EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
FY19 (YEAR 8) CONTINUING PROJECT PROPOSAL SUMMARY PAGE

Project Number and Title

Gulf Watch Alaska: Nearshore Component Project

19120114-H—Nearshore ecosystems in the Gulf of Alaska

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Project Abstract

Nearshore monitoring in the Gulf of Alaska (GOA) provides ongoing evaluation of the status and trend of more than 200 species, including many of those injured by the 1989 *Exxon Valdez* oil spill (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. We would expect a lag in recovery in these latter two regions as the disease seemed to move across the GOA from the east to the west; however, total star counts remain low across all sites following the large sea star die-off that began in 2015. We also initiated marine bird and mammal surveys and black oystercatcher productivity monitoring as well as increased sea otter foraging data collection efforts in FY18 in KBAY. We are not proposing any major changes to this project or budget for FY19.

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

FY17	FY18	FY19	FY20	FY21	TOTAL
$401,900	**$452,700**	**$411,400**	**$402,300**	**$402,800**	**$2,071,000**

Non-EVOSTC Funds to be used, please include source and amount per source: (see Section 6C for details)

FY17	FY18	FY19	FY20	FY21	TOTAL
$410,000	**$410,000**	**$410,000**	**$392,000**	**$392,000**	**$2,014,000**

1. PROJECT EXECUTIVE SUMMARY

Nearshore marine ecosystems face significant challenges at global and regional scales, with threats arising from both the adjacent lands and oceans. An example of such threats was the 1989 grounding of the T/V *Exxon Valdez* in Prince William Sound (PWS). An important lesson arising from this event, as well as similar events around the world, was that understanding the structure and function of the ecosystem and the processes that drive it are essential when responding to and managing present and anticipated threats.

The nearshore is broadly recognized as highly susceptible and sensitive to natural and human disturbances on a variety of temporal and spatial scales (reviewed in Valiela 2006, Bennett et al. 2006, Dean and Bodkin 2006, Dean et al. 2014). For example, changes in nearshore systems have been attributed to such diverse causes as global climate change (e.g., Barry et al. 1995, Sagarin et al. 1999, Hawkins et al. 2008, Hoegh-Guldberg and Bruno 2010, Doney et al. 2012), earthquakes (e.g., Baxter 1971, Noda et al., 2015), oil spills (e.g., Peterson 2001, Peterson et al. 2003, Bodkin et al. 2014), human disturbance and removals (e.g., Schiel and Taylor 1999, Crain et al. 2009, Fenberg and Roy 2012), and influences of invasive species (e.g., Jamieson et al. 1998, O'Connor 2014). Nearshore systems are especially good indicators of change because organisms in the nearshore are relatively sedentary, accessible, and manipulable (e.g., Dayton 1971, Sousa 1979, Peterson 1993, Lewis 1996). In contrast to other marine habitats, there is a comparatively thorough understanding of mechanistic links between species and their environment (e.g., Connell 1972, Paine 1974, 1977, Estes et al. 1998, Menge and Menge 2013, Menge et al. 2015) that facilitates understanding causes for change. Many of the organisms in the nearshore are sessile or have relatively limited home ranges, providing a geographic link to sources of change. Nearshore habitats likely will have meaningful changes in the future, and we will be able to detect relatively localized sources of change, assess human induced vs. naturally induced changes, and provide suggestions for management of human impacts.

The Nearshore Component of the Gulf Watch Alaska (GWA) long-term monitoring project investigates and monitors the nearshore environment of the greater *Exxon Valdez* oil spill (EVOS) area, with focus on selected elements of the nearshore food web (Fig. 1). Our overarching goal is to understand drivers of variation in the Gulf of Alaska (GOA) nearshore ecosystem. The foundational hypotheses of the Nearshore Project include: (1) What are the spatial and temporal scales over which change in nearshore ecosystems is observed? (2) Are observed changes related to broad-scale environmental variation, local perturbations, or underlying ecological processes? (3) Does the magnitude and timing of changes in nearshore ecosystems correspond to those measured in pelagic ecosystems? The design features of the nearshore monitoring project include a rigorous site selection process that allows statistical inference over various spatial scales (e.g., GOA and regions within the GOA) as well as the capacity to evaluate potential impacts from more localized sources, especially those resulting from human activities, including lingering effects of EVOS (Fig. 2). In addition to detecting change at various spatial scales, design features incorporate both static (e.g., substrate, exposure, and bathymetry) and dynamic (e.g., variation in oceanographic conditions, productivity, and predation) drivers as potential mechanisms responsible for change. More than 200 species dependent on nearshore habitats, many with well-recognized ecological roles in the nearshore food web, are monitored annually within four regional blocks in the GOA. Evaluation of those species over time in relation to well-defined static and dynamic drivers will allow accurate and defensible measures of change and support management and policy needs addressing nearshore resources both within the GOA and globally.

