ATTACHMENT D **EVOSTC Annual Program Status Form**

Form Rev. 8.30.18

1. Program Number:

18120114

2. Program Title:

Gulf Watch Alaska

3. Program Lead Name(s):

Mandy Lindeberg, NOAA Fisheries, Alaska Fisheries Science Center, Auke Bay Laboratories

Katrina Hoffman, Prince William Sound Science Center

4. Time Period Covered by the Summary:

February 1, 2018 to January 31, 2019

5. Date of Summary:

April 15, 2019

6. Program Website (if applicable):

www.gulfwatchalaska.org

7. Overview of Work Performed during the Reporting Period:

Program Introduction

This report summarizes Gulf Watch Alaska (GWA) program progress and achievements for FY18, monitoring year 7. 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. The program has five primary objectives: (1) sustain and build upon existing time series in the *Exxon Valdez* oil spill (EVOS)-affected regions of the Gulf of Alaska (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) 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 and lingering oil; and 5) leverage partnerships with outside agencies and groups to integrate data and expand capacity through collaborative efforts. Program and project operations have not changed and continue to add to the legacy of our long-term monitoring datasets and expanding our knowledge of the GOA ecosystem and its changing conditions.

A. Progress toward objectives and achieving goals

The GWA program made substantive progress towards our objectives in FY18 (year 7), as noted in the brief summaries presented below.

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

- All GWA monitoring projects successfully completed their planned surveys and added another year of data to their time series.
- We implemented a transparent and efficient internal proposal and review process to prioritize efforts to secure new funding to support lost agency in-kind or matching funds and new collaborative

opportunities for data collection by GWA principal investigators (PIs). This resulted in four successfully funded requests for $188,800 annually for FY19-21 and included:

- (18120114-C) June Prince William Sound forage fish surveys and species validation for aerial forage fish surveys conducted by the Herring Research and Management Program
- (18120114-O) Humpback whale winter survey vessel charters – allowing continuation of a former agency-funded activity through in-kind vessel support
- (18120114-E) Marine bird winter survey vessel charters in Prince William Sound (PWS) - allowing continuation of previous survey efforts that were lost due to reliance on vessels of opportunity
- (18120114-A) Post-doctoral researcher to assist with GWA science synthesis efforts

2. *Provide scientific data, data products, and outreach to management agencies and a wide variety of users*

- GWA program datasets for year 6 are available through the Alaska Ocean Observing System (AOOS) Catalog through the Gulf of Alaska Data Portal. GWA project datasets from the first five years of the program are published to DataONE.
- During this reporting period the GWA program produced: 36 publications/reports, 65 oral presentations, and 26 outreach media/events with the public.
- GWA PMT members and PIs participated scientific conferences during FY18:
  - Ocean Sciences conference, Portland, Oregon, February 2018: GWA team members contributed to a GOA workshop and presented oral papers and posters.
  - Kachemak Bay Science Conference, Homer, Alaska, March 2018: GWA team members participated on the steering committee, led workshops, chaired sessions, contributed a keynote address, and presented oral papers and posters.
  - PICES conference in Yokahama, Japan in October 2018: GWA team members presented oral papers and posters.
  - Alaska Marine Science Symposium (AMSS), Anchorage, Alaska, January 2019: GWA team members presented oral papers and posters. Federally employed team members were not able to attend due to a partial federal government shutdown.
- The GWA team participated in planning and conducting outreach events to spill-affected Alaska Native communities in the Kachemak Bay area, including conversations with Chugachmiut Heritage Preservation local education coordinators and Chugachmiut region elders from Tatitlek, Chenega Bay, Valdez, Port Graham, and Nanwalek; an information exchange session in Port Graham; and a bird die-off alert training session in Seldovia. A planned information exchange session in Nanwalek was not conducted due to unforeseen circumstances.
- GWA project data collected in FY18 (year 7) are generally on track for submission to the AOOS Gulf of Alaska data portal based on project requirements. In most cases, projects are meeting or exceeding expectations for data sharing. Some projects are typically delayed annually due to late-in-year sampling schedules, longer sample processing times, and data processing delays, but are compliant and being updated when ready using the Research Workspace.
- GWA continued to work with the National Oceanographic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) to include GWA time series as indicators in the 2018

GOA ecosystem assessments and reports to the North Pacific Fisheries Management Council. GWA contributed 17 metrics to the report in 2018; 11 of these were new to the report.

- Each year the GWA program includes two pages of content in PWSSC's annual outreach publication *Delta Sound Connections*. *Delta Sound Connections* is widely distributed throughout the PWS region, Anchorage, and beyond.
- An outcome of a special marine bird workshop held at the GWA fall 2017 PI meeting in Cordova was to secure funds for a contractor to write a computer program to read in field collected marine bird survey data, then error check, summarize, and output standardized metrics for analysis and archiving in the North Pacific Pelagic Seabird Database (NPPSD). This effort is nearly completed and will allow rapid data processing post field collection and allow for larger scale analyses of marine bird trends across all GWA components and sampling areas over time.
- We continually update GWA's public website which is now the primary location for users to find information about the program, recent activities, and access to datasets, reports, publications, news feeds, educational materials, monitoring projects, scientist profiles, and contacts.

3. Develop science synthesis products to assist management actions, inform the public, and guide monitoring priorities for the future

- GWA and HRM's joint special issue on GOA ecology in the journal *Deep Sea Research Part II* was featured on the journal's website during February 2018. All papers in the special issue are open access. The papers are also available through the GWA website.
- GWA's Science Coordinator is leading science synthesis efforts for the current five-year funding period including a workshop in year 8 and longer-term planning for the second ten years of GWA.
- Science synthesis during the current funding cycle will include four publications focused on biological responses to the marine heatwave in the GOA, which all contributors and collaborators agree that GWA is uniquely positioned to address. These four manuscripts, including one overarching publication and three additional cross-component publications, will be the foundation of our FY19 science synthesis report. Synthesis efforts will not be exclusive to these four manuscripts; additional cross-component and cross-program (HRM) manuscripts are underway.
- Planning for longer-term syntheses for years 10-20 includes three additional efforts: i) developing time series indicators for the GOA ecosystem and stakeholder interests, ii) designing a GWA ecosystem modeling component, iii) filling gaps in current efforts that are needed to meet stakeholder interest.

4. Enhance connections between GWA and HRM programs as well as other Trustee focus areas

- GWA program management team (PMT) and PIs worked collaboratively on monitoring activities including sharing of data, vessel time, and aerial survey time between GWA and HRM projects.
- GWA and HRM were successful in securing funds from two different sources to resume collaborative June forage fish surveys in PWS in FY19-21.
- Two GWA PIs are lead authors on separate manuscripts that integrate GWA and HRM data.
- The GWA Science Coordinator worked with HRM PIs to include HRM time series into the 2018 NOAA Gulf of Alaska ecosystem status report to the North Pacific Fisheries Management Council.
- GWA evaluated additional time series indicators that could be of interest to other Trustee Council stakeholders, such as the U.S. Forest Service with a marbled murrelet population index for PWS.

- The GWA PMT worked closely with the HRM Program Lead to plan and host a joint program annual meeting.

5. *Leverage partnerships with outside agencies and groups to integrate data from broader efforts*

- Two GWA PIs are also lead PIs on the new National Science Foundation (NSF) funded northern GOA Long-term Ecological Research (LTER) program. This effort leverages, complements, and enhances overall GWA program activities. Together, GWA and the GOA LTER are the primary annual sampling efforts in the GOA and are major contributors to knowledge of ocean conditions and effects on biological resources.
- GWA, with the North Pacific Research Board (NPRB) and NOAA Alaska Fisheries Science Center, co-hosted a GOA workshop and special session during the February 2018 Ocean Sciences meeting in Portland, Oregon. GWA PIs also co-authored the final workshop report.
- The Science Coordinator is lead author of the overarching GWA synthesis manuscript that includes data and co-authors from multiple federal, state, and university-based investigators.
- The Program Coordinator participated in several activities associated with the Coastal Observation and Seabird Survey Team (COASST) based out of the University of Washington.

All GWA program-level measureable tasks have been completed for FY18 (year 7; Table 1).

Table 1. Measurable GWA program tasks completed in FY18.

FY18 Measurable Program Tasks	Status
Conduct quarterly program teleconferences	Completed
Submit annual reports for FY17 and semi-annual NOAA report	13 annual reports submitted March 2018
Updates to program website	Ongoing
Submit annual program work plans and semi-annual NOAA report	Completed and submitted August 2018; responded to Science Panel comments September 2018
Participate in EVOSTC annual Public Advisory Committee meeting	Completed. GWA Program Lead attended in person
PI data compliance on workspace	Most projects are meeting or exceeding expectations for data sharing and those lagging behind are planned for compliance by summer 2019.
Contributions to NOAA Ecosystems Considerations Report for the GOA	17 GWA metrics used in 2018 report
Present to EVOSTC	Presentation on October 17, 2018
Annual PI meeting and program review	Completed Nov. 15-16, Anchorage
Presentation of GWA projects at AMSS; sidebar meeting with PIs	Completed. PIs, team members, and partners presented 7 oral presentations and 12 posters, January 2019; GWA team meeting not held due to partial federal government shutdown, teleconference held February 21, 2019

B. Noteworthy issues and findings within the GWA program and projects

This section provides brief project-level highlights. Please refer to FY17 project annual reports for more detail. Projects are listed by component (administration, environmental drivers, pelagic, and nearshore).

