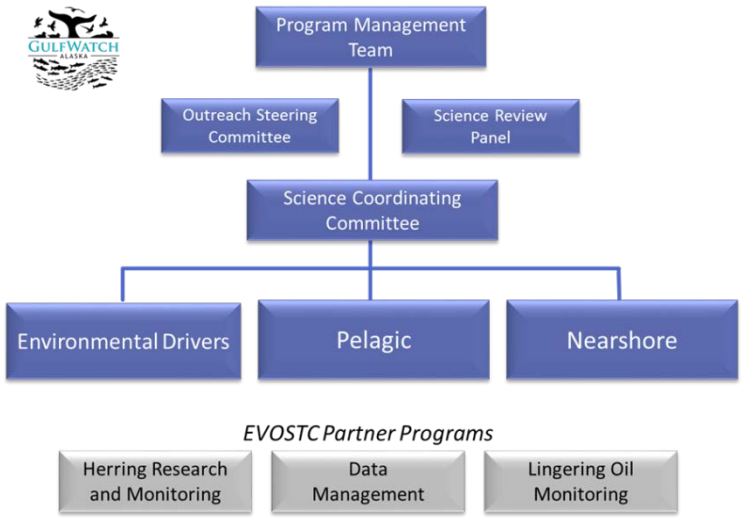

Figure 13. Organizational chart for GWA program and other EVOSTC programs. The Program Management Team consists of Program Lead, Administration and Outreach Lead, Science Coordinator, and Program Coordinator who are responsible for coordination and collaborations across EVOSTC programs and with outside agencies and non-governmental organizations. The Science Coordinating Committee consists of the Science Coordinator and the three Component Leads.

Coordination and Collaboration Between Programs

With Herring Research and Monitoring Program

The following outlines how the GWA leadership personnel will achieve coordination and collaboration activities between the GWA and HRM programs:

- Data from GWA projects are provided to the HRM program for their use and analysis.
- The GWA team regularly engages the HRM program lead, Scott Pegau by phone, email, and in person.
- The HRM program lead is included on all GWA PI general correspondence. Likewise, the GWA PMT is included in all HRM general correspondence.
- The HRM program lead is invited to all PI teleconferences and meetings and given an opportunity to hear GWA PI updates and provide HRM updates to PIs.
- The GWA and HRM programs will collaborate on the 3-year synthesis workshop and report.

With Data Management Program

The GWA and Data Management programs are fully integrated and dependent on each other. The Program Lead and Science and Program Coordinators will work closely with the Alaska Ocean Observing System and Axiom data management staff to maintain data access tools, providing data and feedback in the Gulf of Alaska Data Portal, and metadata generation tools. The Science and Program Coordinators will continue to work with all

project PIs within the program to ensure new data are loaded to the Gulf of Alaska Data Portal, have undergone QA/QC measures, and have appropriate metadata available for public access. In addition, PWSSC acts as the fiscal agent between AOOS and NOAA for the Data Management grant.

With Lingering Oil

Based on our leadership role with the GWA program, we maintain a strong connection to Lingering Oil issues. We anticipate collaborations in the future.

B. With Other EVOSTC-funded Projects

The GWA program does not have specific goals or objectives to support EVOSTC-funded projects that are not part of a program. However, data, reports, and publications from GWA projects are available and the Science and Program Coordinators are available to work with EVOSTC-funded projects where appropriate and applicable.

C. With Trustee or Management Agencies

The GWA program integrates ecosystem monitoring activities with NOAA, USFWS, USGS, Bureau of Ocean Energy Management (BOEM), and NPS. We also coordinate with Alaska Department of Fish and Game researchers and managers through coordination on synthesis activities with the HRM program.

At the February 2018 Ocean Sciences conference in Portland, Oregon, GWA PMT members co-convened and PIs participated in a GOA workshop hosted by the North Pacific Research Board (NPRB) and NOAA leads for the GOA Integrated Ecosystem Research Program. The workshop was titled "To unpathed waters, undreamed shores: Current and future marine research in the Gulf of Alaska". The workshop report will be shared with resource managers and will help drive future studies. GWA is also continuing to work with NOAA to develop and include GWA time series as indicators in ecosystem assessments and reports to the North Pacific Fisheries Management Council.

