

**EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
FY20 (YEAR 9) CONTINUING PROGRAM PROPOSAL SUMMARY PAGE**

Program Number and Title

20120114 - Gulf Watch Alaska Program: Long-term Monitoring of Marine Conditions and Injured Resources

Primary Investigator(s) and Affiliation(s)

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Date Proposal Submitted

16 August 2019

Program Abstract

The Gulf Watch Alaska (GWA) program directly addresses the *Exxon Valdez* Oil Spill Trustee Council's focus area, integrated long-term monitoring of marine conditions and injured resources services. The overarching goal of GWA is to provide sound scientific data and products that inform management agencies and the public of changes in the environment and the impacts of these changes on injured resources. GWA has a consortium of 12 projects organized in the following functional groups: three monitoring components (environmental drivers, pelagic, and nearshore), a program management team, a science review panel, a science coordinating committee, and an outreach steering committee.

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

To date in FY19, all field sampling projects have been completed as planned and science synthesis efforts are underway among GWA components and with HRM. PIs continued to leverage GWA funding and resources to enhance collaborative efforts and the program management team has completed reporting requirements, continued development of data products, and conducted outreach activities to engage stakeholders.

Overall, there are no changes to GWA program management and outreach. We are requesting additional funding for two existing projects: 1) to continue upper trophic level surveys on the now combined Seward Line and Northern Gulf of Alaska Long-term Ecological Research oceanographic cruises, and 2) to address unanticipated increased operational costs of an agency research vessel for the nearshore ecosystem component. In addition, we are proposing a lingering oil project in FY20 as part of the recommended monitoring schedule by GWA's previous FY2012-16 lingering oil project.

EVOSTC Funding Requested (must include 9% GA)

FY17	FY18	FY19	FY20	FY21	TOTAL
\$2,278,750	\$2,574,860	\$2,540,070	\$2,792,890*	\$2,593,860*	\$12,780,430*

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

FY17	FY18	FY19	FY20	FY21	TOTAL
\$3,205,100	\$3,260,300	\$3,027,500	\$3,421,800	\$3,377,600	\$16,292,300

*Totals with asterisks (FY20-21) include new funding requests for two existing projects (includes 9% GA): Nearshore Ecosystems \$24K (20120114-H) and PWS Bird Population Trends \$25.8K (20120114-M) and a proposed Lingering Oil project totaling \$65.2K (20200114-P).

1. PROGRAM EXECUTIVE SUMMARY

This proposal requests continuation of the Gulf Watch Alaska (GWA) long-term monitoring (LTM) program for FY 2020, year 9 of the program. The *Exxon Valdez* Oil Spill (EVOS) Trustee Council (EVOSTC) initiated 5-year funding for the GWA LTM program beginning in 2012 (McCammon et al. 2011) and in 2016 recommended continuation for the next 5-year increment, years 6-10 (Lindeberg et al. 2016). The Trustees plan to support an LTM program for 20 years. As requested by the EVOSTC, this program is designed to monitor key components that play important roles in the Gulf of Alaska (GOA) marine ecosystem. These components include environmental drivers such as temperature and nutrient availability; pelagic populations of predators and prey; and the nearshore ecosystem. Through this effort, scientists and resource managers will be able to continue to monitor injured resources from the EVOS and have a better understanding of potential impacts to these resources from natural and anthropogenic changes in the environment.

GWA is a consortium of 12 projects, ten of which started before 2012 and several with long-term data sets extending over 30 years and prior to the EVOS. A wide array of information and tools have been effectively coordinated and synthesized by the GWA program to date (e.g., 3 Year Science Synthesis Report, 2015; GWA first 5-year final reports; special issue publication of *Deep-Sea Research II – Topical Studies in Oceanography*; contributions to ecosystem status reports used in fisheries management, and the 2nd Science Synthesis Report is in progress). The program has fostered partnerships that include professional administrative support, advanced data housing, scientific collaboration and synthesis across projects and disciplines, and a significant outreach capacity through agency partners. Collectively, this group of 28 principal investigators (PIs) represents unsurpassed expertise and knowledge of the GOA ecosystem and spill-affected region. The overarching goals of the program are to:

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

For FY20, we are submitting a program proposal (this document), a program management (PM) proposal (combined for the PM I and PM II projects) and 11 monitoring project proposals. Individual project proposals and budget plans are provided, as requested, in the program's Research Workspace for EVOSTC staff members.

Our plans for the next fiscal year have three changes from the original FY17-21 proposal package. First, we are requesting supplemental funding to continue marine bird and mammal surveys on the recently expanded Seward Line oceanographic cruises now that they are combined with the newly established National Science Foundation Northern Gulf of Alaska Long-term Ecological Research site (NGOA LTER; Fig. 1). Second, we are asking for supplemental funding for the USGS agency vessel *R/V Alaskan Gyre*. This vessel is used heavily by GWA projects and operational costs have recently increased. This increase was unanticipated in the original proposal but it still remains a cost-effective option for fieldwork. Third, we are submitting a new lingering oil proposal developed in coordination with EVOSTC staff to provide a sensible monitoring program that continues past efforts and addresses recommendations by the GWA project 16120114-S (FY12-16). Please see Section 6B of this program workplan and the specific project workplans for more details on these requests.

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

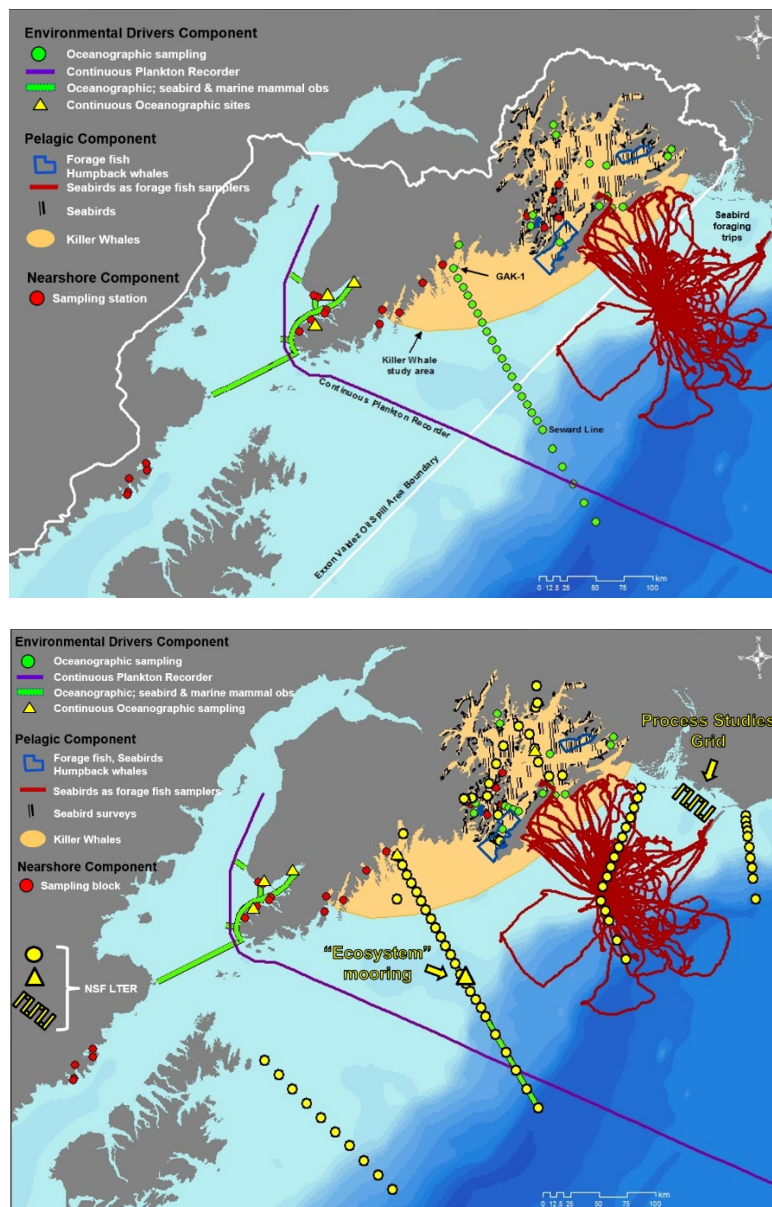


Figure 1. Gulf Watch Alaska monitoring “footprint” by ecosystem component and project focus (upper panel). Gulf Watch Alaska with the National Science Foundation-funded Northern Gulf of Alaska Long-term Ecological Research sampling footprint (lower panel).

Integrated Program Management and Administration

Program coordination and science synthesis (GWA Program Management I) – Mandy Lindeberg and Rob Suryan, NOAA Auke Bay Laboratories and Donna Aderhold, Prince William Sound Science Center – Project 20120114-A,

and Program administration, logistics, and outreach (GWA Program Management II) – Katrina Hoffman, Prince William Sound Science Center (PWSSC) –Project 20120114-B

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

The program management team (PMT, collectively PM I and PM II) oversees a group of 28 PIs, collaborators, and science reviewers to produce and integrate a wealth of scientific information on the northern GOA ecosystem and spill-affected area and share that information with others. Program coordination and science synthesis (PM I) improves linkages between monitoring efforts spanning large regional areas (Prince William Sound [PWS], GOA shelf, and lower Cook Inlet). Program coordination includes facilitating program planning and sharing of information between PIs, other Trustee-funded programs, and non-Trustee organizations. High quality products and science synthesis efforts help communicate monitoring results by delivering reports, publishing data, developing scientific papers, supporting outreach, and integrating information across the entire program. Program administration, science review panel (SRP), logistics, and outreach and community involvement (PM II) complements work under the PM I project in many ways. The administrative portion of the PM II project oversees funds for non-trustee agencies, while also providing travel and logistics for GWA in-person meetings, teleconferences, maintaining GWA's website, and managing community outreach and engagement.

During FY20, the PMT will continue science synthesis efforts within GWA and HRM, submit the final draft of the science synthesis report, present at the February 2020 science synthesis workshop, respond to EVOSTC Science Panel reviews, and submit a final version of the science synthesis report. Ecosystem indicators will continue to be developed and contribute to the Annual Ecosystem Status Report to the North Pacific Fishery Management Council. We will continue strategic planning for the FY22-26 work plans. In addition, FY20 is the year in which we propose to conduct a local and traditional ecological knowledge roundtable-type symposium in one or more villages in Prince William Sound (PWS) in either Chenega Bay, Tatitlek, or both, depending on community receptivity. This is an opportunity for program scientists to learn from community members and elders about changes they have observed in the marine environment and an opportunity for community members to ask program scientists questions about ecosystem function and recovery.

Environmental Drivers Component

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

Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf – Sonia Batten, MBA, and Robin Brown, North Pacific Marine Science Org. – Project 20120114-D

The Continuous Plankton Recorder (CPR) transect samples the Alaskan shelf from lower Cook Inlet across the slope into the open Gulf of Alaska, providing a now 19-year record of taxonomically resolved, seasonal, near-surface zooplankton and large phytoplankton abundance over a wide spatial scale. Sampling takes place approximately monthly, six times per year, usually between April and September. Outputs from the project include indices of plankton abundance (e.g., large diatom abundances, estimated zooplankton biomass),

seasonal cycles (phenology of key groups) and community composition (e.g., appearance of warm water species, change in dominance by some groups). Variability in any, or all, of these indices might be expected to flow-through to higher trophic levels such as herring, salmon, birds and mammals that forage across the region, some of which have been impacted by the *Exxon Valdez* oil spill. Results show that interannual variability in plankton dynamics is high and plankton responded clearly and rapidly to the warm conditions of 2014-2016, with changes evident in abundance, composition and timing. Fig. 2 shows that the heatwave years had low diatom abundance which changed dramatically in 2017 and 2018 to high abundances. Furthermore, the small copepods were very abundant during the heatwave and this abundance continued into 2017 but declined back to average levels in 2018.

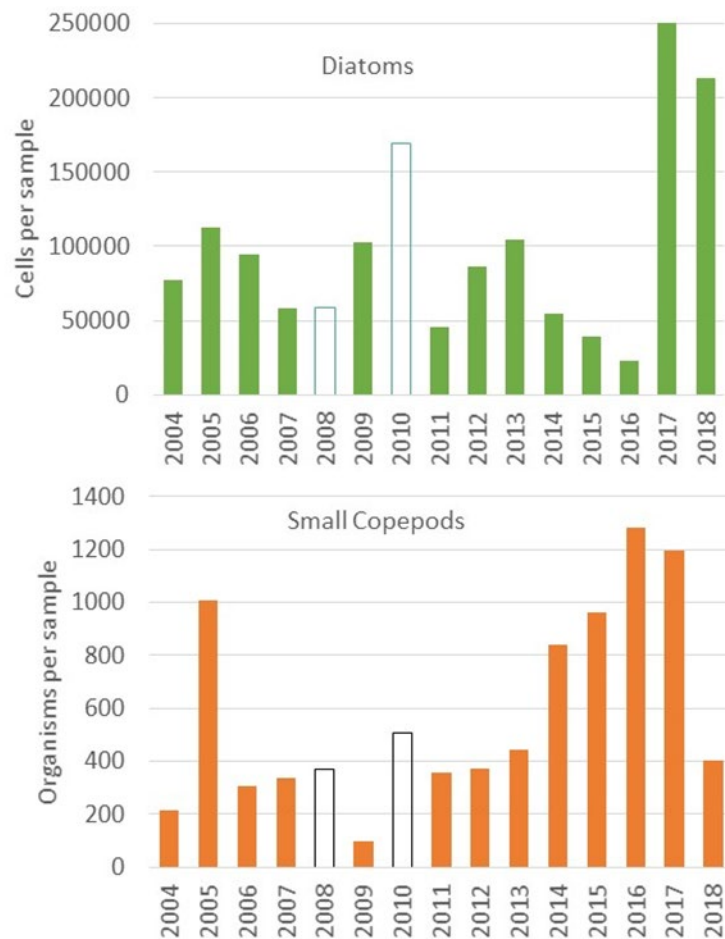


Figure 2. Mean annual abundance of diatoms and small copepods (<2mm total length) from shelf samples. Unfilled bars are years when sampled months <4 and so data are not as robust.

Gulf of Alaska mooring (GAK1) – Seth Danielson and Tom Weingartner, University of Alaska Fairbanks (UAF) – Project 20120114-I

The goal of the GAK-1 project is to provide a long-term high-quality reference dataset for the coastal northern GOA that enables scientists, students, commercial and subsistence fishers, and resource managers to better understand climatic and ecological conditions, their changes, and ramifications of change. Untangling the relations between climatic and other drivers of change (e.g., oil spills or fishing regulations) requires long reference time-series. Environmental time-series data can provide information valuable to the management of

fish and shellfish populations and fisheries (Anderson and Piatt 1999, Munro and Tide 2014). There exists no other full water column temperature and salinity time-series in the northern GOA with comparable data quality, temporal extent, and frequency of sampling to GAK-1. Hence, the GAK-1 dataset is the premier reference dataset for evaluating hypotheses that seek mechanistic descriptions of the regional ocean environment and ecosystem. GAK-1 data demonstrate a long-term warming trend punctuated by signals associated with the cycles of El Nino and other phenomena (Fig. 3).

