August 24, 2016

Elise Hsieh, Executive Director
Exxon Valdez Oil Spill Trustee Council
4210 University Drive
Anchorage, AK 99508-4626

Dear Elise:

Final FY 2017-2021 Proposal Submittal for Long-term Monitoring

17120114-J. Oceanographic Monitoring in Cook Inlet and Kachemak Bay

Gulf Watch Alaska, the long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC), has finalized our program and project proposals for fiscal years 2017-2021 funding based on comments received from EVOSTC's Science Panel on May 19, 2016. Below is the final budget summary and response to Science Panel comments for the Oceanographic Monitoring in Cook Inlet and Kachemak Bay project.

EVOSTC Funding Requested *(including 9% GA)*

FY17	FY18	FY19	FY20	FY21	TOTAL
$169,700	$174,400	$183,400	$135,700	$133,300	$796,500

Non-EVOSTC Funding Available

FY17	FY18	FY19	FY20	FY21	TOTAL
$205,000	$213,000	$215,000	$217,000	$194,000	$1,044,000

Science Panel comment: *The investigators propose to modify sampling conducted in 2012-2016 to profile oceanographic variables (water temperature, salinity, nutrients) and plankton from ship and shore in lower Cook Inlet and Kachemak Bay in response to the anomalously warm waters in 2014-2015*.

PI Response:

- Clarified that the purposes for modifying the study design are to 1) maintain core oceanographic and plankton time-series from FY12-16, 2) increase sampling frequency in Kachemak Bay and southeast Cook Inlet to better characterize estuary-shelf gradients in oceanographic and nutrient conditions for an area of high biological productivity, and 3) reduce the spatial coverage of shipboard sampling in northern and western Cook Inlet to limit overall project costs. Also clarified that spatial variability in marine conditions across Cook Inlet was characterized

throughout the FY12-16 sampling period, but only by leveraging additional non-EVOSTC funding sources.

- Revised text to clarify that both the continued time-series data collections and increased temporal sampling in a portion of the study area are intended to strengthen our monitoring of climate driven variability in general rather than for the recent Pacific warm water anomaly specifically; higher frequency sampling in areas where marine conditions support high biological productivity will improve the utility of these coastal time-series data for other proposed monitoring efforts in the GWA Nearshore Component, as well as for state and federal Trustee Agency pelagic species management in the area.

Science Panel comment: *The Panel does not feel that the proposed research is a priority, given the cost and the relative lack of connection to the larger program.*

PI Response:

- Clarified the connections between the lower Cook Inlet and Kachemak Bay oceanographic sampling to the other Environmental Drivers (ED) projects and the Nearshore project, as well as project support for pelagic species monitoring efforts of the GWA program (by hosting a seabird/marine mammal observer from the Pelagic component) and for Trustee Agency management efforts in the area outside of the long-term monitoring program
- Revised project methodology to reduce costs by sampling as much as possible with a smaller vessel and focusing sampling of the entire Cook Inlet entrance (which requires a larger charter vessel) on the spring phytoplankton bloom time period. Clarified that this sampling is coordinated with the spring sampling by the ED Seward Line and Continuous Plankton Recorder (CPR) projects.

Science Panel comment: *Answers to the proposed hypotheses are largely self-evident as stated and seemingly could be tested with data already in hand. A more compelling justification for the proposed research would have been helpful. For instance, hypothesis 1 that lower Cook Inlet is mostly synchronous with PWS suggests that continued oceanographic measurements in Cook Inlet may be redundant.*

PI Response:

- Agree that the project hypotheses could be more clearly stated and have revised them to frame four distinct scientific issues that the long-term data from the Cook Inlet/Kachemak Bay oceanography project will help address (see page 8).
- Revised the hypothesis statement about similarity in temporal changes across the region to clarify that we expect to continue to observe synchronous variations at longer (seasonal/interannual) time scales, but asynchronous patterns at shorter time scales. The differences in the spatial correlation of marine condition response at different time scales have implications for biological responses of different species, depending on species life histories (see page 8).

Science Panel comment: *The proposal also would have benefitted from a robust statement of how the expected outcomes of the proposed research would be integrated with those from the rest of the program.*

PI Response:

- Significantly revised the statement of expected project outcomes and integration with other GWA projects throughout the proposal. Clarified that the Cook Inlet/Kachemak Bay project contributes nearshore marine condition and estuary/shelf oceanographic gradient information to the GWA program with sufficient temporal and spatial resolution to assess seasonal and annual variability in primary and secondary productivity (as measured by sampling in the Cook Inlet, Seward Line and CPR projects). Included more examples of results from the FY12-16 sampling period to help illustrate the benefits gained by the higher frequency sampling. Clarified that the data products provided for the Nearshore component programs and Trustee Agency pelagic species management include temperature/salinity anomalies, water column stratification changes, an index of freshwater content, and time-series of dissolved oxygen, fluorescence, turbidity, chlorophyll and nutrient conditions. Clarified that sampling in both the Prince William Sound and Cook Inlet estuaries strengthens the ability of the GWA program to evaluate local (within estuary) and remote (shelf, North Pacific Ocean) climate forcing effects on nearshore and pelagic food webs.

Science Panel comment: *It is not clear that extending a modified version of the previous five years of research via monitoring would significantly advance our understanding of productivity and links to nearshore species, seabirds and marine mammals in the study area, especially given the expense of the project.*

PI Response:

- Clarified that lower Cook Inlet and Kachemak Bay oceanographic and plankton monitoring is key to understanding the estuary-shelf water mass exchange and nutrient dynamics that drive high biological production in this area.
- Clarified how the oceanographic and plankton data collected by the Cook Inlet/Kachemak Bay project inform understanding of how climate variability affects seabirds, marine mammals and nearshore species through “bottom-up” food web dynamics in the study area.
- Clarified that the higher frequency, year-round sampling of the Cook Inlet/Kachemak Bay project fills a data gap not met by the Seward Line (spring/fall only) or the CPR (April to October only) project sampling.
- The Cook Inlet/Kachemak Bay project cost has been reduced by $100K to provide additional funds to the Seward Line project for increased plankton and nutrient sampling and analyses during the monthly CTD surveys in Resurrection Bay and at the GAK-1 location. This additional sampling in Resurrection Bay will support the ED component’s goal to improve temporal resolution of marine conditions and characterization of estuary/shelf gradients.

Science Panel comment: *The methods appear to be appropriate; though including a fluorometer with the CTDs to profile chlorophyll fluorescence throughout the water column would have been beneficial.*

PI Response:

- Clarified that the project's CTD has a fluorometer and provided examples of time-series data collected in the first five-year period (see Figure 4 on page 6 and Figure 7 on page 12).

Sincerely,

Mandy Lindeberg
Gulf Watch Alaska Program Lead designate

Attachment: Gulf Watch Alaska: Environmental Drivers Component Project Proposal: 17120114-J—Long-term Monitoring of Oceanographic Conditions in Cook Inlet/Kachemak Bay, Alaska

EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
PROGRAM PROJECT PROPOSAL SUMMARY PAGE

Project Title

Gulf Watch Alaska: Environmental Drivers Component Project:

17120114-J—Long-term Monitoring of Oceanographic Conditions in Cook Inlet/Kachemak Bay, Alaska

Primary Investigator(s) and Affiliation(s)

Angela Doroff, Kachemak Bay National Estuarine Research Reserve/Alaska Center for Conservation Science/ University of Alaska Anchorage

Kris Holderied, NOAA/National Ocean Service/National Centers for Coastal Ocean Science/Kasitsna Bay Laboratory

Date Proposal Submitted

24 August 2016

Project Abstract

The lower Cook Inlet/Kachemak Bay (CIKB) oceanographic monitoring project, in conjunction with other Gulf Watch Alaska (GWA) Environmental Drivers (ED) projects, assesses the effects of oceanographic variability on nearshore and pelagic species injured by the Exxon Valdez Oil Spill. We currently have oceanographic data from a 6-year time-series within CIKB and 15-year record of continuous nearshore water quality station observations in Kachemak Bay. Oceanographic monitoring in this area is important because variables important to biological production change at different time and space scales, including water temperature, stratification, fresh water runoff, the strength and position of the Alaska Coastal Current, regional modes of climate variability and nutrient conditions (changes within season, seasonally, and inter-annually). During the first five years of cross-program synthesis in the ED group, we began to quantify the spatial and temporal trends and variability in oceanographic conditions for CIKB, Prince William Sound (PWS) and the Gulf of Alaska shelf; we found that temporal patterns are quasi-synchronous at longer time scales overall but asynchronous at shorter times and finer space scales in the estuary.

Based on FY12-16 observations (and to refine coordination with other GWA projects) we propose to increase sampling frequency along the estuary gradient and add nutrient monitoring in the eastern portion of our study area, with an associated reduction in spatial coverage across Cook Inlet. Ship-based oceanographic surveys are proposed monthly, seasonally, and annually in CIKB, with conductivity-temperature-depth casts (including fluorescence, turbidity, and dissolved oxygen), phytoplankton, and zooplankton collected along repeated transects. These data will be augmented with continuous oceanographic measurements recorded at Kachemak Bay National Estuarine Research Reserve oceanographic stations in Seldovia harbor, Homer harbor, and at a Bear Cove mooring. This proposal fills data gaps in the monitoring not currently being met by ED monitoring of the Seward Line (spring/fall only) or the Continuous Plankton Recorder (April-October) in the northern part of the Gulf of Alaska and will provide context for shorter time scales of variability relevant to ecosystem-level monitoring in GWA. By sampling in both estuaries (PWS and CIKB), we strengthen the ability of the GWA program to evaluate local (within estuary) and remote (shelf, North Pacific) climate forcing effects on nearshore ecosystems.

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

FY17	FY18	FY19	FY20	FY21	TOTAL
$169.7	$174.4	$183.4	$135.7	$133.3	$796.5

Non-EVOSTC Funding Available

FY17	FY18	FY19	FY20	FY21	TOTAL
$205.0	$213.0	$215.0	$217.0	$194.0	$1,044.0

1. Executive Summary

The Cook Inlet/Kachemak Bay (KIKB) oceanography project extends oceanographic data collection—including physical, chemical, and biological variables—from a 6-year time-series of shipboard oceanographic observations and a 15-year record of continuous nearshore water quality observations. The proposed FY17-21 sampling maintains long-term oceanographic time-series that provides detailed temporal resolution of nearshore gradients in oceanography and nutrient conditions between estuary and shelf waters to better support region-wide assessment of the impact of climate variability on the northern Gulf of Alaska marine ecosystem (Figure 1). This project also supports the Gulf Watch Alaska (GWA) Nearshore component intertidal monitoring project and ongoing pelagic seabird and marine mammal monitoring efforts in Kachemak Bay. Important fish, shellfish, seabird, shorebird and marine mammal species forage in CIKB for some or all of their life history and long-term data on environmental conditions and plankton are required to understand how climate variability and change can affect upper trophic species through "bottom-up" ecosystem processes. Water temperature, stratification, fresh water runoff, the strength and position of the Alaska Coastal Current, and nutrient conditions have been observed to change seasonally and inter-annually with regional climate variations (e.g. El Nino/La Nina, Pacific Decadal Oscillation, and the recent 2014-2016 Pacific Warm Anomaly), and these changes can have significant impacts on marine species in the region (e.g., Speckman et al., 2005). However, we still lack an adequate understanding of how nearshore and pelagic food webs respond to these climate-driven variations in physical processes, particularly for inshore regions (Mundy and Spies, 2005).