PMT members attended two NOAA workshops at the Alaska Fisheries Science Center: 1) Integrated Ecosystem Assessment and 2) Recruitment Processes Alliance to inform attendees of GWA sampling efforts, datasets and invite collaborations. GWA's annual sampling greatly complements NOAA's biennial sampling effort in contributing to ecosystem-based fisheries management efforts in the GOA.

GWA PIs coordinate reporting and sampling of marine mammal carcasses for NOAA Alaska Region Protected Resources Division (Kate Savage and Sadie Wright). GWA PMT members held a teleconference with the Coastal Observation and Seabird Survey Team (COASST), led by Julia Parrish of the University of Washington, to discuss ways that GWA data could support studies of marine bird mortality events. The GWA PMT will present COASST's recently developed die-off alert training to GWA PIs at the fall meeting.

4. PROGRAM DESIGN

A. Overall Program Objectives

At the program-level, GWA has the following annual objectives:

1. Sustain and build upon existing time series in the EVOS-affected regions of GOA.
2. Provide scientific data, data products, and outreach to management agencies and a wide variety of users.

3. Develop science synthesis products to assist management actions, inform the public, and guide monitoring priorities for the next 15 years.
4. Enhance connections between GWA and HRM programs.
5. Leverage partnerships with outside agencies and groups to integrate data from broader efforts.

B. Changes to Program Design

During FY18 we conducted an assessment of gaps in our current sampling efforts that could be filled with relatively small amounts of new funding (hereafter "unfunded needs"). **There are three main reasons why these unfunded needs have arisen**: 1) Agency leveraged funds supporting GWA FY17-21 deliverables are no longer available and if additional funds are not obtained from EVOSTC, then the deliverables cannot be met. These are primarily vessel charter funds; 2) a project conducted in collaboration with HRM during FY12-16 was not funded by EVOSTC during FY17-21 because of a funding cap on GWA and desire to focus on fall integrated predator-prey sampling; and 3) additional data collection opportunities arose that complement ongoing GWA long-term monitoring. Overall, we want this effort to demonstrate that we are continually evaluating the GWA scientific program and are determined to improve where needed and fill knowledge gaps that exist. **Our goal is to maintain a monitoring and research program that is adaptive to EVOSTC and agency needs, environmental variability, and sound scientific inquiry base on GWA PI needs.**

To prevent numerous requests to the EVOSTC from all GWA, we established an equitable, four-step nomination and selection process: 1) The PMT requested unfunded project need proposals from GWA PIs. Proposals were a ~500 word description of the project and why it was needed (see Appendix 1). 2) The PMT compiled the list and sent a survey out to GWA PIs to rank each of the projects from highest to lowest priority (based on scientific merit and contribution to GWA). 3) We used standardized ranking so that each component (PMT [including Scott Pegau from HRM], GWA SRP, Environmental Drivers, Pelagic, and Nearshore) was equally represented. 4) We included the top three (out of 7 total) in the FY19 work plans.

Even though initial rankings were based on scientific contribution to GWA, we also considered three funding priorities: A=GWA FY17-21 deliverable that lost funding, B=GWA FY12-16 deliverable that was not funded in FY17-21, C=Not currently a GWA deliverable (see Appendix A for descriptions of each and resulting ranks by component and GWA overall). The requests were ranked in the following order:

1. June PWS forage fish surveys (19120114-C)
2. Humpback whale winter survey vessel charters (19120114-O)
3. Marine bird winter survey vessel charters in PWS (19120114-E)
4. Kittiwake diets, population, and productivity in PWS (new)
5. Dedicated programmer/modeler (new)
6. Seabird observers on expanded Seward Line surveys in conjunction with northern GOA NSF LTER (19120114-L)
7. Nearshore Component and USFWS winter bird surveys in western PWS (19120114-H)

Our top funding request stemmed from an opportunity to leverage new external FY19-21 funds supporting HRM June aerial juvenile forage fish surveys to resume a HRM-GWA summer forage fish sampling effort and the need for two GWA projects to replace agency in-kind vessel charter funds that will no longer be available in FY19-21. Work plans for the top three projects above, plus the PM I /PM II work plan for a postdoc to contribute to science synthesis, include requests and justifications for the proposed funding increases. The remaining four requests will be placed on hold in hopes of identifying future potential funding sources.