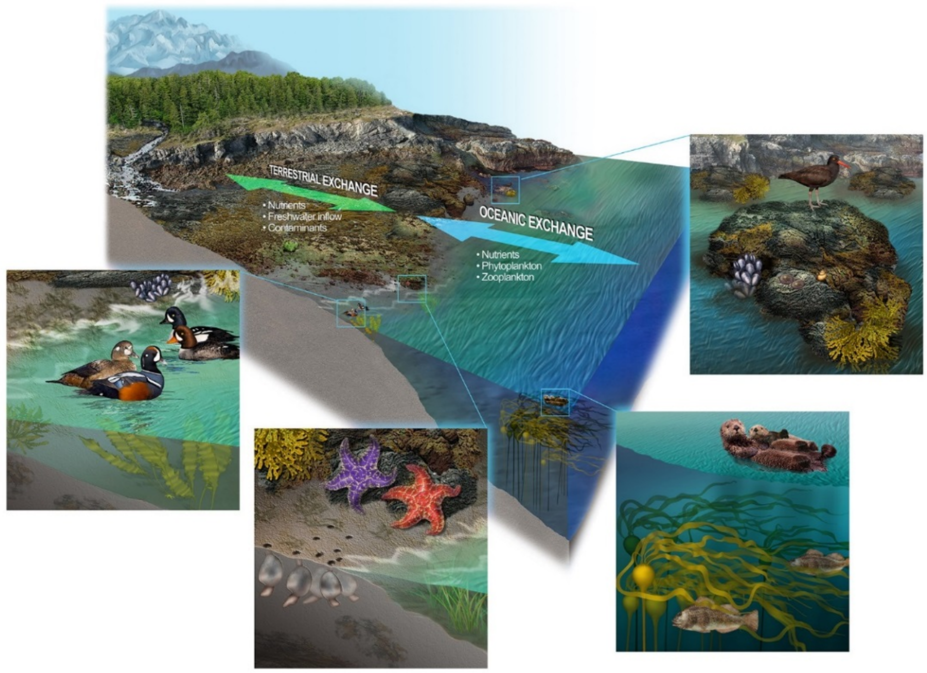

Figure 1. Conceptual illustration of the nearshore food web with terrestrial and oceanic influences indicated. Sea otters, black oystercatchers, sea ducks and sea stars act as the top-level consumers in a system where primary productivity originates mostly from the macroalgae and sea grass and moves through benthic invertebrates to the top-level consumers.

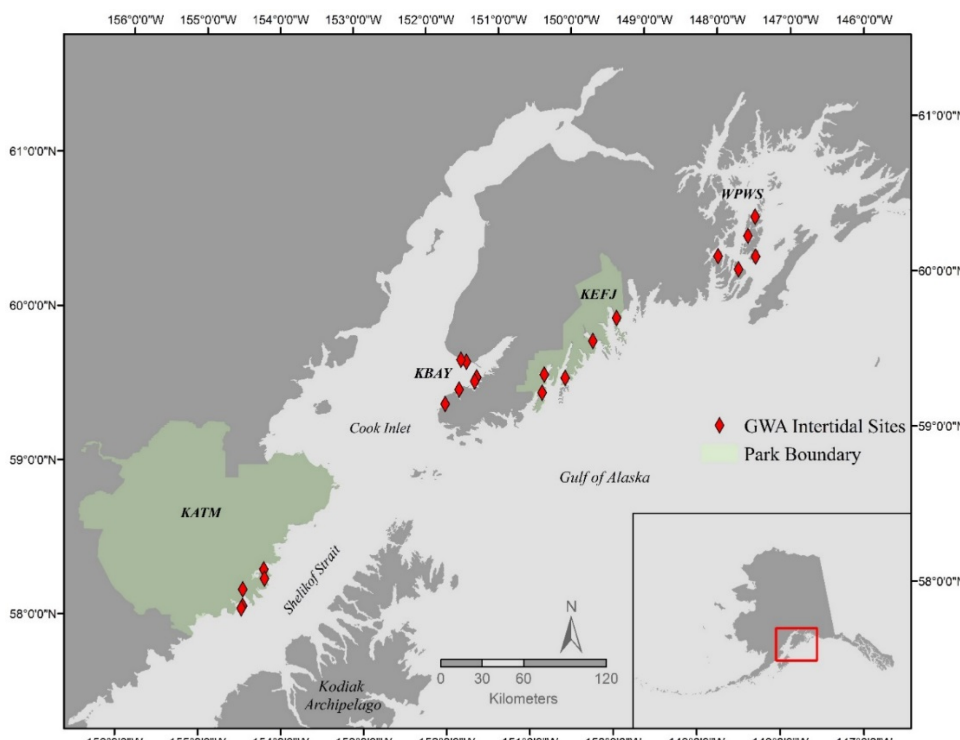

Figure 2. Map showing study sites within Katmai National Park and Preserve (KATM), Kachemak Bay (KBAY), Kenai Fjords National Park (KEFJ), and Western Prince William Sound (WPWS). The red diamonds represent rocky intertidal sites that act as a central point to established monitoring sites or transects of several other marine nearshore metrics.

In following our scheduled monitoring plan for GWA, we added upper-trophic level sampling components to KBAY in 2018. We conducted coastal surveys for marine birds and mammals and nesting black oystercatchers in all four regions. We also increased efforts to collect sea otter foraging data in KBAY. These data will be used to aid in population assessment, similar to other nearshore regions in GWA.

Here we present some highlights through 2017 and 2018. These include: (1) nearshore water temperature anomalies through 2017, (2) sea star declines and potential recovery across the GOA through 2018, and (3) sea otter abundance and density estimates across all four regions in the GOA through 2017. For several metrics, 2018 data are still being collected and processed at this time.

Intertidal water temperature anomalies confirm that warm-water anomalies observed offshore in the GOA (i.e., "The Blob") also was expressed in nearshore habitats in May of 2014 across the northern GOA, with temperature sensors showing a similar magnitude of warming in all blocks (Fig. 3). However, we have documented that nearshore environments experience a wider range of extremes than the offshore waters therefore continued monitoring of water quality parameters along the coast is critical to understand biological response to these shifts. Loggers that measured the 2017-2018 season are currently being retrieved and will be downloaded and analyzed for the 2018 GWA annual report. Efforts are also underway to collaborate across GWA projects to examine not only recent ocean temperature anomalies (draft manuscript Monson et al.) but also examining biological responses to those anomalies (draft manuscripts Suryan et al. and Arimitsu et al.).