Long-term data on variability and change in both nearshore and shelf water column conditions are required to evaluate several hypotheses that have been put forward to explain climate-driven changes in Gulf of Alaska biological production (summarized in Mundy and Spies, 2005), including the match-mismatch hypothesis (Mackas et al., 2007; Anderson and Piatt, 1999), pelagic-benthic split hypothesis (Eslinger et al., 2001), and optimum stability window hypothesis (Gargett, 1997). The GWA Environmental Drivers (ED) component projects provide the long-term, high quality time-series needed for these regional evaluations of ecosystem dynamics, as well as for distinguishing between natural and human-caused (e.g., oil spills, fishing, aquaculture, nutrient runoff, climate change) changes in species populations. The CIKB oceanographic monitoring project provides critical information on nearshore and estuarine oceanographic patterns, as well as estuary-to-shelf oceanographic gradients and nutrient exchange to the GWA program's regional assessment.

Results from the first years of coordinated monitoring in the GWA ED were used in the GWA science synthesis report to assess oceanographic variability across the EVOS spill-affected region. The initial

assessment showed spatial differences in monthly mean oceanographic conditions between CIKB (this project), PWS (Campbell GWA project) and the Gulf of Alaska shelf (GAK-1 and Seward Line projects); indicating that oceanographic changes over time are quasi-synchronous at longer time scales and asynchronous at shorter time scales across the region (Holderied and Weingartner, in review). Based on the FY12-16 monitoring results, input from the Joint GWA/Herring Research and Monitoring Programs Science Workshop, and coordination with researchers from the ED and Nearshore components, for the FY17-21 period we propose to maintain core oceanography and plankton time-series in Kachemak Bay and southeast Cook Inlet and increase the frequency and spatial resolution of along-estuary oceanography and nutrient sampling, to best characterize seasonal and interannual variability in marine conditions and how those conditions affect plankton abundance and community composition. To constrain project costs we propose to reduce the spatial coverage of ship-based sampling in northern and western Cook Inlet, having characterized spatial and seasonal variability across the Inlet in FY12-16. This will allow us to focus on estuary-shelf linkages and on areas where water mass and nutrient exchange from shelf waters drive relatively high biological production and concentrations of fish, seabirds and marine mammals in Kachemak Bay and southeastern Cook Inlet. *Our overall project goal is to continue and enhance time-series of oceanographic data from shipboard surveys and shore-based stations in lower CIKB that provide information on seasonal, inter-annual, and spatial trends and variability of marine conditions, to help understand of variations in nearshore and pelagic food webs.*

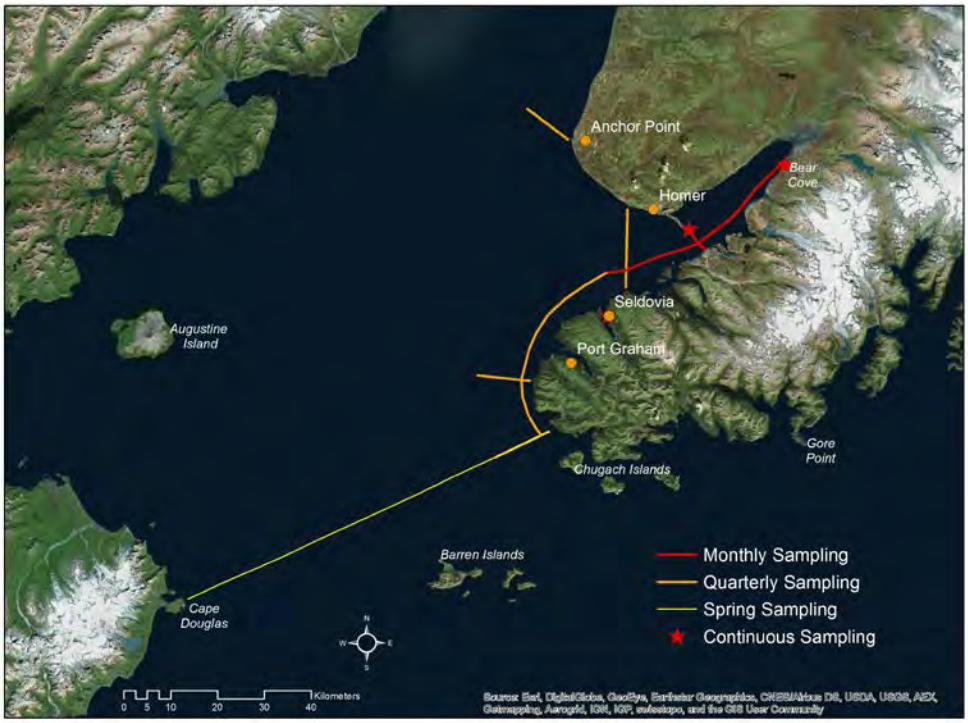

Figure 1. Proposed CIKB sampling locations. Red stars indicate sites of continuous sampling stations. Monthly CTD and plankton sampling (red lines) in mid-Kachemak Bay (Transect 9, T9) expands with along-bay stations. Quarterly sampling (orange lines) adds sampling in high productivity areas in outer Kachemak Bay (T4), near Anchor Point (east part of T3) and southeast Cook Inlet entrance (east parts of T6 and T7, plus along-estuary stations). Spring survey (dashed yellow line) adds stations across the Cook Inlet entrance (T6).

The importance of characterizing and understanding how lower trophic levels change in response to climate-driven variability in marine conditions is underscored both by past events, such as the 1976/1977 North Pacific marine ecosystem regime shift that was associated with a shift in the Pacific Decadal Oscillation (Mantua et al., 1997; Anderson and Piatt, 1999), as well as by the recent biological responses (still being evaluated) to the recent Pacific Warm Anomaly that has affected most of the northeast Pacific Ocean. The FY12-16 GWA monitoring efforts captured the transition in the Gulf of Alaska from relatively cold conditions in 2012 to anomalously warm marine conditions starting in 2014 and continuing to present, with dramatic biological responses observed across the region in 2015, including seabird and marine mammal mortalities, increased toxic algal bloom events, and changing marine species distributions. The interannual variations in the timing and degree of biological response to the unprecedented Pacific warming event provide an example of ecosystem response to changing marine conditions that the GWA program was designed to capture. We are using the CIKB oceanographic data, in collaboration with researchers from other GWA projects, NOAA, U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey and Alaska Department of Fish and Game (ADF&G), to help explain how bottom-up forcing associated with this climate perturbation may have driven observed changes in upper trophic species. We expect to monitor the ecosystem response to an expected return to cooler ocean conditions during the FY17-21 period, as well as continuing to monitor the response of nearshore water to shorter-term (El Nino) and longer-term (PDO) modes of climate variability.

The CIKB project provides nearshore and estuary/shelf oceanographic gradient information to the GWA program with sufficient temporal and spatial resolution to assess seasonal and interannual variability, as shown in the following examples. Figure 2 shows results from long-term temperature observations from the Homer water quality monitoring station. Measured against the climatological monthly means for 2001-2015, conditions in 2014-2015 were persistently warmer than those of the relatively cooler water period that persisted from 2006 until late 2013. While the biological effects of the warm anomaly on upper trophic species were more severe in 2015 than in 2014, the influence of warmer conditions was already reflected in 2014 by sharp changes in abundance of the small copepod *Pseudocalanus* in lower CIKB (Figure 3), as well in samples from the Seward Line and CPR (not shown).

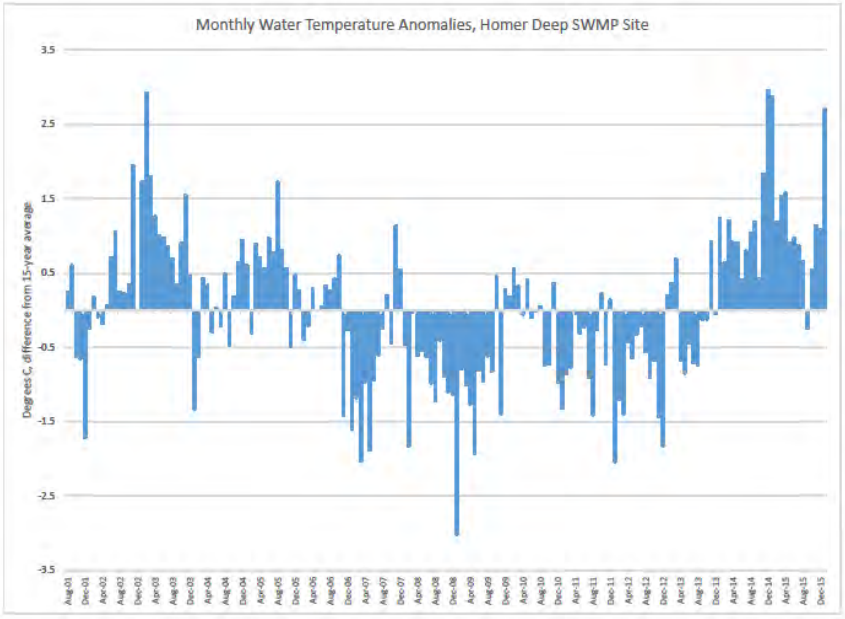

Figure 2. Monthly temperature anomalies based on water temperatures recorded 1m above bottom at the Kachemak Bay National Estuarine Research Reserve long-term water quality monitoring site in Homer harbor from Aug 2001- Dec 2015.

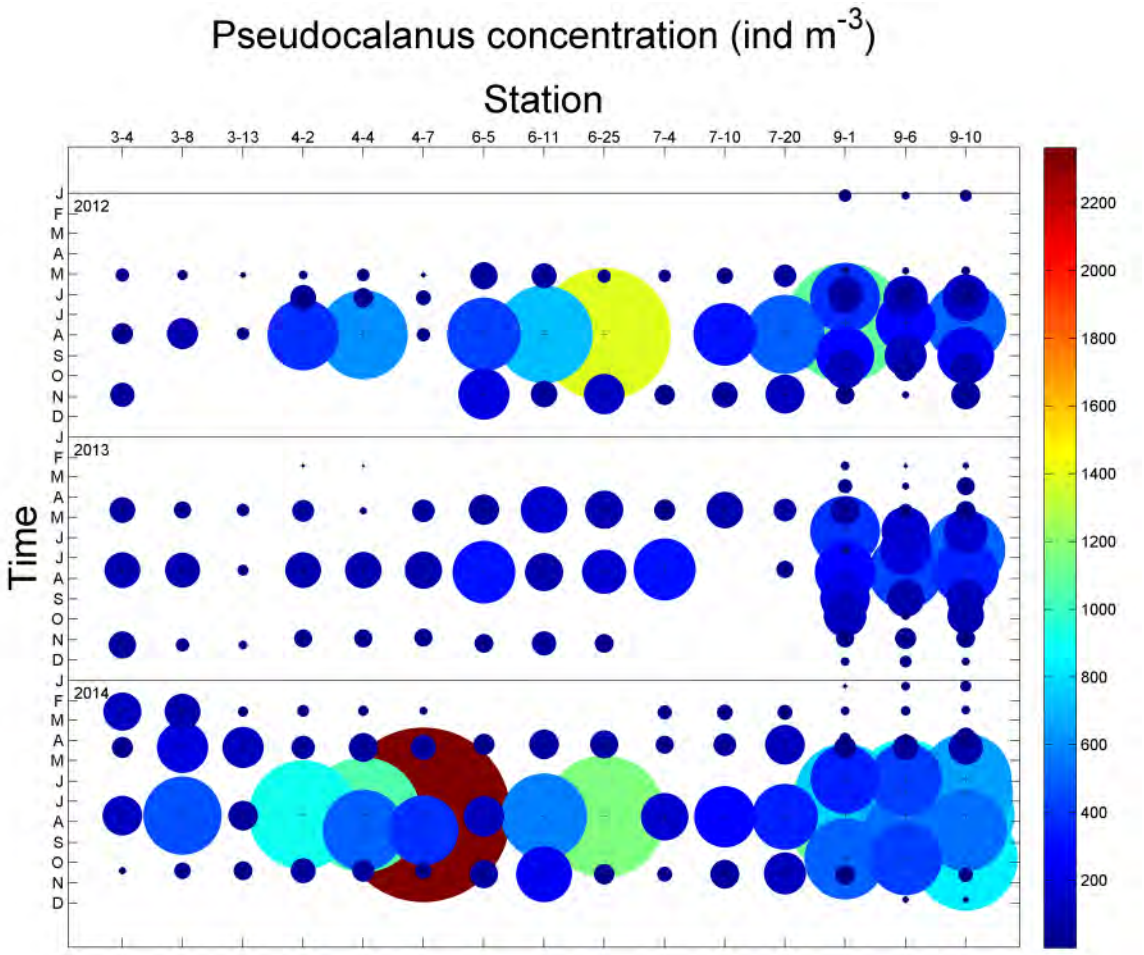

Figure 3. Pseudocalanus concentrations (individuals m^{-3}) observed during 2012-2014 at stations (numbers on x-axis) across the study area. Both the size and color of the dots are proportional to copepod abundance. Station numbers identify transects in Kachemak Bay (T4, T9) and lower Cook Inlet (T3, T6, T7), with plankton sampled at three stations on each transect. Mid-Kachemak Bay stations (T9) are sampled monthly, while other transects are sampled quarterly.