5. PROGRAM PERSONNEL – CHANGES AND UPDATES

The PMT would like to add a postdoc to GWA who will work with the Science Coordinator and project PIs to help produce GWA synthesis products (see manuscripts outlined in section 1 FY19 Goals). A doctoral student, Ben Weitzman, is currently working on and partially funded (0.40 FTE) by GWA. In addition to working on his dissertation, Ben has begun contributing to GWA synthesis efforts and time series indicators. Postdoctoral tasks will be to integrate datasets (EVOSTC and external if appropriate), conduct analyses, and co-authoring synthesis products (see the 19120114-A work plan for more detail).

You will also notice a no-increase budget shift from the PM I to the PM II budget that is associated with a change in employer of our Program Coordinator, Donna Aderhold. The contracting firm through which her NOAA contract was secured changed, and with the change, costs increased significantly. In lieu of approaching the EVOSTC for additional support, the Prince William Sound Science Center will become the employer of the Program Coordinator at no additional cost.

6. PROGRAM BUDGET

A. Budget Forms (Attached)

Please see completed program workbook for program summaries and for each project's five-year budget. No costs are associated with international travel or outreach events unrelated to the program. The following table provides an overall program budget summarized by category rather than project.

Table 2. Proposed GWA program budget summary by category across all projects for FY 2017-2021. Numbers are presented in thousands and reflect requested project-level increases for FY19-21.

Budget Category	FY 17	FY 18	FY 19	FY 20	FY 21	Total
Personnel	1,105.2	1,212.9	1,301.2	1,408.9	1,352.1	6,380.3
Travel	100.7	111.2	92.8	105.4	94.6	504.5
Contractual	610.7	696.8	651.8	646.1	602.1	3,207.5
Commodities	115.9	154.8	133.2	167.5	136.9	708.3
Equipment	56.6	83.9	49.1	38.2	32.4	260.2
Indirect Costs	101.5	102.6	102.3	103.0	104.4	513.8
Subtotal	**2,090.6**	**2,362.3**	**2,330.3**	**2,469.1**	**2,322.4**	**11,574.6**
General Admin. (9% of Subtotal)	188.1	212.6	209.7	222.2	209.0	1,041.7
Program Total	**2,278.8**	**2,574.9**	**2,540.1**	**2,691.3**	**2,531.4**	**12,616.33**
In-kind Funds	3,168.7	3,223.9	3,044.1	3,117.3	3,046.8	15,600.8

B. Changes from Original Proposal

Table 3 summarizes the GWA request for new funds for FY19-21.

Table 3. New funds requested for FY19-21 for the Gulf Watch Alaska program.

Budget Category	New Request FY19	New Request FY20	New Request FY21	Total New Request
Personnel	$81.2	$81.2	$81.2	$243.6
Travel	$3.0	$3.0	$3.0	$9.0
Contractual	$57.0	$57.0	$57.0	$171.0
Commodities	$32.0	$32.0	$32.0	$96.0
Equipment	$0.0	$0.0	$0.0	$0.0
Annual Subtotal	**$173.2**	**$173.2**	**$173.2**	**$519.6**
9% GA	$15.6	$15.59	$15.59	$46.8
Total with GA	$188.8	$188.8	$188.8	$566.4

New Funding Requests by Budget Category:

Personnel: We are requesting $81.2K per year to support a postdoc for PM I ($57.2K per year, 19120114-A) and field crew for summer forage fish surveys ($24K per year, 19120114-C).

Travel: We are requesting $3K per year of travel for summer forage fish sampling crews (19120114-C).

Contractual: We are requesting $57K per year for summer forage fish and zooplankton sample processing ($6K, 19120114-C) and vessel charter fees to replace lost in-kind agency funds for humpback whale ($27K, 19120114-O) and marine bird survey cruises ($24K, 19120114-E).