Integrated Program Management and Administration

Program coordination & science synthesis (18120114-A) (Program Management I; or PMI)

Mandy Lindeberg, Rob Suryan, and Donna Aderhold, NOAA Auke Bay Laboratories

Program administration, logistics, & outreach (18120114-B) (Program Management II; or PMII)

Katrina Hoffman, Prince William Sound Science Center (PWSSC)

- The PMT facilitated submission of final reports for the FY12-16 funding period during spring 2018. Working with the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) Science Coordinator, the PMT facilitated revisions to final reports and submission of finalized final reports during spring 2019. Final reports are available on the GWA website (https://gulfwatchalaska.org/resources/reports-and-documents/).
- The PMT facilitated quarterly GWA program team meetings during FY18. The Program Coordinator scheduled, developed agendas based on input from PMT and Science Coordinating Committee members, and facilitated the meetings. The purpose of the meetings was to provide the GWA program team with updates on programmatic scientific activities and allow for collaboration among team members. All meetings were coordinated in communication with the Herring Research and Monitoring (HRM) program lead, and HRM principal investigators (PIs) engaged with GWA PIs during a portion of the November 2018 meeting to encourage cross-program communication, data sharing, and synthesis.
- The PMT coordinated submission of twelve FY19 work plans including a comprehensive program budget workbook. The Program Coordinator established a schedule, tracked progress, reviewed work plans for consistency, and oversaw the submission of work plans. The Program Lead, Science Coordinator, and Science Coordinating Committee conducted internal scientific reviews. A primary effort for FY19 work plans was establishing a transparent internal proposal, recommendation, and review process for requesting additional EVOSTC funds to support lost agency in-kind or matching funds and new collaborative opportunities for data collection by GWA PIs. This resulted in four additional funding requests for $188,800 annually for FY19-21.
- The PMT compiled and reviewed all FY17 annual reports. We continue efforts to standardize format and content of reports and work plans to help improve efficiencies in GWA PI reporting efforts and EVOSTC review. We also compiled and edited replies to EVOSTC and science panel review comments on the FY17 annual reports and FY19 work plans.
- The PMT distributed the *Quarterly Currents* newsletter to EVOSTC staff, science panel members, public advisory committee members; GWA outreach steering committee members; and sponsoring agency public relations personnel. The newsletter provides highlights of GWA program activities each quarter. All *Quarterly Currents* newsletters are available publicly on the GWA website (https://gulfwatchalaska.org/resources/quarterly-currents-newsletter/).
- The GWA PMT received support from the EVOSTC and their science panel to pursue the four main synthesis manuscripts that will collectively form our 3-year science synthesis report due during FY19. Progress on these synthesis products has catalyzed other cross-component synthesis efforts within

GWA and between GWA and HRM and synthesis efforts provide a framework for maintaining integration throughout the life of the GWA and HRM programs.

- For the FY19 science synthesis report and FY20 workshop, the PMT is spearheading four synthesis publications, all of which include varying amounts of cross-component data integration. These include the following:
    - Suryan et al. – "Ecosystem variability in the Gulf of Alaska during a marine heatwave"
    - Monson et al. – "Coherence in intertidal to oceanic sea surface temperatures in the GOA: The Blob washes ashore"
    - Arimitsu et al. – "Environmental drivers and prey condition leading to the murre die-off"
    - Dean et al. – "Synchronous region-wide responses in intertidal community structure to a marine heat wave in the GOA"

  There are at least five additional related manuscripts in progress by GWA PIs that complement these overarching synthesis manuscripts.

- The PMT continues working with project PIs on our goal for each GWA project to have at least one signature time series that best indicates the state of their part of the GOA ecosystem. Collectively, these would provide GWA's best assessment of the state of the GOA each year. This follows similar efforts for large marine ecosystems throughout Alaska and elsewhere. Several GWA time series already contribute to these efforts, but we would like to increase our participation. Furthermore, GWA, along with the NSF Northern GOA LTER site, sample annually, whereas several other major programs in the GOA are no longer sampling (NPRB's GOAIERP) or sample every other year (some NOAA surveys). Therefore, GWA is uniquely positioned to contribute to the annual ecosystem status reports to the North Pacific Fisheries Management Council. For the 2019 Ecosystem Status Report, seven GWA PIs contributed a total 18 metrics, and 12 of these time series were new contributions in 2018(*). Contributors included: PIs Batten (18120114-D, 3 metrics), Danielson (18120114-I, 1 metric), Hatch/Arimitsu (18120114-C, 2 metrics), Moran/Straley (18120114-O, 2 metrics*), Hopcroft (18120114-L, 2 metrics*), Campbell/McKinstry (18120114-G, 4 metrics*), and Coletti et al. (18120114-H, 4 metrics*). We also facilitated a new contribution by HRM (Pegau et al., 3 metrics*).

- The PWSSC extended contract amendments to all the non-Trustee Agency sub-awardees for the second year of this grant, FY18. The non-Trustee Agency portions of the GWA program that are administered by the PWSSC under this award include projects associated with coordination and oversight, outreach and community involvement, data management, oceanographic monitoring in PWS and the GOA, monitoring of zooplankton and oceanographic conditions in the GOA, monitoring of seabird abundance in PWS, monitoring of orca populations in PWS, and monitoring of intertidal communities in Kachemak Bay. For each of the aforementioned projects, PWSSC invoiced NOAA and subsequently remunerated sub-awardees based on demonstrated expenses; tracked spending for non-Trustee Agency projects; and initiated an annual audit in November 2018. PWSSC submitted semi-annual reports to NOAA in both March and August 2018 for the work that was being conducted in the program.

- The program held four quarterly PI meetings: three were held by phone; one was held in person at the annual PI meeting at the Westmark Hotel in Anchorage from November 15-16, 2018. Our planned in-person winter quarterly meeting at the AMSS on January 28, 2018 had to be modified due to the inability of many PIs to obtain travel permission due to the partial federal government shutdown. Instead, it became a manuscript-focused meeting comprised primarily of Environmental Drivers PIs

and some Nearshore and Pelagic PIs. We scheduled an alternative telephonic winter PI meeting to make up for the altered AMSS meeting.

- We continue to make updates to the website www.gulfwatchalaska.org. The changes include addition of the FY12-16 final reports, updated links to educational resources, blog posts added with relevant program announcements, inclusion of FY18 Quarterly Currents newsletters, incorporation of nearshore resource briefs, hyperlinks added to all publication citations where possible at: http://www.gulfwatchalaska.org/resources/publications-2/, hyperlinks added to all DSRII special issue citations, once available, at: http://www.gulfwatchalaska.org/resources/publications-2/special-issue/, posting of an updated team photo and updated PI photos where appropriate, as well as updated PI and SRP biographies where appropriate, revised text on most landing pages, including current text on the "home" page as well as inclusion of "latest news" links to make the home page content more dynamic, access to the most current data portal link, attachment of PI-written haikus to project pages, making links to the relevant published data available on each project page (see "Download Project Data" button) such as the one viewed here: http://www.gulfwatchalaska.org/monitoring/environmental-drivers/continuous-plankton-recorder/ and added and updated a "Completed Projects" page from projects that are not continuous in the program (e.g., conceptual modeling, historical data compilation, and lingering oil).

- The Program Coordinator and several GWA PIs participated on the steering committee for the triennial Kachemak Bay Science Conference that was held in Homer March 7-10, 2018. The GWA Program Lead gave one of two keynote presentations for the conference. GWA team members led workshops, chaired sessions, and presented papers and posters. The conference intends to share scientific work occurring in the Kachemak Bay region among scientists and community members. Chugachmiut Heritage Preservation local education coordinators held meetings with PWS and Kachemak Bay village elders and other community members in conjunction with the conference, and Chugachmiut local education coordinators and elders attended the conference.

- The Program Coordinator participated in planning and conducting outreach events to spill-affected Alaska Native communities in the Kachemak Bay area, including conversations with Chugachmiut Heritage Preservation local education coordinators and Chugachmiut region elders from Tatitlek, Chenega Bay, Valdez, Port Graham, and Nanwalek; an information exchange session in Port Graham; and a bird die-off alert training session in Seldovia. A planned information exchange session in Nanwalek was not conducted due to unforeseen circumstances.

- The Program Coordinator participated in several activities associated with the Coastal Observation and Seabird Survey Team (COASST) based out of the University of Washington. COASST recently developed die-off alert training as a systematic way for communities or people in remote areas to document a bird die-off. The Program Coordinator attended a die-off alert "train the trainer" training and participated with the Kachemak Bay National Estuarine Research Reserve in die-off alert trainings in Port Graham and Seldovia. The Program Coordinator also provided die-off alert training to GWA team members at the November meeting in Anchorage for times when GWA project teams are working in the field and need to document a bird die-off that is not part of regularly scheduled work. Finally, the PMT held a teleconference with Julia Parrish and other COASST leaders to discuss the availability of GWA data for analysis of marine bird monitoring and die-offs in the Gulf of Alaska.

- Each year the GWA program includes two pages of content in PWSSC's annual outreach publication *Delta Sound Connections*. *Delta Sound Connections* is widely distributed throughout the PWS region, Anchorage, and beyond.

- The GWA PMT ensured there was regular, frequent communication with the HRM Program Lead to ensure ease of coordination and synthesis between the two programs.

Environmental Drivers Component

GOA mooring (GAK1) (18120114-I)

Seth Danielson and Tom Weingartner, University of Alaska Fairbanks (UAF)

- Data from GAK1 during 2018 show that the surface waters continue to warm faster than waters near the seafloor. In addition, the surface is freshening and the waters near the seafloor have an opposite trend, but the latter is just barely significantly different than zero at the 95% confidence level. These trends continue to show that the water column is progressively stratifying over time: a result that carries potentially important ramification for the productivity of the GOA ecosystem. Positive temperature anomalies that began during the recent marine heatwave starting winter 2013/2014 in the GOA have persisted throughout the water column at GAK1 through 2018.

Seward line (18120114-L)

Russ Hopcroft, Seth Danielson, and Kenneth Coyle, UAF

- In 2018, the Seward Line program began a greatly expanded spatial extent, and an additional cruise added to mid-summer due to elevation as a National Long-term Ecological Research (LTER) site through new funding from the National Science Foundation (NSF). All three cruises were successful in accomplishing their primary objectives.
- During May, surface temperatures averaged across the upper 100 m of the Seward Line were near the 20-year mean. By July, surface temperatures had warmed, and the Alaska Coast Current had begun to intensify. Although cooling typically begins by September, during 2018 temperature had continued to increase and were still well above normal. Despite these warm surface temperatures, temperatures averaged across the upper 100 m were below normal over the shelf (particularly in the Alaska Coastal Current) but slightly above average off the shelf, resulting in an overall means across the Seward line's upper 100m of 0.4°C below the 20 years mean.
- Phytoplankton biomass on the Seward Line was generally relatively low during the May 2018 sampling period. With an exception of an offshore peak in summer and several coastal stations during September most cells were small. These size related patterns applied across most of the expanded sampling domain.
- Microzooplankton biomass on the Seward Line in May 2018 remained low, similar to observations for recent warm years, but was more typical of prior years during the September cruise. The high numbers of southern copepods observed in recent years were almost absent during May of 2018, suggesting a return to more normal community structure.
- New to 2018, we have begun using a large 5 m^2 Methot net to target macro jellies during summer and fall cruises in the surface layer. Results from the first year already suggest a much higher than expected biomass of these larger predators. It is likely that the bycatch of forage fish obtained with this net can fill some information gaps of mid-trophic level species during Seward Line and NSF LTER sampling on the GOA shelf (we are working with GWA PI Arimitsu, 18120114-C, to process the forage fish samples).