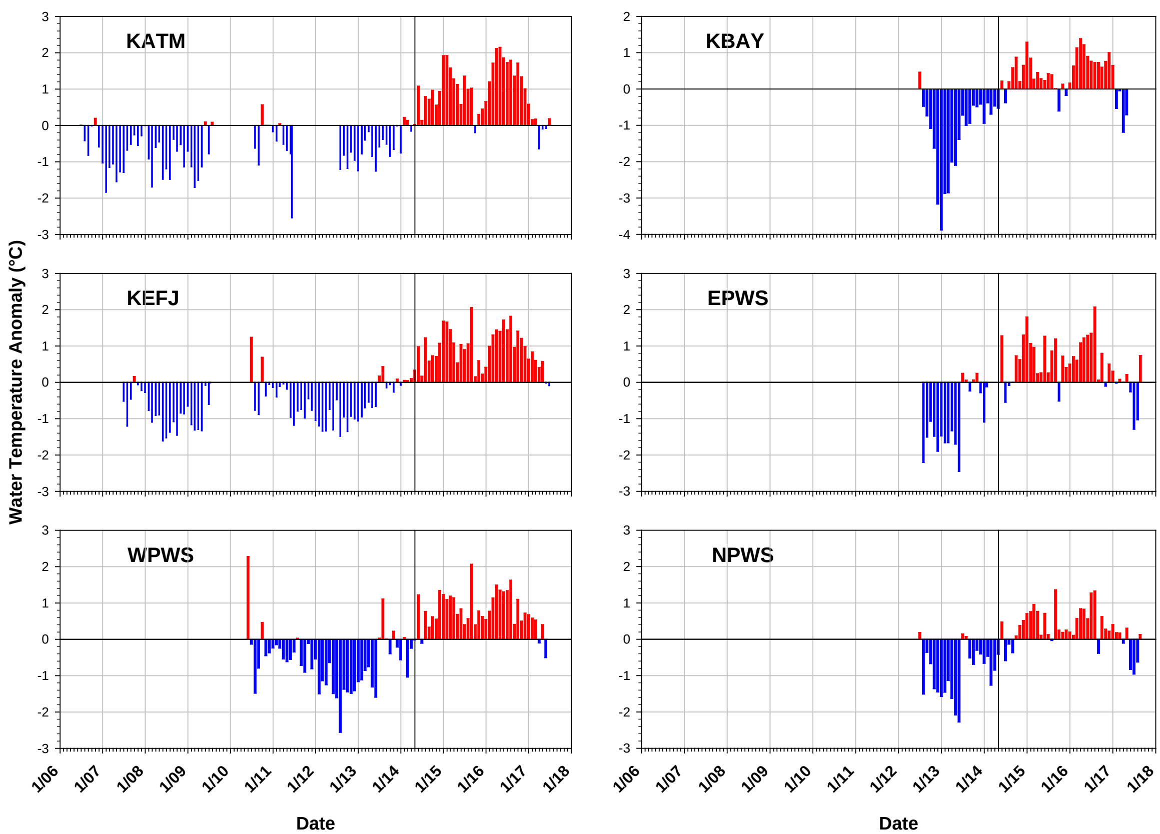

Figure 3. Monthly water temperature anomalies at intertidal sites in the Gulf of Alaska show concordance in timing and magnitude of warming beginning in May 2014 (bolded vertical line).

Sea star observations to date include low densities across all four regions through 2018. This is likely due to the incidence of sea star wasting disease documented in the GOA. Disease specific surveys began in 2014 and incidence of disease has been documented in three of the four regions including WPWS, KBAY and KEFJ. In FY18, sea star observations continue to include some recruitment and recovery in WPWS and KEFJ but not in KBAY or KATM (Fig. 4). We would expect a bit of a lag in recovery in these latter two regions as the disease seemed to move across this region from the east to the west. We initially saw the disease in WPWS, then KEFJ, then KBAY. Continued monitoring of sea stars and their associated communities also will provide insights into the impacts that sea star wasting is having over time.