Monthly shipboard sampling in Kachemak Bay provides temporal resolution of changing water column properties, as shown in the 2015 time-series of vertical profiles of temperature and fluorescence (Figure 4), which can help explain lower trophic level changes. An initial, cross-region ocean temperature climatology has been calculated from long-term measurements made across the ED components and is being used to help evaluate changes in intertidal species and habitats observed at GWA Nearshore component monitoring sites. Figure 5 shows an example of monthly climatology calculated from continuous temperature measurements at the Seldovia water quality station, by near-surface sensors on the GAK-1 mooring and at the NOAA tide gauge station at Cordova in PWS. Figure 6 provides a comparison of monthly mean salinity time-series between Seldovia and near surface sensors at the GAK-1 mooring. Interestingly, the near-surface conditions in outer Kachemak Bay are colder and saltier than for shelf waters at GAK-1 for most months of the year, with estuary and shelf conditions being most similar in the spring.

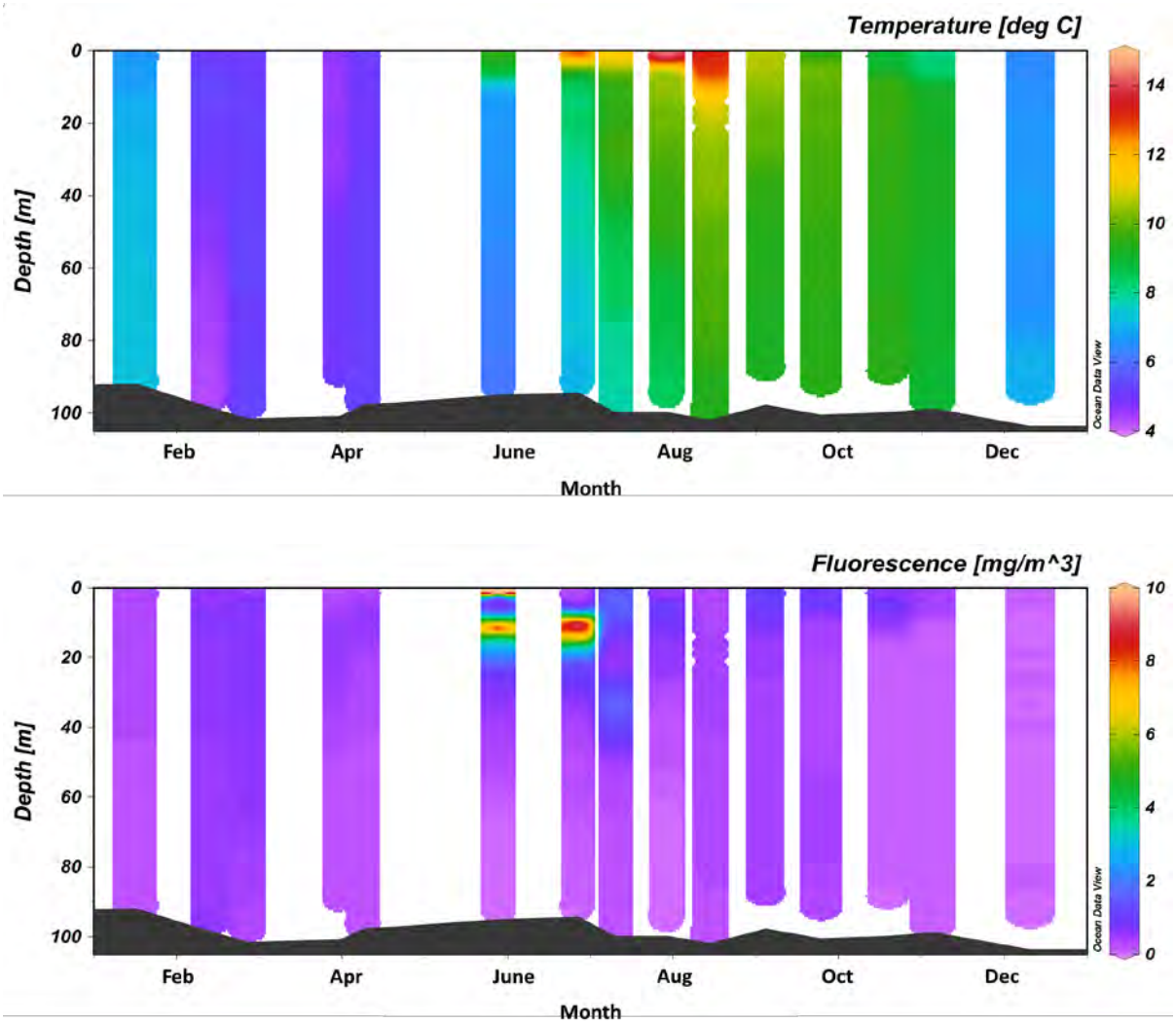

Figure 4. Water column temperature (top) and fluorescence (bottom) time-series for 2015 from repeated CTD casts at a station along the mid-Kachemak Bay transect (Transect 9).

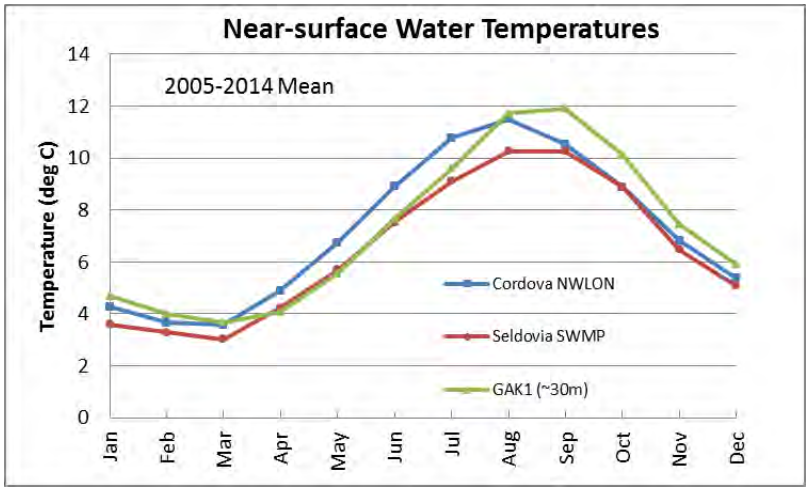

Figure 5. Monthly water temperature climatology for PWS, shelf and Kachemak Bay waters, calculated from continuous observations at Cordova, GAK-1 mooring and Seldovia, from 2005-2014.

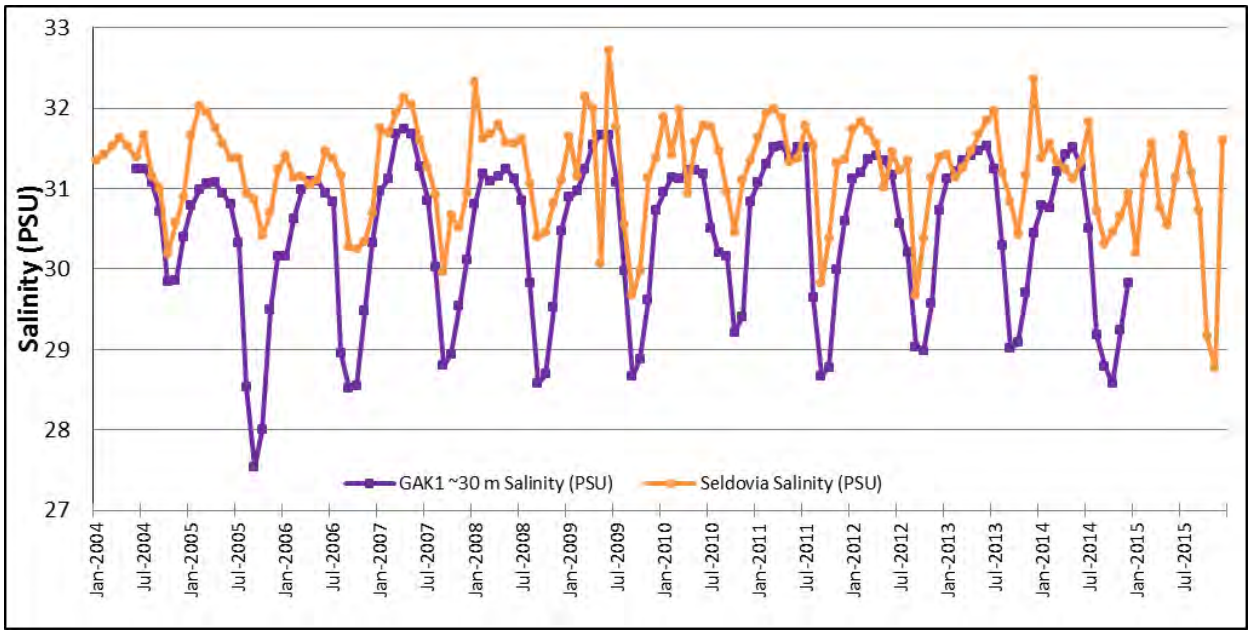

Figure 6. Monthly mean near-surface salinity from 2004-2015 at continuous oceanographic monitoring stations in the northern Gulf of Alaska (in practical salinity units, PSU). GAK-1 mooring observations are at ~30m depth on the shelf and Seldovia water quality station observations are at ~8m depth in the Kachemak Bay estuary.

With five years of integrated monitoring results from the GWA program, we are starting to be able to assess the biological implications of these spatial and temporal trends and associated variability marine conditions across the region, for both nearshore and pelagic species. The recent climate perturbation of the unprecedented Pacific warming also provides a preview of future changes that Trustee agencies could expect and need to manage for under a warmer Gulf of Alaska climate change scenario. How these longer-term climate changes will impact nearshore and pelagic ecosystems are still not well understood; continuing the established time-series of GWA oceanography and marine plankton monitoring will provide the data needed to better understand the consequences of changes in economically important marine resources and populations within EVOS-affected areas.

Project hypotheses:

H1. Climate variability in the Gulf of Alaska region drives measureable changes in oceanographic conditions in both Cook Inlet and Kachemak Bay, which in turn affect the abundance, composition and phenology of phytoplankton and zooplankton communities within the region.

H2. Gradients in oceanographic conditions and nutrient distributions between the Kachemak Bay estuary and Gulf of Alaska shelf waters are altered by climate variations, and changes in these gradients influence the distribution of plankton and upper trophic species.

H3. Time-series of relative freshwater content, derived from repeated oceanographic sections across Kachemak Bay, provide a useful, integrated index of seasonal and interannual variability in freshwater input for the estuary and lower Cook Inlet region.

H4. Longer-term regional observations will show that the temporal response of oceanographic conditions across estuarine (Prince William Sound; lower Cook Inlet) and shelf waters of the northern Gulf of Alaska remains quasi-synchronous at seasonal and longer time scales, but asynchronous at shorter time scales.