Oceanographic conditions in PWS (18120114-G)

Rob Campbell, PWSSC

- The 2018 time series from the profiler showed temperature anomalies near baseline in spring and primarily positive anomalies by autumn. The negative temperature anomalies at depth during summer months likely reflect a shallowing of the annual mixed layer. Both the profiler and satellite estimates of surface chlorophyll showed that the bloom peaked in early May. An estimate of the historical magnitude and the timing of the spring bloom shows a decline over the satellite record, and that the 2018 near-surface bloom was of larger magnitude than those during the marine heat wave (i.e., "Blob") years of 2014-2017, but still comparatively low.
- The plankton camera collected 636,596 images during the 2018 deployment. The highest particle concentrations were during the spring bloom in late April-early May. There were also a large number of particles in the surface mixed layer in late June-early July.

Oceanographic conditions in Lower Cook Inlet/ Kachemak Bay (18120114-J)

Kris Holderied and Jessica Shepherd, NOAA Kasitsna Bay Laboratory and University of Alaska Anchorage (UAA)/Kachemak Bay National Estuarine Research Reserve (KBNERR)

- Kachemak Bay water temperatures were slightly warmer than average, with near average salinities, for most months in 2018, similar to 2017. These conditions were cooler and more saline than the anomalously warm conditions of more than +2 ˚C and extended period of freshening in 2014-2016. However, starting in October 2018, monthly average warm temperature anomalies have averaged +1 ˚C (Fig. 2, top) at Seldovia and salinities also became fresher than normal.
- The annual salinity pattern was disrupted in 2014-2016, with persistently fresher than normal monthly average salinities and much fresher conditions and more variability during the winters of 2014-2015 and 2015-2016. In 2017 and early 2018, salinities were closer to average and the freshening in late 2018 was not as extreme and variable as 2015 and 2016.
- Peak chlorophyll fluorescence values observed in both 2017 and 2018 were considerably lower than those from 2011 to 2016.
- The diversity of phytoplankton samples declined in 2018, likely a result of much lower total cell counts than previous years. In 2018, there continued to be low counts of *Chaetoceros*, first noted in 2017.

Continuous plankton recorder (CPR) (18120114-D)

Sonia Batten, Marine Biological Association and Robin Brown, North Pacific Marine Science Organization

- Analysis during the last year has focused on investigating the impacts of the marine heat wave of 2014-2016 on the lower trophic levels and assessing whether 2017 (and eventually 2018 once the data are finalized) changed to more typical plankton communities. For example, bulk metrics of phytoplankton and zooplankton abundance show that the years 2014-2016 had very low numbers of large diatoms but high numbers of zooplankton. This could be the result of top down impacts with the abundant zooplankton consuming the diatoms; however, in 2017 large diatoms were very numerous and zooplankton were still abundant. Instead it suggests that the larger diatoms did poorly in the heatwave years while zooplankton as a combined group, did well.
- While there is a clear shift towards warmer communities, the heatwave years of 2014-2016 were not noticeably different from the preceding warm period in 2004-05.

- The final results for 2017 suggest that plankton are not yet typical in terms of abundance, although some indicators are now in the middle of the range seen.

Pelagic Component

Long-term killer whale surveys (18120114-N)

Craig Matkin, North Gulf Oceanic Society

- In 2018, all 7 of the AT1 (Chugach) transients were identified, whose ages are now estimated between 34-53. The youngest female is estimated to be 44 years old, which is likely beyond reproductive age, and no new calves were documented.
- It appears that for AB pod, all the AB26, AB27, and AB54 matrilines are present and there are no new calves in 2018. However, as in 2017, three matrilines that contain all adult males and their mothers (the AB14, AB17, and AB 22 matrilines) were not encountered for the second year running.
- There remains an increasing tendency toward temporary (and in some cases permanent) splitting of pods. This may signify more challenging feeding opportunities (e.g., fewer numbers of fish/smaller school size) that favor hunting in smaller groups.
- A trend of zero or negative growth may be developing in the southern Alaska killer whale population.
- As part of our feeding habits studies we continued work determining rivers of origin for salmon consumed by killer whales based on genetic analysis. Our preliminary results indicate chum diet of southern resident killer whales are from British Columbia and Washington, in addition to Alaska.
- We have had good success in using remote Soundtrap hydrophones to track presence and absence of killer whales in areas of importance during the winter months. The hydrophone program has effectively replaced our satellite tagging program.

PWS marine bird surveys (18120114-M)

Kathy Kuletz and Robert Kaler, U.S. Fish and Wildlife Service (USFWS)

- We successfully completed our 2018 biennial PWS marine bird survey. In total, we surveyed 212 shoreline transects, 44 coastal-pelagic transects, and 29 pelagic transects. We completed post-season data quality and assurance checks and began preliminary analysis, which we expect to complete by 31 March 2019. Following completion of 2018 analyses, Kaler will upload the 2018 marine bird data to the Gulf of Alaska Data Portal by 30 April 2019.

Forage fish distribution and relative abundance (18120114-C)

Mayumi Arimitsu and John Piatt, U. S. Geological Survey (USGS) Alaska Science Center

- Kittiwake diets in April and May 2018 showed a relatively high proportion of myctophids, perhaps reflecting those species' resumption of near-surface migration at night. During incubation and chick-rearing in 2018, the kittiwake diet favored herring, sablefish, and sand lance. Consistent with results since 2014, a notable scarcity of capelin continued in 2018, and juvenile pink and chum salmon had a poor showing in the kittiwake chick diets. During summer, kittiwake diets (June-August) and rhinoceros auklet chick diets (July-August) indicate greater composition of sand lance in 2018 compared to recent years.
- In September 2018, we conducted the integrated predator prey (IPP) survey in collaboration with the humpback whale (18120114-O) and fall/winter marine bird surveys (18120114-E). Preliminary results indicate that acoustic backscatter due to fish was patchier, with large swaths of nearly empty water column in 2018 compared to 2017. We encountered juvenile herring near The Needle in

Montague Strait, in Hanning Bay, and in Port Gravina in 2018. Walleye pollock were notably missing from Bainbridge and Montague Strait subareas in 2018.

- Acoustic indices of macrozooplankton also show changes in depth distribution and density of key forage taxa. In 2018, macrozooplankton layers were nearly absent from Bainbridge and parts of Montague Strait (particularly on the LaTouche Island side). The macrozooplankton scattering layer was denser and occupied a higher position in the water column in 2017 than in 2018 at Montague and Gravina subregions. Declines in macrozooplankton in recent years may help explain the abrupt decline in humpback whale use in these areas since 2014.

Humpback whale predation on herring (18120114-O)

John Moran and Jan Straley, NOAA NMFS Auke Bay Laboratory and University of Alaska Southeast (UAS)

- We completed the fall IPP survey with the fall/winter marine bird (18120114-E) and forage fish (18120114-C) projects and a NOAA funded whale-prey survey in mid-March. The trends seen in 2017 continued into 2018, with low numbers of humpback whales and marine birds, along with a reduced abundance of other forage fish and krill. We failed to locate any major concentrations of humpback whales or prey. The whales were targeting smaller, disperse, patches of prey with a shift towards young of the year and juvenile herring relative to earlier years.

- During 2017 and 2018 the number of humpback whales on the breeding grounds in Hawaii was also reported to be low. This led to the formation of several working groups to identify the causes of the apparent decline. Data from our study and other GWA projects have been essential for researchers from Hawaii and Alaska in understanding declines in whale abundance.

- We continued to monitor trophic level and energy density for forage species in PWS. As in 2017, based on plankton net sampling, we found a shift it the species composition during 2018 to *T. spinifera* and *E. pacifica* replacing the typical common species (*T. longipes, T. inermis, and T. raschii*). Young of the year herring continue to be a relatively low-quality prey for humpback whales, we saw a decline in the energy density of juvenile herring (age 1 and 2) between 2014 and 2017.

Fall and winter habitat use and distribution of seabirds in PWS (18120114-E)

Mary Anne Bishop, PWSSC

- We examined the use of ecosystem indicators to understand the influence of environmental variability on marine bird populations in PWS. We examined anomalies in murre and murrelet densities over time because, as piscivorous seabirds, murres and murrelets are particularly sensitive to changes in the marine ecosystem. Since the peak murre die-off in December 2015, we have observed murre densities below the long-term monthly averages during fall 2016-2018 surveys and spring 2018 surveys. Murrelet densities followed a similar pattern as murres and were also below long-term monthly averages.

- In September 2018, marine bird densities during the IPP surveys were lower than densities observed in our two previous predator-prey surveys (2014 and 2017), mirroring patterns observed in macrozooplankton density indices.

- Observations of foraging aggregations indicate potential competitive interactions between humpback whales and foraging birds for the few herring schools available during the recent years of very low herring biomass in PWS.

Nearshore Monitoring Component

Nearshore systems in the GOA (18120114-H)

Heather Coletti, Daniel Esler, Kim Kloecker, Dan Monson, Ben Weitzman, Brenda Konar, and Katrin Iken, National Park Service (NPS), USGS Alaska Science Center, and UAF

- Nearshore water temperature trends in all four intertidal zones from PWS to the Alaska Peninsula show warming beginning in 2014 that persisted at least through 2017. These results confirm that the marine heatwave in the GOA affected intertidal zones with some indication of lagged effects and regional variation.
- Despite considerable variability in percent cover of *Fucus distichus* among sites and generally positive anomalies through 2014, all regions showed consistently negative trends during the recent marine heatwave, with effects starting in 2015 and continuing through 2018.
- Sea star abundance varied greatly among regions through 2015. In 2016, abundance trends began to decline and have remained strongly negative across all regions through 2018. The decline in sea star abundance was likely due to sea star wasting disease, which was first detected in the study region in 2014 and is generally associated with the warm water temperature anomalies.
- In contrast to *F. distichus* and sea stars, densities of large mussels (≥ 20 mm) showed a strong positive trend across all regions consistent with the timing of the marine heatwave.