Commodities: We are requesting $32K per year to support operation of the USGS research vessel for summer forage fish surveys (19120114-C).

New Funding Requests by Project:

PM I (19120114-A): We are seeking additional $57.2K per year for FY19-21 to partially support a postdoctoral position (0.6 FTE) for the GWA program.

Forage Fish (19120114-C): We are requesting an additional $65K per year for FY19-21 to conduct summer forage fish surveys, including vessel support to validate HRM aerial shoreline forage fish surveys, and acoustic-trawl surveys.

Wintering Marine Birds (19120114-E): In order to continue fulfilling project objectives, an additional $24K in supplemental funds are requested annually for FY19-21. Supplemental funds would cover the cost of 12 days of dedicated vessel charter fees for marine bird surveys in November.

Humpback Whales (19120114-O): NOAA funds for winter and spring surveys in PWS are no longer available for FY19-21. We are therefore requesting funds for one additional survey in early spring (March, 6 days) for $27K/year for the next three years.

Funding Transfer Request Between Projects:

Budget for Program Coordinator: We are proposing a shift of salary from PM I to PMII to accommodate the change in employer for the Program Coordinator in FY19-21. This would result in a reduction of $231,000 in the PM I budget and an increase of $231,000 in the PM II budget split among FY19, FY20, and FY21. We propose a seamless transition and will apply this no-cost shift of funds in the remaining fiscal years of the program.

C. Sources of Additional Funding

Because of the diversity of agencies and organizations represented by the GWA program, we are able to leverage over $15.6 million in cost-share, in-kind, direct funds, and other support funding.

A significant highlight of acquiring additional funding has been within the Environmental Drivers Component for projects GAK 1 (18120114-I) and the Seward Line (18120114-L). The new National Science Foundation (NSF)-funded GOA Long-term Ecological Research (LTER) program ($1,127K/year, plus ship-time) that began sampling in 2018 leverages, complements and enhances GWA program activities. The LTER program will provide many years of additional significant research activities that will naturally blend and add value to the GWA program

See the consolidated budget matrix at the beginning of each project Work Plan for more detail about additional funds (also see project budget workbook forms).

7. FY18 PUBLICATIONS AND PRODUCTS

Reports and Publications

Arimitsu, M. L., J. F. Piatt, B. Heflin, V. von Biela, S. K. Schoen. 2018. Monitoring long-term changes in forage fish distribution, abundance and body condition in Prince William Sound. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-O), Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

Arimitsu, M., J. F. Piatt, and S. Hatch. 2018. Monitoring long-term changes in forage fish distribution, abundance, and body conditions in PWS. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-C.

Batten, S. D., and R. Brown. 2018. Long-term monitoring of plankton populations on the Alaskan shelf and in the Gulf of Alaska using Continuous Plankton Recorders. Long-Term Monitoring Program (Gulf Watch Alaska) Final Report, (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-A), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Batten, S. D., and R. Brown. 2018. Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-D.

Bowen, L., K. Counihan, B. Ballachey, H. Coletti, T. Hollmen, and B. Pister. *In Prep*. Physiological and gene expression in razor clams (*Siliqua patula*). ICES Journal of Marine Science.

Campbell, R. W. 2018. Long term monitoring of oceanographic conditions in Prince William Sound. *Exxon Valdez* Oil Spill Trustee Council Project Final Report (Project 16120114-E), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Campbell, R. W. 2018. Long term monitoring of oceanographic trends in Prince William Sound. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-G.

Coletti, H., D. Esler, B. Konar, K. Iken, K. Kloecker, D. Monson, B. Weitzman, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, B. Robinson, and M. Lindeberg. 2018. Gulf Watch Alaska: Nearshore Ecosystems in the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 17120114-H), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Coletti, H., D. Esler, B. Konar, K. Iken, K. Kloecker, D. Monson, B. Weitzman, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, B. Robinson, and M. Lindeberg. 2018. Nearshore ecosystems of the Gulf of Alaska. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-H.