Please see Section 4. A. below for the specific project objectives that address these hypotheses.

2. Relevance to the Invitation for Proposals

The proposed CIKB project addresses the EVOSTC goal to determine "how factors other than oil may inhibit full recovery or adversely impact recovering resources" by providing oceanographic data at the time and space scales required to characterize ocean variability and the impact of that variability on lower trophic levels. The project responds directly to the EVOSTC FY17-21 Invitation for Proposals for "monitoring of oceanographic conditions, including water temperature, salinity and turbidity, … particularly in support of biological studies conducted by the Programs" and for "an evaluation of the possible effects of climate change on the pelagic and nearshore ecosystems." The CIKB project provides information on seasonal and interannual patterns in water temperature, stratification, freshwater content and nutrients needed by the GWA Nearshore monitoring component to assess marine drivers of intertidal ecosystem changes. The CIKB project also contributes information on nearshore oceanographic patterns, as well as estuary-shelf oceanographic gradients and nutrient exchange to the GWA ED component, providing part of the long-term data needed to distinguish between natural and human-caused (e.g., oil spill) changes in marine populations. By collecting oceanographic data with high temporal resolution and year-round coverage, we can evaluate interannual variability in conditions that influence regional ecosystems, as well as changes in seasonal conditions and timing. This higher temporal resolution of sampling fills a data gap in the monitoring not met by the Seward Line (spring/fall only) or the Continuous Plankton Recorder (April-October) for oceanographic and marine plankton data; monthly and quarterly plankton sampling conducted in CIKB provides context for the results obtained in the other ED projects for this region. By sampling in both estuaries, PWS and CIKB, we strengthen the ability of the GWA program to evaluate local (within estuary) and remote (shelf, North Pacific) climate forcing effects on nearshore ecosystems. In addition, the oceanographic time-series collected in CIKB support state (ADFG, ADEC) and federal (NOAA, USFWS) Trustee Agency resource management in the region, including understanding distribution and changes in shellfish, fish, marine birds, sea ducks, and marine mammal populations, as well as identifying triggers for harmful algal bloom events.

Specifically, the lower CIKB oceanographic project addresses EVOSTC goals by providing temperature, salinity, nutrient, and plankton data at the temporal and spatial scales required to:

- Characterize seasonal and interannual trends and changes in marine conditions for GWA Nearshore component monitoring sites in Kachemak Bay,
- Quantify long-term marine trends and anomalies and identify the response of plankton communities to those physical changes, in order to assess climatic forcings on biological production,
- Improve characterization of estuary-shelf linkages and how changes in estuary-shelf exchange affect changes in nearshore and pelagic species,
- Provide information on changing marine conditions needed to assess the effect of climate variations on harmful algal blooms, marine invertebrates, pelagic seabirds, and marine mammals in lower Cook Inlet and Kachemak Bay,
- Assess spatial and temporal variability in oceanographic conditions and marine plankton communities across the northern Gulf of Alaska, including PWS, shelf waters and lower Cook Inlet, in collaboration with other GWA ED projects.

3. Project Personnel

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Please see CVs provided at the end of this document.

4. Project Design

A. Objectives

The overall project goal is to continue and enhance time-series of oceanographic data from shipboard surveys and shore-based stations in lower CIKB that provide information on seasonal, inter-annual, and spatial trends and variability of marine conditions, to help understand of variations in nearshore and pelagic food webs. We also put these observations in the context of other ongoing physical and biological oceanographic studies occurring in PWS, the outer Kenai Peninsula, and the Gulf of Alaska under the Gulf Watch Alaska program, as well as other ongoing state and federal agency studies in the region. Our data will be used to better understand how the coastal region responds to climate variability and change.

Specific project objectives include (with links to project hypotheses in parentheses):

1. Determine the thermohaline structure of Kachemak Bay and the southeastern Cook Inlet entrance at seasonal and longer time scales.(H1, H2, H3)
2. Determine long-term trends and variability from daily to interannual time scales in Kachemak Bay oceanography. (H1, H4)
3. Determine seasonal patterns of phytoplankton and zooplankton species abundance and community composition within Kachemak Bay and southeastern Cook Inlet. (H1, H2)
4. Assess interannual changes in oceanographic structure and phytoplankton/zooplankton species composition across the Cook Inlet entrance. (H1, H2)
5. Assess seasonal patterns in oceanography, macronutrients, and plankton between Kachemak Bay, southeastern Cook Inlet and the adjacent shelf (collaboration with Seward Line and CPR projects). (H1, H4)
6. Determine temporal patterns and linkages in oceanographic conditions and plankton communities between CIKB and the Gulf of Alaska continental shelf (GAK-1, Seward Line, CPR GWA ED projects), and PWS (PWS and Seward Line GWA ED projects). (H4)
7. Provide environmental forcing data for correlation with biological data sets in the nearshore benthic project component and pelagic components of GWA. (H1, H2, H3)
8. Provide ADF&G, NOAA and USFWS resource managers with assessment of oceanographic trends and seasonal conditions. (H1, H2, H3)

B. Procedural and Scientific Methods

Ship-based oceanographic sampling and nearshore water quality station sampling, including instrument calibration, data collection, sample processing, quality control, and quality assurance, will continue to be conducted in accordance with the project sampling protocols used in FY12-16 (available on the GWA program Ocean Workspace operated by the Alaska Ocean Observing System/Axiom data management team).

Ship-based oceanographic surveys will be conducted monthly, seasonally and annually in Kachemak Bay and lower Cook Inlet, with vertical oceanographic profiles, phytoplankton and zooplankton data collected along repeated transects (see Figure 1 for transect locations). Oceanographic data are collected from near-surface to just above the sea floor at vertical stations with CTD profilers, using KBL and KBNERR Seabird Electronics 19plus CTD profilers. For consistency among sampling efforts within the ED and historic data collections, zooplankton are sampled with vertical tows of 150 and 333 μm bongo nets equipped with a flowmeter, to depths of 50 meters depth or 5 meters from the sea floor if bottom depths are shallower than 50 meters. Phytoplankton species are sampled with collection of a measured quantity of surface water (amount varies by season) and filtered through 20 μm mesh nets. During FY17-21 we will increase sampling and analyses for nutrients (nitrate, ammonium, orthophosphate, silicate) on ship-based surveys by leveraging funding to NOAA Kasitsna Bay Laboratory from the Alaska Ocean Observing System, through the NOAA Integrated Ocean Observing System program.

Monthly oceanographic surveys will be conducted in Kachemak Bay along mid-bay (Transect 9) and along-bay transects (red lines in Figure 1) with Kasitsna Bay Laboratory small boats. Quarterly, additional sampling locations will be added to the monthly small boat surveys to assess seasonal conditions (in February, April, July, October) with stations along transects in outer Kachemak Bay (Transect 4), near Anchor Point (eastern stations on Transect 3), and the southeastern part of Cook Inlet entrance (eastern

portions of Transects 6 and 7 and along-estuary stations). The additional quarterly sampling transects are indicated with orange lines in Figure 1. In spring (April/May), a larger vessel will be chartered to conduct a survey across the Cook Inlet entrance (Transect 6, yellow line on Figure 1), in addition to the monthly and quarterly sampling locations in Kachemak Bay and eastern Cook Inlet. Plankton sampling will be conducted at the same three stations on the cross-Kachemak Bay transects (Transects 9 and 4), at the same eastern Cook Inlet stations (quarterly on Transects 3, 6 and 7) and at the same Cook Inlet entrance stations (spring on Transect 6) that were sampled for plankton in FY12-16, to maintain consistent time-series in FY17-21.

In order to increase temporal sampling of estuary-shelf gradients consistently throughout the FY17-21 study period (which required us to find other funding sources in the first five-year period), we propose to reduce the spatial extent of seasonal sampling along transects 3, 6 and 7 (compared to FY12-16), and only sample across the entire Cook Inlet entrance (Transect 6) once a year during spring. This modification will significantly reduce large vessel charter costs. We are prioritizing a spring survey of Cook Inlet entrance based on results from GWA FY12-16 monitoring in Cook Inlet and to coordinate with spring Seward Line and Continuous Plankton Recorder sampling. The modified sampling design allows us to maintain core oceanographic time-series, while maintaining high temporal resolution in areas where shelf waters enter Cook Inlet and Kachemak Bay (southeast Cook Inlet) and in spatial locations with relatively high fish, seabird and marine mammal populations (outer Kachemak Bay, Anchor Point and southeast Cook Inlet). More frequent along-estuary small-boat sampling in Kachemak Bay will also improve information on the timing and spatial patterns of spring and fall oceanographic transitions and on marine plankton blooms to support the GWA Nearshore Component as well as NOAA and ADFG resource management.

Continuous oceanographic measurements will be made year-round at KBNERR SWMP water quality stations at the Seldovia and Homer harbors as well as in ice-free months (March to November) from a buoy in Bear Cove at the head of Kachemak Bay (see locations in Figure 1). The National Estuarine Research Reserve SWMP program is transitioning the sensor package used for water quality monitoring stations from the YSI 6660 model to the YSI EXOII model and we expect the new sondes to be installed at the Homer and Seldovia stations in 2016. The new sensors will collect the same data as the previous sensors and the NERR program has conducted cross-calibrations between the two sonde models to ensure consistency. Otherwise the procedures for the nearshore water quality station measurements are the same as in the FY12-16 sampling period. Oceanographic data collected continuously and recorded every 15 minutes includes temperature, salinity, pressure, dissolved oxygen, turbidity and chlorophyll. Water samples are collected monthly at each station to measure nutrients (nitrate, nitrite, silicate, phosphate) and chlorophyll.

C. Data analysis and statistical methods

Data analysis and statistical methods will be consistent with methods used during the first five-year period.

All KBNERR long-term water quality and meteorological data are subjected to primary data quality assurance-quality control (QAQC) at the National Estuarine Research Reserve System Central Data Management Office (CDMO). Provisional data are ingested into the CDMO database within one week of data retrieval. The data are then returned to KBNERR, where Reserve staff use tools (Excel macros) provided by the CDMO to perform secondary QAQC on the data. Data that have been through secondary QAQC are submitted back to the CDMO quarterly and again annually and these data are posted as provisional plus. After annual submission to the CDMO is complete, the data undergo final tertiary QAQC by the CDMO. The data and accompanying metadata documentation are checked for completeness before dissemination as authenticated historical data via the CDMO Online Data Information Server (http://cdmo.baruch.sc.edu)

and on the GWA program Ocean Workspace and public data portal http://portal.aoos.org/gulf-of-alaska.php#metadata/4e28304c-22a1-4976-8881-7289776e4173/project/files.

Seabird Electronics (SBE) 19Plus CTD profiler data from all transects are processed with standard SBE Seasoft software algorithms and averaged into 1 meter depth bins. Subsequent data processing uses Matlab and Ocean Data Viewer software algorithms to compute density and construct along-transect distance versus depth contour plots of temperature, salinity, density, fluorescence and other parameters (e.g. Figure 7). Water density fields are used to estimate vertical stratification at each station. Lateral variability across the transect and temporal variability between sampling periods are assessed by calculating means and standard deviations for temperature, salinity and density fields. The relative amount of freshwater at each station is calculated using a reference salinity (32 psu) consistent with earlier studies. Freshwater content is also derived for each cross-bay section, to provide an integrated index of freshwater input to the bay over time.

We will provide CTD and data in a format and with metadata compatible with the data management protocols of the integrated monitoring program. CTD data will be provided to other integrated program investigators and publicly through the program website as soon as practical, no later than a year after initial data collection. We will also assist the integrated program data management team to synthesize past oceanographic data from the existing water quality station time-series and CTD surveys in lower Cook Inlet. Methods for integrating these data across study areas in the GWA project will build on initial analyses in the GWA synthesis report by Holderied and Weingartner (in review).