C. Efforts to achieve community involvement/TEK and resource management application provisions

At the 2018 Kachemak Bay Science Conference, collaborating researchers and coordinators of the GWA program participated in two-way listening sessions with members from the Chugachmiut region. Chugachmiut is a non-profit organization that services the seven communities in the Chugach Region including Cordova, Tatitlek, Chenega Bay, Valdez, Seward, Nanwalek, and Port Graham. At the conference, GWA collaborators engaged with community members and educators from the spill-affected area in two work sessions where both scientists and native community members exchanged information about different ways of knowing, as well as changes they have observed in the ecosystem. In the first session, GWA collaborators assisted the Local Education Coordinators from the Chugachmiut region in the developing their Heritage Kit curricula based around five themes: climate change, watersheds, food from the sea, traditional place names, and cultural clothing. Heritage Kits are designed for kindergarten through twelfth grade and align with Alaska Cultural and Content Standards addressed through hands-on activities. The content of the draft kits were presented in a work session later that week with Elders from the Chugachmiut region. Elders from the seven Chugachmiut communities help make the preservation and revitalization of native heritage and language possible. The Elders are a great resource and shared additional information to be included in the curricula based on their traditional knowledge. Further, they engaged with GWA collaborators to ask questions about the ecosystem changes they have observed. These efforts were coordinated with the EVOSTC Herring and Research Monitoring program.

GWA teamed with the KBNERR to conduct local knowledge exchange outreach events in Port Graham, Seldovia, and Nanwalek. Kris Holderied, Ben Weitzman, Brenda Konar, Katrin Iken, and Donna Aderhold from the GWA program and Maya Groner from the HRM program participated in the Port Graham event, discussing sea stars, warm water, and changes in salmon behavior and health. Robb Kaler and Donna Aderhold participated in the Seldovia event which was focused on COASST DOA training. Kaler presented information on the common murre die off in the GOA, including current analysis efforts into the causes, and Donna answered questions about the local die-off in Kachemak Bay. The Nanwalek engagement was postponed due to unforeseen circumstances.

D. Any known problems, unusual developments or other information

The GWA program has no known problems, developments or other information to report to the EVOSTC.

8. Coordination/Collaboration:

A. Projects Within a Trustee Council-funded program

1. Within the Program

The GWA program continues to deepen coordination among projects and programs to strengthen collaboration. Summaries are provided here. For additional descriptions of collaborative efforts, please see the individual project reports.

The science synthesis report and workshop planned for FY19 requires advanced preparation by the GWA PMT and projects across the GWA program.

A cross-component effort continues (including projects 18120114-C, E, H, L, M, and O) with the intent to integrate bird survey data to examine spatial and temporal trends in a variety of species and guilds across the northern GOA. During the November 2018 PI meeting, next steps were drafted for a synthesis of coastal bird survey data. Building on that, the Nearshore component worked with ABR Inc. to create a tool to process dlog data for rapid QA/QC as well as automating the processing required to upload dlog data into the NPPSD maintained by USGS. Incorporation of all GWA marine bird survey data into NPPSD, along with other marine bird survey data (outside of GWA), will allow for larger scale analyses of marine bird trends throughout the GOA over time.

Collaboration within the GWA Pelagic component (projects 18120114-C, E, N, and O) and between the Pelagic component and the HRM program will continue to focus on physical and biological features of locations and prey availability where whales and seabirds have been found to overlap in time and space.

GWA Pelagic component projects (18120114-E, M, and O) developed the IPP during which the three projects share a vessel during the fall to collaboratively collect data on forage fish, marine birds, and humpback whales.

GWA Environmental Driver component projects (18120117-D, G, I, J, L) have focused recent efforts on developing a standardized zooplankton metric that can be generated across projects.

GWA Nearshore component 18120114-H has been working closely with the Environmental Drivers component projects (18120117-D, G, I, J, L) to analyze water temperature data from all GWA regions.

GWA projects regularly support each other in data collection, species identification, analysis, equipment deployment and retrieval, vessel sharing, data sharing, and additional information exchange.

2. Across Programs

a. Herring Research and Monitoring

GWA considers HRM a sister program with frequent coordination and collaboration. The GWA PMT coordinates regularly with the HRM program. The HRM Program Lead is invited to all GWA meetings and teleconferences. The fall 2018 HRM program PI meeting was held in Anchorage one day prior to, and at the same location as, the two-day GWA PI meeting to facilitate cross-program learning and synthesis, as well as economize on data management training opportunities with Axiom staff. The GWA PMT attended the fall 2018 HRM program meeting, as did several GWA PIs and data management team members.

All non-Trustee Agency administrative functions are combined at PWSSC to serve both the GWA and HRM programs. The GWA Science Coordinator made a concerted effort to enhance

collaboration between HRM and GWA, especially when it came to queuing up synthesis efforts that will be completed in the upcoming program year.

HRM team members were invited to participate in GWA outreach activities in Homer and Port Graham. Hayley Hoover participated in a Chugachmiut meeting in Homer and Maya Groner participated the local knowledge exchange outreach event in Port Graham.

The GWA forage fish and humpback whale projects are closely aligned with the HRM program through data collection and information sharing. These projects shared sampling platforms with HRM PI Kristin Gorman (PWSSC and HRM) on their fall IPP cruise to facilitate the collection of adult herring for her maturation study. Dr. Gorman conducted gill net sampling each night at anchorages during the cruise, which benefitted fish sampling efforts. In 2019 the forage fish project will resume summer forage fish surveys in collaboration with HRM PI Scott Pegau (PWSSC).

Both PWS marine bird survey projects (18120114-E and M) provide data and reporting to the HRM program related to predators and herring population modeling. Environmental Drivers component projects provide oceanographic data to the HRM program.

Other GWA projects provide vessel platforms for HRM PIs and GAK1 is working with HRM PI Mary Anne Bishop to deploy a Pacific Ocean Self Tracking array acoustic tag recorder on the GAK1 mooring.

GWA PIs Straley and Moran (18120114-O) are working with HRM to incorporate herring data into a humpback whale manuscript and in multiple presentations.

b. Data Management

GWA coordinates closely with the Data Management program. Data Management staff are invited to all GWA meetings and teleconferences. Data Management one-on-one consultations were incorporated into the fall meeting in Anchorage. A Data Management team member (Buckelew) is active on the Outreach Steering Committee. Data Management is also a part of the NOAA grant through which PWSSC manages all project funds for non-Trustee Agencies. As such, PM II coordinates with the Data Management team on all reporting requirements to NOAA. In addition, GAK1 PI Danielson is working with Data Management team members to generate data visualizations that can be shared via the AOOS data portals and other web pages and develop a real-time ship tracking interface to provide up-to-the-hour ship-to-shore data transfers while the Seward Line cruise is in the field on the *R/V Sikuliaq*.

The Nearshore Component team members worked with Axiom staff to finalize workflow standardizations to create data and products from mussel data. Specifically, Jim Bodkin (USGS Alaska Science Center, Emeritus) and Heather Coletti (NPS) worked with Axiom staff to build Jupyter Notebook scripts to process and summarize mussel bed width data as a function of time and region. The updated notebook process concatenates data files across collection years, generates basic statistical summaries, outputs comma-separated values files with the summary results and generates consistent, publication-quality plots in a manner of seconds.

c. Lingering Oil

While GWA projects do not collaborate with the EVOSTC Lingering Oil program, some (e.g., Nearshore 18120114-H, PWS summer bird surveys 18120114-M, PWS winter bird surveys 18120114-E, and long-term killer whale monitoring 18120114-N) contribute to population trends and long-term assessment of previously injured resources in nearshore ecosystems.

In preparation for the EVOS 30th Anniversary, the GWA Program Lead participated in the 2019 Alaska Forum on the Environment's EVOS Day subcommittee plan team and was interviewed for the EVOSTC short documentary. The GWA Program Lead also helped coordinate an EVOS anniversary workshop on lingering oil at the 2019 AMSS.

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

B. Projects not Within a Trustee Council-funded program

GWA summer and winter marine bird surveys in PWS (18120114-H, 18120114-M, 18120114-E) provide information on population trends of species studied by EVOSTC-funded pigeon guillemot restoration project (18100853). In addition, the GWA Program Coordinator provides support to the pigeon guillemot restoration project as needed.

C. With Trustee or Management Agencies

GWA program projects are highly collaborative with Trustee and Management Agencies, as well as other scientists and research and monitoring efforts in the GOA and beyond. Below is a brief sampling of GWA collaboration; detailed information is available in individual project reports.

NOAA

GWA contributed a total 18 time series metrics, 12 of which were new contributions in 2018 to the NOAA Ecosystem Status Report to the North Pacific Fisheries Management Council. This report is used to facilitate ecosystem-based fisheries management in the GOA.

The NOAA-based AOOS is a regional association within the national Integrated Ocean Observing System network. AOOS and the NSF-funded Northern GOA LTER program facilitate ocean observations in the GOA in partnership and in conjunction with the EVOSTC-funded GAK1 mooring. For the most recent reporting period, this partnership facilitated the planning, design tasks, and purchase of sensors that will form a new set of outer shelf moorings that will be located near Seward Line station GAK7. The development of the outer shelf mooring expands the network of GOA moorings (the GAK1 mooring [18120114-I], Seward Line (18120114-L], and the PWS Oceanographic mooring [18120114-G]) and helps advance the AOOS vision for multi-disciplinary moored "ecosystem observatories" in each of Alaska's Large Marine Ecosystems. The Northern GOA LTER program is providing salary and vessel support for servicing the new outer shelf moorings.

The Kachemak Bay/lower Cook Inlet oceanography project (18120114-J) collaborates with researchers at the NOAA National Centers for Coastal Ocean Science Laboratory (in Beaufort, North Carolina) to use project oceanography and phytoplankton data to identify environmental triggers for increases in the phytoplankton

species (*Alexandrium* spp.) that cause paralytic shellfish poisoning events. In 2018, we started a study to investigate the potential for forage fish to provide a vector for paralytic shellfish poisoning toxins to seabirds and whales. We collaborate with NOAA NMFS on the NOAA Kachemak Bay Habitat Focus Area, including clam restoration and paralytic shellfish poisoning risk assessment efforts.

The humpback whale project (18120114-O) contributed to several NOAA marine mammal data collection efforts, including collecting harbor porpoise eDNA to assess stock structure in collaboration with NMFS Marine Mammal Laboratory, collecting young of the year pollock for the NOAA Cooperative Institute for Marine Resources Studies at Oregon State University, and coordinating with the NMFS Marine Mammal Stranding Network on a minke whale stranding and humpback whale baleen collection.

Department of Interior

Within the Department of Interior, GWA projects coordinated with the USFWS, NPS, USGS, and the Bureau of Ocean Energy Management (BOEM).