Coletti, H. A., and T. L. Wilson. 2018. Nearshore marine bird surveys: Data synthesis, analysis and recommendations for sampling frequency and intensity to detect population trends. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 12120114-F). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Counihan, K., L. Bowen, B. Ballachey, H. Coletti, T. Hollmen, and B. Pister. *In Prep*. Physiological and gene transcription assays in combinations: a new paradigm for marine intertidal assessment. ICES Journal of Marine Science.

Danielson, S. L., and T. J. Weingartner. 2018. Long-term monitoring of oceanographic conditions in the Alaska Coastal Current from hydrographic station GAK1. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-I.

Davis, R., J. L. Bodkin, H. A. Coletti, D. H. Monson, S. E. Larson, L. P. Carswell, and L. M. Nichol. *In Review*. Future direction in sea otter research and management. Frontiers in Marine Science – Marine Megafauna.

Doroff, A., and K. Holderied. 2018. Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay to understand recovery and restoration of injured near-shore species. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-G), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Hoffman, K. C., and M. E. McCammon. 2018. Long-term monitoring: program coordination and logistics and outreach. Long-term Monitoring Program (Gulf Watch Alaska) Final Report, (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-B), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Holderied, K., and D. Aderhold. 2018. Science coordination and synthesis for the long-term monitoring program. Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-H), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Holderied, K., and J. Shepherd. 2018. Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay to understand recovery and restoration of injured near-shore species. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-J.

Hopcroft, R. R., S. L. Danielson, and K. Coyle. 2018. The Seward Line – Marine Ecosystem monitoring in the Northern Gulf of Alaska. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-L.

Hopcroft, R. R., S. L. Danielson, S. L. Strom, and K. Kuletz. 2018. The Seward Line: Marine ecosystem monitoring in the Northern Gulf of Alaska. *Exxon Valdez* Oil Spill Long-Term Monitoring

Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-J). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Kaler, R., E. Labunski, and K. J. Kuletz. 2018. Prince William Sound marine bird surveys. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-K), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Kuletz, K., and R. Kaler. 2018. Continuing the legacy: Prince William Sound marine bird population trends. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-M.

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Published and updated datasets

Published data: four DataONE published datasets updated in August 2018 as part of the FY12-16 program: Continuous Plankton Recorder plankton data, Lower Cook Inlet/Kachemak Bay Oceanography National Estuarine Research Reserve System-wide Monitoring and zooplankton data, and Prince William Sound Oceanography zooplankton data.

Updated data: data collected in 2017 (except plankton data) have been uploaded to the Research Workspace and are undergoing QA/QC for publication to the Gulf of Alaska Data Portal. All projects are on or ahead of schedule.

Presentations

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Outreach

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Arimitsu, M.L. 2018. Monitoring forage fish in Alaska: Detecting change in non-commercial prey populations. Department of Fisheries and Oceans Canada forage fish workshop. Pacific Biological Station, Nanaimo, BC, Mar.

Buckelew, S. 2018. Gulf Watch Alaska website updates.

Campbell, R., J. Jaffe, and P. Roberts. 2018. Photographing plankton. Delta Sound Connections. Prince William Sound Science Center. http://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf

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Trotter, M. H. 2018. The Seward Line's May 2018 cruise hosted a media group lead by Michele Hoffman Trotter (Columbia College) that has prepared various video clips chronicling our research. She provided for outreach to K-12 teachers and students and to adult audiences in the Chicago area where she is based. Her K-12 audience also included homeschool students in California. Michele's outreach team included Carlee Belt, a media and education specialist, and Katherine Brennan, a cinematographer. The team provided 15 daily dispatches from the ship that included videos of ship operations and interviews with scientists and the crew deploying

sampling equipment. They also collected footage for the on-going Microcosm film project that will feature the diversity and roles of microscopic life in the ocean.

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ONLINE RESOURCES

Gulf Watch Alaska – http://www.gulfwatchalaska.org/

AOOS Gulf Watch Alaska Data Portal – http://portal.aoos.org/gulf-of-alaska.php

DataONE published datasets. Gulf Watch Alaska Research Workspace. Doi: 10.24431/rw1k113.