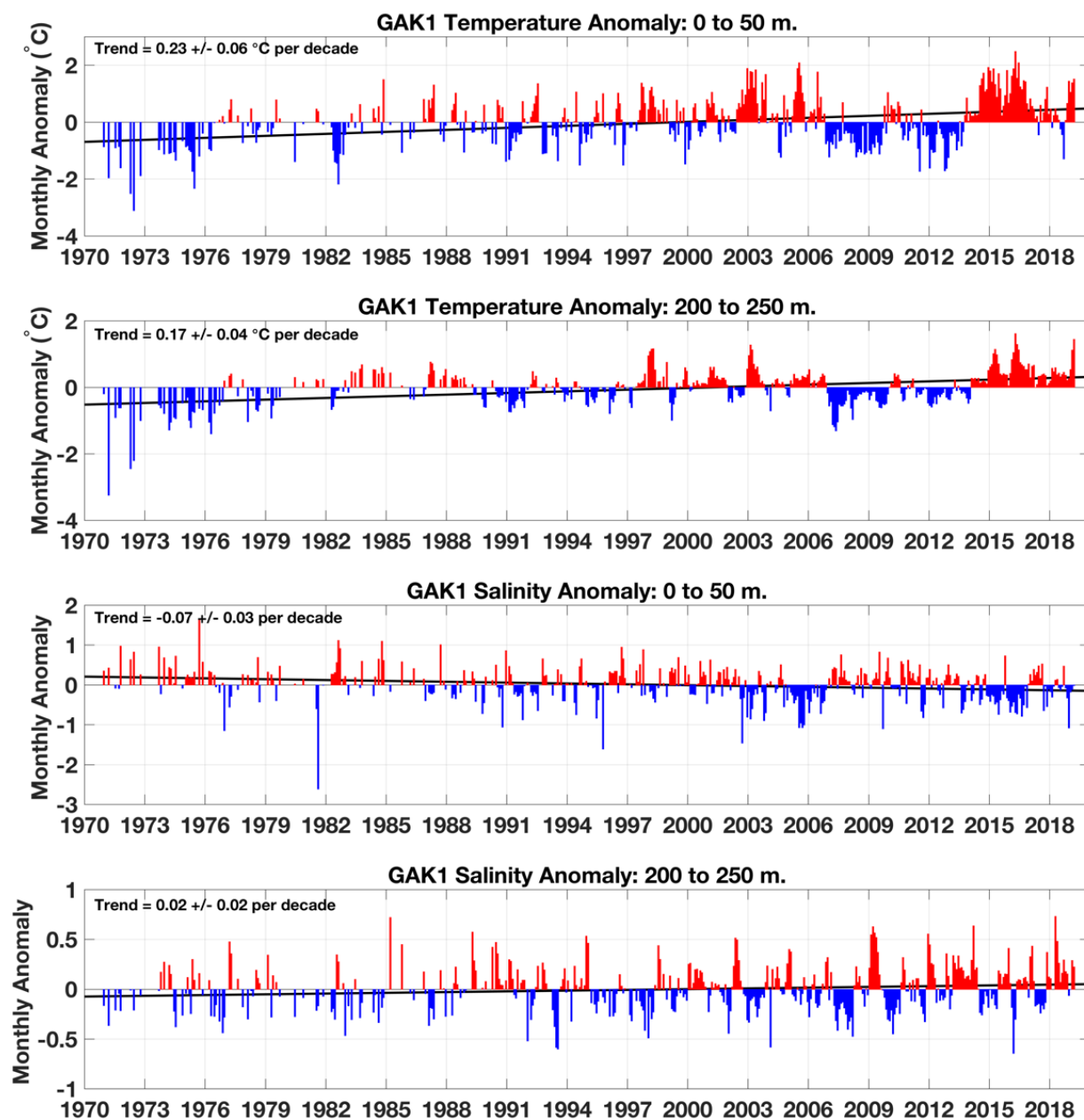


Figure 3. GAK-1 monthly anomaly time series for the 1970-2019 period of record. Temperature (upper two panels) and salinity (lower two panels) anomalies represent averages over the uppermost and lowermost 50 m of the water column. Black lines show the least squares best fit trend over the period of record. Text provides trend statistics (best fit least squares linear) over the record length

We are continuing multi-disciplinary oceanographic observations begun in fall 1997 in the northern GOA. We determine the physical-chemical structure, the distribution and abundance of phytoplankton, microzooplankton, and mesozooplankton, and survey seabirds and marine mammals. These observations enable descriptions of the seasonal and inter-annual variations of this ecosystem. Our goal is to characterize and understand how different climatic conditions influence the biological conditions across these domains within each year, and what may be anticipated under future climate scenarios.

Our understanding of community level changes would not be possible without long-term observation programs, whose value is becoming increasingly apparent as our understanding of ecosystem change and its drivers becomes more sophisticated. Dominated by a strong seasonal cycle (Waite and Mueter 2013), the northern GOA ecosystem does not respond in a currently predictable way to intermittent basin-scale events such as El Niño or to longer-term regime shifts such as the PDO (Stabeno et al. 2004), perhaps because the ecosystem is highly adapted to great variability. Nonetheless, it is profoundly affected by warmer years, fresher years, and light conditions in spring that influence the timing of planktonic processes. After a return to average temperatures during May 2017 and 2018, temperatures during May 2019 were above average and representing the 5th warmest in the time series.

Warmer years result in reduced body size and typically lower lipid storage by the large-bodied spring copepods (i.e., *Neocalanus* spp.). In contrast to spring, temperature is much less variable during late summer, although biological communities continue to show high variability, including increased prevalence of southern species during warmer years such as those during the marine heat wave in 2014-2016 (Fig. 4). While southern species returned to more normal abundances during spring 2017 and spring 2018, during late summer several of these species persisted at very low abundances. Preliminary data for 2019 suggests some increase of these southern species during summer.

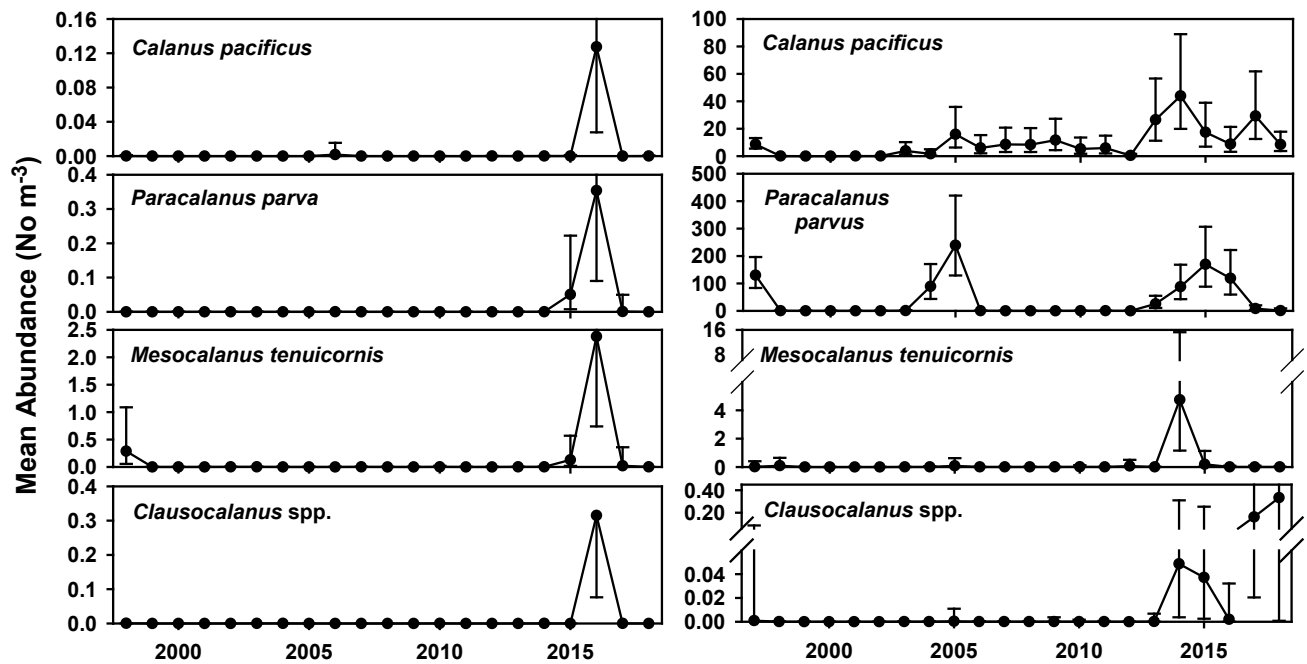


Figure 4. Abundance of the four most prevalent California Current copepods along the Seward Line, during May and late summer. Although these warm-water species have recently disappeared from May, some still remain during late summer albeit in very low numbers.

Oceanographic conditions in Prince William Sound – Rob Campbell, PWSSC – Project 20120114-G

The goal of this project is to continue the time series of oceanographic observations in PWS that began in 2009 and to continue to put that new data into context with a 45-year conductivity-temperature-depth (CTD) database that was assembled during the first five years of GWA (Campbell 2018). These data are used to observe and describe how the region changed in response to the 2014-2016 marine heat wave and to begin to address the many hypotheses for the mechanisms that are driving productivity in the region. In addition to more traditional vessel-based surveys to assess spatial variability of environmental drivers, a state-of-the-art autonomous profiling mooring is used to observe the annual cycle of physical, biogeochemical, and biological metrics in central PWS at very high frequency.

In late 2013, temperature anomalies shifted to primarily positive (Fig. 5), like those observed throughout the GOA (Bond et al. 2015). Anomalies within PWS in 2015 were as much as 2 °C above average (4° above average at the profiler site), which appears to have caused numerous changes in the marine ecosystem including observations of rare southern species; mortality events in birds, mammals and starfish; and larger than average blooms of toxin producing phytoplankton. Temperature trends in 2017 suggested a return to temperatures near the long-term average, but anomalies in 2018 and 2019 were again primarily positive (Fig. 5).

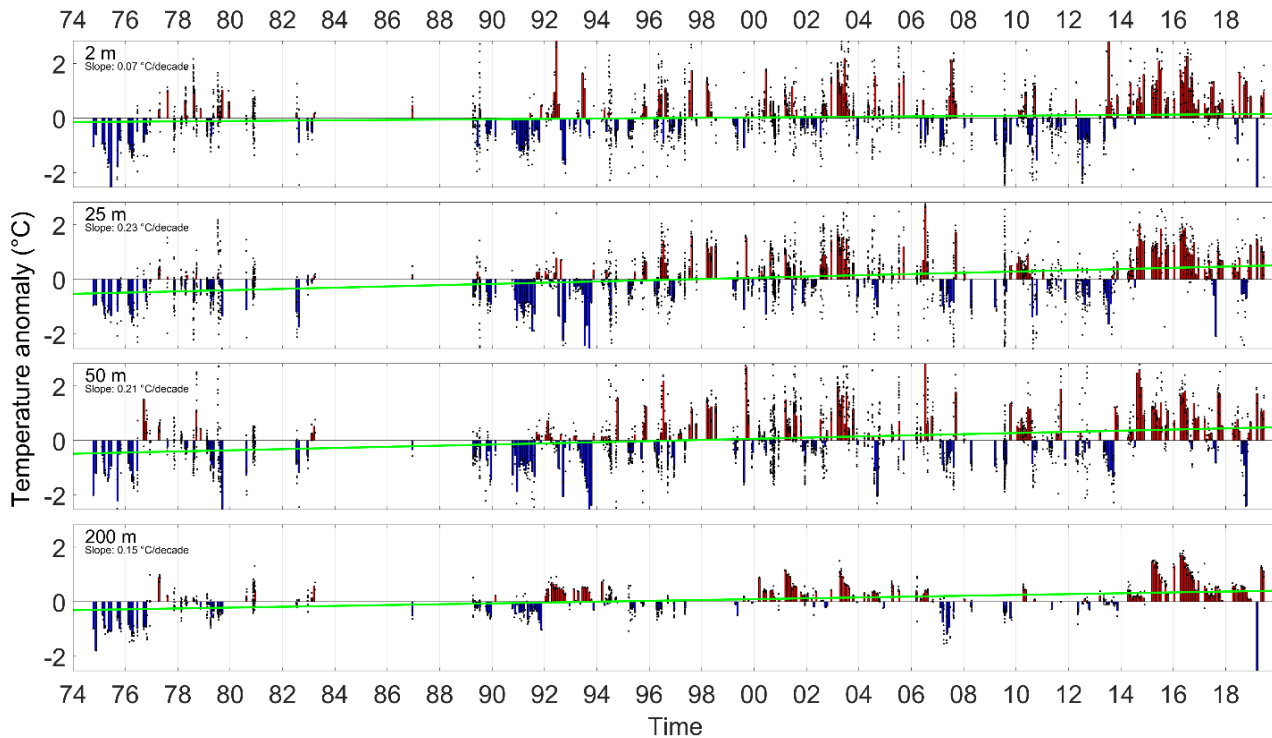


Figure 5. Temperature anomalies at four selected depths in central PWS. Anomalies were calculated as the residual to a second order cosine curve fit to all year's data (to remove seasonality: Campbell 2018). Black points are observations, bars are quarterly averages, and the green line indicates the linear trend. Slopes with text in black are significantly different from zero ($p < 0.05$).

Oceanographic conditions in Lower Cook Inlet/ Kachemak Bay – Kris Holderied, National Oceanographic and Atmospheric Administration (NOAA) Kasitsna Bay Laboratory, and Steve Baird, University of Alaska Anchorage (UAA) Kachemak Bay National Estuarine Research Reserve (KBNERR) – Project 20120114-J

The Cook Inlet/Kachemak Bay oceanography monitoring project provides seasonally resolved oceanographic and plankton data, with critical information on nearshore patterns and estuary to shelf oceanographic gradients for the Environmental Drivers component. Project data support the GWA Nearshore component intertidal monitoring project in Kachemak Bay, as well as harmful algal bloom (HAB), forage fish, seabird and marine mammal monitoring efforts funded under other programs in Kachemak Bay and lower Cook Inlet.

Highlights for zooplankton data analyzed through 2017 (2018 sample processing are nearly complete) indicate some increase in the abundance of warm water species in 2016 (Fig. 6), as was observed in PWS, but the shift was not as clear in the aggregate as it is for individual species at different locations. The differences may also reflect relatively cool conditions in Kachemak Bay waters, relative to PWS and the adjacent shelf (Holderied and Weingartner, 2016).