USFWS has trust responsibility for migratory birds Alaska, including marine birds. GWA projects that collect data on marine birds and marine bird prey (forage fish [18120114-C], fall and wintering marine birds [18120114-E], nearshore [18120114-H], and PWS marine bird surveys [18120114-M]) share data with USFWS for their management purposes. Each of these projects shared data specifically related to the 2015-2016 common murre die-off related to birds and marine bird prey. The Kachemak Bay/lower Cook Inlet oceanography project (18120114-J) opportunistically hosts USFWS shipboard seabird/marine mammal observers during surveys, coordinates with the USFWS Marine Mammals Office on sea otter stranding and sampling programs, and project data are provided to USFWS (Alaska Maritime National Wildlife Refuge) to help understand potential causes of seabird and sea otter mortality events. The Seward Line project (18120114-L), in conjunction with the Northern GOA LTER, collaborates with the USFWS to provide a platform for visual surveys of seabirds and marine mammals during cruises.

Two nearshore (18120114-H) project sites are located in national parks (Kenai Fjords and Katmai), and the nearshore team coordinates closely with the NPS. In 2013, building on GWA findings indicating that sea otters in Kenai Fjords National Park consume mussels at much higher frequencies than at other areas, the Nearshore component initiated a study of annual patterns in mussel energetics and sea otter foraging at Kenai Fjords National Park, funded by NPS and USGS. In addition, Nearshore program PIs are working with NPS on the 'Changing Tides' project, which examines the linkages between terrestrial and marine ecosystems and is funded by the National Park Foundation.

Nearshore (18120114-H) PIs, in collaboration with NPS, have initiated work aimed at documenting variation in nearshore physical oceanography in relation to tidewater glacial input, and quantify biological responses to that variation across trophic levels in Kenai Fjords National Park. This work will allow prediction of changes in nearshore ecosystems in the face of ongoing glacier mass loss and retreat from the marine environment. This proposed work relies heavily on GWA nearshore monitoring data and will build on our understanding of nearshore marine processes.

The GAK1 project (18120114-I) assists the NPS in a quasi-monthly CTD sampling and data processing protocol in Glacier Bay National Park and Preserve through the agency's Inventory and Monitoring program. The sampling in Glacier Bay provides a complementary data set that is made upstream of GAK1 in terms of the general circulation of the GOA shelf. Collectively, the Glacier Bay, PWS, Cook Inlet, and GAK1 data sets provide a broad-scale perspective of the GOA shelf environment.

The forage fish (18120114-C) and nearshore (18120114-H) projects coordinate closely with USGS. GWA projects collecting data on marine birds (forage dish, fall and wintering marine birds [18120114-E], nearshore, and PWS marine bird surveys [18120114-M]) are coordinating to provide data to the NPPSD

which is maintained by the USGS. The GAK1 effort has assisted many others with their research over the years. For example, in 2001-02 it provided a test bed for prototype halibut tags (developed by USGS scientists), which were then used to study halibut migrations in the GOA and the Bering Sea.

Nearshore (18120114-H) component PIs have been working on the development of recommendations to the BOEM for nearshore community assessment and long-term monitoring. The BOEM Proposed Final Outer Continental Shelf (OCS) Oil and Gas Leasing Program included proposed Lease Sale 258 in the Cook Inlet Planning Area in 2021. Until this leasing program, an OCS Cook Inlet Lease Sale National Environmental Policy Act analysis had not been undertaken since 2003. Updated nearshore information was needed to support the environmental analyses associated with the planned lease sale. The overall objective of this study is to provide data on habitats and sensitive species to support environmental analyses for National Environmental Policy Act documents, potential future exploration plans, and development and production plans. Throughout this process, a goal has been to utilize existing nearshore monitoring protocols already developed through GWA when possible to ensure data comparability across all regions.

In collaboration with NPS, during recent nearshore monitoring trips on the Katmai coast, the GWA Nearshore component (18120114-H) continues to test the use of an unmanned aircraft system (UAS) to map intertidal sites. The elevation data collected by the small UAS will allow tracking of changes in topography over time and enable correlating species presence and abundance with elevation in the intertidal zone. The high-resolution elevation data may also be critical for future assessments of ecosystem change due to sea-level rise, earthquakes, or other natural phenomena.

In addition, Nearshore PIs tested the use of UASs for various aspects of coastal biological monitoring in Kachemak Bay. With BOEM funding, UASs were compared to traditional methods of rocky intertidal and seagrass sampling with some success and suggestions for future work. After this success, UASs were tested to determine their feasibility to complete sea otter foraging observations in Kachemak Bay with USGS funding, and the Nearshore program anticipates using unmanned aircraft systems to map intertidal sites in Kenai Fjords National Park during FY19. The proposed work will be primarily funded by NPS. Also, Nearshore component PIs are working with a student on analyzing food web structure in western Cook Inlet and at GWA Neashore project sites in Kachemak Bay using carbon and nitrogen stable isotope analysis. This effort is funded through the Coastal Marine Institute and a partnership between BOEM and UAF.

Alaska Department of Fish and Game

Numerous GWA projects coordinate with and/or share data with the Alaska Department of Fish and Game (ADF&G). GAK1 (18120114-I) and Seward Line (18120114-L) data are used by ADF&G to aid in salmon forecasts. During past years, ADF&G has provided a berth for a marine bird observer from the fall and wintering marine birds project (18120114-E) during the October spot shrimp surveys. The PWS oceanography project (18120114-G) conducts a spring cruise around the time of herring spawning when ADF&G is performing their surveys. The Kachemak Bay/lower Cook Inlet oceanography (1812-114-J) project provides real-time and historical trends for water temperature data to shellfish managers with the ADF&G (Commercial and Sportfish Divisions) in Homer and Kenai, and with the Alaska Department of Environmental Conservation in Anchorage; project data helps inform management for shellfish harvest, mariculture operations, harmful algal bloom event response and marine invasive species monitoring. The Humpback Whale project photographs sea lion brands for ADF&G.

Other Resource Management and Research Organizations

The GWA program is highly collaborative with the NPRB, either through direct project funding or through collaboration with NPRB-funded programs such as the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP). These include the following:

- The forage fish project (18120114-C) is collaborating with NPRB GOAIERP PIs (associated agencies) and are nearing completion of a synthesis of capelin in the GOA which will be submitted for peer-reviewed publication in FY19.
- An NPRB project (1801: Prevalence of Paralytic Shellfish Toxins in the Marine Food Webs of PWS and Kachemak Bay, Alaska) began in September 2018. Dr. Xiuning Du (Oregon State University) is the lead PI and Campbell (PWS oceanography [18120114-G]) is a co-investigator. Phytoplankton and toxin samples are being collected for that project at all the sites visited by this program. Campbell is also coordinating sampling efforts of larger taxa in PWS (shellfish, forage fish and salmon). The forage fish project (18120114-C) provides forage fish and macrozooplankton samples collected during the IPP survey for this project.
- Nearshore (18120114-H) data from Katmai National Park and Preserve study sites contributed to USGS and NPRB studies of the status of the southwest Alaska stock of sea otters, which is listed as threatened under the Marine Mammal Protection Act.
- Kachemak Bay/lower Cook Inlet oceanography (18120114-J) PI Holderied participated in the NPRB-funded FY16-18 synthesis effort for the GOAIERP with researchers from NOAA, USFWS, ADF&G and other organizations. Project data are being used to help understand how linkages between nearshore and shelf waters affect capelin distributions.
- The Seward Line/LTER (18120114-L) is co-funded by EVOSTC, NPRB, AOOS, and NSF, all sharing common goals of understanding environmental drivers on the GOA shelf and the major passages of PWS.

Other organizations that GWA projects collaborated with include the following:

- GAK1 (18120114-I) data are used by the AOOS-supported ocean acidification monitoring study on the surface buoy near GAK1, which is known as mooring GAK-OA.
- Zooplankton collections and CTD casts were done in Port Valdez for the PWS Regional Citizens' Advisory Council in May 2018, as an add-on to one of the PWS oceanography (18120114-G) surveys. The plankton samples were enumerated with standard methods and preserved samples sent to the Geller lab at Moss Landing for genetic analysis.
- In-kind support from the GWA nearshore project (18120114-H) and NPS was provided to the Pacific Nearshore Project (https://pubs.usgs.gov/fs/2010/3099/) that investigated methods to assess overall health of nearshore ecosystems across the north Pacific.
- In collaboration with researchers at UAA and UAS, Nearshore GWA nearshore project (18120114-H) PIs (Konar and Iken) received funding from the NSF EPSCoR Program to examine how the timing, duration, and character of the freshwater flux from precipitation vs glacial melt influences nearshore biological communities. This five-year project will examine an array of sites from Lynn Canal in southeast Alaska to Kachemak Bay.
- In collaboration with other UAF researchers, GWA nearshore project (18120114-H) PIs (Konar and Iken) received a Field Station and Marine Laboratories Award from the NSF to install an array of

SeapHOx Sensors in Kachemak Bay to monitor pH, oxygen, salinity, and temperature at multiple sites. These data will be available for all GWA PIs.

9. Information and Data Transfer:

A. Publications Produced During the Reporting Period

Arimitsu, M.L., J.F. Piatt, B. Heflin, V. von Biela, S.K. Schoen. 2018. Monitoring long-term changes in forage fish distribution, abundance and body condition in Prince William Sound. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-O), U. S. Geological Survey Alaska Science Center, Anchorage, AK. 64 pp.

Batten, S.D., Raitsos, D.E., Danielson, S., Hopcroft, R.R., Coyle, K. and McQuatters-Gollop, A. 2018. Interannual variability in lower trophic levels on the Alaskan Shelf. Deep Sea Research II. 147, 58-68.

Batten, S.D. 2018. Continuous plankton recorder data from the northeast Pacific through 2017 *in* Zador, S. G., and E. M. Yasumiishi. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, Anchorage, Alaska.

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.

Bishop, M.A. 2018. Long-term monitoring of seabird abundance and habitat associations during late fall and winter in Prince William Sound. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-C), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Bishop, M.A., and A. Schaefer. 2018. Long term monitoring of marine bird abundance and habitat associations during fall and winter in Prince William Sound. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-M.

Campbell, R.W. 2018. Hydrographic trends in Prince William Sound, Alaska, 1960–2016. Deep Sea Res. doi: 10.1016/j.dsr2.2017.08.014

Campbell, R.W. and C.A. McKinstry. 2018. Temperature trends in the surface waters of Prince William Sound. pp. 57-58 *in* Zador, S. and E. Yasumiishi (eds) Ecosystem Status Report 2018: Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, Alaska.