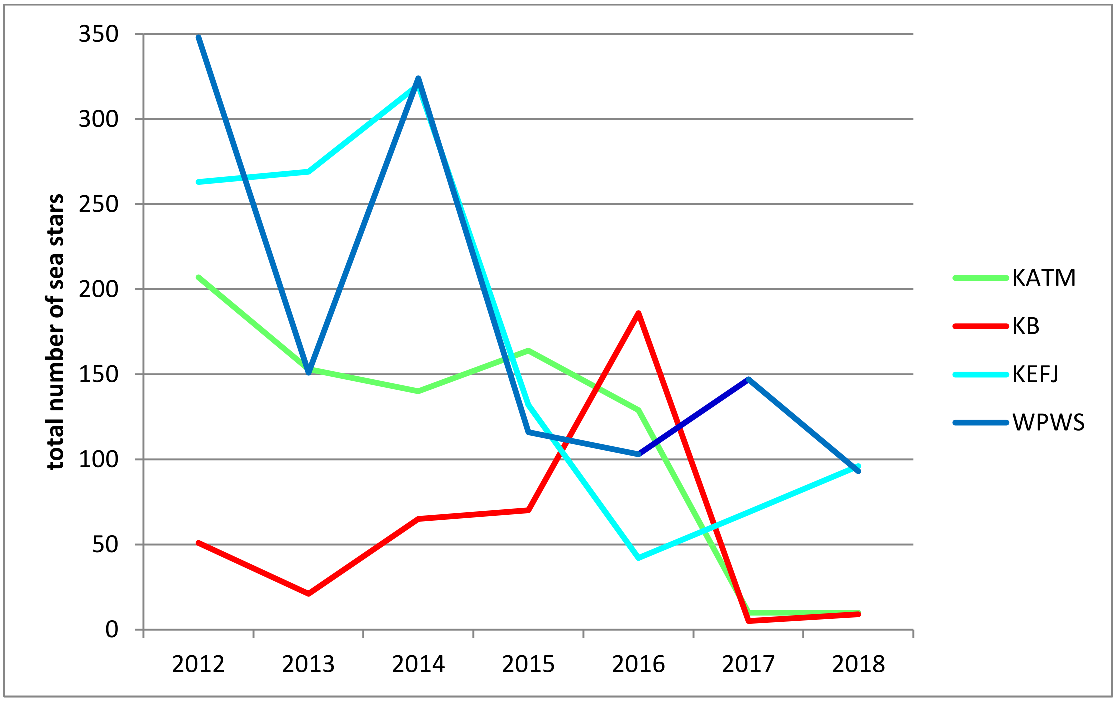

Figure 4. Total number (per 4 x 50 m swath) of sea stars present in each region from 2012-2018.

Data on sea otter population dynamics have revealed that patterns of changes in abundance differ among all four regions. Changes in sea otter populations are driven largely by local conditions, although drivers may vary (e.g., recovery from the EVOS in PWS, recolonization following fur harvest in Katmai and Kachemak Bay, and prey availability in Kenai Fjords) (Coletti et al. 2016). Recent survey results from Kachemak Bay indicate a population that has increased rapidly, achieving high densities, with ramifications to the nearshore foodweb (Fig. 5).

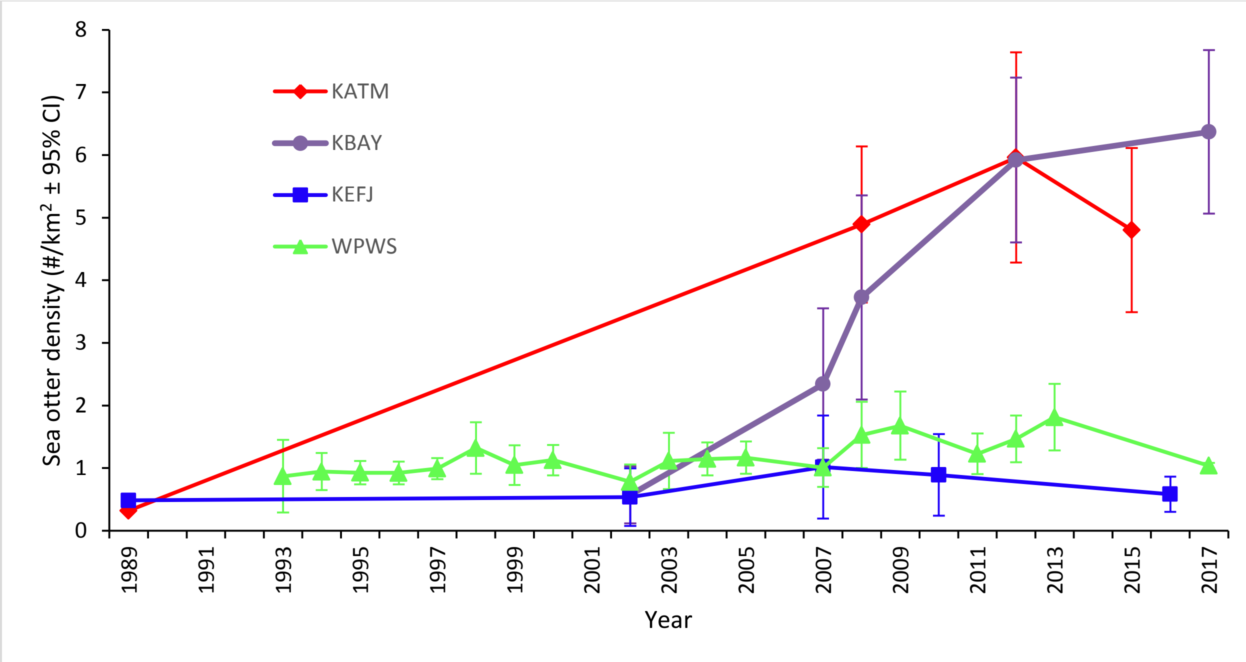

Figure 5. Sea otter densities in KATM, KBAY, KEFJ and WPWS. Error bars indicate 95% CI.

For the second year in a row, in collaboration with the National Park Service (NPS), the GWA nearshore project tested the use of a small Unmanned Aircraft System (UAS) to map intertidal sites along the KATM coast. The elevation data collected by the UAS will allow us to track changes in topography over time, and enable us to correlate species presence and abundance with elevation in the intertidal zone. The high-resolution photographic and elevation data also may be critical for future assessments of ecosystem change due to sea-level rise, earthquakes, or other natural phenomena. Annual collection of UAS based aerial imagery for each site would allow documentation of physical disturbances, which would be valuable when trying to interpret high-frequency variation in community structure within sites (Fig. 6). This year, eleven UAS flights collected imagery over five rocky intertidal sites with both true color and multi-spectral sensors. Structure from Motion (SfM) image processing techniques will be used to generate orthorectified images, 3D hillshades, and digital elevation model (DEM) datasets for each site. These and derivative products will then be used to perform analysis on species presence and abundance, as well as change detection analysis with data from 2017. Next year (FY19), we plan to add KEFJ and KBAY intertidal sites to these efforts.