Appendix A: The following is the survey sent to GWA PIs for ranking seven internal requests for additional funding, including initial guidelines in making selections, description of how rankings will be standardized, an ~500 word description of each funding request, and a summary table (Table A1) showing number of respondents by component and overall standardized rankings.

We are working internally to rank unfunded project needs that the team members have identified during the past year. Each of these needs is associated with one or multiple existing GWA program projects.

Please review each of the brief justifications below and then fill out the survey based on the order in which you believe the projects should be funded based on the scientific needs of the program (the current numbering is arbitrary and does not reflect any inherent ranking). The program management team will compile the rankings by component (nearshore, environmental drivers, pelagic, science review panel, and program management team - n=5 [1 each] in the final sample).

We will share the rankings with the group before making final decisions on how to move forward during the work plan process.

Even though your rankings will be based on scientific contribution to GWA, ultimately will consider the following 3 funding priorities: A=GWA FY17-21 deliverable that lost funding, B=GWA FY12-16 deliverable that was not funded in FY17-21, C=Not currently a GWA deliverable.

1. Marine bird winter survey vessel charters in PWS (A) [Pelagic Component]

As part of the fall/winter marine bird surveys on ships of opportunity in PWS, an observer was onboard the HRM's juvenile herring surveys (Nov 2007-2016 and March 2008-2012) but this project was discontinued in FY17. This survey represented the longest time series of PWS winter data and survey coverage within bays of PWS, which allows for identifying changes in the nonbreeding season marine bird community. Our research has shown that compared to the open waters, marine birds are more likely to be present and in larger aggregations in the protected bays in PWS during winter. We are proposing to add a dedicated marine bird survey in Nov. and March each year to extend our long-term dataset of marine bird abundance and distribution within bays of PWS.

2. Seabird observers on expanded Seward Line surveys in conjunction with NGOA LTER (C) [Pelagic and Env Drivers Components]

The USFWS conducted seabird surveys as part of the Seward Line project twice a year (2006-2017). Starting in 2018 the Seward Line will expand via a NSF LTER grant to Dr. Hopcroft; he is funding extended seabird surveys in 2018, but there are no funds to continue these seabird surveys in the future. We propose seabird surveys be conducted with the annual NGOA LTER project (April, July, September). This will provide data on the seasonal and interannual variability of seabird distribution in the NGOA along strong cross-shelf and alongshore environmental gradients, and will integrate with and inform other GWA components.

3. Humpback whale winter survey vessel charters (C) [Humpback Whale project - Pelagic Component]

We have been using NOAA funds for vessel charter for 2 PWS whale survey cruises in December and March. The NOAA funds will no longer be available after FY18. We are requesting vessel charter funds to support one of the lost cruises for FY19-21. We would drop the December cruise, but maintain the March cruise. The March cruise allows better weather conditions and is a good assessment of spring conditions, whale abundance and predator-directed location of large herring schools. Surveys from winter 2017/18 indicate that whale abundance is still very low in PWS.

4. June PWS forage fish surveys (B) [Pelagic Component, 19120114-C]

The June aerial shoreline survey and acoustic-trawl surveys for forage fish in PWS were part of HRM and GWA during FY12-16 and were discontinued in FY17-21. In FY17 Scott Pegau used other funds to fly the surveys (without vessel-based school validation) to continue the time series (1995-1999, 2010, 2012-2017). At a minimum, we are seeking funding support to continue June aerial surveys in order to provide indices of annual juvenile herring and forage fish school relative abundance. Ideally, this effort would also include aerial-directed fish school sampling, species/age class verification, and forage fish collection for condition indices, all tasks that were conducted along with the acoustic-trawl forage fish survey in the first five years. Providing funding support for logistics of Sound-wide vessel-based validation would also provide a platform for acoustic-trawl surveys, which were discontinued in FY17-21 to prioritize Middleton seabird diet sampling. Resuming aerial and acoustic surveys of forage fish would provide valuable information on juvenile herring, sand lance, and other forage fish school abundance indices in PWS, and acoustic indices of herring, capelin, juvenile pollock, krill, and jellyfish. Additionally, the continuation of this coordinated HRM-GWA effort will facilitate linkages to other program objectives by providing quantitative indices of 1) juvenile and adult herring for age-structured stock assessments, 2) prey resources influencing marine bird trends during the breeding season, 3) prey resources potentially affecting humpback whale distribution and abundance, 4) PWS forage fish communities to identify context for comparisons with Middleton Island's longest running forage fish time series in the Gulf of Alaska, 5) PWS capelin and sand lance condition and recovery following the 2014-16 marine heat wave. (note: the HRM aerial surveys for FY19-21 were subsequently funded externally by the PWS Regional Citizens' Advisory Council, thereby reducing the overall proposed cost to the EVOSTC for this effort)