Campbell, R.W. and C.A. McKinstry. 2018. Zooplankton trends in Prince William Sound. pp. 67-70 *in* Zador, S. and E. Yasumiishi (eds) Ecosystem Status Report 2018: Gulf of Alaska. North Pacific Fishery Management Council.

Chenoweth, E.M., K.R. Criddle. 2019. The economic impacts of humpback whale depredation on hatchery-released juvenile Pacific salmon in southeast Alaska. Marine and Coastal Fisheries, V11, 1, pp. 62-75, https://doi.org/10.1002/mcf2.10061

Chenoweth, E.M. 2018. Bioenergetic and economic impacts of humpback whale depredation at salmon hatchery release sites, Ph.D. Dissertation, University of Alaska Fairbanks, Fairbanks, AK

Coletti, H., J. Bodkin, T. Dean, K. Iken, B. Konar, D. Monson, D. Esler, M. Lindeberg, R. Suryan. 2018 Intertidal Ecosystem Indicators in the Northern Gulf of Alaska *in* Zador, S. G., and E. M. Yasumiishi. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, Anchorage, Alaska.

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

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

Danielson, S.L. and R.R. Hopcroft. 2018. Seward line May temperatures *in* Zador, S.G., and E.M. Yasumiishi. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, , Anchorage, Alaska.

Danishevskaya, A.V., O. Filatova, C. Matkin, et al. 2018. Crowd intelligence can discern between repertoires of killer whale ecotypes. Bioacoustics. DOI: 10.1080/09524622.2018.1538902

Davis, R., J.L. Bodkin, H.A. Coletti, D.H. Monson, S.E. Larson, L.P. Carswell, and L.M. Nichol. 2019. Future direction in sea otter research and management. Frontiers in Marine Science 5:510. doi:10.3389/fmars.2018.00510

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

Garlich-Miller, J., Esslinger, G., and Weitzman, B. 2018. Aerial surveys of sea otters (Enhydra lutris) in lower Cook Inlet, Alaska, May 2017. USFWS Technical Report MMM 2018-01. U.S. Fish & Wildlife Service, Marine Mammals Management. Anchorage, AK

Hatch, S.A., M. Arimitsu, J.F. Piatt. 2018. Seabird-derived forage fish indicators from Middleton Island *in* Zador, S. G., and E. M. Yasumiishi. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, Anchorage, Alaska.

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

Konar, B., and K. Iken. 2018. The use of unmanned aerial vehicle imagery in intertidal monitoring. Deep Sea Research Part II: Topical Studies in Oceanography, 147, pp.79-86.

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

Lindeberg, M., and K. Hoffman. 2018. Program management I—Program coordination and science synthesis and program management II—Administration, science review panel, PI meeting logistics, outreach, and community involvement. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, projects 17120114-A and B.

McKinstry, C.A.E., and R.W. Campbell. 2018. Seasonal variation of zooplankton abundance and community structure in Prince William Sound, Alaska, 2009–2016. Deep Sea Res. doi: 10.1016/j.dsr2.2017.08.016

Moran, J., and J. Straley. 2019. Summer survey of population level indices for Southeast Alaska humpback whales and fall surveys of humpback whales in Prince William Sound *in* Zador, S. G., and E. M. Yasumiishi. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, Anchorage, Alaska.

Olson, A.P., C.E. Siddon, G.L. Eckert. 2018. Spatial variability in size at maturity of golden king crab (*Lithodes aequispinus*) and implications for fisheries management. Royal Society Open Science. 5. http://doi.org/10.1098/rsos.171802

Piatt, J.F., M. Arimitsu, W. Sydeman, S.A. Thompson, H. Renner, S. Zador, D. Douglas, S. Hatch, A. Kettle, J. Williams. 2018. Biogeography of Pelagic Food Webs: Forage Fish Distribution and Habitat Use in the North Pacific Revealed by Puffins. Fisheries Oceanography. 27:366-380.

Roberts, M.V. 2018. The temporal and spatial distribution of dissolved and particulate iron over the Gulf of Alaska shelf. M.S. Thesis, University of Alaska Fairbanks, Fairbanks, AK

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

Roncalli, V., S.A. Sommer, M.C. Cieslak, C. Clarke, R.R. Hopcroft, and P.H. Lenz. 2018. Physiological characterization of the emergence from diapause: A transcriptomics approach. *Nature Sci. Rep.* 8: 12577

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

Stocking, J.S., M.A. Bishop, and A. Arab. 2018. Spatio-temporal distributions of piscivorous birds in a subarctic sound during the nonbreeding season. Deep-Sea Research II 147:138–147. doi: 10.1016/j.dsr2.2017.07.017.

Vandersea, M.W., S.R. Kibler, P.A. Tester, K. Holderied, D.E. Hondolero, K. Powell, S. Baird, A. Doroff, D. Dugan, R.W. Litaker. 2018. Environmental factors influencing the distribution and abundance of *Alexandrium catenella* in Kachemak bay and lower cook inlet, Alaska, Harmful Algae, V77, pp. 81-92, ISSN 1568-9883, https://doi.org/10.1016/j.hal.2018.06.008.

von Biela, V.R., M.L. Arimitsu, J.F. Piatt, B. Heflin, S. Schoen, J. Trowbridge, C. Clawson. In press. Extreme reduction in nutritional value of a key forage fish during the Pacific marine heatwave of 2014-2016. Marine Ecology Progress Series. doi: 10.3354/meps12891

Walsh, J.R., R. Thoman, U.S. Bhatt, P.A. Bieniek, B. Brettschneider, M. Brubaker, S. Danielson, R. Lader, F. Fetterer, K. Holderied, K. Iken, A. Mahoney, M. McCammon, and J. Partain. 2018. The high latitude marine heat wave of 2016 and its impacts on Alaska [in "Explaining Extreme Events of 2016 from a Climate Perspective"]. Bull. Amer. Meteor. Soc. 99 (1). S39-43. doi:10.1175/BAMS-D-17-0105.1

B. Dates and Locations of any Conference or Workshop Presentations where EVOSTC-funded Work was Presented

Presentations

Aderhold, D. 2018. An overview of GWA. Presentation. Oral presentation to Cook Inlet Regional Citizens' Advisory Council Board of Directors.

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. et al. Still Awaiting Ecosystem Recovery Following the North Pacific Marine Heat Wave: Gulf Watch Alaska Pelagic Monitoring Update 2018. Poster AMSS (January 2019)

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.

Barbeau, Hopcroft, Schofield, and 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, AMSS, January 2019, Anchorage, Alaska.

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.

Campbell, R.W. 2018. A Profiling Observatory for High Resolution Oceanographic, Biogeochemical, and Plankton Observations in Prince William Sound. Poster presentation, ASLO Ocean Sciences Meeting, Portland.

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.

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. AMSS. January 28 – February 1.

Coyle, Hermann, and Hopcroft. 2018. Modeled spatial-temporal distribution of production and biomass relative to field observations in the northern Gulf of Alaska. Presentation Ocean Sciences Meeting – Portland, OR (February 2)

Cushing, D., K. Kuletz, E. Labunski, and R. Hopcroft. 2019. Seabird Studies During the Northern Gulf of Alaska Long Term Ecological Research Program. Poster AMSS (January)

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, Aguilar-Islas, Fiechter, Hopcroft, Kuletz, Statscewich, and Strom. 2018. Acrobat Observations along the Gulf of Alaska Hydrographic Tightrope. Poster LTER All Scientists Meeting, Pacific Grove, CA (October)

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. AMSS. January 28 – February 1.

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. AMSS, Anchorage, AK. 28-31 January.

Hauri, Hedstro, Schultz, Danielson, Beamer, Dony, Hill, and Stock. 2019. Influence of Ocean Acidification and Climate Change on the Biogeochemistry in the Gulf of Alaska: A Regional Modeling Study. Presentation AMSS (January)

Holderied, K. 2018. Alaska Coastal Science and Management Examples. Oral presentation at Joint Polar Satellite System Arctic Summit, Anchorage, AK. May.

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. February.

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. March.

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 AMSS, Anchorage AK. January.

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. March.

Hopcroft, R.R., A. Aguilar-Islas, S.L. Danielson, J. Feichter, and S. Strom. 2018. NGA-LTER Overview. LTER PI Meeting, October, Asilomar, CA.

Hopcroft and Lindsay. 2018. Gelatinous zooplankton in Alaskan waters: from nets to ROVs. Invited PICES Annual Meeting, Yokohoma, Japan (October)

Hopcroft, R., S. Strom, A. Aguilar-Islas, S. Danielson, and J. Fiechter. 2018. A new Long-term Ecological Research (LTER) site in the Northern Gulf of Alaska. Poster PICES Anual Meeting, Yokohoma, Japan (October)

Iken, K., and B. Konar. 2018. Nearshore Gulf Watch Alaska monitoring in Kachemak Bay. Kachemak Bay Science Conference. March 7-10.

Kibler, S., X. Du, R.W. Campbell, K. Holderied, D. Hondolero, K. Powell Schuster, R. Robinson, M. Arimitsu, M., and J. Piatt. 2018. NPRB 1801: Prevalence of Paralytic Shellfish Toxins in the Marine Food Webs of Prince William Sound and Kachemak Bay, Alaska. Poster presentation, AMSS, Anchorage.

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.

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.

Kuletz, Hopcroft, Danielson, Santora, Sydeman, Hoover, and 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. AMSS. January 28 – February 1.

Lindeberg, M. 2018. GWA program overview. Speed talk. RPA Annual Meeting. March, Juneau, Alaska.

Lindeberg, M. 2018. GWA program overview. Speed talk. Ocean Sciences Conference. February, Portland, Oregon.

Lindeberg, M. 2018. GWA Nearshore Ecosystems. Speed talk. Ocean Sciences Conference. February, Portland, Oregon.

Lindeberg, M. 2018. GWA program overview. Presentation. EVOSTC Trustees. November, Anchorage, Alaska.

Lindeberg, M. 2018. Science Without Borders – is it possible? Plenary presentation. Kachemak Bay Science Conference. March, Homer, Alaska.

Lindeberg, M., R.A. Heintz, and J. Maselko. 2018. Decadal Persistence of *Exxon Valdez* Oil in Prince William Sound – that was not anticipated. Poster. Ocean Sciences Conference, February, Portland, Oregon.