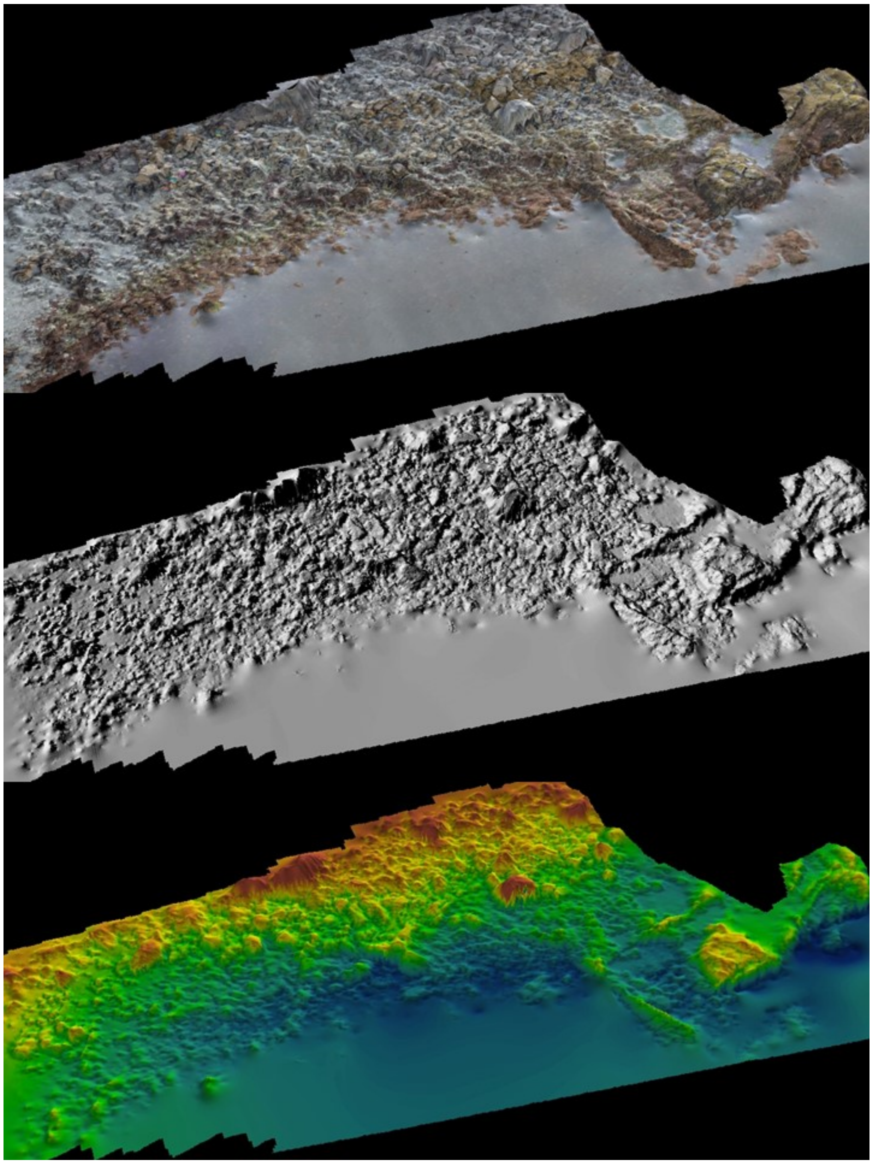

Figure 6. Draft examples of orthophoto mosaic, hillshade, and DEM datasets for the Kaflia, KATM intertidal site.

Our FY19 goals for the nearshore long-term monitoring program are to continue to document the status of the nearshore system by continuing time series, some of which date more than five decades, and many that were initiated soon after the 1989 spill. This information will be synthesized with other components of GWA to identify potential causes of change, including those related to EVOS. We will continue to use existing and new information to address our overarching hypotheses and to communicate those findings to the public, resource managers, and communities across the GOA. We are not proposing any major changes to this project for FY19.

2. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

A. Project Milestones and Tasks

Table 1. Project 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
Milestone 1: Surveys																				
1. Collection of sea otter skulls for determination of age-at-death	C	C			C	C			X	X			X	X			X	X		
2. Annual collection of sea otter diet and energy recovery rate data		C				C				X				X				X		
3. Aerial surveys of sea otter abundance (alternating between KATM, KEFJ and WPWS)		C				C				X				X				X		
4. Sampling of intertidal invertebrates and algae		C				C				X				X				X		
5. Sampling of sea grasses and subtidal kelps		C				C				X				X				X		
6. Diet and productivity of BLOY		C				C				X				X				X		
7. Marine bird and mammal surveys (summer KATM, KEFJ)		C				C				X				X				X		
8. Marine bird and mammal surveys (winter KATM or KEFJ, alternate years)	C				C				X											
Milestone 2: Analyses																				
9. Stable isotope analysis of selected nearshore species		C				C				X				X				X		
10 - Contaminant analysis						C	X	X												
Milestone 3: Reporting																				

Published data sets available			C				C				X				X				X	
Annual Reports	C				C				X				X				X			
Annual PI meeting				C				X				X				X				X
FY Work Plan (DPD)			C				C				X				X					

B. Explanation for not completing any planned milestones and tasks

Samples for contaminant analyses were collected during the second quarter of FY18. Samples will be shipped and analyzed during the third and fourth quarter of FY18. We anticipate results will be provided by the end of FY18.

C. Justification for new milestones/tasks

No new milestones/tasks

3. PROJECT COORDINATION AND COLLABORATION

A. Within an EVOSTC-funded Program

Gulf Watch Alaska

The Nearshore Component of GWA is a highly coordinated effort involving multiple principal investigators (PIs) with expertise on various aspects of nearshore ecosystems; the overall design and coordination are critical for drawing inference about factors affecting the nearshore. Beginning in 2012 under GWA, there were two nearshore projects (16120114-R Nearshore Benthic Systems in the GOA and 16120114-L, Ecological Trends in Kachemak Bay). The two projects have worked closely over the past several years to ensure that data from all sites are comparable when possible, allowing the strongest possible inferences about the causative factors and spatial extent of changes in nearshore systems. For example, data sets were combined across projects for analyses which were published in a peer reviewed journal (Konar et al. 2016). In 2017, the two nearshore projects integrated into a single, coordinated project. We anticipate this will enhance collaboration across the GWA in the nearshore.