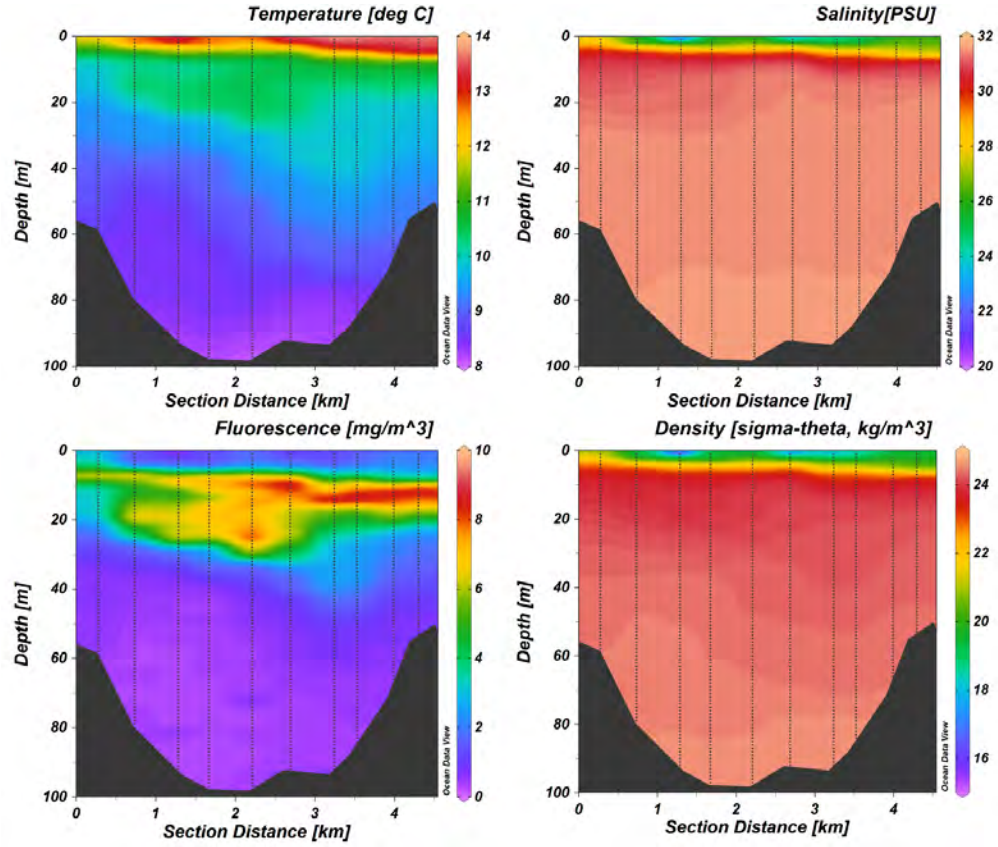

Figure 7. Contours of water column properties from CTD profiler casts (shown as dashed vertical lines) taken along the mid-Kachemak Bay transect (Transect 9) on 21 July 2014. The perspective is looking west or out of the bay, with the end of the Homer Spit on the right side.

Zooplankton data identification and analyses will be provided by Rob Campbell at the PWSSC and we will coordinate with Campbell to correlate temporal and spatial patterns between zooplankton and physical oceanographic data and to compare patterns between Cook Inlet and PWS. In collaboration with Campbell, we are analyzing our zooplankton samples with a set of common multivariate approaches. Species by station matrices will be assigned into clusters by various similarity metrics (Bray-Curtis being the most common). Following clustering, Indicator species analysis (ISA) applied to the clusters returns information on the species that define the cluster groups (Legendre and Gallager, 2001). The impact of environmental parameters on species assemblages will be analyzed with Canonical Correlation Analysis, which permits reducing dimensionality and determining which environmental axes most closely relate to different zooplankton taxa. Multivariate approaches are descriptive analyses (versus inferential), and power analysis is not usually applied. Marine plankton will be linked across study areas within the GWA program following methods described in Batten et al. (in review).

D. DESCRIPTION OF STUDY AREA

Our study area includes waters in eastern portions of lower Cook Inlet, the Cook Inlet entrance, and Kachemak Bay, Alaska (60.056, -154.365; 60.02, -150.9; 58.573, -154.349; 58.539, -151.033). See Figure 1 for proposed FY17-21 shipboard and shore station sampling locations. Transect numbers and locations for shipboard surveys are consistent with the FY12-16 sampling design, but additional along-estuary stations have been added to improve characterization of estuary-shelf gradients in water column properties. Stations in northern and western portions of lower Cook Inlet will not be sampled in FY17-21, except along the Cook Inlet entrance. In the next five years we will: 1) maintain monthly shipboard oceanographic and plankton sampling in mid-Kachemak Bay (Transect 9) and add along-bay oceanographic sampling stations; 2) maintain quarterly shipboard oceanographic and plankton sampling at stations in outer Kachemak Bay (Transect 4), near Anchor Point (Transect 3) and in southeast Cook Inlet (Transects 6 and 7); and 3) add spring (April/May) sampling across the Cook Inlet entrance from Point Adam to Cape Douglas (Transect 6). Continuous oceanographic and monthly nutrient measurements will be made year-round at KBNERR water quality monitoring stations at the Seldovia and Homer harbors and a mooring will be deployed to make continuous oceanographic measurements from March-November each year in Bear Cove near the head of Kachemak Bay. The sampling locations cover estuarine-shelf gradients in marine conditions from the head of Kachemak Bay to the Cook Inlet entrance, capture estuary waters influenced by glacial (inner Kachemak Bay) and non-glacial (outer Kachemak Bay) watersheds, and provide time-series information on estuarine conditions at a location “downstream” in the Alaska Coastal Current from the shelf water observations at the GAK-1 mooring and along the Seward Line.

5. Coordination and Collaboration

The Kachemak Bay National Estuarine Research Reserve (KBNERR), a State of Alaska and NOAA partnership, and the NOAA Kasitsna Bay Laboratory (KBL) collaborate on this oceanographic monitoring project to cost-effectively leverage organization resources as well as historical data sets. The KBNERR has 15 years of water quality and meteorological data at two System-Wide Monitoring Program (SWMP) sites in Homer and Seldovia harbors, as well as from two meteorological stations (Homer harbor and Anchor Point). We also leverage historical oceanographic data collected with from several CTD profiler surveys in Kachemak Bay and lower Cook Inlet, including during recent studies by Speckman et al. (2005), Okkonen et al. (2009), and Murphy (2010). Our sampling design includes transects sampled routinely by Okkonen (2009) and Murphy (2010), which extends the project time-series. Temperature and water level data from 1964 to present are also available from the NOAA tide station at Seldovia

(https://tidesandcurrents.noaa.gov/physocean.html?id=9455500), which provides an even longer climate change context for the current program. Complementing the physical data, annual intertidal invertebrate and macroalgae monitoring has been conducted at sites near KBL for 15 years, which are included in the GWA nearshore component (PIs Iken/Konar).

Specific collaborations include the following:

WITHIN THE PROGRAM

1) *Environmental Drivers component*: We coordinate on oceanographic and zooplankton sampling protocols and synthesis of monitoring results with other Environmental Drivers component PIs (Weingartner, Hopcroft, Batten, Campbell) through teleconferences, joint field work and in breakout discussions at the annual principal investigators (PI) meeting.
2) *Nearshore component*: The CIKB project provides information on seasonal and interannual patterns in water temperature, stratification, freshwater content and nutrients needed by the GWA Nearshore team to assess drivers of intertidal ecosystem changes at their Kachemak Bay sites.
3) *Pelagic component*: We coordinate with Kathy Kuletz (GWA Pelagic component, USFWS Migratory Bird Management office) to opportunistically host a seabird/marine mammal observer on our shipboard surveys, with the goal of improving understanding of relationships between marine conditions, primary productivity, and seabird and marine mammal populations.

WITH OTHER EVOSTC-FUNDED PROGRAMS AND PROJECTS

1) *Herring Research and Monitoring Program*: We coordinate informally with Scott Pegau (HRM program lead) and Rob Campbell (PWS oceanography project under GWA program) to compare PWS and Cook Inlet oceanographic patterns and changes in plankton, herring and other forage fish populations. These discussions helped us decide to modify our project sampling design to enhance measurement of estuary-shelf gradients in oceanography and nutrient conditions.
2) *FY17-21 Data Management Program*: We worked closely with the AOOS/Axiom data management team in the FY12-16 program and expect to continue those collaborations in the future, including providing data to the Ocean Workspace and AOOS Gulf of Alaska public data portal.

WITH TRUSTEE OR MANAGEMENT AGENCIES

1) *NOAA/National Ocean Service:* We collaborate with researchers at our NOS/NCCOS Beaufort Laboratory (North Carolina) to use the project oceanography and phytoplankton sampling data to identify environmental triggers for increases in the phytoplankton species (*Alexandrium* spp.) that cause paralytic shellfish poisoning events.
2) *State of Alaska agencies – ADFG and ADEC:* We provide real-time and historical trends for water temperature data to shellfish managers with the Alaska Department of Fish and Game (Commercial and Sportfish) in Homer and Kenai and with the Alaska Department of Environmental Conservation in Anchorage. We use project data to help inform management for shellfish harvest, mariculture operations, harmful algal bloom event response and marine invasive species monitoring.
3) *U.S. Fish and Wildlife Service*: As described above, we collaborate with Kathy Kuletz to host shipboard seabird/marine mammal observers. Doroff also works on sea otter mortality response efforts in Kachemak Bay and project data is provided to USFWS and NOAA to help understand potential ecosystem causes of seabird, sea otter and whale mortality events.
4) *North Pacific Research Board*: Holderied is participating in the NPRB-funded FY16-18 synthesis effort for the Gulf of Alaska Integrated Ecosystem Research Program with researchers from NOAA,

USFWS, ADFG and other organizations. Project data is being used to help understand how linkages between nearshore and shelf waters affect groundfish recruitment.

WITH NATIVE AND LOCAL COMMUNITIES

1) *Alutiiq Pride Shellfish Hatchery*: We collaborate with the hatchery on a regional project to monitor ocean acidification in coastal waters. Water samples for measurement of carbonate chemistry will be taken during our shipboard surveys and sent to the analysis facility at the Alutiiq Pride Shellfish Hatchery in Seward (owned and operated by the Chugach Regional Resource Division, a coalition of several native villages in the Chugach region).
2) *KBNERR Community Council and other local venues*: Doroff and Holderied present information from this study quarterly to the KBNERR Community Council, routinely provide public talks on project results in Homer and Seldovia, and participate in public education "Discovery Labs". To inform Kachemak Bay communities about changing marine conditions, we provide information on monitoring results via local radio and newspaper media. We also provide information on oceanographic monitoring techniques and results to K-12 students in in Homer, Seldovia, Port Graham and Nanwalek. We will continue these local community collaborations in FY17-21.

6. Schedule

PROJECT MILESTONES

Project Milestones (Table 1) include monthly, seasonal and annual ship-based oceanographic surveys, data delivery, reports, publications and annual GWA PI meeting attendance. Doroff and Holderied will also present monitoring results annually at the Alaska Marine Science Symposium.

Table 1. Schedule of Measurable Project Tasks

Task	FY17				FY18				FY19				FY20				FY21			
	Quarter (EVOSTC FY beginning Feb. 1)																			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Field Sampling																				
Monthly Surveys	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Spring Surveys (all)	x				x				x				x				x			
Summer Surveys		x				x				x				x				x		
Fall Surveys			x				x				x				x				x	
Winter Surveys	x				x				x				x				x			
SWMP Water quality	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SWMP Nutrients	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SWMP Meteorological	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Data Delivery	x			x	x			x	x			x	x			x	x			x
Reporting																				
Annual Reports	x				x				x				x				x			
Annual PI meeting				x				x				x				x				x
Annual Work Plan			x				x				x				x				x	

MEASUREABLE PROJECT TASKS

Tasks include repeated monthly, quarterly and annual oceanographic survey tasks, listed below by fiscal quarter. Data delivery occurs within no more than 1 year of collection. Other annual tasks include Doroff and Holderied attending the annual principal investigators meeting and presenting of project results at the Alaska Marine Science Symposium. We also plan to produce peer-reviewed science manuscripts for the year 3 program synthesis and at the end of the FY17-21 period.