Matkin, C., et al. 2019. An unfortunate legacy: Continuing effects of the *Exxon Valdez* oil spill on killer whales AMSS, Anchorage Alaska.

McKinstry, C. and R.W. Campbell. 2018. Seasonal variation of zooplankton abundance and community structure in Prince William Sound, Alaska, 2009-2016. Poster presentation, ASLO Ocean Sciences Meeting, Portland.

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. AMSS, Anchorage, AK. 28-31 January.

Mendoza-Islas and Hopcroft. 2019. First year pollock and their zooplankton predators in the Gulf of Alaska. Poster AMSS (January)

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. AMSS. January 28 – February 1.

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., 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.

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 AMSS, Anchorage AK. January.

Roncalli, Cieslak, Hopcroft, and Lenz. 2019. Environmental heterogeneity in the northern Gulf of Alaska impacts physiological status in the copepod *Neocalanus flemingeri.* Poster AMSS (January)

Roncalli, Hartline, Germano, Cieslak, Strom, Hopcroft, and Lenz. 2019. Consequences of regional heterogeneity on the physiology of a calanid copepod, *Neocalanus flemingeri,* in the northern Gulf of Alaska. Presentation Ocean Sciences Meeting – Portland, OR (February)

Siegert, D., K. Iken, S. Saupe, and M. Lindeberg. 2019. Comparison of intertidal food web structure between two regions of lower Cook Inlet. AMSS. January 28 – February 1.

Schloemer, J., S. Baird, S. Bentz, M. Johnson, and R. Masui. 2019. Using circulaton mapping and long-term water quality data to aid community monitoring programs in Kachemak Bay, Alaska. Poster presentation at AMSS, Anchorage AK. January.

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. AMSS, Anchorage, AK. 28-31 January.

Straley, J. and J. Moran. 2018. Have Gulf of Alaska Humpback Whales Reached Carrying Capacity or Has the Blob Made the Food Web Screwy? Poster Presentation. Ocean Science Meeting, Portland OR. 11-16 February.

Strom, Bright, and Fredrickson. 2019. Mixotrophy in the Gulf of Alaska: Abundant plant-animal cells have major implications for ecology and biogeochemistry. Presentation AMSS (January)

StromS., and R. Hopcroft. 2018. Planktonic Communities in the Coastal Gulf of Alaska: Strong Dichotomies in Structure and Function. Presentation Ocean Sciences Meeting – Portland, OR (February)

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, AMSS, January, Anchorage, AK.

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. (presentation)

Suryan, R.M. 2018. Gulf of Alaska ecosystem variability. Juneau Marine Naturalists Symposium. Juneau, Alaska. (presentation)

Suryan, R.M. 2018. Gulf Watch Alaska: Why we study ecosystems. Juneau Yacht Club, Juneau, Alaska. (presentation)

Suryan, R., M. Lindeberg, D. Aderhold, M. Arimitsu, J. Piatt, J. Moran, J. Straley, H. Colletti, D. Monson, S. Hatch, T. Dean, R. Hopcroft, S. Batten, S. Danielson, B. Konar, K. Iken, B. Laurel, R. Campbell, S. Pegau. 2018. Ecosystem variability and connectivity in the Gulf of Alaska following another major ecosystem perturbation. North Pacific Marine Science Organization (PICES) annual meeting, Yokohama, Japan. 25 October - 4 November.

Suryan, R., M. Lindeberg, D. Aderhold, K. Hoffman, M. Arimitsu, H. Colletti, R. Hopcroft. 2018. Gulf Watch Alaska: Taking the pulse of the northern Gulf of Alaska. Kachemak Bay Science Conference, Homer, Alaska. (poster presented by coauthors)

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.

Suryan, R., M. Lindeberg, D. Aderhold, K. Hoffman, M. Arimitsu, H. Colletti, R. Hopcroft. 2018. Gulf Watch Alaska: Taking the pulse of the northern Gulf of Alaska. Ocean Sciences Meeting, Portland, Oregon. (poster)

Weitzman, B. Esler, D., Coletti, H., Konar, B., and Iken, K. 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.

Outreach

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

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.

Konar, B., and K. Iken. 2018. Wasting sea stars in the Gulf of Alaska. Delta Sound Connections 2018-2019. Prince William Sound Science Center.

Campbell, R. 2018. Productive plankton in the world's richest waters: the role of nutrients in the annual plankton cycle. Delta Sound Connections 2018-2019. Prince William Sound Science Center.

Lindeberg, M. 2018. AFSC Feature web story. Lingering Oil from *Exxon Valdez* Spill - Long-term study of lingering oil from *Exxon Valdez* spill offers new insights for resource managers. February 26, 2018. https://www.fisheries.noaa.gov/feature-story/lingering-oil-exxon-valdez-spill

Lindeberg, M. 2018. AFSC Feature web story. A Wealth of Scientific Information, Decades in the Making - a recent special issue journal highlights the status of an Alaska marine ecosystem more than a quarter century after the *Exxon Valdez* oil spill. February 26, 2018. https://www.fisheries.noaa.gov/feature-story/wealth-scientific-information-decades-making

Lindeberg, M., and J. Moran. 2018. AFSC Feature web story. Dall's Porpoise Expands Territory in a Changing Prince William Sound. Territory increases as killer whale population dwindles. February 26, 2018. https://www.fisheries.noaa.gov/feature-story/dalls-porpoise-expands-territory-changing-prince-william-sound

McKinstry, C. 2018. Microscopic tourists. PWSSC Delta Sound Connections (http://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf)

Moran, J. Dall's Porpoise: Life in the fast lane. Delta Sound Connections 2018-2019. Prince William Sound Science Center.

Moran, J. 2018. Dall's Porpoise Expands Territory in a Changing Prince William Sound. February 26, 2018. Feature Story. https://www.fisheries.noaa.gov/feature-story/dalls-porpoise-expands-territory-changing-prince-william-sound.

Moran, J. 2018. Dall's Porpoise Research in Alaska. NOAA Fisheries website. https://www.fisheries.noaa.gov/alaska/marine-mammal-protection/dalls-porpoise-research-alaska.

Olsen, D. 2018. Killer whales of the world. Zegrahm Expeditions. January and July.

Olsen, D. 2018. Mom knows best: Killer whale culture in Prince William Sound. Kenai Fjords National Park training. May.

Olsen, D. 2018. Mom knows best: Killer whale culture in Prince William Sound. Prince William Sound Science Center Brown Bag. May.

Olsen, D. 2018. Mom knows best: Killer whale culture in Prince William Sound. Seward Public, Naturalists, and Captains. May.

Olsen, D. 2018. Mom knows best: Killer whale culture in Prince William Sound. Kayak Adventures guide training. May.

Olsen, D. 2018. Life of the killer whale. Seabourne Sojuourn. August.

Olsen, D. 2018. Life history and social structure of Alaskan killer whales. Kenai Peninsula College. October.

Olsen, D. 2018. Mom knows best: Killer whale culture in Prince William Sound. Kenai Peninsula College. November.

Schaefer, A. 2018. A winter refuge for seabirds. Delta Sound Connections 2018-2019. Prince William Sound Science Center.

Shepherd, J. 2018. Reading the landscape. 49 Writers Online Blog. April 2018.

Suryan, R.M. 2018. Gulf Watch Alaska looks beyond "the Blob". Delta Sound Connections 2018-2019. Prince William Sound Science Center.

C. Data and/or Information Products Developed During the Reporting Period, if Applicable

Data

DataONE published datasets can be found at the following link: Doi: 10.24431/rw1k113. Recently archived GWA datasets that were updated in the DataOne repository during the FY18 reporting period, as reported by the Data Management Program include the following:

- Oceanographic Monitoring in Cook Inlet and Kachemak Bay, Zooplankton Data, 2012-2016, GWA Environmental Drivers Component. Research Workspace. 10.24431/rw1k21g, version: 262a47ff-bed8-452b-a87b-a9f733bed0f3.
- Oceanographic Monitoring in Cook Inlet and Kachemak Bay, Water Quality, Meteorological, and Nutrient Data collected by the KBNERR's System-wide Monitoring Program, 2012-2016, GWA Environmental Drivers Component. Research Workspace. 10.24431/rw1k21f, version: 17b18387-5a16-4d9a-a404-31ac040fdffd.
- Seward Line and Lower Cook Inlet Marine Bird Survey Data, 2006-2016, GWA Pelagic Component. Research Workspace. 10.24431/rw1k21l, version:0571fa8f-bfa1-4c4b-959b-e80c1e072fc6.
- PWS Marine Bird Surveys, July 2012 to 2016, GWA Pelagic Component. Research Workspace. 10.24431/rw1k21k, version:b1d9148c-4a45-41a8-856d-da8585a8907d.
- CPR and Temperature Data, GOA, 2011-2016, GWA Environmental Drivers Component. Research Workspace. 10.24431/rw1k21a, version: 1156722c-45bc-4c4e-a33a-6998c2ab84d5.

GAK1 (18120114-I) PIs are working on GOA region satellite-based estimates of transport and sea level variability. These products may be useful for future analyses.

For the PWS marine bird survey project (18120114-M), Program R scripts have been created by a contractor, Scott Wolfe, to analyze PWS marine bird and mammal data, with automated output for comparison between

(i) oiled, unoiled, and all of PWS; (ii) regression and population trends; and (iii) figure creation. Final corrections to program coding should be completed by 30 April 2019.

Information Products

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter. Volume 2.1: spring quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter. Volume 2.2: summer quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter. Volume 2.3: fall quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter. Volume 2.4: winter quarter. Link on gulfwatchalaska.org.

Online Resources

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

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

Additional online resources are listed in the individual project annual reports and the program annual report.

The Kachemak Bay/Lower Cook Inlet Oceanography project published a video, "Keys to Restoring Kachemak Bay." https://coastalscience.noaa.gov/news/kachemak-bay-hfa-video/.