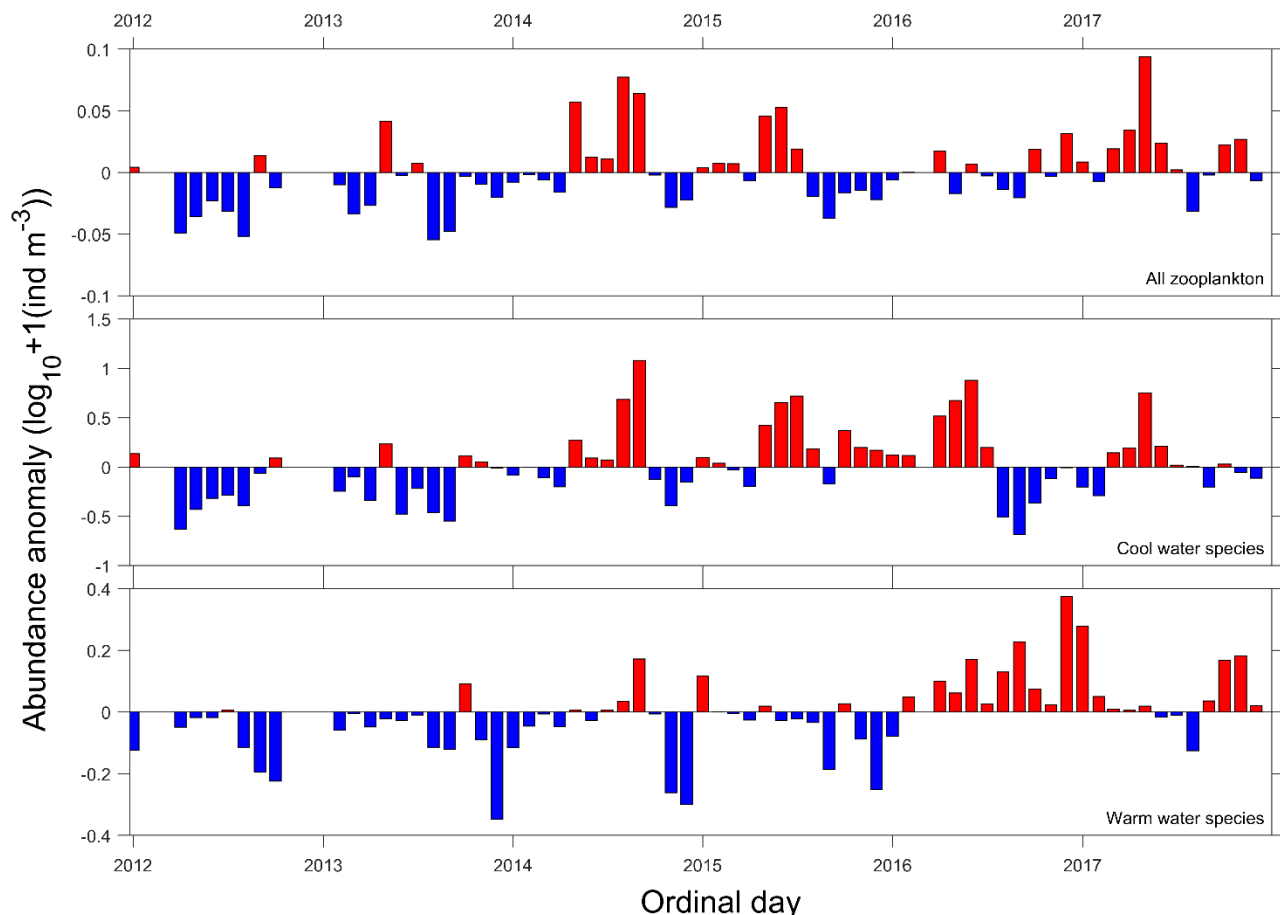


Figure 6. Abundance anomalies of all zooplankton (top panel), warm water copepod species (middle panel) and cool water copepod species (bottom) panel from all Kachemak Bay and Cook Inlet stations, 2012–2017. Observations were $\log_{10}+1$ transformed, averaged by month, and subtracted from the monthly average to produce an anomaly (without detrending). Note that scaling on the y-axis varies among panels. Warm water and cool water species were those identified as indicative by Fisher et al. (2015) and Peterson et al. (2017). Warm water species include *Calanus pacificus*, *Clausocalanus* spp., *Corycaeus anglicus*, *Ctenocalanus vanus*, *Mesocalanus tenuicornis*, and *Paracalanus parvus*. Cool water species are *Calanus marshallae*, *Pseudocalanus* spp., *Acartia longiremis*, and *Oithona similis*. Graphic courtesy of Rob Campbell (PWSSC).

Pelagic Component

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

Long-term killer whale surveys – Craig Matkin, North Gulf Oceanic Society – Project 20120114-N

This project has determined that killer whales are sensitive to perturbations such as oil spills but has not yet determined the long-term consequence (which may include extinction) or the recovery period required. As an apex predator, this species (both fish and mammal eating types) has an important role in the ecosystem.

Additionally, they are a primary focus of viewing by a vibrant tour boat industry in the region. Data from this project are used by tour boats to enhance viewers experience and understanding of the local environment and fauna. Both resident ecotype (AB pod) and transient ecotype (AT1 population) killer whales suffered significant mortalities following EVOS in 1989. AB pod is recovering after 30 years but has still not reached pre-spill numbers (Fig. 7). The AT1 population is not recovering and may be headed toward extinction (Matkin et al. 2008).

Collecting scat samples is part of our long-term study of resident killer whale feeding ecology. Recent results indicate the dominance of Chinook, coho, and chum salmon in the diet, with minor contributions from other species (including halibut). The data support the accuracy of scale and flesh (predation) analysis that was questioned in the previous final report. Also of note, the seasonally ubiquitous pink salmon have not been found in the predation samples (scales and flesh collected at predation sites) or in the scat.

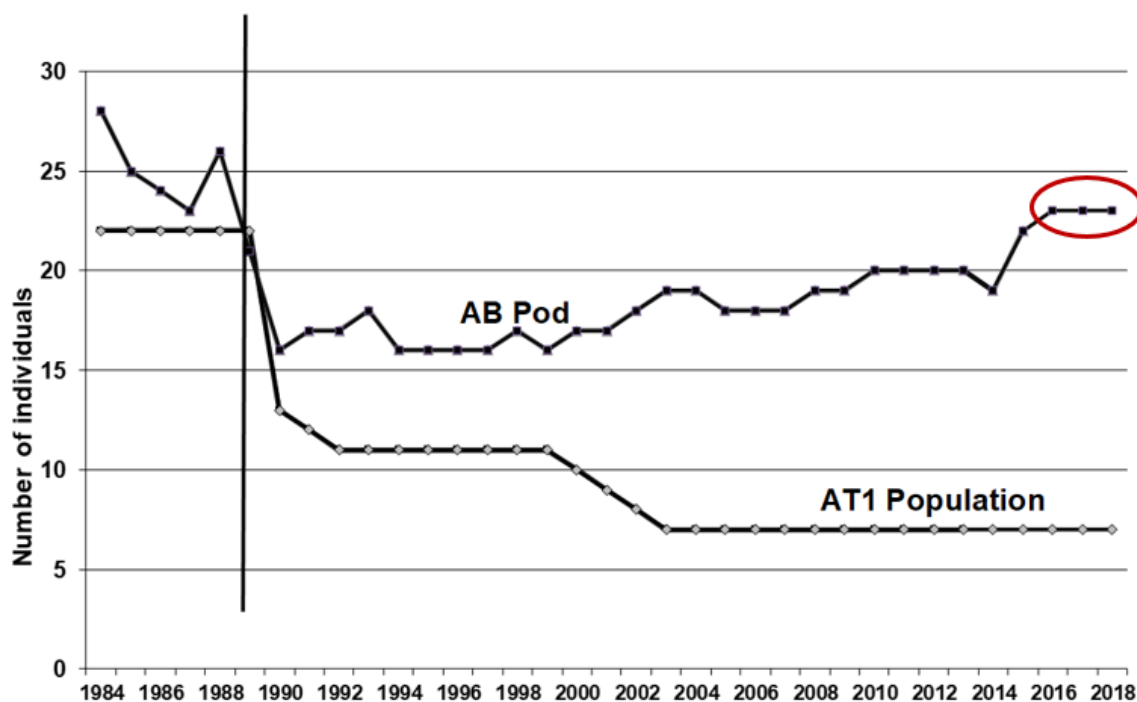


Figure 7. Number of whales in AB pod and AT1 population by year. Note: past three years total for AB pod (red circle) does not take into account three missing matriline (AB17, AB22, and AB14).

Prince William Sound marine bird surveys – Kathy Kuletz and Robert Kaler, U.S. Fish and Wildlife Service (USFWS) – Project 20120114-M

Boat-based marine bird surveys have been conducted in PWS for over a 30-year period following the 1989 EVOS. The surveys are conducted every two years and therefore occur during July 2018 and 2020 during the current Gulf Watch Alaska (GWA) funding cycle (FY17-21). In order to better understand the dynamics of a marine bird community that has experienced the simultaneous effects of a major oil spill and climate variability, this project collects additional information to monitor the distribution and abundance of marine birds in PWS.

Using data collected during small boat surveys (1989-2012), Cushing (2018) found that abundance estimates for both marbled murrelets and Kittlitz's murrelets decreased by more than two-thirds over the study period.

Density of marbled and Kittlitz's murrelets continued a long-term pattern of decline in 2018 (Fig. 8). Additionally, densities of pigeon guillemots continued to decrease PWS-wide (Fig. 8). Also notable was complete or nearly complete breeding failures of black-legged kittiwakes occurred in PWS 2016-2018 while density of kittiwakes throughout PWS trended downward during the same period (Fig. 8).

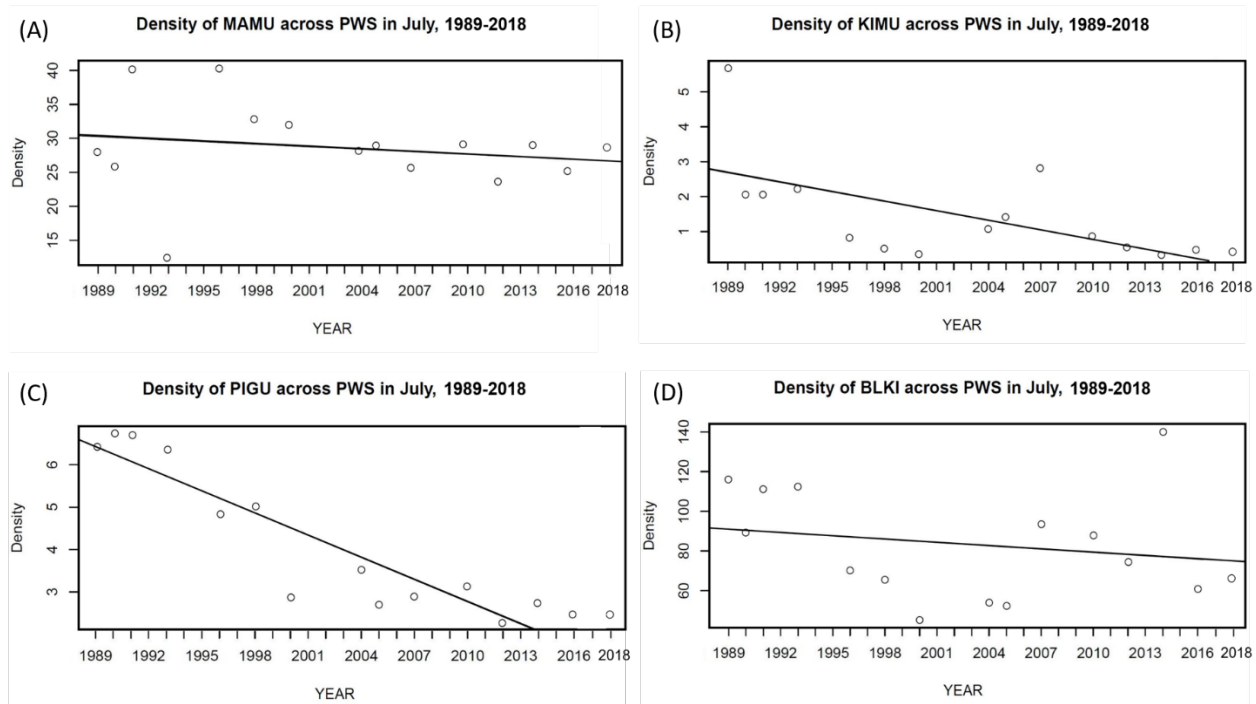


Figure 8. Density (birds/km²) estimated for (A) marbled murrelet [MAMU], (B) Kittlitz's murrelet [KIMU], (C) pigeon guillemot [PIGU], and (D) black-legged kittiwake [BLKI] across Prince Williams Sound, Alaska, 1989-2018.

Forage fish distribution and relative abundance – Mayumi Arimitsu and John Piatt, U.S. Geological Survey (USGS) Alaska Science Center – Project 20120114-C

Forage species are important in marine food webs because they are consumed by marine predators such as birds, mammals, and predatory fish. Forage species typically produce many offspring and have short life spans, and these traits predispose populations towards large fluctuations in abundance, with subsequent consequences for their predators. Examples of important forage taxa in PWS include capelin, Pacific sand lance, Pacific herring, juvenile walleye pollock, and krill. The primary objectives of the forage fish monitoring project are to: 1) monitor the status and trends of forage fish in areas with known persistent aggregations of predators and prey during fall, and 2) support annual field and laboratory efforts to continue the Middleton Island long-term seabird diet index in spring/summer, 3) assess changes in forage fish abundance indices on acoustic-trawl surveys during summer, and 4) support HRM program aerial survey validation efforts in summer.

With additional funding from EVOSTC, in FY19 we conducted summer forage fish surveys to validate June HRM program aerial surveys and summer acoustic-trawl surveys to provide indices of fish, macrozooplankton, and gelatinous zooplankton. The aerial survey validation includes directed sampling of specific fish schools detected by the aerial observer. To do this, our team on the ground (in skiffs or a larger vessel) was directed to schools by the pilot after he had assessed the species and age of the schools. We collected fish by using jigs, purse seine,

cast net, or video to ground-truth the pilot's observations, which ultimately provides a measure of uncertainty in the pilot's observations. The summer acoustic surveys include transects in regions with historically high densities of forage fish schools throughout the Sound. Sampling methods and protocols are consistent with those approved during the first five years of GWA.

Time series data from Middleton Island, the longest available from any location in Alaska, show that after several years of high frequency of occurrence in seabird diets in 2008 – 2013, capelin virtually disappeared from diets in 2014-2018 (Fig. 9, Hatch 2018). Although 2019 sampling is still underway, early signs are that there are more capelin than usual in PWS and Cook Inlet, and in seabird diets at Middleton Island.