FY 2017 (Year 6)

FY17, 1st quarter (February 1, 2017 - April 30, 2017)

February: *Project funding approved by Trustee Council; Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*

March: *Monthly survey Kachemak Bay; Deploy seasonal Bear Cove water quality mooring*

April: *Monthly survey Kachemak Bay; Annual survey of all transects in Kachemak Bay and lower Cook Inlet, including across Cook Inlet entrance*

FY17, 2nd quarter (May 1, 2017 - July 31, 2017)

May: *Monthly survey Kachemak Bay*

June: *Monthly survey Kachemak Bay*

July: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*

FY17, 3rd quarter (Aug. 1 2017 - Oct. 31 2017)

August: *Monthly survey Kachemak Bay; Submit annual project workplan*

September: *Monthly survey Kachemak Bay*

October: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*

FY17, 4th quarter (Nov. 1 2017 - Jan. 31 2017)

November: *Monthly survey Kachemak Bay; Annual GWA PI Meeting; Remove Bear Cove mooring*

December: *Monthly survey Kachemak Bay*

January: *Monthly survey Kachemak Bay; Alaska Marine Science Symposium & PI meeting*

FY 2018 (Year 7)

FY18, 1st quarter (February 1, 2018 - April 30, 2018)

February: *Project funding approved by Trustee Council; Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet; Submit annual project report*

March: *Monthly survey Kachemak Bay; Deploy seasonal Bear Cove water quality mooring*

April: *Monthly survey Kachemak Bay; Annual survey of all transects in Kachemak Bay and lower Cook Inlet, including across Cook Inlet entrance*

FY18, 2nd quarter (May 1, 2018 - July 31, 2018)

May: *Monthly survey Kachemak Bay*

June: *Monthly survey Kachemak Bay*

July: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*

FY18, 3rd quarter (August 1, 2018 - October 31, 2018)

August: *Monthly survey Kachemak Bay; Submit annual project workplan*

September: *Monthly survey Kachemak Bay*

October: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet;*

FY18, 4th quarter (November 1, 2018 - January 31, 2019)

November: *Monthly survey Kachemak Bay; Annual GWA PI Meeting; Remove Bear Cove mooring*

December: *Monthly survey Kachemak Bay;*

January: *Monthly survey Kachemak Bay; Alaska Marine Science Symposium & PI meeting*

FY 2019 (Year 8)

FY19, 1st quarter (February 1, 2019 - April 30, 2019)

February: *Project funding approved by Trustee Council; monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet; Submit annual project report*

March: *Monthly survey Kachemak Bay; Deploy seasonal Bear Cove water quality mooring*

April: *Monthly survey Kachemak Bay; Annual survey of all transects in Kachemak Bay and lower Cook Inlet, including across Cook Inlet entrance*

FY19, 2nd quarter (May 1, 2019 - July 31, 2019)

May: *Monthly survey Kachemak Bay*

June: *Monthly survey Kachemak Bay*

July: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*

FY19, 3rd quarter (August 1, 2019 - October 31, 2019)

August: *Monthly survey Kachemak Bay; Submit annual project workplan*

September: *Monthly survey Kachemak Bay*

October: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet; Submit draft manuscript for year 3 science synthesis.*

FY19, 4th quarter (November 1, 2019 - January 31, 2020)

November: *Monthly survey Kachemak Bay; Annual GWA PI Meeting; Remove Bear Cove mooring*

December: *Monthly survey Kachemak Bay; Submit final manuscript for science synthesis*

January: *Monthly survey Kachemak Bay; Alaska Marine Science Symposium & PI meeting*

FY 2020 (Year 9)

FY20, 1st quarter (February 1, 2020 - April 30, 2020)
February: *Project funding approved by Trustee Council; Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet; Submit annual project report*
March: *Monthly survey Kachemak Bay; Deploy seasonal Bear Cove water quality mooring*
April: *Monthly survey Kachemak Bay; Annual survey of all transects in Kachemak Bay and lower Cook Inlet, including across Cook Inlet entrance*

FY20, 2nd quarter (May 1, 2020 - July 31, 2020)
May: *Monthly survey Kachemak Bay*
June: *Monthly survey Kachemak Bay*
July: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*

FY20, 3rd quarter (August 1, 2020 - October 31, 2020)
August: *Monthly survey Kachemak Bay; Submit annual project workplan*
September: *Monthly survey Kachemak Bay*
October: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*

FY20, 4th quarter (November 1, 2020 - January 31, 2021)
November: *Monthly survey Kachemak Bay; Annual GWA PI Meeting; Remove Bear Cove mooring*
December: *Monthly survey Kachemak Bay*
January: *Monthly survey Kachemak Bay; Alaska Marine Science Symposium & PI meeting*

FY 2021 (Year 10)

FY21, 1st quarter (February 1, 2021 - April 30, 2021)
February: *Project funding approved by Trustee Council; monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet; Submit annual project report*
March: *Monthly survey Kachemak Bay; Deploy seasonal Bear Cove water quality mooring*
April: *Monthly survey Kachemak Bay; Annual survey of all transects in Kachemak Bay and lower Cook Inlet, including across Cook Inlet entrance*

FY21, 2nd quarter (May 1, 2021 - July 31, 2021)
May: *Monthly survey Kachemak Bay*
June: *Monthly survey Kachemak Bay*
July: *Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*

FY21, 3rd quarter (August 1, 2021 - October 31, 2021)
August: *Monthly survey Kachemak Bay; Submit annual project workplan*
September: *Monthly survey Kachemak Bay*

October:	*Monthly survey Kachemak Bay; Quarterly survey of transects in Kachemak Bay and eastern Cook Inlet*
FY21, 4th quarter	(November 1, 2021 - January 31, 2022)
November:	*Monthly survey Kachemak Bay; Annual GWA PI Meeting; Remove Bear Cove mooring*
December:	*Monthly survey Kachemak Bay; Submit manuscript for peer reviewed science journal publication*
January:	*Monthly survey Kachemak Bay; Alaska Marine Science Symposium & PI meeting;*

7. Budget

BUDGET FORMS (ATTACHED)

Please see the attached project budget forms included in the program budget workbook, with a Non-trustee Agency form for Doroff, a Trustee Agency form for Holderied and a summary form for the entire project.

SOURCES OF ADDITIONAL FUNDING:

We expect to continue significant leveraging for this project in FY17-21.

1) *KBNERR System-wide monitoring program*: this long-term monitoring program provides the continuous measures in Kachemak Bay for temp/conductivity, DO, pressure (depth), pH, turbidity and fluorescence (a measure of phytoplankton biomass); nutrients (Nitrite + Nitrate, Ammonium, Orthophosphate, and Silicate) are analyzed at the Virginia Institute of Marine Science (VIMS) Lab. Chlorophyll-a and Phaeophytin pigments are analyzed using standard methods at the KBNERR from water samples collected at five sites throughout the ice-free periods in the Bay. The Reserve also provides real-time and archival meteorological data from two sites for this program which include measures of: air temperature, relative humidity, barometric pressure, wind speed, wind direction, and total solar radiation, precipitation, and PAR. Collectively, these data provide a longer term perspective for our point-sample oceanographic data. This monitoring contributes $120K/year.

2) *KBNERR/ADF&G community-based monitoring for harmful species*: this project contributes an extensive volunteer network for monitoring phytoplankton in the event of a harmful algal bloom in Kachemak Bay. We hosted stakeholder engagement workshops to identify and fill data gaps in understanding harmful algal blooms and improve communications during bloom events (Cooney 2014). This project has supplemented our monitoring with SST at all mariculture sites located in sub-bays of Kachemak Bay since 2006.

3) *NOAA Kasitsna Bay Laboratory and AOOS:* NOAA KBL and AOOS have an ongoing collaboration to assess oceanography, ocean acidification and harmful algal bloom conditions in Kachemak Bay, and to develop risk assessment tools for paralytic shellfish poisoning and other harmful algal bloom events. AOOS plans to provide $25K annually from FY17-20 to support these efforts. The AOOS-funded monitoring will both expand and benefit from the oceanographic monitoring in our EVOSTC project and will help support additional nutrient analyses.

4) *USFWS Migratory Bird Management and Marine Mammals Management*: We coordinate with Kathy Kuletz of the USFWS Migratory Bird Management office to host a seabird/marine mammal observer on our Cook Inlet surveys, with the goal of improving understanding of relationships between marine conditions, primary productivity, and seabird and marine mammal populations. We

coordinate with Joel Garlic Miller in the USFWS Marine Mammals Office on sea otter stranding and sampling programs.

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PROJECT DATA ONLINE

Publicly available data from this project are available online at the following link:

http://portal.aoos.org/gulf-of-alaska.php#metadata/4e28304c-22a1-4976-8881-7289776e4173/project/files

CURRICULUM VITAE

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EDUCATION: M.Sc. in Wildlife Ecology (1988) University of Wisconsin, Madison; B.S. in Biology (1984) University of Minnesota, St. Paul

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Affiliate Faculty at the University of Alaska, Fairbanks School of Fisheries and Ocean Sciences (2015-2018).

RECENT JOURNAL PUBLICATIONS:

Carrasco, S. E., B. B. Chomel, V. A. Gill, A. M. Doroff, M. A. Miller, K. A. Burek, R. W. Kasten, B. A. Byrne, T. G. Goldstein, J. A. K. Mazet. 2014. Exposure to *Bartonella spp*. is common in Alaskan sea otters. Vector-borne and Zoonotic Diseases. Vol. 14(12) 831.

Stewart, N.L., B. Konar, A. Doroff. 2014. Sea Otter (*Enhydra lutris*) foraging in a heterogeneous environment in Kachemak Bay, Alaska. Bulletin of Marine Science 90:921-939.

Newsome, S. D., M. T. Tinker, V.A. Gill, A.M. Doroff, L. Nichol, and J.L. Bodkin. 2015. The interaction of intraspecific competition and habitat on individual diet specialization. OecologiaDOI 10.1007/s00442-015-3223-8.

Traiger, S., B. Konar, A. Doroff, and L. McCaslin. In review. Sea otters versus sea stars as major clam predators: evidence from foraging pits and shell litter. Submitted: Marine Ecological Progress Series.

Doroff, A., S. Baird, J. Freymeuller, M. Murphy, and S. Buckelew. In review. Assessing coastal habitat changes in a glacially influenced estuary system, Kachemak Bay, Alaska. Submitted: Estuaries and Coasts special issue journal.

T.L. Burgess, C. Kreuder Johnson, A.Burdin, V.A. Gill, A. M. Doroff, P.Tuomi, W. A. Smith, and T. Goldstein. In prep. *Brucella* infection in common sea otters (*Enhydra lutris lutris*) at Bering Island, Russia. Short Communications. Journal of Wildlife Diseases.

RECENT GRANTS AWARDED:

State Wildlife Grants annually 2009-2016: Principal Investigator /Project Manager (145K); University of New Hampshire, Science Collaborative (2010-2013): Principal Investigator (915K); *Exxon Valdez* Trustee Council, Long-term monitoring (2011-2016): Principal Investigator (700K); NOAA Habitat Focus Area Kachemak Bay (2016-2017): Principal Investigator (385K).