D. Data Sets and Associated Metadata that have been Uploaded to the Program's Data Portal

All projects are generally on schedule for having data posted one year after collection. Some projects are typically delayed annually due to late-in-year sampling schedules, longer sample processing times, and data processing delays, but are compliant and being updated when ready. In these instances PIs are working closely with Axiom staff on a plan and schedule for compliance. Please see individual FY18 annual project reports section 9.D for listing of data and metadata. Data and metadata for GWA projects can be found on the Gulf of Alaska Data Portal at this link: https://portal.aoos.org/gulf-of-alaska#search?type_group=all&tag|tag=evos-gulf-watch-projects&page=1

10. Response to EVOSTC Review, Recommendations and Comments:

Science Panel Comments on FY18 Work Plan, September 2017

The Panel is very pleased with Mandy's role in coordinating logistics and synthesizing results. The Panel is pleased about the hiring of Rob and Donna as the Science Coordinator and Program Coordinator, respectively, and looks forward to working with them. The quality of this proposal has improved greatly compared to previous years. The Panel is encouraged to see data presented and the evaluation of past years data to determine what the projects should do in the future. This Program has published many papers, which is a positive development and the panel is excited about the Long-Term Ecological Research funding (National Science Foundation) awarded to some of the projects. The Panel was encouraged about Rob's plans for synthesis products including an analysis and publication(s) on biological impacts of the recent environmental changes.

PI Response

Thank you for the comments.

11. Budget:

Please see provided GWA program workbook. Table 2 provides a summary of spending to date by project, comparing proposed spending for FY18 (year 7) with actual spending for the year.

Table 2. Spending summary by project, showing proposed FY18 (year 7) and actual cumulative spending for the FY17 (year 6) and FY18 (year 7). All numbers are in thousands.

Project Number	PI	Project Title	FY18 Proposed	Cumulative Total
Environmental Drivers				
17120114-D	Batten	CPR	$72.3	$142.5
17120114-G	Campbell	PWS Ocean	$205.0	$299.3
17120114-I	Danielson	GAK1	$136.2	$215.0
17120114-J	Holderied/Baird	LCI/KBay Ocean	$159.9	$248.1
17120114-L	Hopcroft	Seward Line	$124.9	$246.2
Pelagic				
17120114-C	Arimitsu/Piatt	Forage Fish	$210.8	$363.0
17120114-E	Bishop	Wintering Birds	$85.05	$145.6
17120114-M	Kuletz/Kaler	PWS Marine Birds	$203.8	$221.8
17120114-N	Matkin	Killer Whales	$138.8	$251.4
17120114-O	Moran/Straley	Humpback Whales	$142.2	$206.7
Nearshore				
17120114-H	Coletti et al.	Nearshore	$415.4	$719.1
Integrated Program Management and Administration				
17120114-A	Lindeberg	Synthesis/Coord	$208.8	$408.4
17120114-B	Hoffman	Admin/Outreach	$259.1	$443.1
			$2,362.3	$3,910.3

Below is a brief explanation for cumulative spending deviations greater than 10% by project for FY18 (year 7).

- 18120114-A: A few line items deviated ± 10% from the originally proposed amount in cases where reporting accounts lagged behind actual expenses, or due to inconsistencies between federal and EVOSTC fiscal year start dates. Due to the partial federal government shut down some costs had not been charged to the account at the time of this report, however, these costs will even out over time, and we expect to spend the total proposed budget amount by the end of the project.
- 18120114-B: SRP members have had less travel availability than originally anticipated and budgeted for. Additionally, PMT members have rotated responsibility for who will attend certain meetings (for example, one PMT member has attended things like a Public Advisory Committee meeting, as opposed to multiple PMT members). One SRP member has retired from the panel and we are seeking a replacement. There have been minor invoicing delays by some subawardees, and we have reminded

them of their invoicing frequency obligations. Some computer hardware and software that we expected to purchase in FY18 has not yet been purchased, but that will be resolved in FY19.

- 18120114-C: Current expenditures of some line items exceed ± 10% deviation from the originally proposed amount in cases where reporting accounts lagged behind actual expenses, or due to inconsistencies between federal and EVOSTC fiscal year start dates, and because USGS budget system categories differ from those shown on the EVOSTC proposal. All expenditures are within keeping to our planned budget. Due to the government shut down some costs had not been charged to the account at the time of this report, however, these costs will even out over time and we expect to spend the total proposed budget amount by the end of the project.
- 18120114-E: Personnel for this project was underspent in FY18 as the avian research assistant took a 2-month leave of absence.
- 18120114-G: Spending is slightly behind schedule, more of Campbell's time than expected was occupied by other projects in FY18, including several projects that were ending and were prioritized to be spent out. Nutrient analysis also did not begin until January 2019 because the nutrient technician was not available until then.
- 18120114-I: No significant alterations in funding allocation are anticipated. In order to take advantage of the M.J. Murdock Charitable Trust matching funds, we postponed spending 2017 equipment funds until 2018. Though not shown in this breakdown, PI Danielson's transition from Research Faculty to Tenure Track Faculty status will allow him to re-allocate some of his salary into student and staff support over FY19-FY21.
- 18120114-J: PI Holderied (NOAA) was delayed in fully obligating FY18 (project year 7) funds by 31 January 2019, for travel, contracts, and commodities ($22.4K total). Travel issues were due primarily to federal employee travel issues associated with the federal government shutdown. We expect to accomplish additional cross-GWA project field work collaborations with the travel funds. Obligations for contracts are behind schedule primarily due to issues with the vessel charter for spring 2018 Cook Inlet entrance sampling and obligations for commodities are behind schedule primarily due to contract administration delays (including those associated with the shutdown). We expect to be able to catch up on these contractual and commodity obligations by the end of FY19 and we do not expect to need any >10% change of funding between budget categories. KBNERR was again without a designated research coordinator for FY18, so charges to this project were reduced because staff with a lower pay rate took on most of the research coordinator's duties. Despite being short-handed, all field sampling tasks were met by remaining staff on the project. To rectify the staff shortage, KBNERR's GIS analyst, Steve Baird, has assumed the role of acting research coordinator, and will act as the GWA PI for FY19 and beyond.
- 18120114-L: While compiling the FY17 cumulative budget spent for the Seward Line project we discovered internal accounting discrepancies for FY17. The accounting has been rectified in FY18.
- 18120114-M: The contractual category includes a charter vessel to provide support during boat-based survey. The Per Day vessel charter cost was higher than anticipated, and only one vendor bid on the contract.
- 18120114-N: The budget is in need of revision as the tagging program has been put on indefinite hold due to humane considerations, reducing projected expenditures in commodities. Expenses on Soundtrap recorders have also been below budget. However, expenses for analysis of recordings and acoustic analysis software development have exceeded and likely will continue exceed expected amounts. In future years we may need to shift funds from commodities to contractual to provide for

additional contract analytical time for acoustic analysis and software development and possible population dynamics analysis. Our 5-year budget plan is skewed to reduce commodities costs and increase analytical costs as we move toward the later segment of the project, but some additional adjustment might be required to balance these categories.

- 18120114-O: NOAA funds were used to secure vessel time for December 2017 and March 2018 surveys; however, NOAA funds are exclusively for vessel cost. Cost for logistics (travel, shipping, overtime) and data processing are covered by GWA funds. NOAA funds are no longer available for vessel costs after March 2019.

2017-2021 Gulf Watch Alaska Program Proposal
Funds shown in thousands USD

Principal Investigators and Institution	Activity - short project title	FY 17	FY 18	FY 19	FY 20	FY 21	5 Yr proposed TOTAL	Actual Cumulative
Environmental Drivers								
Batten, *SAHFOS*	Continuous plankton recorder (CPR)	$70.19	$72.30	$74.47	$76.70	$79.00	$372.66	$142.5
Campbell, *PWSSC*	PWS Oceanographic	$200.64	$204.99	$209.46	$214.07	$218.83	$1,047.98	$299.3
Danielson & Weingartner, *UAF*	GAK-1 (Gulf of Alaska) Mooring	$134.64	$136.18	$121.68	$115.22	$116.85	$624.57	$215.0
Holderied, *NOAA, & Shepherd, UAA*	Lower Cook Inlet Oceanographic	$155.71	$159.96	$168.23	$124.55	$122.25	$730.69	$248.1
Hopcroft, *UAF*	Seward Line	$121.76	$124.86	$127.98	$131.21	$134.47	$640.28	$246.2
Environmental Drivers Total		**$682.93**	**$698.28**	**$701.82**	**$661.75**	**$671.40**	**$3,416.17**	**$1,151.1**
Pelagic Monitoring								
Bishop, *PWSSC*	PWS fall/winter seabirds	$82.70	$85.05	$111.80	$114.46	$117.30	$511.31	$145.6
Kuletz & Kaler, *USFWS*	Nearshore marine birds surveys	$22.87	$203.83	$22.87	$203.83	$22.87	$476.27	$221.8
Matkin, *NGOS*	Killer whale monitoring	$140.15	$138.83	$130.38	$128.73	$128.02	$666.12	$251.4
Moran, *NOAA,* & Straley, *UAS*	Humpback whale monitoring	$148.54	$142.20	$171.91	$169.14	$162.41	$794.20	$206.7
Arimitsu & Piatt, *USGS*	Forage fish	$182.42	$210.82	$267.98	$270.95	$277.80	$1,209.98	$363.0
Pelagic Monitoring Total		**$576.68**	**$780.73**	**$704.94**	**$887.12**	**$708.39**	**$3,657.87**	**$1,188.5**
Nearshore Monitoring								
Coletti, *NPS,* Esler, *USGS*, Konar & Iken, *UAF*	Nearshore Monitoring	$368.70	$415.35	$377.40	$369.06	$369.54	$1,900.04	$719.1
Nearshore Monitoring Total		**$368.70**	**$415.35**	**$377.40**	**$369.06**	**$369.54**	**$1,900.04**	**$719.1**
Coordination, Data Management, Outreach and Administration								
Lindeberg, *NOAA*	PM I: Science synthesis & coordination	$208.10	$208.80	$138.10	$141.10	$146.76	$842.86	$408.4
Lindeberg, *NOAA,* & Esler, *USGS*	PM I: Science synthesis & coordination--Post-Doc	$0.00	$0.00	$57.19	$57.19	$57.19	$171.57	$0.0
Hoffman, *PWSSC*	PM II: Administration, logistics, & Outreach	$254.19	$259.10	$350.90	$352.85	$369.07	$1,586.11	$443.1
Coordination, Data Management, Outreach and Administration Total		**$462.29**	**$467.90**	**$546.19**	**$551.14**	**$573.02**	**$2,600.54**	**$851.5**
	LTM Program Total Cost	**$2,090.60**	**$2,362.26**	**$2,330.34**	**$2,469.07**	**$2,322.35**	**$11,574.62**	**$3,910.3**
Total all EVOSTC GWA projects including 9% GA		**$2,278.75**	**$2,574.86**	**$2,540.07**	**$2,691.28**	**$2,531.36**	**$12,616.33**	