An educational collaboration also exists within this project. There are two University of Alaska field courses taught by Konar and Iken at the Kasitsna Bay Lab that assist with data collection for this program. Students get valuable experience and training from participating in the project, and the project benefits from having these students. In addition, the KBAY portion of this project provides summer funding for one graduate student who can dedicate more time to assist in the sampling, sample processing, and outreach.

We have worked closely with the other GWA components (Environmental Drivers and Pelagic) over the previous five years to identify data sets that can be shared. For example, Environmental Drivers data were used extensively in an analysis of mussel trends across the GOA, presented in the GWA Science Synthesis report (Monson et al. 2015). For the next five years (2017-2021), we will explore the spatial and temporal variation in productivity across the nearshore and linkages to physical oceanographic processes. It will be a priority to evaluate whether changes in nearshore systems correlate with oceanographic conditions or with synchronous changes in pelagic species and conditions. The geographic scale of our study (GOA-wide) will provide greater ability to discern both potential linkages across these diverse components, as well as among the study areas within the nearshore, allowing us to evaluate variability and relations among the nearshore resources. We will incorporate data on annual and seasonal patterns measured both in the Environmental Drivers and Pelagic components of the overall GWA study.

Two Pelagic Component projects of the overall GWA program of particular importance to the nearshore are surveys of nearshore marine birds, including summer (19120114-M) and fall-winter (19120114-E) marine bird population trend projects (for additional long-term data sets of marine birds see Irons et al. 2000, Stocking et al. 2018). The nearshore project conducts comparable surveys in KEFJ and KATM, with surveys added to KBAY and in 2018. Contrasting the changes occurring in the pelagic and nearshore environments during the recent years when GOA waters have warmed by several degrees (https://alaskapacificblob.wordpress.com/2016/02/09/subsurface-warmth-persists/) may be particularly illuminating.

Lingering Oil

The Nearshore Component of GWA historically has been closely linked with the Lingering Oil component, given that lingering oil occurs in nearshore habitats and affects nearshore species. Although the EVOSTC has indicated that Lingering Oil will be treated as a separate program in the current 5-year period, the conceptual and collaborative linkages remain. Data collected by the Nearshore Component are relevant for understanding ecosystem recovery with respect to the Lingering Oil Program; for example, sea otter abundance, energy recovery rate, and age-at-death data have been used to evaluate population recovery to this point (Bodkin et al. 2014, Ballachey et al. 2014). Contaminants samples (mussels) collected during the 2018 field season will be analyzed for a broad suite of compounds, including hydrocarbons.

Herring Research and Monitoring

The nearshore component does not have any collaborations to date with the Herring Research and Monitoring program.

Data Management

This project coordinates with the data management program by submitting data and preparing metadata for publication on the Gulf of Alaska Data Portal and DataONE within the timeframes required.

B. With Other EVOSTC-funded Projects

This project will coordinate with other EVOSTC-funded projects as appropriate by providing data, discussing the relevance and interpretation of data, and collaborating on reports and publications.

C. With Trustee or Management Agencies

In addition to the logistical, administrative, and in-kind support that the NPS, U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA) and University of Alaska Fairbanks (UAF) have provided to ensure the success of the GWA Nearshore Component, there are several additional projects with trustee and management agencies that the Nearshore Component of GWA has collaborated with. Below are several recent examples. We expect to continue these kinds of related projects.

NOAA Fisheries

Contributed nearshore indices will be used by NOAA Fisheries (Stephani Zador and Ellen Yasumiishi, Alaska Fisheries Science Center) in the annual stock assessments Ecosystems Considerations Chapter to the North Pacific Fisheries Management Council. The health of nearshore ecosystems informs managers on essential fish habitat and sensitive early life stages of federally managed fish species mandated through the Magnuson-Stevens Act.

NPS sea otters in KEFJ

In 2013, building on GWA findings indicating that sea otters in KEFJ consume mussels at much higher frequencies than at other areas, we initiated a study of annual patterns in mussel energetics and sea otter foraging at KEFJ, funded by NPS and USGS. The field portion of the study was completed in 2016. Lab analyses have been completed. Initial data analyses indicate that mussel energy density varies seasonally, likely corresponding to spawning condition. Further, we found that mussel consumption by otters varied slightly seasonally in association with varying mussel energy density, but overall mussel consumption was high in KEFJ across seasons.

NPRB sea otter study

Our GWA nearshore data from KATM contributed to USGS and North Pacific Research Board (NPRB) studies of the status of the southwest Alaska stock of sea otters, which is listed as threatened under the Marine Mammal Protection Act. These data are shared with the U.S. Fish and Wildlife Service, Marine Mammals Management, who is responsible for sea otter management (NPRB Project 717 Final Report, Estes, Bodkin and Tinker 2010).