RECENT COLLABORATORS (EXCLUSIVE OF CO-AUTHORS ABOVE):

Brenda Ballachey (USGS/ retired); Sonia Batten (SAHFOS); Tim Blackmon (ADF&G); James Bodkin (USGS/ retired); Mike Booz (ADF&G); Catie Bursch (UAA/KBNERR); Rob Campbell (PWSSC); Nicole Duplaix (IUCN OSG); Dan Esler(USGS); Joel GarlicMiller (USFWS); Marcus Geist (UAA); Georgina Gibson (UAF); Verena Gill (BOEM); Jeff Hetrick (Alutiiq Pride Shellfish Hatchery); Kris Holderied (NOAA KBL); Dominic Hondolero (NOAA); Russ Hopcroft (UAF); Katrin Iken (UAF); Mark Johnson (UAF); Carol Kervilet (ADF&G); Kim Kloecker(USGS); Kathy Kuletz (USFWS); Elizabeth Labunski (USFWS); Wayne Litaker (NOAA); Caitlin McKinstry (PWSSC); Dan Monson (USGS); Michael Opheim (Seldovia Tribes Environmental Coordinator); Heather Renner(USFWS); Jessica Shepard (UAA/KBNERR); Pat Tester (NOAA/OceanTester); Deb Tobin (UAA); E. Jamie Trammel (UAA); Marc Webber (USFWS); Tom Weingartner (UAF); Jeff Williams (USFWS).

Curriculum Vitae

Kristine (Kris) Holderied
National Oceanic and Atmospheric Administration (NOAA) Kasitsna Bay Laboratory
95 Sterling Highway, Suite 2, Homer, Alaska 99603 907-235-4004 *kris.holderied@noaa.gov*

EDUCATION

Massachusetts Institute of Technology-Woods Hole Oceanographic Institution Joint Program,
M.S. 1988, Physical Oceanography, Cambridge MA. (Satellite scatterometer wind study)
U.S. Naval Academy, B.S. 1984, Oceanography, Annapolis MD. Valedictorian.

WORK EXPERIENCE

Director/Supervisory Physical Oceanographer: 09/2005- present
NOAA, National Centers for Coastal Ocean Science (NCCOS), Kasitsna Bay Laboratory. Homer, AK

Physical Scientist: 06/2000-09/2005
NOAA, NCCOS, Center for Coastal Monitoring and Assessment. Silver Spring, MD

Graduate Research Assistant: 11/1996-06/2000
Old Dominion University, Center for Coastal Physical Oceanography. Norfolk, VA

Oceanographer: 01/1992-11/1996
U.S. Army Corps of Engineers, Norfolk District. Norfolk, VA

Systems Engineer (acoustics): 11/1991-01/1992
GE Government Services. Norfolk, VA

Naval Officer (Oceanographer): 05/1984-09/1991
U.S. Navy active duty - Rota, Spain; Cambridge, MA; Norfolk, VA; Bay St Louis, MS

RELEVANT PUBLICATIONS

- Hoem Neher, T. et al. In Review. Quantifying Temporal and Spatial Ecosystem Variability Across the Northern Gulf of Alaska to Understand Mechanisms of Change. Science Synthesis report to the *Exxon Valdez* Oil Spill Trustee Council. 256 pp.
- Holderied K. and T. Weingartner. In review. Linking Variability in Oceanographic Patterns Between Nearshore and Shelf Waters Across the Gulf of Alaska. In Quantifying Temporal and Spatial Ecosystem Variability Across the Northern Gulf of Alaska to Understand Mechanisms of Change. Science Synthesis report to the *Exxon Valdez* Oil Spill Trustee Council. Chapter 2, pp. 26-36.
- Sigler M.F, R. J. Foy, M. Carls, M. Dalton, L. B. Eisner, K. Holderied, T. P. Hurst, J. F. Morado, P. Stabeno, and R. P. Stone. 2010. NOAA Alaska Region Ocean Acidification Research Plan. Chapter 2 in: NOAA Ocean Acidification Steering Committee. NOAA Ocean and Great Lakes Acidification Research Plan. NOAA Special Report. 143pp.
- Valle-Levinson, A., K. Holderied, C. Li, and R. J. Chant. 2007. Subtidal flow structure at the turning region of a wide outflow plume. J. Geophys. Res. 112. C04004, doi:10.1029/2006JC003746.
- Stumpf, R., S. Dunham, L. Ojanen, A. Richardson, T. Wynne, K. Holderied. 2005. Characterization and Monitoring of Temperature, Chlorophyll, and Light Availability Patterns in National Marine Sanctuary Waters: Final Report. NOAA NCCOS Technical Memorandum 13. Silver Spring, MD. 56 pp.
- National Oceanic and Atmospheric Administration. 2003. Atlas of the Shallow-Water Benthic Habitats of the Northwestern Hawaiian Islands. 160 pp.

- Stumpf, R.P., K. Holderied, and M. Sinclair. 2003. Determination of water depth with high-resolution satellite imagery over variable bottom types. *Limnology and Oceanography*, v. 48(1, part 2), pp. 547-556.
- Caceres, M., A. Valle-Levinson, H.H. Sepulveda, and K. Holderied. 2002. Transverse variability of flow and density in a Chilean fjord. Continental Shelf Research, v. 22(11-13), pp. 1683-1698.

COLLABORATORS IN PAST FOUR YEARS

Apeti, Dennis (NOAA/NOS/NCCOS), Arimitsu, Mayumi (USGS), Ballachey, Brenda (USGS), Bochenek, Rob (Axiom Consulting), Bodkin, Jim (USGS), Batten, Sonia (Sir Alister Hardy Foundation for Ocean Science), Bishop, Mary Ann (PWSSC), Brainard, Starr (NOAA Hollings Scholar), Buckelew, Stacey (Axiom Data Science), Cammarata, Charlayna (NOAA Hollings Scholar), Campbell, Rob (PWSSC), Claar, Danielle (NOAA Hollings Scholar), Coletti, Heather (USNPS), Dean, Tom (Coastal Resources Associates, Inc), Delmaine, Avery (University of North Carolina Wilmington intern), Doroff, Angela (Kachemak Bay National Estuarine Research Reserve), Dugan, Darcy (Alaska Ocean Observing System), Field, Don (NOAA/NOS/NCCOS), Hartwell, Ian (NOAA/NOS/NCCOS), He, Jing (Middlebury College intern), Hoffman, Katrina (PWSSC), Hollmann, Rebecca (NOAA Hollings Scholar), Holman, Amy (NOAA), Hollmen, Tuula (Alaska Sea Life Center), Hondolero, Dominic (NOAA/NOS/NCCOS), Hopcroft, Russ (University of Alaska Fairbanks), Iken, Katrin (UAF), Irons, David (USFWS), Ko, Stanley (NOAA Hollings Scholar), Konar, Brenda (UAF), Lanerolle, Lyon (NOAA/NOS/Office of Coast Survey), Litaker, Wayne (NOAA/NOS/NCCOS), Mathis, Jeremy (UAF), Matkin, Craig (North Gulf Oceanic Society), McCammon, Molly (AOOS), Moran, John (NOAA/NMFS/AFSC), Neher, Tammy (NOAA/NOS/NCCOS), Opheim, Michael (Seldovia Village Tribe), Patchen, Rich (NOAA/NOS/Office of Coast Survey), Paternostro, Chris ((NOAA/NOS/CO-OPS), Pegau, Scott (Oil Spill Recovery Institute), Piatt, John (USGS), Pickens, Chris (NOAA Hollings Scholar), Rear-McLaughlin, Laura (NOAA/NOS/CO-OPS), Rice, Jeep (NOAA/NMFS/AFSC), Rosenberg, Lily (Mt Holyoke College intern), Roy, Emily (University of Massachusetts Amherst intern), Seaman, Glenn (consultant), Sethi, Suresh (USFWS), Tester, Pat (NOAA/NOS/NCCOS), Thompson, Terry (KBNERR), Weingartner, Tom (UAF)

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$47.2	$49.3	$50.8	$49.6	$53.3	$250.3	
Travel	$7.9	$7.6	$10.5	$8.6	$9.1	$43.7	
Contractual	$74.8	$76.8	$80.3	$38.9	$31.4	$302.2	
Commodities	$11.0	$11.5	$11.5	$12.5	$12.5	$59.0	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*will vary by proposer*)	$14.8	$14.8	$15.2	$14.9	$16.0	$75.6	
SUBTOTAL	$155.7	$160.0	$168.2	$124.5	$122.3	$730.8	
General Administration (9% of subtotal)	$14.0	$14.4	$15.1	$11.2	$11.0	$65.8	N/A
PROJECT TOTAL	$169.7	$174.4	$183.4	$135.7	$133.3	$796.5	
Other Resources (Cost Share Funds)	$205.0	$213.0	$215.0	$217.0	$194.0	$1,044.0	

COMMENTS:
This is the combined budget for the individual Doroff and Holderied budgets that follow. Doroff is affiliated with the University of Alaska Anchorage, a Non-Trustee Agency, and Holderied is affiliated with NOAA, a Trustee Agency. The budgets have been combined by using a Non-Trustee Agency budget reporting form. This form contains the summary information only. Detail by year for each PI can be found in the following two worksheets.
Cost Share Funds, Doroff: $120K for KBNERR water quality and meteorology long-term monitoring and $5K for CTD uses for a total of $125K/year
Cost Share Funds, Holderied: Annual in-kind support of $50K in NOAA salary (increased annually), $5K for CTD use, $6K for small boat use (~$61K/yr).
Leveraged Funds, Holderied: $25K/yr from AOOS (FY17-20), subject to availability of federal funding.

FY17-21

Project Title: Lower Cook Inlet Oceanographic
Primary Investigators: Angela Doroff (UAA, KBNERR) & Kris Holderied (NOAA)

NON-TRUSTEE AGENCY SUMMARY PAGE

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$47.2	$49.3	$50.8	$49.6	$53.3	$250.3	
Travel	$2.4	$2.0	$2.0	$2.0	$2.5	$10.8	
Contractual	$5.5	$4.0	$4.0	$4.0	$4.0	$21.5	
Commodities	$4.0	$4.0	$4.0	$4.0	$4.0	$20.0	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*25%*)	$14.8	$14.8	$15.2	$14.9	$16.0	$75.6	
SUBTOTAL	$73.8	$74.1	$75.9	$74.5	$79.8	$378.2	
General Administration (9% of subtotal)	$6.6	$6.7	$6.8	$6.7	$7.2	$34.0	N/A
PROJECT TOTAL	$80.5	$80.8	$82.8	$81.2	$87.0	$412.3	
Other Resources (Cost Share Funds)	$125.0	$125.0	$125.0	$125.0	$125.0	$625.0	

COMMENTS:
Cost Share Funds: $120K for KBNERR water quality and meteorology long-term monitoring and $5K for CTD uses for a total of $125K/year

FY17-21

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

NON-TRUSTEE AGENCY SUMMARY PAGE

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Angela Doroff	Research Coordinator	2.8	12.0	0.0	33.6
Jame Schlomer	Biological Technician	2.3	4.7	0.0	10.8
Steve Baird	Research Analyst	0.3	11.2	0.0	2.8
Dana Nelson	Education Coordinator	0.0	4.7	0.0	0.0
Rosie Robinson	Biological Technician	0.0	4.7	0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	37.3	0.0	
				Personnel Total	$47.2

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
EVOS PI Meeting	0.3	1	4	0.1	0.7
AMSS	0.3	1	5	0.1	0.8
lodging			9	0.1	0.9
Taxi			2	0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.4

FY17

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
CTD Calibration	3.0
YSI Bear Cove Sonde Calibration	1.0
Bear Cove Nutrient Analyses	1.5
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$5.5

Commodities Costs: Description	Commodities Sum
Zooplankton supplies(jars, shipping, nets)	1.7
SBE tools and upgrades	0.5
Rite-in-Rain paper/labels, notebooks, pens	0.3
ship/boat safety gear	0.5
Boat fuel	1.0
Commodities Total	$4.0