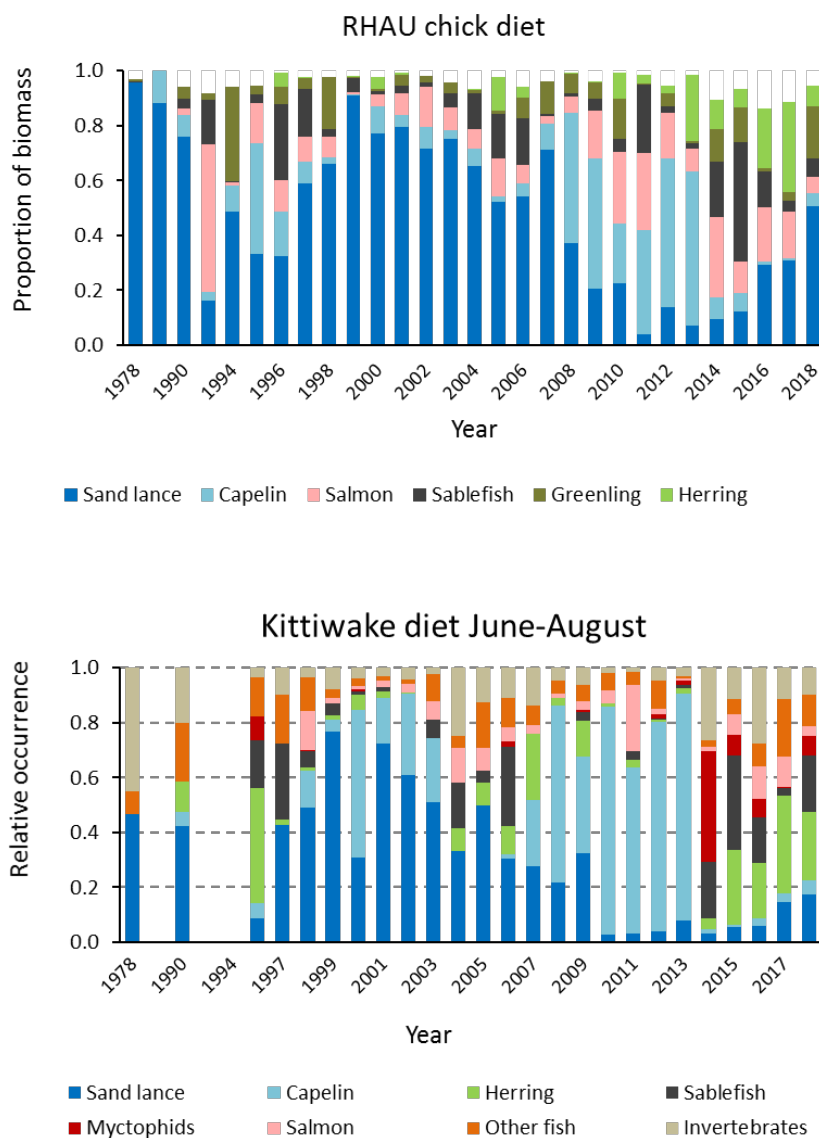


Figure 9. Interannual variation in diet composition of chick-rearing rhinoceros auklets (top) and black-legged kittiwakes (bottom) on Middleton Island, 1978 to 2018.

Monitoring humpback whales and their diets is important to understanding predator prey interactions in the pelagic waters of PWS. Because humpback whales are significant predators in the ecosystem, they may have the potential to control the distribution and abundance of forage fish. The humpback whale population in the North Pacific has rebounded from near extinction in the late 1960s to over 22,000 individuals (Barlow et al. 2011), and parallel increases in whale abundance have been documented in PWS. Over much of the same period the abundance of the dominant forage fish, Pacific herring, shifted from an abundant to a diminished state. Pacific herring were identified as an injured species following EVOS. Understanding the mechanisms behind their failed recovery requires a comprehensive understanding of both top-down and bottom-up processes in the context of a changing ecosystem.

In PWS, it appeared that humpback whales were maximizing the exploitation of over-wintering herring prior to their southbound migration to the breeding grounds and our studies suggest that top-down forcing may be limiting the recovery of herring in PWS. However, since 2013 and in parallel with a marine heatwave and seabird and marine mammal die-offs, counts of humpback whales have dropped in our surveys (Fig. 10). This is likely the result of reduced prey availability. Humpback whales will continue to have an impact on PWS herring but to what extent is unknown. There is a need to continue evaluating predation pressure on herring stocks in PWS and to understand the ecosystem impacts of a humpback whale population that has been functionally absent from the GOA for over 50 years, rebounded and now is in a potential decline.

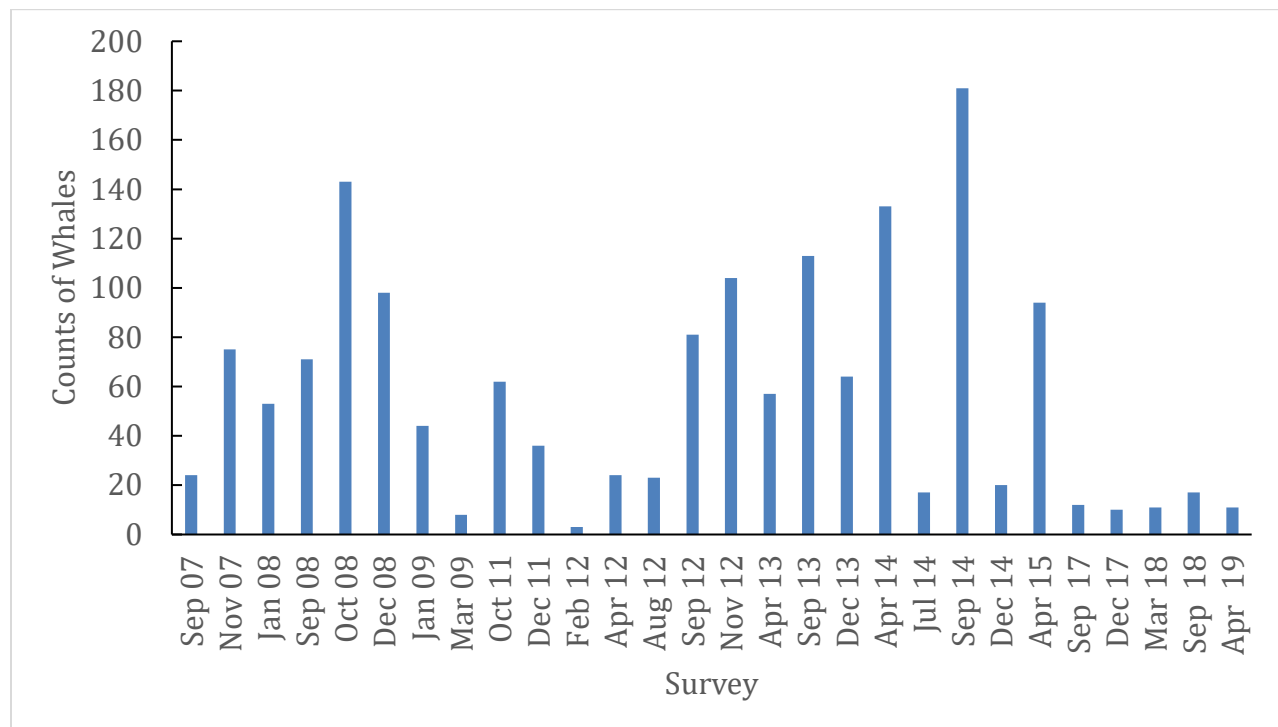


Figure 10. Counts of humpback whales in Prince William Sound provide an index of whale abundance, recent declines in whale numbers correspond to declines in herring biomass.

Of the marine birds that overwinter in PWS, nine species were initially injured by EVOS. As of 2014, two species that overwinter in PWS have not yet recovered (marbled murrelet and pigeon guillemot) and a third species, Kittlitz's murrelet, has an unknown recovery status (EVOSTC 2014). Most of the marine bird monitoring in areas affected by EVOS has occurred around breeding colonies during the reproductive season when food is generally at its most plentiful and the marine bird community changes markedly in winter compared to summer. Therefore, long-term monitoring of marine birds in PWS during fall and winter is needed to understand post-spill ecosystem recovery and how changing ocean conditions are affecting marine bird populations.

We have documented consistent temporal patterns in density and distribution and habitat associations that supports the assertion that birds are seeking refuge during winter, which could render PWS superior winter habitat relative to the harsher GOA (Stocking et al. 2018). Furthermore, we have identified areas of persistent, high marine bird concentrations, some of which coincide with known hotspots for killer whales and other predators, suggesting that environmental drivers are creating dependable, favorable foraging conditions in these areas. During the recent marine heat wave murre and murrelet numbers increased in winter months as birds moved inshore, but then generally declined afterwards (Fig. 11). Like GWA studies of humpback whales (Project 20120114-O), our results highlight the importance of herring as prey in PWS during winter and suggest that predation by marine birds may have an important top-down effect on the PWS herring population.

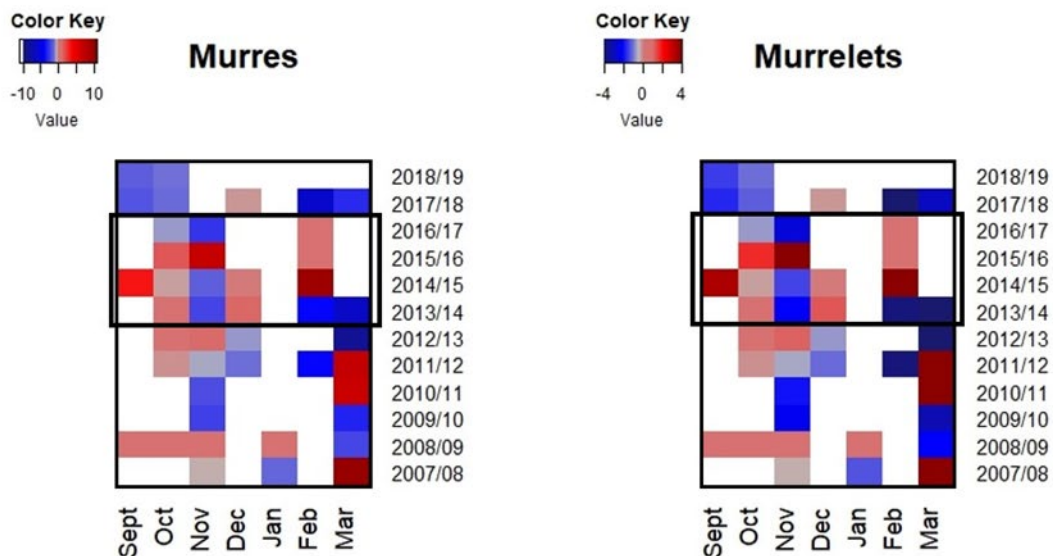


Figure 11. Monthly density anomalies for murre and murrelet observed during fall and winter bird surveys in Prince William Sound, 2007-2018. A marine heatwave event occurred throughout the Northeast Pacific Ocean beginning in the winter of 2013/14 and was strongest (with regional variability) through 2017 (indicated by black box).

Nearshore Monitoring Component

Nearshore systems in the Gulf of Alaska – Heather Coletti, National Park Service (NPS), Daniel Esler, Kim Kloecker, Dan Monson, and Ben Weitzman, USGS Alaska Science Center, and Brenda Konar and Katrin Iken, UAF – Project 20120114-H

The Nearshore component of the GWA long-term monitoring program investigates and monitors the nearshore environment of the greater EVOS area, with a focus on selected elements of the nearshore food web. Our overarching goal is to understand drivers of variation in the 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 study design allows us to evaluate potential impacts from more localized sources, especially those resulting from human activities, including lingering effects of EVOS, and identifying potential mechanisms of change. We monitor more than 200 species dependent on nearshore habitats, many with well-recognized ecological roles in the nearshore food web.

The time series of marine bird and mammal data is starting to reveal important patterns within individual species. For example, black oystercatcher densities show different seasonal patterns in Katmai National Park and Preserve (KATM) and Kenai Fjords National Park (KEFJ). In KATM, black oystercatchers occur at similar densities during summer and winter, suggesting that either KATM breeders are non-migratory or that different individuals move into KATM post-breeding. In contrast, black oystercatchers in KEFJ occur regularly during the breeding season but are absent, or nearly so, during winter, indicating that breeders there migrate elsewhere post-breeding (Fig. 12).

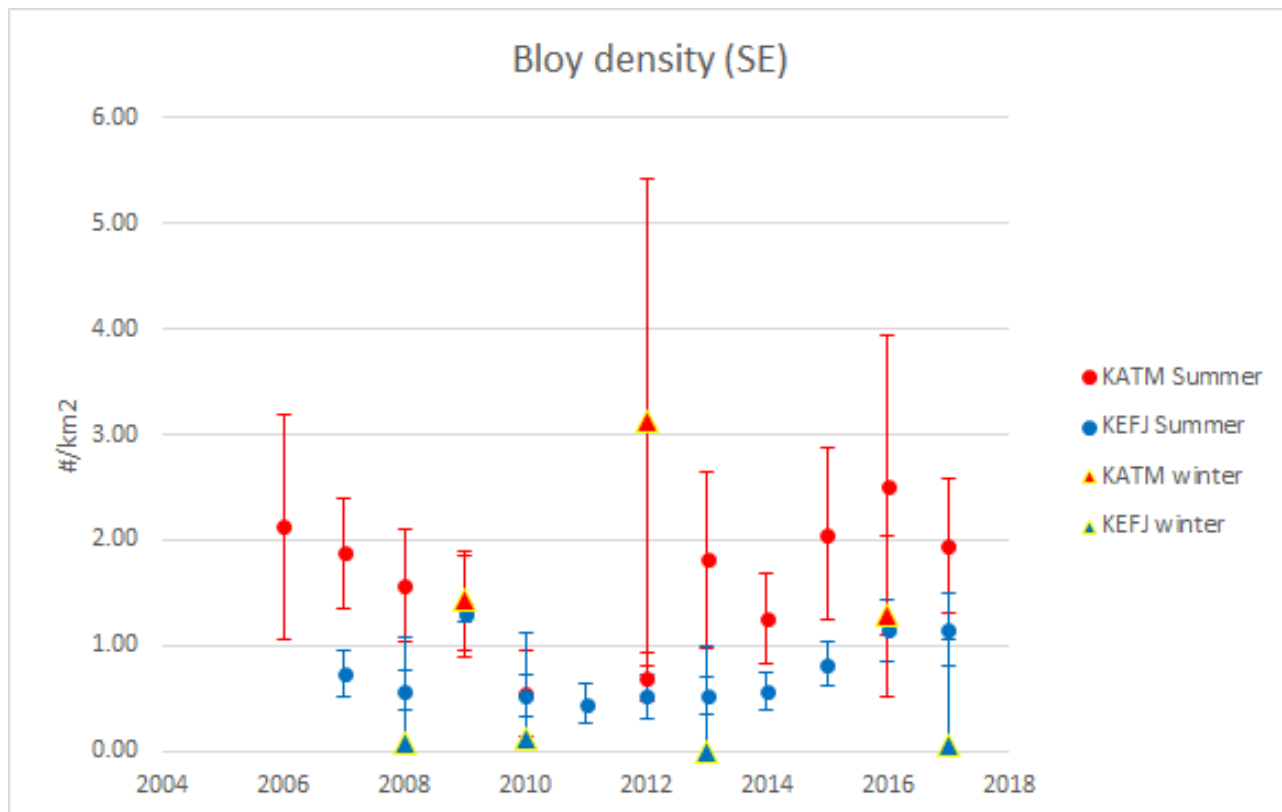


Figure 12. Black oystercatcher (BLOY) densities in Katmai (KATM) and Kenai Fjords (KEFJ) National Parks during summer and winter, based on nearshore bird surveys.