NPS Changing Tides

Nearshore GWA PIs (Ballachey, Bodkin, Coletti, and Esler) are working with NPS on the 'Changing Tides' Project. This study examines the linkages between terrestrial and marine ecosystems and is funded by the National Park Foundation. Field work was initiated in July 2015 with in-kind support from our KATM vessel charter. National Parks in Southwest Alaska are facing a myriad of management concerns that were previously unknown for these remote coasts, including increasing visitation, expanded commercial and industrial development, and environmental changes due to natural and anthropogenic forces. These are concerns because of their potential to significantly degrade and potentially impair resources in coastal systems. The project has three key components: (1) brown bear fitness and use of marine resources, (2) health of bivalves (clams and mussels), and (3) an integrated outreach program. We (GWA Nearshore Component) assisted with the collection of a variety of bivalve species from the coast of KATM. Several specimens were kept live in small aquarium-like containers, and condition and performance metrics were assessed in the laboratory by Alaska SeaLife Center collaborators Tuula Hollmen and Katrina Counihan. Others are being used to perform genetic transcription diagnostics (gene expression) to measure the physiologic responses of individuals to stressors, in collaboration with Liz Bowen and Keith Miles of USGS. This project will increase our understanding of how various stressors may affect both marine intertidal invertebrates and bear populations at multiple spatial and temporal scales. Additional work examining the interaction between bears and marine mammals was added in 2016 (initiated by D. Monson). Previously, it was generally believed that bears likely utilize marine mammals via scavenging of beached carcasses. This component will shed light on the importance of marine mammals (primarily sea otters and harbor seals) as live prey taken on offshore islands along the Katmai coast.

BOEM Nearshore community assessments

Nearshore Component PIs (Coletti, Iken, Konar, and Lindeberg) have been working on the development of recommendations to the Bureau of Ocean Energy Management (BOEM) for nearshore community assessment and long-term monitoring. The BOEM Proposed Final Outer Continental Shelf (OCS) Oil and Gas

Leasing Program 2012-2017 included proposed Lease Sale 244 in the Cook Inlet Planning Area in 2017. Until this leasing program, an OCS Cook Inlet Lease Sale National Environmental Policy Act analysis had not been undertaken since 2003. Updated nearshore information was needed to support the environmental analyses associated with the planned lease sale. The overall objective of this study is to provide data on habitats and sensitive species to support environmental analyses for NEPA documents, potential future Exploration Plans, and Development and Production Plans. Throughout this process, a goal has been to utilize existing nearshore monitoring protocols already developed through GWA when possible to ensure data comparability across all reagions. The project will be ongoing through 2019 and, in addition to providing the data to BOEM, all data are being provided to the Alaska Ocean Observing System Gulf of Alaska Data Portal.

CMI Nearshore food webs in Cook Inlet

Funded through the Coastal Marine Institute (CMI), a partnership between BOEM and UAF, GWA PIs Iken and Konar are working with a student on analyzing food web structure in western Cook Inlet (above-mentioned BOEM project) and at GWA sites in Kachemak Bay. This adds valuable information about the energetic links among the species that are analyzed for their abundance and distribution through GWA.

Drones to collect monitoring data in Kachemak Bay

Nearshore GWA PIs (Iken and Konar) tested the use of UASs for various aspects of coastal biological monitoring in KBAY. With BOEM funding, UASs were compared to traditional methods of rocky intertidal and seagrass sampling with some success and suggestions for future work (Konar and Iken, 2018). After this success, UASs were tested to determine their feasibility to complete sea otter foraging observations in KBAY with USGS funding (Monson and Weitzman). We anticipate using UASs to map intertidal sites in KBAY and KEFJ during FY19. The proposed work will be primarily funded by NPS.

The Pacific nearshore project

In kind support from GWA and NPS was provided to the Pacific Nearshore Project (https://pubs.usgs.gov/fs/2010/3099/) that investigated methods to asses overall health of nearshore ecosystems across the north Pacific. In particular, samples were collected during GWA trips to KATM and WPWS to examine the sources of primary productivity to two fish species that differed in their feeding mode (kelp greenling/nearshore benthic vs. black rockfish/pelagic). Stable isotope analyses showed that both benthic foraging and pelagic foraging fish species derive their energy from a combination of macro- (kelps) and micro-algae (phytoplankton) sources (von Biela 2016a). Initial stable isotope analyses from across the GOA of a variety of nearshore invertebrates supports the concept that kelps are a primary contributor of carbon to nearshore ecosystems in the GOA (unpublished data). Further work was completed by von Biela et al. (2016b), with support from GWA, examining the role of local and basin-wide ocean conditions on growth rates of benthic foraging and pelagic foraging fish species. In 2018, we initiated a pilot study to build on the Pacific Nearshore Project by sampling fish and mussels across all four regions. Objectives are to 1) examine how variable relative contributions of macroalgae and phytoplankton to nearshore intertidal mussels and subtidal fishes are over space and time; 2) examine variation in the relative contributions of primary producers and determine if it is related to growth performance; and 3) assess annual growth rates of mussels and fish to determine if they are synchronous with other GWA environmental drivers or indicators of productivity in nearshore or pelagic ecosystems.

Nearshore ecosystem responses to glacial inputs

Nearshore GWA PIs (Esler, Coletti, Weitzman), in collaboration with NPS and UAF, have submitted proposals to NPS aimed at documenting variation in nearshore physical oceanography in relation to tidewater glacial input, and quantify biological responses to that variation across trophic levels in Kenai Fjords National Park. This work will allow prediction of changes in nearshore ecosystems in the face of ongoing glacier mass loss and retreat from the marine environment. This proposed work relies heavily on GWA nearshore monitoring data and will build on our understanding of nearshore marine processes.

In collaboration with researchers at University of Alaska Anchorage (UAA) and University of Alaska Southeast (UAS), nearshore GWA PIs (Konar and Iken) have a proposal pending with the National Science Foundation to examine how the timing, duration, and character of the freshwater flux from precipitation vs glacial melt influences nearshore biological communities. This work will examine an array of sites from southeast Alaska to Kachemak Bay.