FY17

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
None	0.0	0.0	0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
SBE19+ CTD	1	KBNERR
60cm dia 333mircron mesh bongo nets	1	KBNERR
Davet/lines/weights	multiple	KBNERR
YSI Buoy	1	KBNERR
EXO II water quality data sondes	2	KBNERR
Phytoplankton Nets, bottles, & preservation supplies	multiple	KBNERR
25ft Boston Whaler	1	KBNERR

FY17

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Angela Doroff	Research Coordinator	2.8	12.3	0.0	34.4
James Schlomer	Biological Technician	2.5	4.8	0.0	12.0
Steve Baird	Research Analyst	0.3	11.5	0.0	2.9
Dana Nelson	Education Coordinator	0.0	4.8	0.0	0.0
Rosie Robinson	Biological Technician	0.0	4.8	0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	38.2	0.0	
				Personnel Total	$49.3

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
EVOS PI Meeting	0.3	1	4	0.1	0.5
AMSS	0.3	1	5	0.1	0.6
lodging			9	0.1	0.9
Taxi			2	0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.0

FY18

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
CTD Calibration	2.5
YSI Bear Cove Sonde Calibration	0.7
Bear Cove Nutrient Analyses	0.8
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$4.0

Commodities Costs: Description	Commodities Sum
Zooplankton supplies (jars, shipping, nets)	1.7
SBE tools and upgrades	0.5
Rite-in-Rain paper/labels, notebooks, pens	0.3
ship/boat safety gear	0.5
Boat fuel	1.0
Commodities Total	$4.0

FY18

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
None	0.0	0.0	0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
SBE19+ CTD	1	KBNERR
60cm dia 333mircron mesh bongo nets	1	KBNERR
Davet/lines/weights	multiple	KBNERR
YSI Buoy	1	KBNERR
EXO II water quality data sondes	2	KBNERR
Phytoplankton Nets, bottles, & preservation supplies	multiple	KBNERR
25ft Boston Whaler	1	KBNERR

FY18

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Angela Doroff	Research Coordinator	2.8	12.7	0.0	35.6
James Schlomer	Biological Technician	2.5	4.9	0.0	12.3
Steve Baird	Research Analyst	0.3	11.8	0.0	3.0
Dana Nelson	Education Coordinator	0.0	4.9	0.0	0.0
Rosie Robinson	Biological Technician	0.0	4.9	0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	39.2	0.0	
				Personnel Total	$50.8

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
EVOS PI Meeting	0.3	1	4	0.1	0.5
AMSS	0.3	1	5	0.1	0.6
lodging			9	0.1	0.9
Taxi			2	0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.0

FY19

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
CTD Calibration	2.5
YSI Bear Cove Sonde Calibration	0.5
Bear Cove Nutrient Analyses	1.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$4.0

Commodities Costs: Description	Commodities Sum
Zooplankton supplies (jars, shipping, nets)	1.7
SBE tools and upgrades	0.5
Rite-in-Rain paper/labels, notebooks, pens	0.3
ship/boat safety gear	0.5
Boat fuel	1.0
Commodities Total	$4.0

FY19

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
SBE19+ CTD	1	KBNERR
60cm dia 333mircron mesh bongo nets	1	KBNERR
Davet/lines/weights	multiple	KBNERR
YSI Buoy	1	KBNERR
EXO II water quality data sondes	2	KBNERR
Phytoplankton Nets, bottles, & preservation supplies	multiple	KBNERR
25ft Boston Whaler	1	KBNERR

FY19

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Angela Doroff	Research Coordinator	2.8	13.0	0.0	36.4
James Schlomer	Biological Technician	2.0	5.1	0.0	10.2
Steve Baird	Research Analyst	0.3	12.1	0.0	3.0
Dana Nelson	Education Coordinator	0.0	5.1	0.0	0.0
Rosie Robinson	Biological Technician	0.0	5.1	0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	40.4	0.0	
				Personnel Total	$49.6

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
EVOS PI Meeting	0.3	1	4	0.1	0.5
AMSS	0.3	1	5	0.1	0.6
lodging			9	0.1	0.9
Taxi			2	0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.0

FY20

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
CTD Calibration	2.7
YSI Bear Cove Sonde Calibration	0.5
Bear Cove Nutrient Analyses	0.8
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$4.0

Commodities Costs: Description	Commodities Sum
Zooplankton supplies (jars, shipping, nets)	1.7
SBE tools and upgrades	0.5
Rite-in-Rain paper/labels, notebooks, pens	0.3
ship/boat safety gear	0.5
Boat fuel	1.0
Commodities Total	$4.0

FY20

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
SBE19+ CTD	1	KBNERR
60cm dia 333mircron mesh bongo nets	1	KBNERR
Davet/lines/weights	multiple	KBNERR
YSI Buoy	1	KBNERR
EXO II water quality data sondes	2	KBNERR
Phytoplankton Nets, bottles, & preservation supplies	multiple	KBNERR
25ft Boston Whaler	1	KBNERR

FY20

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Angela Doroff	Research Coordinator	2.8	13.3	0.0	37.2
James Schlomer	Biological Technician	2.0	5.2	0.0	10.4
Steve Baird	Research Analyst	0.3	12.4	0.0	3.1
Dana Nelson	Education Coordinator	0.1	5.2	0.0	0.5
Rosie Robinson	Biological Technician	0.4	5.2	0.0	2.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	41.3	0.0	
				Personnel Total	$53.3

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
EVOS PI Meeting	0.3	1	4	0.1	0.5
AMSS	0.3	1	5	0.1	0.6
lodging			9	0.1	0.9
Taxi			1	0.0	0.0
one additional conference TBD	0.3	1	4	0.1	0.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.5

FY21

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
CTD Calibration	2.7
YSI Bear Cove Sonde Calibration	0.5
Bear Cove Nutrient Analyses	0.8
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$4.0

Commodities Costs: Description	Commodities Sum
Zooplankton supplies (jars, shipping, nets)	1.7
SBE tools and upgrades	0.5
Rite-in-Rain paper/labels, notebooks, pens	0.3
ship/boat safety gear	0.5
Boat fuel	1.0
Commodities Total	$4.0

FY21

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
None	0.0	0.0	0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
SBE19+ CTD	1	KBNERR
60cm dia 333mircron mesh bongo nets	1	KBNERR
Davet/lines/weights	multiple	KBNERR
YSI Buoy	1	KBNERR
EXO II water quality data sondes	2	KBNERR
Phytoplankton Nets, bottles, & preservation supplies	multiple	KBNERR
25ft Boston Whaler	1	KBNERR

FY21

Project Title:Lower Cook Inlet Oceanographic
Primary Investigator: Angela Doroff

FORM 3B
EQUIPMENT DETAIL

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Travel	$5.6	$5.6	$8.5	$6.6	$6.6	$32.8	
Contractual	$69.3	$72.8	$76.3	$34.9	$27.4	$280.7	
Commodities	$7.0	$7.5	$7.5	$8.5	$8.5	$39.0	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
SUBTOTAL	$81.9	$85.9	$92.3	$50.0	$42.5	$352.5	
General Administration (9% of subtotal)	$7.4	$7.7	$8.3	$4.5	$3.8	$31.7	N/A
PROJECT TOTAL	$89.2	$93.6	$100.6	$54.5	$46.3	$384.2	
Other Resources (Cost Share Funds)	$80.0	$88.0	$90.0	$92.0	$69.0	$419.0	

COMMENTS:
Cost Share Funds:
In-kind: Annual NOAA Kasitsna Bay Laboratory in-kind contributions of $50K in NOAA salary support (increased annually), $5K for CTD use, and $6K for small boat use.
Leveraged Funds: $25K/yr from AOOS (FY17-20), subject to availability of federal funding.
Contractual costs include personnel support for KBL contractor staff in FY17-19.

FY17-21

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

TRUSTEE AGENCY SUMMARY PAGE

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	0.0	0.0	
				Personnel Total	$0.0

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Gulf Watch Alaska annual PI Meeting, 1 person	0.4	1	4	0.3	1.4
Alaska Marine Science Symposium, 2 people	0.4	2	10	0.3	3.2
Water taxi	0.1	12			1.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$5.6

FY17

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel charter contracts for Cook Inlet surveys	20.5
Data analysis and field sampling support (KBL contractor, Kim Powell)	46.0
CTD calibration	2.8
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$69.3

Commodities Costs: Description	Commodities Sum
Field and boat supplies	1.5
Office supplies	0.5
Boat fuel for KBL small boats	5.0
Commodities Total	$7.0

FY17

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
NOAA Kasitsna Bay Lab 19plus CTD profiler	1	1

FY17

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	0.0	0.0	
				Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Gulf Watch Alaska annual PI Meeting, 1 person	0.4	1	4	0.3	1.4
Alaska Marine Science Symposium, 2 people	0.4	2	10	0.3	3.2
Water taxi	0.1	12			1.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$5.6

FY18

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel charter contracts for Cook Inlet surveys	22.0
Data analysis and field sampling support (KBL contractor, Kim Powell)	48.0
CTD calibration	2.8
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$72.8

Commodities Costs: Description	Commodities Sum
Field and boat supplies	1.0
Office supplies	1.0
Boat fuel for KBL small boats	5.5
Commodities Total	$7.5

FY18

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
NOAA Kasitsna Bay Lab 19plus CTD profiler	1	1

FY18

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	0.0	0.0	
				Personnel Total	$0.0

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Gulf Watch Alaska annual PI Meeting, 1 person	0.4	1	4	0.3	1.6
Alaska Marine Science Symposium, 2 people	0.4	2	10	0.3	3.8
Water taxi	0.1	12			1.1
Joint field work (PWS, Campbell project) to refine sampling protocols	0.5	1	6	0.3	2.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$8.5

FY19

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel charter contracts for Cook Inlet surveys	23.5
Data analysis and field sampling support (KBL contractor, Kim Powell)	50.0
CTD calibration	2.8
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$76.3

Commodities Costs: Description	Commodities Sum
Field and boat supplies	1.0
Office/poster supplies	0.5
Boat fuel for KBL small boats	6.0
Commodities Total	$7.5

FY19

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
NOAA Kasitsna Bay Lab 19plus CTD profiler	1	1

FY19

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	0.0	0.0	
				Personnel Total	$0.0

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Gulf Watch Alaska annual PI Meeting, 1 person	0.4	1	4	0.3	1.6
Alaska Marine Science Symposium, 2 people	0.4	2	10	0.3	3.8
Water taxi	0.1	12			1.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$6.6

FY20

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel charter contracts for Cook Inlet surveys	22.0
Data analysis and field sampling support (KBL contractor)	10.0
CTD calibration	2.9
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$34.9

Commodities Costs: Description	Commodities Sum
Field and boat supplies	1.5
Office supplies	0.5
Boat fuel for KBL small boats	6.5
Commodities Total	$8.5

FY20

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
CONTRACTUAL &
COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
NOAA Kasitsna Bay Lab 19plus CTD profiler	1	1

FY20

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
				0.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	0.0	0.0	
				Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Gulf Watch Alaska annual PI Meeting, 1 person	0.4	1	4	0.3	1.6
Alaska Marine Science Symposium, 2 people	0.4	2	10	0.3	3.8
Water taxi	0.1	12			1.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$6.6

FY21

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel charter contracts for Cook Inlet surveys	24.5
Data analysis and field sampling support (KBL contractor)	0.0
CTD calibration	2.9
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$27.4

Commodities Costs: Description	Commodities Sum
Field and boat supplies	1.5
Office supplies	0.5
Boat fuel for KBL small boats	6.5
Commodities Total	$8.5

FY21

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
NOAA Kasitsna Bay Lab 19plus CTD profiler	1	1

FY21

Project Title: Cook Inlet/Kachemak Bay Oceanography
Primary Investigator: Kris Holderied
Agency: NOAA

FORM 4B
EQUIPMENT DETAIL