2. PROGRAM STATUS OF SCHEDULED ACCOMPLISHMENTS

A. Program Milestones and Tasks

Table 1. This table breaks down project deliverables and their status into milestones and tasks by fiscal year and quarter, beginning February 1, 2017. Yellow highlight indicates proposed fiscal year workplan. 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.

Milestone/Task	FY17				FY18				FY19				FY20				FY21			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Field sampling																				
Environmental drivers	C	C	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Pelagic	C		C	C	C		C	C	C		X	X	X		X	X	X		X	X
Nearshore	C	C			C	C			C	C			X	X			X	X		
Data																				
Data to workspace				C				C				X				X				X
Prior year data to public					C				C				X				X			
Meetings																				
PI meetings	C	C	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Trustee Council/PAC			C				C				X				X				X	

Milestone/Task	FY17				FY18				FY19				FY20				FY21			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
AMSS				C				C				X				X				X
Community engagement			C			C				C					X				X	
Year 3 joint workshop													X							
Reporting																				
Annual reports					C				C				X				X			
FY work plan (DPD)			C				C				C				X					
Year 3 synthesis report												X								
FY12-21 final report																				X

In addition to the primary program deliverables in Table 2, during the past year the program contributed to at least 18 ecosystem indicators from all GWA components to the NOAA Fisheries Gulf of Alaska Ecosystems Status Report to the North Pacific Fisheries Management Council and participated in two agency workshops promoting the use of GWA datasets. Program PIs produced five peer reviewed publications, 15 manuscripts in prep, and one PhD dissertation. Outreach efforts included 40 presentations, seven articles, two editions of GWA Quarterly Currents, four outreach events, and planning for two EVOS 30th anniversary events. We anticipate completing FY19 and FY20 milestones and tasks as planned.

B. Explanation for not completing any planned milestones and tasks

All sampling, milestones, and tasks for 2018 and first two quarters of 2019 were completed in accordance with our GWA project proposals and with project sampling protocols available on the GWA Research Workspace.

C. Justification for new milestones/tasks

While there are no changes to program level milestones, one project, PWS Marine Bird Surveys (20120114-M), is requesting additional funding and generating a task from a previous collaboration with the Seward Line project (20120114-L). The new task would provide a marine bird and mammal observer during spring and fall Seward Line cruises and secure the continuation of a long-term dataset.

A new lingering oil monitoring project is being proposed for FY20-21 that builds on previous lingering oil projects and their recommendations for a monitoring schedule (5 years). Surveys were last completed in 2015 and we have now reached FY20. If approved for funding by the EVOSTC, this project would fall under the lingering oil component of the GWA program (originally in FY12-16) and continues a cost-effective approach to maintaining the monitoring baseline established by project 12120114-S.

3. PROGRAM COORDINATION AND COLLABORATION

A. Within an EVOSTC-funded Program

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

Coordination and Collaboration Within GWA

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

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

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

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

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

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

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

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

- Providing logistics for teleconferences and in-person meetings
- Acting as the fiscal agent for non-Trustee agencies and organizations
- Coordinating outreach activities and the Outreach Steering Committee; overseeing the Outreach Coordinator
- Facilitating and funding participation by the SRP
- Completing annual audits to demonstrate compliance with federal grants management standards
- Ensuring collaboration, where appropriate, with HRM and Data Management

- Submitting all required narrative (semi-annual) and fiscal (quarterly) reports to NOAA, through which GWA funding flows to all non-Trustee agencies via PWSSC

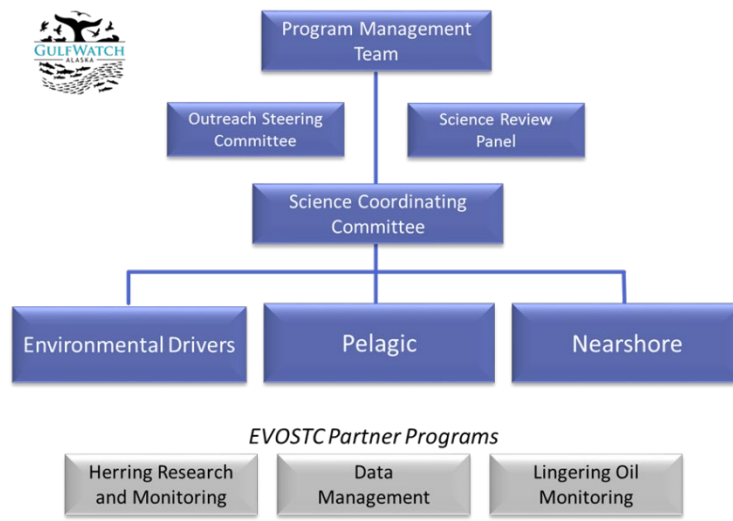


Figure 13. Organizational chart for GWA program and other EVOSTC programs. The Program Management Team consists of Program Lead, Administration and Outreach Lead, Science Coordinator, and Program Coordinator who are responsible for coordination and collaborations across EVOSTC programs and with outside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

Coordination and Collaboration Between Programs

With Herring Research and Monitoring Program

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

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

With Data Management Program

The GWA and Data Management programs are fully integrated and dependent on each other. The Program Lead and Science and Program Coordinators will work closely with the Alaska Ocean Observing System

(AOOS) and Axiom data management staff to maintain data access tools, providing data and feedback in the Gulf of Alaska Data Portal, and metadata generation tools. The Science and Program Coordinators will continue to work with all project PIs within the program to ensure new data are loaded to the Gulf of Alaska Data Portal, have undergone QA/QC measures, and have appropriate metadata available for public access. In addition, PWSSC acts as the fiscal agent between AOOS and NOAA for the Data Management grant.

B. With Other EVOSTC-funded Projects

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

C. With Trustee or Management Agencies

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

PMT members attended two NOAA workshops at the Alaska Fisheries Science Center: 1) Ecosystem and Socioeconomic Profile (ESP) Data Workshop and 2) Recruitment Processes Alliance planning workshop. GWA's annual sampling greatly complements NOAA's biennial sampling effort in contributing to ecosystem-based fisheries management efforts in the GOA.

GWA PIs coordinate reporting and sampling of marine mammal carcasses for NOAA Alaska Region Protected Resources Division (Kate Savage and Sadie Wright) and the Coastal Observation and Seabird Survey Team (COASST), led by Julia Parrish of the University of Washington.

4. PROGRAM DESIGN

D. Overall Program Objectives

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

1. Sustain and build upon existing time series in the EVOS-affected regions of GOA.
2. Provide scientific data, data products, and outreach to management agencies and a wide variety of users.
3. Develop science synthesis products to assist management actions, inform the public, and guide monitoring priorities for the next 15 years.
4. Enhance connections between GWA and HRM programs.
5. Leverage partnerships with outside agencies and groups to integrate data from broader efforts.

E. Changes to Program Design and Objectives

There are no changes to the GWA Program overall design or objectives.

5. PROGRAM PERSONNEL – CHANGES AND UPDATES

The PM I project added a doctoral student, Ben Weitzman, to the GWA program based on our funding request in the FY19 workplan. Dr. Weitzman shared his time between the Nearshore project (20120114-H) and the PM I project (20120114-A). Ben recently took a new job at the NOAA Kasitsna Bay Laboratory working with Kris Holderied's group (project 20120114-J). Ben's transition to a group that is still a part of

GWA will be a net benefit for GWA synthesis efforts and there will be no interruption to his current key contributions: 1) the Dean et al. manuscript that will be part of the synthesis report - Ben is conducting all the analyses and preparing figures, and 2) working with the Science Coordinator to continue integrating Kachemak Bay and lower Cook Inlet data into GWA synthesis efforts.

We are in the process of writing a position description to fill the postdoc position and have already been contacted by several prospective applicants even before sending out the vacancy notice. Ultimately this should benefit GWA, as Ben will remain a GWA contributor and we will have another postdoc onboard in the coming months.

Program Coordinator Donna Aderhold has successfully transitioned from employment as a NOAA contractor to PWSSC and funding for her position has transitioned from PM I to PM II. Her roles and responsibilities to the program remain the same.

6. PROGRAM BUDGET

A. Budget Forms (See GWA FY20 Budget Workbook)

Please see completed program workbook for program summaries and for each project's five-year budget. No costs are associated with international travel or outreach events unrelated to the program. Table 2 provides an overall program budget summarized by category rather than project.

Table 2. Proposed GWA program budget summary by category across all projects for FY 2017-2021. Numbers for FY20 and FY21 include additional funding requests for two existing projects (Nearshore, 20120114-H, and PWS Bird Population Trends, 20120114-M) and one proposed new project (Lingering Oil, 20200114-P). Numbers are presented in thousands.

Budget Category	FY 17	FY 18	FY 19	FY 20	FY 21	Total
Personnel	1,105.2	1,212.9	1,301.2	1,429.7	1,372.8	6,421.8
Travel	100.7	111.2	92.8	75.2	87.6	467.4
Contractual	610.7	696.8	651.8	727.1	630.2	3,316.7
Commodities	115.9	154.8	133.2	192.1	155.4	751.4
Equipment	56.6	83.9	49.1	35.2	29.4	254.2
Indirect Costs	101.5	102.6	102.3	103.0	104.4	513.8
Subtotal	2,090.6	2,362.3	2,330.3	2,562.3	2,379.7	11,725.2
General Admin. (9% of Subtotal)	188.2	212.6	209.7	230.6	214.2	1,055.3
Program Total	2,278.8	2,574.9	2,540.1	2,792.9	2,593.9	12,780.4
In-kind Funds	3,205.1	3,260.3	3,027.5	3,421.8	3,377.6	16,292.3

B. Changes from Original Project Program

Our FY20 budget includes additional funding requests for two existing and one proposed new project. In addition, our budget requests approval for adjustments to budget allocations between categories for several projects. This section describes the funding requests and adjustments by project (Table 3) and by category (Table 4).

New Funding Requests by Project:

Nearshore Ecosystem Component (20120114-H): We are requesting an additional \$22K for FY20 and FY21. These funds would cover some of the costs of operating the USGS RV *Alaskan Gyre*, which have increased substantially and were unanticipated at the time of the original proposal. Without additional funds to defray some operating costs, we might need to reduce number of days of use, which in turn would require reductions in field activities and data collected (Table 3).

PWS Bird Population Trends (20120114-M): We are requesting an additional \$23.6K in FY20 and \$23.7K FY21 to continue offshore seabird surveys on the Seward Line (project 20120114-L, PI Hopcroft) that are now a part of the NGOA LTER project. Leveraged funding previously acquired is insufficient to support the extended sampling of the LTER. These surveys continue a 20-year time series on the Seward Line and link shifts in seabird abundance and cross-shelf distribution to annual and long-term patterns observed in the inshore waters of PWS (Table 3).

Long-term Monitoring of Lingering Oil in PWS (20200114-P): We are requesting an additional \$47.9K in FY20 and \$12.0K in FY21 to conduct sampling at heavily oiled sites in PWS and reporting (Table 3).

Table 3. FY20-21 additional funding requests by project, including two existing and one proposed new project. Numbers do not include 9% GA and are presented in thousands.

Project Requesting Additional Funds	Requested for FY20	Requested for FY21	Total Funds Requested
20120114-H, Nearshore Ecosystems	\$22.0	\$22.0	\$44.0
20120114-M, PWS Bird Population Trends	\$23.6	\$23.7	\$47.3
20200114-P, Lingering Oil	\$47.9	\$12.0	\$59.9
Total Additional Request for FY20	\$93.5	\$57.7	\$151.2

New Funding Requests by Budget Category:

Travel: We are requesting \$1.4K for travel in FY20 related to a proposed new project to conduct lingering oil sampling in PWS (20200114-P) (Table 4).

Contractual: We are requesting \$70.1K in FY20 and \$35.7K in FY21 to support one existing and one proposed new project: 23.6K in FY20 and \$23.7K in FY21 to allow continuation of marine bird surveys (20120114-M) on the Seward Line each year with the inclusion of additional sampling associated with the Northern Gulf of Alaska LTER, and \$46.5K in FY20 and \$12K in FY21 to conduct lingering oil sampling in PWS (20200114-P) (Table 4).

Commodities: We are requesting \$22K per year to support operation of the USGS research vessel for nearshore surveys (20120114-H) (Table 4).

Table 4. New funds requested for FY20 and FY21 for the Gulf Watch Alaska program. This request includes two existing projects (20120114-H, Nearshore, and 20120114-M PWS Bird Population Trends) and one proposed new project (20200114-P, Lingering Oil). Numbers are presented in thousands.

Budget Category	New Request FY20	New Request FY21	Total New Request
Personnel	\$0.0	\$0.0	\$0.0
Travel	\$1.4	\$0.0	\$1.4
Contractual	\$70.1	\$35.7	\$105.8
Commodities	\$22.0	\$22.0	\$44.0
Equipment	\$0.0	\$0.0	\$0.0
Annual Subtotal	\$93.5	\$57.7	\$151.2
9% GA	\$8.42	\$5.19	\$13.61
Total with GA	\$101.9	\$62.9	\$164.8

Approval for Adjustments to Project Budget Allocations:

The past year had the added challenge of a government shutdown (10% of the federal fiscal year). This affected spending plans for some of the GWA projects lead by government agencies (e.g., cancelled travel, expired contracts, delayed startup of contracts, etc.) as well as participation by SRP members, but PIs were able to balance things for the most part. Various unforeseen events also affected project spending plans. The following projects are requesting approval for adjustments to budget categories (line item transfers) within their projects which will not affect their overall costs: 20120114-B, 20120114-H, 20120114-J, and 20120114-N. Please see individual project work plans for further details.

C. Sources of Additional Program Funding

Because of the diversity of agencies and organizations represented by the GWA program, we are able to leverage more than \$16 million in cost-share, in-kind, direct funds, and other support funding.

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

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

7. FY17-19 PROGRAM PUBLICATIONS AND PRODUCTS

Publications

Aderhold, D.G.R, Lindeberg, M.R., Holderied, K., Pegau, S.W., 2018. Introduction: Spatial and temporal ecological variability in the northern Gulf of Alaska: What have we learned since the *Exxon Valdez* oil spill? Deep-Sea Research Part II. [DOI:10.1016/j.dsr2.2017.11.015](https://doi.org/10.1016/j.dsr2.2017.11.015)

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- Bentz, S., M. Johnson, G. Gibson, S. Baird, and J. Schloemer. 2018. Ocean Circulation Mapping to Aid Monitoring Programs for Harmful Algal Blooms and Marine Invasive Transport in South-central, Alaska. State Wildlife Grant, Alaska Dept. of Fish and Game. Annual Report. 45pp.
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North Pacific Pelagic Seabird Database

Drew, G. and J. Piatt. *In prep.* Fall and Winter Seabird Abundance: PWS fall and winter 2007-2016 seabird observations. Bishop, M. A. and A Schaefer contribution to North Pacific Pelagic Seabird Database 3.0 (NPPSD): U.S. Geological Survey data release.