5. Dedicated programmer/modeler (C) [Env Drivers Component]

The GWA Science Review Panel suggested that we begin including modeling efforts in GWA. After further discussions with several GWA PIs and other GWA investigators, we concluded that what might be most relevant for the current funding cycle is to begin designing what a GWA modeling effort for FY22-32 might involve and to begin updating one of the existing physical models that subsequent higher trophic level modeling would build upon. With this approach, if new funding were received for the last year or two of the current funding cycle, it would be part of the Environmental Drivers component of GWA. More details will require further vetting with all GWA investigators. Any GWA ecosystem models would highly leverage other ongoing modeling efforts for the GOA.

6. Kittiwake diets, population, and productivity in PWS (C) [Pelagic Component]]

Kittiwake diets, populations, and productivity have been monitored in PWS for decades. 2018 is the last funded year for the surveys. Diets have not been sampled for several years. These data provide valuable information on the status of the most abundant colonial seabird in PWS and help determine "good years and bad years", including the widespread breeding failure in 2016. We propose to monitor diets, populations, and productivity, of kittiwakes in PWS to continue to integrate with and help inform other GWA components. The diet portion will complement the Middleton Island diet sampling by including birds nesting in PWS.

7. Nearshore Component and USFWS winter bird surveys in western PWS (C) [Nearshore Component]

The NPS, as part of Nearshore/GWA, has supported winter surveys in two of four regions, Katmai (2009,2012, 2016, and 2018) and Kenai Fjords NP (2008, 2010, 2013, and 2017). We propose to add a third region, WPWS, where historical FWS winter surveys were conducted during 10 years, 1989-2005. We would survey a subset of the FWS nearshore transects, plus additional selected areas. These will provide insight into changes in distribution and abundance of over-wintering sea ducks and seabirds that depend on coastal resources. Data will be comparable to surveys conducted in two of the nearshore component regions. We would add a charter vessel to support USGS, NPS and FWS personnel to conduct March surveys in WPWS.

Table A1. Standardized rankings of new funding requests by GWA component. First series of columns are counts of the number of PIs that ranked that project 1st-7th. The second series are those counts multiplied by points – 7 points for 1st down to 1 point for 7th. The final sum of ranks for each Component is standardized by the number of PIs that voted within that component. The overall ranking (bottom) was used for final selection.