4. PROJECT DESIGN

A. Overall Project Objectives

The fundamental objective of this work is the continued long-term monitoring of a suite of nearshore species at multiple locations across the Gulf of Alaska, with an overall goal of understanding drivers of variation in the GOA nearshore ecosystem and understanding pathways to recovery of EVOS affected resources.

The specific objectives for the nearshore component are:

1. To determine status and detect patterns of change and variation in a suite of nearshore species and communities.
2. Identify temporal and spatial extent of observed changes and variation.
3. Identify potential causes of change or variation in biological communities.
4. Communicate results to the public and to resource managers to preserve nearshore resources.
5. Continue restoration monitoring in the nearshore in order to evaluate the current status of injured resources in oiled areas and identify factors potentially affecting present and future trends in population status.

B. Changes to Project Design and Objectives

No changes have been made to the project design or objectives.

5. PROJECT PERSONNEL – CHANGES AND UPDATES

We anticipate continued support from M. Lindeberg (NOAA), A. Miller (NPS), and other USGS and NPS scientific staff, will continue the data collection and sampling across all four regions. This team of scientists has an extensive background of research efforts in coastal marine areas of Alaska.

We anticipate a team approach to the overall field work effort, with shared personnel across areas wherever possible, to ensure consistency of data collection and enhance our understanding of comparisons and contrasts across areas. We will attend an annual meeting of the larger group of scientists involved in the overall long-term monitoring; but also expect that we will continue to work closely together as a sub-group and to meet less formally as required throughout each year.

6. PROJECT BUDGET FOR FY19

A. *Budget Forms (See GWA FY19 Budget Workbook)*

Please see project budget forms compiled for the program.

B. *Changes from Original Project Proposal*

No changes to the overall Nearshore budget have been made; however, a few items have been re-allocated within the project. For FY18 - FY21, the $6,000.00 allocated to USGS (Coletti and Esler) for stable isotope analyses have been moved to UAF (Konar and Iken). UAF has the capacity to manage and analyze the samples for the nearshore project as a whole. Salary support to collect sea otter foraging observations in KBAY has been moved from Konar and Iken to Coletti and Esler (FY18 5.7k, FY19 5.8k, FY20 6.0K and FY21 6.1k). This will ensure the continued integration of the nearshore project.

C. *Sources of Additional Project Funding*

Annual in-kind contributions consist of staff time (USGS = $92K; NPS = $130k; NOAA = $10k), reduced charter costs (USGS = $45K; NPS= $25K), winter bird surveys (NPS=$18K through 2019), use of equipment such as rigid-hull inflatable, inflatables/outboards, GPSs, spotting scopes, field laptops, sounding equipment (USGS = $40K; NPS = $40K) and commodities (USGS = $5k; NPS = $5K).

7. FY18 PROJECT PUBLICATIONS AND PRODUCTS

Publications

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.

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.

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.

Konar B., K. Iken, and A. Doroff. 2018. Long-term monitoring: nearshore benthic ecosystems in Kachemak Bay. Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-L). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Robinson, B. H., H. A. Coletti, L. M. Phillips, and A. N. Powell. 2018. Are prey remains accurate indicators of chick diet? A comparison of diet quantification techniques for Black Oystercatchers. Wader Study 125(1): 00–00. doi:10.18194/ws.00105. http://www.waderstudygroup.org/article/10823/

Starcevich, L. A. H., T. McDonald, A. Chung-MacCoubrey, A. Heard, J. C. B. Nesmith, H. Coletti, and T. Philippi. 2018. Methods for estimating trend in binary and count response variables from complex survey designs. Natural Resource Report NPS/KLMN/NRR—2018/1641. National Park Service, Fort Collins, Colorado. https://irma.nps.gov/DataStore/Reference/Profile/2253180

Published and updated datasets

Research Workspace: 2017 data for all parameters uploaded to Research Workspace and undergoing QC. Data will be added to Gulf of Alaska Data Portal on schedule.

Presentations

Bowen, L., H. A. Coletti, B. Ballachey, T. Hollmen, S. Waters, and K. Counihan. Transcription as a Tool for Assessing Bivalve Responses to Changing Ocean Conditions. Ocean Sciences Meeting. February 11-16, 2018.

Coletti, H. A., P. Martyn, D. H. Monson, D. Esler and A. E. Miller. Using Small Unmanned Aircraft Systems (sUAS) to map intertidal topography in Katmai National Park and Preserve, Alaska. Ocean Sciences Meeting. February 11-16, 2018.

Konar, B., K. Iken, H. Coletti, T. Dean, D. Esler, K. Kloecker, M. Lindeberg, B. Pister, and B. Weitzman. 2018. Trends in intertidal sea star abundance and diversity across the Gulf of Alaska: effects of sea star wasting. Ocean Sciences Meeting. February 11-16, 2018.

Konar, B., K. Iken, H. Coletti, T. Dean, D. Esler, K. Kloecker, M. Lindeberg, B. Pister, and B. Weitzman. 2018. Trends in intertidal sea star abundance and diversity across the Gulf of Alaska: effects of sea star wasting. Kachemak Bay Science Conference. March 7-10, 2018.

Weitzman, B. Esler, D., Coletti, H., Konar, B., and Iken, Katrin2. 2018. Can you dig it? Patterns of variability in clam assemblages within mixed-sediment habitats across the Gulf of Alaska. Kachemak Bay Science Conference. March 7-10, 2018.

Outreach

Aderhold, D., S. Buckelew, M. Groner, K. Holderied, K. Iken, B. Konar, H. Coletti, and B. Weitzman. 2018. GWA and HRM information exchange event in Port Graham, AK, May 15.

Coletti, H., D. Esler, B. Robinson, and B. Weitzman. 2018. Ocean Alaska Science and Learning Center Teacher Workshop. Kenai Fjords National Park, AK, June.

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