Presentations

Arimitsu, M.L. 2018. Monitoring forage fish in Alaska: Detecting change in non-commercial prey populations. Oral Presentation. Department of Fisheries and Oceans Canada Forage Fish Workshop. Pacific Biological Station, Nanaimo, BC. 13-15 March. [Invited, travel paid by DFO]

Arimitsu, M.L., Bishop, M.A., Hatch, S., Kaler, R., Kuletz, K., Matkin, C., Moran, J., Olsen, D., Piatt, J.F., Schaeffer, A., Straley, J. 2018. Changes in marine predator and prey populations in the aftermath of the North Pacific heat wave: Gulf Watch Alaska Pelagic update 2017. Alaska Marine Science Symposium, Anchorage, AK, January.

Arimitsu, M.L., S. Pegau, J. Piatt, B. Heflin, and S. Schoen. 2017. Spatial and temporal variability of forage fish in coastal waters of Prince William Sound, Alaska, Alaska Marine Science Symposium, Anchorage, AK. January.

Arimitsu, M.L., J. Piatt, B. Heflin, and S. Schoen. 2017. Jellyfish blooms in warm water may signal trouble for forage fish in a warming climate. ICES/PICES Symposium on Drivers of Dynamics of Small Pelagic Fish Resources, Victoria, BC Canada, March.

Arimitsu, M.L., J.F. Piatt, B.M. Heflin, S.K. Schoen, V.R. von Biela. 2018. Ripples of the North Pacific heatwave: signals from seabirds and their forage base in the Gulf of Alaska. Poster Presentation. Ocean Sciences Meeting, Portland, OR. 11-16 February.

Arimitsu, M.L., Piatt, J.F., Schoen, S.S., Heflin, B.H., von Biela, V.R., Hatch, S. 2018. Changes in forage fish during the winter 2015-16 seabird die-off and the North Pacific marine heat wave. Alaska Marine Science Symposium, Anchorage, AK, January.

Barbeau, K., R.R. Hopcroft, O. Schofield, and H. Sosik. 2018. Pelagic LTER site: site overviews, inter-comparisons and synthesis planning. Workshop. LTER All Scientists Meeting, Pacific Grove, CA, October.

Batten, S.D. 2018. Lower Trophic Level Variability Across the Subarctic North Pacific, From Continuous Plankton Recorder Sampling. Oral presentation, RS41A-04, Ocean Sciences February 2018, Portland, Oregon.

Batten, S.D, A. Walne, and P. Helaouet. 2019. Impact of the marine heat wave on Gulf of Alaska plankton communities. Has normal service now been resumed? Oral presentation, Alaska Marine Science Symposium, January 2019, Anchorage, Alaska.

- Bodkin, J.L., B.E. Ballachey, G.E. Esslinger, B.P. Weitzman, A.M. Burdin, L. Nichol and H.A. Coletti. 2017. A century of sea otter science and conservation in National Parks. X Sea Otter Conservation Workshop, 17-19 March 2017, Seattle Aquarium. Oral Presentation. Seattle WA.
- Bodkin, J., H. Coletti, B. Ballachey, D. Monson, T. Dean, D. Esler, G. Esslinger, K. Iken, K. Kloecker, B. Konar, M. Lindeberg, and B. Weitzman. 2018. Detecting and inferring cause of change in Alaska nearshore marine ecosystem: An approach using sea otters as a component of the nearshore benthic food web. Oral Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 21-25 2018.
- Bowen, L., H.A. Coletti, B. Ballachey, T. Hollmen, S. Waters, and K. Counihan. 2018. Transcription as a Tool for Assessing Bivalve Responses to Changing Ocean Conditions. Oral Presentation. Ocean Sciences Meeting. February 11-16, 2018.
- Campbell, R. 2018. A profiling observatory for high resolution oceanographic, biogeochemical, and plankton observations in Prince William Sound. Alaska Marine Science Symposium, Anchorage. Oral presentation.
- Campbell, R.W. 2018. A Profiling Observatory for High Resolution Oceanographic, Biogeochemical, and Plankton Observations in Prince William Sound. ASLO Ocean Sciences Meeting, Portland. Poster presentation.
- Campbell, R.W. 2019. The PWS Plankton Cam: an underwater microscope to view the zooplankton ecosystem of Prince William Sound. PWSSC Lecture series, Cordova. Oral presentation.
- Campbell, R.W., Jaffe, J., and P. Roberts. 2019. The PWS Plankton Cam: An In-situ Look Into the Zooplankton Ecosystem of Prince William Sound. Alaska Marine Science Symposium, Anchorage. Poster presentation.
- Coletti, H., D. Esler, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, K. Iken, K. Kloecker, B. Konar, M. Lindeberg, D. Monson, B. Robinson, and B. Weitzman. 2018. A decade's worth of data: Key metrics from a large-scale, trophic web based long term monitoring program in the northern Gulf of Alaska. Poster Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 21-25 2018.
- Coletti, H.A., P. Martyn, D.H. Monson, D. Esler and A.E. Miller. 2018. Using Small Unmanned Aircraft Systems (sUAS) to map intertidal topography in Katmai National Park and Preserve, Alaska. Poster Presentation. Ocean Sciences Meeting. February 11-16, 2018.
- Coletti, H.A., R. Suryan, D. Esler, R. Kaler, T. Hollmen, M. Arimitsu, J. Bodkin, T. Dean, K. Kloecker, K. Kuletz, J. Piatt, B. Robinson, and B. Weitzman. 2019. Birds of a feather flock together... or do they? Regional and temporal patterns of community composition and abundance in nearshore marine birds across the Gulf of Alaska. Oral Presentation. Alaska Bird Conference. March 2019.
- Coletti, H.A., G. Hilderbrand, D. Monson, J. Erlenbach, B. Ballachey, B. Pister and B. Mangipane. 2019. Where carnivores clash: Evidence of competition - Prey-shifting by brown bears during a period of sea otter recovery. Oral Presentation. Sea Otter Conservation Workshop 2019. March 2019.
- Collins, R.E. 2018. Microbial community structure in Prince William Sound. Poster Presentation, Alaska Marine Science Symposium, January.
- Counihan, K., L. Bowen, B. Ballachey, H. Coletti, T. Hollmen, and B. Pister. 2019. Physiological and gene transcription assays in combinations: a new paradigm for marine intertidal assessment. Oral Presentation. Alaska Marine Science Symposium. January 28 – February 1, 2019.

- Coyle, K.O., A.J. Hermann, and R.R. Hopcroft. 2018. Modeled spatial-temporal distribution of production and biomass relative to field observations in the northern Gulf of Alaska. Oral Presentation Ocean Sciences Meeting – Portland, OR, February.
- Crusius, J., Schroth, A.W., Gasso, S, and R.W. Campbell. 2018. “Gap” winds through mountainous topography dominate offshore winds along the curved coastline of southern Alaska, influencing transport of dust-derived Fe as well as Fe from upwelling and eddies. ASLO Ocean Sciences Meeting, Portland.
- Cushing, D., K. Kuletz, R.R. Hopcroft, S.L. Danielson, and E. Labunski. 2017. Shifts in cross-shelf distribution of seabirds in the northern Gulf of Alaska under different temperature regimes, 2007-2015. Poster Presentation. Pacific Seabird Group, Tacoma, WA, February.
- Cushing, D., K. Kuletz, E. Labunski, and R.R. Hopcroft. 2019. Seabird Studies During the Northern Gulf of Alaska Long Term Ecological Research Program. Poster Presentation. Alaska Marine Science Symposium, January.
- Danielson, S. L., 2017. UAF Site Review: Northern Gulf of Alaska Marine Ecosystem Monitoring, M.J. Murdock Charitable Trust, 10 August 2017. Oral Presentation.
- Danielson, S. 2017. Marine heatwaves in the North Pacific & Pacific Arctic 2013-2017, UAF-CFOS Fisheries and Oceanography Seminar Series. Oral Presentation.
- Danielson, S.L. 2018. The short and the long of it: the importance of high-resolution Alaskan marine process studies and monitoring. Oral Presentation. UAF-CFOS FOS Seminar, September. Fairbanks, AK.
- Danielson, S.L., 2019. Changing stratification over Alaska region continental shelves suggests altered diapycnal mixing and nutrient fluxes, 3rd International Symposium: Ocean Mixing Processes: Impact on Biogeochemistry, Climate and Ecosystem. University of Tokyo, 23 May 2019. Oral Presentation.
- Dorsaz, T., and B. Konar. 2019. Clam predation patterns as a way of understanding sea star wasting disease’s impacts in Kachemak Bay. Poster Presentation. Alaska Marine Science Symposium. January 28 – February 1, 2019.
- Danielson, S.L., A. Aguilar-Islas, J. Fiechter, R.R. Hopcroft, K. Kuletz, H. Statscewich, and S.L. Strom. 2018. Acrobat Observations along the Gulf of Alaska Hydrographic Tighrope. Poster Presentation. LTER All Scientists Meeting, Pacific Grove, CA, October.
- Du, X., R. Campbell, S. Kibler, K. Holderied, D. Hondolero, K. Shuster, R. Robinson, M. Arimitsu, J. Piatt. 2019. Prevalence of paralytic shellfish toxins in the marine food webs of Prince William Sound and Kachemak Bay, Alaska. Poster Presentation. Alaska Marine Science Symposium, Anchorage, AK. 28-31 January.
- Esler, D. 2017. Sea ducks as indicators of nearshore marine conditions. Oral Presentation. 6th International Sea Duck Conference, San Francisco.
- Esler, D. 2017. Sea Duck Traits: Their Influence on Oil Spill Vulnerability and Restoration Potential. Oral Presentation. 6th International Sea Duck Conference, San Francisco.
- Esler, D., B. Ballachey, C. Matkin, D. Cushing, R. Kaler, J. Bodkin, D. Monson, G. Esslinger, and K. Kloecker. 2016. Long-term data provide perspective on ecosystem recovery following the *Exxon Valdez* oil spill. Oral presentation. Gulf of Mexico Oil Spill and Ecosystem Science Conference, Tampa, Florida.

- Esslinger, G.G., H.A. Coletti, J.L. Bodkin, D.H. Monson, B.E. Ballachey, T.A. Dean, and D. Esler. 2017. Contrasting demography and behavior among sea otter populations in the northern Gulf of Alaska. Oral Presentation. Alaska Chapter of The Wildlife Society Annual Meeting, Fairbanks.
- Esslinger, G.G., H.A. Coletti, J.L. Bodkin, D.H. Monson, B.E. Ballachey, T.A. Dean, and D. Esler. 2017. Trends and equilibrium density vary among sea otter populations in the northern Gulf of Alaska. Oral Presentation. Sea Otter Conservation Workshop, Seattle.
- Hauri, C., K Hedstrom, C. Schultz, S.L. Danielson, J. Beamer, S. Dony, D.F. Hill, and C. Stock. 2019. Influence of Ocean Acidification and Climate Change on the Biogeochemistry in the Gulf of Alaska: A Regional Modeling Study. Presentation. Alaska Marine Science Symposium, January.
- Heflin, B., M. Arimitsu, J. Piatt, S. Schoen, and E. Madison. 2016. Seabird and forage fish response to contrasting cold and warm years in Prince William Sound, Alaska. Pacific Seabird Group meeting, Honolulu, HI, February.
- Holderied, K. 2018. Alaska Coastal Science and Management Examples. Oral presentation at Joint Polar Satellite System Arctic Summit, Anchorage, AK. May 2018.
- Holderied, K., and E. Ammann. 2017. Improving shellfish restoration and habitat assessment in coastal Alaska: Kachemak Bay Habitat Focus Area. Oral presentation at Coastal and Estuarine Research Federation conference. Providence, RI. Nov 2017.
- Holderied, K., D. Hondolero, S. Kibler, M. Vandersea, A. Doroff, J. Schloemer, and S. Buckelew. 2017. Using coastal Alaska marine responses to the 2014-2016 Pacific Warm Anomaly to improve risk assessment for climate-driven increases in paralytic shellfish poisoning events. Oral presentation at Climate Predictions Applications Science Workshop. Anchorage AK. May 2017.
- Holderied, K., K. Powell, S. Baird, and J. Schloemer. 2018. Variability in estuarine salinity and stratification in Kachemak Bay, Alaska from 2012-2017. Poster presentation at Alaska Marine Science Symposium, Anchorage AK. Jan 2018.
- Holderied, K., K. Powell, J. Schloemer, S. Baird, and D. Hondolero. 2018. Heating up and cooling off in Kachemak Bay Alaska – what does it mean for the marine ecosystem? Oral presentation at the Kachemak Bay Science Conference, Homer, AK. Mar 2018.
- Holderied, K., K. Powell, J. Schloemer, and D. Hondolero. 2018. Variability in nearshore and estuarine oceanography in the northern Gulf of Alaska: 2004-2017. Poster presentation at 2018 Ocean Sciences Meeting, Portland, OR. Feb 2018.
- Holderied, K., J. Schloemer, K. Powell Schuster, S. Baird, and D. Hondolero. 2019. Seasonal and spatial variability in ocean acidification conditions in Kachemak Bay and Cook Inlet Alaska. Poster presentation at Alaska Marine Science Symposium, Anchorage AK. Jan 2019.
- Hondolero, D., M. Vandersea, K. Holderied, S. Kibler, K. Powell, S. Baird, A. Doroff, and W. Litaker. 2018. Environmental factors affecting toxic phytoplankton plankton in Kachemak Bay. Oral presentation at the Kachemak Bay Science Conference, Homer, AK. Mar 2018.
- Hopcroft, R.R., S.L. Strom, A. Aguilar-Islas, S.L. Danielson, and J. Fiechter. 2018. The Northern Gulf of Alaska Long-term Ecological Research Program. Poster Presentation. Alaska Marine Science Symposium, January.