Project	1st	2nd	3rd	4th	5th	6th	7th		1st	2nd	3rd	4th	5th	6th	7th	Sum of Ranks (Standardized - divided by n)
Environmental Drivers (n=3)																
Dedicated programmer/modeler	1					1	1		7	0	0	0	0	2	1	**3.33**
Humpback whale winter survey vessel charters		1	1	1					0	6	5	4	0	0	0	**5.00**
June PWS forage fish surveys	1		1			1			7	0	5	0	0	2	0	**4.67**
Kittiwake diets, population, and productivity in PWS		1			1		1		0	6	0	0	3	0	1	**3.33**
Marine bird winter survey vessel charters in PWS			1	1		1			0	0	5	4	0	2	0	**3.67**
Nearshore Component and USFWS winter bird surveys in western PWS		1			1		1		0	6	0	0	3	0	1	**3.33**
Seabird observers on expanded Seward Line surveys in conjunction with NGOA LTER	1			1	1				7	0	0	4	3	0	0	**4.67**
Nearshore (n=7)																
Dedicated programmer/modeler	2		1	3			1		14	0	5	12	0	0	1	**4.57**
Humpback whale winter survey vessel charters		1	2	1	1	1	1		0	6	10	4	3	2	1	**3.71**
June PWS forage fish surveys			1	1	2	2	1		0	0	5	4	6	4	1	**2.86**
Kittiwake diets, population, and productivity in PWS	1	2	2	1	1				7	12	10	4	3	0	0	**5.14**
Marine bird winter survey vessel charters in PWS	2		1	1		1	2		14	0	5	4	0	2	2	**3.86**
Nearshore Component and USFWS winter bird surveys in western PWS	1	3			1	2			7	18	0	0	3	4	0	**4.57**
Seabird observers on expanded Seward Line surveys in conjunction with NGOA LTER	1	1			2	1	2		7	6	0	0	6	2	2	**3.29**
Pelagic (n=7)																
Dedicated programmer/modeler					2	2	3		0	0	0	0	6	4	3	**1.86**
Humpback whale winter survey vessel charters	2	2		1	1	1			14	12	0	4	3	2	0	**5.00**
June PWS forage fish surveys	1	3	1	2					7	18	5	8	0	0	0	**5.43**
Kittiwake diets, population, and productivity in PWS	1	1	2	1		2			7	6	10	4	0	4	0	**4.43**
Marine bird winter survey vessel charters in PWS	2	1	1		1		2		14	6	5	0	3	0	2	**4.29**
Nearshore Component and USFWS winter bird surveys in western PWS	1			1	2	1	2		7	0	0	4	6	2	2	**3.00**
Seabird observers on expanded Seward Line surveys in conjunction with NGOA LTER			3	2	1	1			0	0	15	8	3	2	0	**4.00**
Program Management (n=5)																
Dedicated programmer/modeler				2	1	2			0	0	0	8	3	4	0	**3.00**
Humpback whale winter survey vessel charters		2	1	2					0	12	5	8	0	0	0	**5.00**
June PWS forage fish surveys	2	3							14	18	0	0	0	0	0	**6.40**
Kittiwake diets, population, and productivity in PWS					1	2	2		0	0	0	0	3	4	2	**1.80**
Marine bird winter survey vessel charters in PWS	3		2						21	0	10	0	0	0	0	**6.20**
Nearshore Component and USFWS winter bird surveys in western PWS				1	2		2		0	0	0	4	6	0	2	**2.40**
Seabird observers on expanded Seward Line surveys in conjunction with NGOA LTER			2		1	1	1		0	0	10	0	3	2	1	**3.20**
Science Review Panel (n=2)																
Dedicated programmer/modeler	1			1					7	0	0	4	0	0	0	**5.50**
Humpback whale winter survey vessel charters		1					1		0	6	0	0	0	0	1	**3.50**
June PWS forage fish surveys		1	1						0	6	5	0	0	0	0	**5.50**
Kittiwake diets, population, and productivity in PWS	1				1				7	0	0	0	3	0	0	**5.00**
Marine bird winter survey vessel charters in PWS						2			0	0	0	0	0	4	0	**2.00**
Nearshore Component and USFWS winter bird surveys in western PWS				1	1				0	0	0	4	3	0	0	**3.50**
Seabird observers on expanded Seward Line surveys in conjunction with NGOA LTER			1				1		0	0	5	0	0	0	1	**3.00**
Overall (n=5)	**ED**	**N**	**P**	**PM**	**SR**		**Sum**	**Rank**								
June PWS forage fish surveys	4.67	2.86	5.43	6.40	5.50		4.97	1								
Humpback whale winter survey vessel charters	5.00	3.71	5.00	5.00	3.50		4.44	2								
Marine bird winter survey vessel charters in PWS	3.67	3.86	4.29	6.20	2.00		4.00	3								
Kittiwake diets, population, and productivity in PWS	3.33	5.14	4.43	1.80	5.00		3.94	4								
Dedicated programmer/modeler	3.33	4.57	1.86	3.00	5.50		3.65	5								
Seabird observers on expanded Seward Line surveys in conjunction with NGOA LTER	4.67	3.29	4.00	3.20	3.00		3.63	6								
Nearshore Component and USFWS winter bird surveys in western PWS	3.33	4.57	3.00	2.40	3.50		3.36	7								