- Hopcroft, R.R., K.O. Coyle, and S.L. Danielson. 2018. The Seward Line - 2017. Poster Presentation. Alaska Marine Science Symposium, January.
- Hopcroft, R.R., K.O. Coyle, S.L. Danielson, and S.L. Strom. 2017. Twenty Years of Observations Along the Gulf of Alaska's Seward Line: Impact of Continued Warm Conditions. Oral Presentation. Kodiak Marine Science Symposium, Kodiak, April.
- Hopcroft, R.R., K.O. Coyle, S.L. Danielson, and S.L. Strom. 2017. Oceanography in the Northern Gulf of Alaska: the Seward Line. Public Presentation for Osher Lifelong Learning Institute, Fairbanks, December.
- Hopcroft, R.R. and D. J. Lindsay. 2018. Gelatinous zooplankton in Alaskan waters: from nets to ROVs. Invited PICES Annual Meeting, Yokohoma, Japan, October.
- Hopcroft, R.R., S.L. Strom, A. Aguilar-Islas, S.L. Danielson, and J. Fiechter. 2018. The Northern Gulf of Alaska Long-term Ecological Research program: coming to an ocean near you in 2018. Poster Presentation. Ocean Sciences Meeting – Portland, OR, February.
- Hopcroft, R.R., S.L. Strom, A. Aguilar-Islas, S.L. Danielson, and J. Fiechter. 2018. A new Long-term Ecological Research (LTER) site in the Northern Gulf of Alaska. Poster PICES Annual Meeting, Yokohoma, Japan, October.
- Hopcroft, R.R., S.L. Strom, K.O. Coyle, and S.L. Danielson. 2017. Three in a row: continued warm conditions along the Gulf of Alaska's Seward Line. Oral Presentation. Association for the Sciences of Limnology and Oceanography, Honolulu, March.
- Iken, K., and B. Konar. 2018. Nearshore Gulf Watch Alaska monitoring in Kachemak Bay. Oral Presentation. Kachemak Bay Science Conference, Homer, AK. 8-9 March 2018.
- Iken, K., and B. Konar. 2018. Freezing in a warming climate? Poster Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 21-25 2018.
- Iken, K., and B. Konar. 2018. Nearshore Gulf Watch Alaska monitoring in Kachemak Bay. Poster Presentation. Kachemak Bay Science Conference. March 7-10, 2018.
- Jones, J., et al. 2018. Climate Change at LTER sites. Workshop. LTER All Scientists Meeting, Pacific Grove, CA, October.
- Kibler, S., X. Du, R.W. Campbell, K. Holderied, D. Hondolero, K. Powell Schuster, R. Robinson, M. Arimitsu, and J. Piatt. 2019. NPRB 1801: Prevalence of Paralytic Shellfish Toxins in the Marine Food Webs of Prince William Sound and Kachemak Bay, Alaska. Alaska Marine Science Symposium, Anchorage. Poster presentation.
- Kloecker, K.A., D.H. Monson, B. Robinson, H.A. Coletti, B.E. Ballachey, and D. Esler. 2017. Correlates between sea otter diet and prey energetics in a mussel-specialist population. Oral Presentation. Sea Otter Conservation Workshop, Seattle.
- 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. Poster Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 21-25 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. Oral Presentation. 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. Oral Presentation. Kachemak Bay Science Conference. March 7-10, 2018.
- Kuletz, K., D. Cushing, R.R. Hopcroft, S.L. Danielson, and E. Labunski. 2017. Running Hot and Cold: Shifts in Seabird Distribution in the Northern Gulf of Alaska under Different Temperature Regimes, Based on Seward Line Surveys, 2007-2015. Poster Presentation. Alaska Marine Science Symposium, January.
- Kuletz, K., R.R. Hopcroft, S.L. Danielson, J. Santora, W. Sydeman, B. Hoover, and D. Cushing. 2018. Seabird distribution relative to biophysical oceanographic properties in North Pacific ecosystems. Poster LTER All Scientists Meeting, Pacific Grove, CA, October.
- Kurtz, D., D. Esler, T. Jones, B. Weitzman, and B. Robinson. 2019. Spatial and temporal patterns in nearshore physical oceanography in tidewater glacial fjords. Poster Presentation. Alaska Marine Science Symposium. January 28 – February 1, 2019.
- Lenz, P.H., V. Roncalli, Hartline, M. Germano, M.C. Cieslak, S.L. Strom, & R.R. Hopcroft. 2018. The physiological ecology of the calanid copepod, *Neocalanus flemingeri* in the northern Gulf of Alaska. Oral Presentation. Alaska Marine Science Symposium, January.
- Lindeberg, M. 2017. The Long-Term Monitoring Program of the *Exxon Valdez* Trustee Council. Briefing to the EVOSTC Trustees, Nov. 14.
- Lindeberg, M. 2017. We are Watching – the long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council. PWS RCAC Science Night. December.
- Lindeberg, M. 2018. The Long-term Monitoring Program of the *Exxon Valdez* Trustee Council. Briefing to the EVOSTC Trustees, Nov. 14.
- Lindeberg, M. 2018. Science without borders – is it possible? Keynote presentation. 2018 Kachemak Bay Science Conference, Homer, AK, March 7-10.
- Lindeberg, M. 2018. Gulf Watch Alaska Long-term Monitoring Program. Speed talk. 2018 Ocean Sciences Conference, Portland, OR, February 11-16.
- Lindeberg, M. 2018. Nearshore Ecosystem Component of the Gulf Watch Alaska Long-term Monitoring Program. Speed talk. 2018 Ocean Sciences Conference, Portland, OR, February 11-16.
- Lindeberg, M.R. 2019. Long-term Programs of the *Exxon Valdez* Oil Spill Trustee Council. Presentation. 2019 Alaska Forum on the Environment, Feb. 11-15, Anchorage, Alaska.
- Lindeberg, M., K. Holderied, D. Aderhold, K. Hoffman, M. Arimitsu, H. Coletti, and R. Hopcroft. 2017. Gulf Watch Alaska: Results from five years of ecosystem monitoring in the northern Gulf of Alaska. Presentation. 2017 Alaska Marine Science Symposium, Anchorage.
- Lindeberg, M., K. Holderied, D. Aderhold, K. Hoffman, M. Arimitsu, H. Coletti, and R. Hopcroft. 2017. Gulf Watch Alaska: Results from five years of ecosystem monitoring in the northern Gulf of Alaska. Presentation. 2017 NMFS Alaska Fisheries Science Center mini symposium.

- Lindeberg, M., M. McCammon, K. Holderied, K. Hoffman, D. Aderhold, R. Hopcroft, M. Arimitsu, H. Coletti. Five years of ecosystem monitoring in the Northern Gulf of Alaska. Alaska Marine Science Symposium. January.
- Lindeberg, M., R. Suryan, D. Aderhold, K. Hoffman, R. Hopcroft, H. Coletti, and M. Arimitsu. 2018. Gulf Watch Alaska Report: Residual effects of the marine heatwave persist in the Gulf of Alaska. Alaska Marine Science Symposium, Anchorage, AK, January.
- Martyn, P., D. Monson, H. Coletti, A. Miller, and D. Esler. 2018. Using Small Unmanned Aircraft Systems (sUAS) to map intertidal topography in Katmai National Park and Preserve, Alaska. Poster Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 21-25 2018.
- Matkin, C.O. 2017. Tracking whales with hydrophones. Delta Sound Connections, PWS Science Center. March 2017.
- Matkin C.O. 2018. Life History and Social Structure of Alaskan Killer Whales, 2018. Oral Presentation to Kenai Peninsula College, October 2018.
- Matkin C.O., D.W. Olsen, and G. Ellis. 2018. Southern Alaska resident killer whales may be dependent on more than Alaska salmon: some initial stream of origin genetic data from prey samples. Poster Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 2018.
- Matkin, C.O., Olsen D.W. and Ellis, G. 2019. An unfortunate legacy: Continuing effects of the *Exxon Valdez* oil spill on killer whales. Alaska Marine Science Symposium, Anchorage Alaska. Poster Presentation.
- McGowan, D.W., M.L. Arimitsu, K. Coyle, A.L. Dreary, A. De Robertis, E.D. Golstein, K. Holderied, J.K. Horne, O. Ormseth, J.F. Piatt, L.A. Rogers, M.T. Wilson, S. Zador. 2019. Spatial and temporal dynamics of capelin (*Mallotus villosus*) in the Gulf of Alaska: implications for fisheries and ecosystem-based management. Oral Presentation. Alaska Marine Science Symposium, Anchorage, AK. 28-31 January.
- McKinstry, C., and R.W. Campbell. 2018. Seasonal variation of zooplankton abundance and community structure in Prince William Sound, Alaska, 2009-2016. ASLO Ocean Sciences Meeting, Portland. Poster presentation.
- McKinstry, C., and R. Campbell. 2018. Zooplankton community structure and seasonal abundance in Prince William Sound. Alaska Marine Science Symposium, Anchorage. Poster presentation.
- Mearns, A., D. Janka, P. Marloff, R. Campbell, S. Pegau, and D. Esler. 2018. Twenty-eight years of intertidal biological variability based on volunteer visits to photo sites in Western Prince William Sound. Alaska Marine Science Symposium, Anchorage. Poster presentation.
- Mendoza-Islas, H.M., and R.R. Hopcroft. 2019. First year pollock and their zooplankton predators in the Gulf of Alaska. Poster Presentation. Alaska Marine Science Symposium, January.
- Monacci, N.M., J. Cross, and J. Mathis. 2019. Ocean acidification observations along the Seward Line: 2008-2017. Poster Presentation. Alaska Marine Science Symposium, January.
- Monson, D., K. Holderied, R. Campbell, S. Danielson, R. Hopcroft, B. Ballachey, J. Bodkin, H. Coletti, T. Dean, K. Iken, K. Kloecker, B. Konar, M. Lindeberg, B. Robinson, B. Weitzman, and R. Suryan. 2018. Congruence of intertidal and pelagic water and air temperatures during an anomalously warm period in the northern Gulf of Alaska; the “Blob” washes ashore. Alaska Marine Science Symposium, Anchorage. Poster Presentation.

- Monson, D., R. Taylor, G. Hilderbrand, J. Erlenbach, and H. Coletti. 2019. Top-Level Carnivores Linked Across the Marine / Terrestrial Interface: Sea Otter Haulouts Offer a Unique Foraging Opportunity to Brown Bears. Oral Presentation. Alaska Marine Science Symposium. January 28 – February 1, 2019.
- Monson, D.H., B.P. Weitzman, K.A. Kloecker, D. Esler, L.A. Sztukowski, S.A. Sethi, H.A. Coletti, and T. Hollmen. 2017. Understanding Trophic Relationships of Sea Otters and Their Effects on Demographic Attributes. Oral Presentation. Sea Otter Conservation Workshop, Seattle.
- Moran, J. 2018. A whale of an update. Auke Bay Laboratory Mini Seminar. Juneau, AK. 4 April.
- Moran, J. 2018. What do predators tell us about prey? Juneau Marine Naturalist Symposium. Juneau, AK. 10 May.
- Moran, J., K. Boswell, and J. M. Straley. 2017. Humpback whales ruin a perfectly good overwintering strategy for Pacific herring in Alaska. Presentation. PICES - Drivers of Dynamics of Small Pelagic Fish Resources, Victoria, British Columbia, CA, 6-11 March.
- Moran, J., C. Gabriele, J. Neilson, K. Savage, and J. Straley. 2018. Recent observations of humpback whales in the Gulf of Alaska: carrying capacity or a cause for concern? Poster Presentation. Ocean Science Meeting, Portland OR. 11-16 February.
- Moran, J., M. O'Dell, D. Dickson, J. Straley, and M.L. Arimitsu. 2017. Seasonal distribution of Dall's Porpoise in Prince William Sound, Alaska. Alaska Marine Science Symposium. January.
- Moran, J.R., and J.M. Straley. 2018. Recent observations of humpback whales in the Gulf of Alaska: carrying capacity or a cause for concern? 2018 Ocean Science Meeting. Portland, OR, 11-16 February.
- Olsen, D.W. 2017. Kenai Fjords National Park Interpretive guide training. Oral Presentation. May 5, 2017.
- Olsen, D.W. 2017. Killer whales. Oral Presentation. Seward public science night, Resurrect Art Coffee House. May 16, 2017.
- Olsen, D.W. 2017. Killer Whales. Oral presentation to Kenai Fjords National Park Interpretive guide training. May 2017.
- Olsen D.W. 2017. Killer whales. Presentation. Seward public science night, Resurrect Art Coffee House. May 2017.
- Olsen et al. 2017. Behavioral Changes During Multi-pod Aggregations of Southern Alaska Resident Killer Whales (*Orcinus orca*). Oral Presentation. Society of Marine Mammalogy Conference, Halifax, Nova Scotia, November 2017.
- Olsen, D.W. 2018. Zegrahm Expeditions, Killer whales of the world. Oral Presentation to Zegrahm Expeditions May 2018.
- Olsen, DW. 2018. Mom knows best: Killer whale culture in Prince William Sound. Oral Presentation. Kenai Fjords National Park naturalist training May 2018.
- Olsen, D.W. 2018. Mom knows best: Killer whale culture in Prince William Sound. Oral Presentation. Prince William Sound Science Center Brown Bag May 2018.
- Olsen, D.W. 2018. Mom knows best: Killer whale culture in Southern Alaska. Oral Presentation to Public / naturalists / Captains, Seward, May 2018.

- Olsen, D.W. 2018. Mom knows best: Killer whale culture in Southern Alaska. Oral Presentation. Kayak Adventures guide training, May 2018.
- Olsen, D. 2018. Killer whales of Alaska. Kenai Fjords National Park interpretive guide training. Oral Presentation. May 2018.
- Olsen, D. 2018. Mother knows best: Killer whale culture in Alaska. Annual Kenai Fjord Tourboat Operators and Boaters meeting. Oral Presentation. May 2018.
- Olsen, D. 2018. Killer whales of the world. Zegrahm Expeditions, Antarctica. Oral Presentation. January 2018
- Olsen, D. 2018. Killer whales of Prince William Sound. Prince William Sound Science Center Brown Bag presentation. Oral Presentation. May 2018.
- Olsen, D.W. 2018. Killer whales of the world. Oral Presentation to Zegrahm Expeditions July 2018.
- Olsen, D.W. 2018. Life of the Killer Whale. Oral Presentation to Seabourne Sojourn August 2018.
- Olsen, D.W. 2018. Mom knows best: Killer whale culture in Prince William Sound. Oral Presentation to Kenai Peninsula College. November 2018.
- Olsen, D. 2019. Killer whales of Kenai Fjords. Seward naturalists and boat operators, Seward, Alaska. Oral Presentation. May, 2019.
- Olsen, D. 2019. Killer whales of Kenai Fjords. Kayak Adventures Worldwide guide training, Seward, Alaska. Oral Presentation. May 2019.
- Olsen, D. 2019. Killer whales of Kenai Fjords. Kenai Fjords National Park interpretive staff training, Seward, Alaska. Oral Presentation. May 2019.
- Olsen, D. 2019. Killer Whale Acoustic Identification. Kenai Fjords National Park staff and general Seward naturalists. Seward, Alaska. Oral Presentation. June 2019.
- Olsen, D. 2019. Killer whales of Alaska. Lindblad Expeditions, Southeast Alaska. Oral Presentation. July 2019.
- Piatt, J., T. Jones, K. Kuletz, H. Renner, J. Parish, R. Corcoran, S. Schoen, B. Bodenstein, R. Kaler, M. Garcia-Reyes, H. Coletti, M. Arimitsu, R. Duerr, K. Lindquist, J. Lindsey, and W. Sydeman. 2018. Unprecedented Scale of Seabird Mortality in the NE Pacific During the 2015-2016 Marine Heatwave. Oral Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 21-25 2018.
- Powell, K., J. Schloemer, K. Holderied and A. Doroff. 2018. Oceanographic characteristics associated with spring zooplankton community structure in Kachemak Bay, Alaska from 2012 to 2016. Poster presentation at Alaska Marine Science Symposium, Anchorage AK. Jan 2018.
- Powell Schuster, K., K. Holderied, J. Schloemer, and D. Hondolero. 2019. Variability of zooplankton abundance and community structure in Kachemak Bay and lower Cook Inlet Alaska: 2012-2017. Poster presentation at Alaska Marine Science Symposium, Anchorage AK. Jan 2019.
- Renner, M., K. Holderied, K. Powell, D. Hondolero, J. Schloemer, A. Doroff, and K. Kuletz. 2018. Ecosystem variability in Lower Cook Inlet across trophic levels, space, seasons, and climate regimes. Oral presentation at Alaska Marine Science Symposium, Anchorage, AK. Jan 2018.

- Roncalli, V. 2018. Physiological ecology of the calanoid *Neocalanus flemingeri* in the Gulf of Alaska. Invited presentation presented at the Pacific Biosciences Research Center, University Hawaii Manoa, Honolulu, HI, February.
- Roncalli, V., M. Cieslak, R.R. Hopcroft, and P.H. Lenz. 2019. Environmental heterogeneity in the northern Gulf of Alaska impacts physiological status in the copepod *Neocalanus flemingeri*. Poster Presentation. Alaska Marine Science Symposium, January.
- Roncalli, V., D.K. Hartline, M. Germano, M.C. Cieslak, S.L. Strom, R.R. Hopcroft, and P.H. Lenz. 2018. Consequences of regional heterogeneity on the physiology of a calanid copepod, *Neocalanus flemingeri*, in the northern Gulf of Alaska. Oral Presentation Ocean Sciences Meeting – Portland, OR, February.
- Roncalli, V., M.C. Cieslak, S. Mathews, C. Clarke-Hopcroft, R.R. Hopcroft, and P.H. Lenz. 2017. Physiological changes in *Neocalanus flemingeri* females during the transition from diapause to reproduction. Oral Presentation. Association for the Sciences of Limnology and Oceanography, February.
- Schaefer, A.L., M.A. Bishop, and R. Thorne. 2018. Non-breeding marine bird response to forage fish schools in Prince William Sound, Alaska. Poster Presentation. Alaska Marine Science Symposium, January 2018, Anchorage, AK.
- Schloemer, J., S. Baird, S. Bentz, M. Johnson, and R. Masui. 2019. Using circulation mapping and long-term water quality data to aid community monitoring programs in Kachemak Bay, Alaska. Poster presentation at Alaska Marine Science Symposium, Anchorage AK. Jan 2019.
- Sethi, S., K. Iken, B. Konar, and H. Coletti. 2018. Regional and local drivers combine to structure mussel growth and mortality. Poster Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 21-25 2018.
- Siebert, D., K. Iken, B. Konar, S. Saupe, and M. Lindeberg. 2018. Nearshore food web structure in two contrasting regions of Cook Inlet. Poster Presentation. Alaska Marine Science Symposium, Anchorage Alaska. January 21-25 2018.
- Siebert, D., K. Iken, S. Saupe, and M. Lindeberg. 2019. Comparison of intertidal food web structure between two regions of lower Cook Inlet. Poster Presentation. Alaska Marine Science Symposium. January 28 – February 1, 2019.
- Siebert, D., K. Iken, S. Saupe, and M. Lindeberg. 2019. Comparing intertidal food web and community structure across two regions of lower Cook Inlet. Oral Presentation. CMI Annual Review, Anchorage, AK. 1 February 2019.
- Siebert, D., K. Iken, S. Saupe, and M. Lindeberg. 2018. Nearshore food web structure in two contrasting regions of Cook Inlet. Oral Presentation. CMI Annual Review, Anchorage, AK. 26 January 2018.
- Siebert, D., K. Iken, S. Saupe, and M. Lindeberg. 2018. Nearshore food web structure in two contrasting regions of Cook Inlet. Poster Presentation. Kachemak Bay Science Conference, Homer, AK. 8-9 March 2018.
- Straley, J. 2019. Observations of humpback whales in Alaska. Trends in humpback whales meeting, Honolulu HI. 27-28 November.
- Straley, J. 2019. Ecosystem implications for the decline in reproductive success in humpback whales in the Gulf of Alaska. Alaska Marine Science Symposium, Anchorage, AK. 28-31 January.

- Straley, J.M., and J.R. Moran. 2018. Have Gulf of Alaska Humpback Whales Reached Carrying Capacity or Has the Blob Made the Food Web Screwed. Alaska Marine Science Symposium. Anchorage, Alaska. 21-28 January.
- Straley, J.M., and J.R. Moran. 2018. Have Gulf of Alaska Humpback Whales Reached Carrying Capacity or Has the Blob Made the Food Web Screwed? 2018 Ocean Science Meeting. Portland, OR, 11-16 February.
- Straley, J., and J. Moran. 2019. Observations of humpback whales in Alaska. Trends in humpback whales meeting, Honolulu HI. 27-28 November.
- Strom, S.L, K. J. Bright, and K.A. Fredrickson. Mixotrophy in the Gulf of Alaska: Abundant plant-animal cells have major implications for ecology and biogeochemistry. Presentation AMSS (January 2019)
- Strom, S.L., and R.R. Hopcroft. Planktonic Communities in the Coastal Gulf of Alaska: Strong Dichotomies in Structure and Function. Oral Presentation Ocean Sciences Meeting – Portland, OR (February 2018)
- Strom, S., R.R. Hopcroft, A. Aguilar-Islas, S.L. Danielson, J. Feichter. 2019. Resilience Amidst a Sea of Change: The Northern Gulf of Alaska LTER Program, Keynote Presentation, Alaska Marine Science Symposium, January 2019, Anchorage, AK.
- Suryan, R.M. 2019. Gulf of Alaska ecosystem status for 2018 and early indicators for 2019. Alaska Groundfish and Halibut Seabird Working Group, NOAA Alaska regional office, Juneau.
- Suryan, R.M. 2019. Mixed Signals of “Recovery” From the Gulf of Alaska Marine Heatwave: Perspectives from Gulf Watch Alaska. University of Alaska Southeast, Juneau, Alaska.
- Suryan, R., S. Zador, M. Lindeberg, D. Aderhold, J. Moran, B. Laurel, H. Coletti, M. Arimitsu, J. Piatt, D. Monson, S. Hatch, J. Straley, R. Campbell, S. Pegau, R.R. Hopcroft, S.L. Danielson, B. Konar, K. Iken, S. Batten, and T. Dean. 2018. Ecosystem variability and connectivity in the Gulf of Alaska. Oral Presentation. PICES Annual Meeting, Yokohama, Japan, October.
- Sydemann, W.J., S.A. Thompson, M. Garcia-Reyes, M. Arimitsu, J. Piatt, H. Renner, and S. Hatch. 2018. Puffins as samplers of forage fish in Alaska: variation in length and condition relative to ocean climate in the Gulf of Alaska. Alaska Marine Science Symposium, Anchorage, AK, January.
- Vandersea, M., P. Tester, K. Holderied, D. Hondolero, S. Kibler, K. Powell, S. Baird, A. Doroff and W. Litaker. 2018. Distribution and abundance of *Alexandrium catenella* in Kachemak Bay and Lower Cook Inlet, Alaska. Poster presentation at Alaska Marine Science Symposium, Anchorage, AK. Jan 2018.
- Von Biela, V.R., M.L. Arimitsu, S.K. Schoen, B.M. Heflin, J.F. Piatt. 2018. Declining condition of a key forage fish in the Gulf of Alaska during the North Pacific marine heatwave. Oral Presentation. American Fisheries Society, Anchorage, AK. 21-25 May.
- Weiss, C., J.R. Moran, and T. Miller. 2018. Fine-scale trophic ecology and bioenergetics of euphausiids in Prince William Sound, Alaska. Alaska Marine Science Symposium. Anchorage, Alaska. 21-28 January.
- Weitzman, B., D. Esler, H. Coletti, B. Konar, and K. Iken. 2018. Can you dig it? Patterns of variability in clam assemblages within mixed-sediment habitats across the Gulf of Alaska. Oral Presentation. Kachemak Bay Science Conference. March 7-10, 2018.

Outreach

- Aderhold, D. 2018. An overview of GWA. Presentation to Cook Inlet Regional Citizens’ Advisory Council Board of Directors.

- 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.
- 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.
- Arimitsu, M.L., 2016. "Virtual Field Trip: Forage fish studies". http://www.alaskasealife.org/gw_Pelagic.
- Arimitsu, M.L. 2018. Monitoring forage fish in Alaska: Detecting change in non-commercial prey populations. Department of Fisheries and Oceans Canada forage fish workshop. Pacific Biological Station, Nanaimo, BC, Mar. 2018.
- Arimitsu, M., J. Piatt, S. Schoen, and B. Heflin. 2017. Forage fish in hot water contribute to seabird die-off. Delta Sounds Connections 2017-18. <http://pwssc.org/wp-content/uploads/2017/06/DSC-2017-web2.pdf>.
- Buckelew, S. 2018. Gulf Watch Alaska website updates.
- Buckelew, S. 2019. Gulf Watch Alaska website updates.
- Campbell, R. 2018. Productive plankton in the world's richest waters: the role of nutrients in the annual plankton cycle. Delta Sound Connections 2019-2020. Prince William Sound Science Center (http://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf).
- Campbell, R. 2018. Plankton monitoring. Web page and podcast (<http://pwssc.org/plankton-monitoring/>). The podcast has been used by the local radio station, KCHU.
- Campbell, R. 2019. Computers to identify plankton images from Prince William Sound. Delta Sound Connections 2018-2019. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf)
- Campbell, R.W., Jaffe, J. and P.L. Roberts. 2018. Photographing plankton. PWSSC Delta Sound Connections (http://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf)
- Coletti, H., D. Esler, B. Robinson, and B. Weitzman. 2018. Ocean Alaska Science and Learning Center Teacher Workshop. Kenai Fjords National Park, AK, June.
- Coletti, H., D. Esler, B. Robinson, and B. Weitzman. 2019. Ocean Alaska Science and Learning Center Teacher Workshop. Kenai Fjords National Park, AK, June.
- Danielson, S.L. 2017. "Gulf Watch Alaska, Mystery of the Blob." Interview. Available at http://www.alaskasealife.org/gulfwatchblobvft_investigation.
- Danielson, S.L., 2017. GAK-1 internet home page updates. Available at <http://research.cfos.uaf.edu/gak1/>
- Danielson, S.L., 2018. GAK-1 internet home page updates. Available at <http://research.cfos.uaf.edu/gak1/>
- Danielson, S.L., 2019. GAK-1 internet home page updates. Available at <http://research.cfos.uaf.edu/gak1/>
- Danielson, S., Hopcroft, R., Holderied, K. and R. Campbell. 2019. Tracking water layers in the ocean. Delta Sound Connections 2019-2020. Prince William Sound Science Center (http://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf).
- GWA PMT and PIs. 2018. Listening session with Chugachmiut elders. Hosted by Chugachmiut Heritage Preservation Program and attended by GWA, HRM, Kachemak Bay National Estuarine Reserve, and State of Alaska Salmon and People program participants. Alaska Islands and Ocean Visitors Center, March.

- Holderied, K. 2017. What's up with the Blob? Public evening talk. Alaska Islands and Ocean Visitor Center. Homer AK. Feb 2017.
- Holderied, K. 2017. Solving Alaska Ocean Mysteries – connections matter. Keynote address. Northwest Aquatic and Marine Educators Annual Conference. Homer AK. Aug 2017.
- Holderied, K. 2019. Kachemak Bay Oceanography. Alaska Department of Fish and Game Razor Clam Summit. Homer AK. Apr 2019.
- Holderied, K., Hondolero, D., Konar, K., Weitzman, B., Kloecker, K. 2019. GWA evening science talks for community in Seldovia AK. May 2019.
- Hopcroft, R., and S. Danielson. 2018. Website: Seward Line. <http://research.cfos.uaf.edu/sewardline/>. The Seward Line website has been overhauled to accommodate the new LTER dimension. The website provides context for results via summaries of the program's history, hypotheses, methods and publications.
- Kaler, R. 2019. Naked Island Seabird Restoration, Youth Marine Expedition, Organized by Lisa Matlock, Prince William Sound Regional Citizen's Advisory Council. The youth on this trip were a mix of grades 6-8 and included both diverse urban Anchorage kids (some of whom had never been on a hike or on a boat before this trip) and kids from the EVOS region (this year included Cooper Landing, Seward, Girdwood, and Whittier). The EVOS funded seabird restoration effort at the Naked Islands group provided the youth a chance to learn about field biology, social attraction efforts to expedite the recovery of extirpated seabirds, and learn about what seabirds feed their young. Special thanks to Sam Stark and Alexa Piggot (Oregon State University) for making time to connect kids with nature.
- Kaler, R., K. Kuletz, D. Dragoo, and H. Renner. 2017. Unusual observations of seabirds in the Gulf of Alaska following the 2015-2016 mass die-off. Delta Sound Connections. <http://pwssc.org/wp-content/uploads/2017/06/DSC-2017-web2.pdf>
- Konar, B., and K. Iken. 2018. Wasting sea stars in the Gulf of Alaska. Delta Sound Connections 2018-2019. Prince William Sound Science Center.
- Lindeberg, M., and R. Heintz. 2019. 30 years since the *Exxon Valdez* oil spill: An era of scientific research and monitoring that has changed our understanding of oil spill impacts. Delta Sound Connections 2019-20. 16 pp. http://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf
- Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2017. GWA Quarterly Currents. Newsletter to EVOSTC staff, Science Review Panel members, and others as approved by the EVOSTC Executive Director. Volume 1.1: spring quarter. Link on gulfwatchalaska.org.
- Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2017. GWA Quarterly Currents. Newsletter to EVOSTC staff, Science Review Panel members, and others as approved by the EVOSTC Executive Director. Volume 1.2: summer quarter. Link on gulfwatchalaska.org.
- Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2017. GWA Quarterly Currents. Newsletter. Volume 1.3: fall quarter. Link on gulfwatchalaska.org.
- Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2017. GWA Quarterly Currents. Newsletter. Volume 1.4: winter quarter. Link on gulfwatchalaska.org.

- Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter to EVOSTC staff, Science Panel members, and others as approved by the EVOSTC Executive Director. Volume 2.1: spring quarter. Link on gulfwatchalaska.org.
- Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter to EVOSTC staff, Science Panel members, and others as approved by the EVOSTC Executive Director. Volume 2.2: summer quarter. Link on gulfwatchalaska.org.
- Matkin, C. O. 2017. Tracking whales with hydrophones. Delta Sound Connections, PWS Science Center. March 10, 2017.
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