EVOSTC ANNUAL PROGRAM STATUS SUMMARY FORM

1. Project Number:

131200114 and 13120120

2. Program Title: *See,* Reporting Policy at III (D) (2).

Gulf Watch Alaska

3. Program Lead Name(s): *See,* Reporting Policy at III (D) (3).

M. McCammon, K. Holderied, K. Hoffman

4. Time Period Covered by the Summary: *See,* Reporting Policy at III (D) (4).

1 February 42014 to 31 January 52015

5. Date of Summary: *See,* Reporting Policy at III (D) (5).

March 1, 2015

6. Program Website (if applicable): *See,* Reporting Policy at III (D) (6).

www.gulfwatchalaska.org

7. Overview of Work Performed during the Reporting Period: *See,* Reporting Policy at III (D) (7).

PROGRAM INTRODUCTION

The overarching goal of the Gulf Watch Alaska long-term monitoring program 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 *Exxon Valdez* oil spill (EVOS) injured resources and services. This report describes work completed in year two of the first five-year period of the ecosystem monitoring program in the spill-affected region.

The long-term monitoring program has six main objectives:

1) Sustain and build upon existing time series of data collected in Prince William Sound, lower Cook Inlet and adjacent Gulf of Alaska coast.
2) Provide scientific data, data products and outreach to management agencies and a wide variety of users.
3) Develop improved monitoring for certain species and ecosystems.
4) Develop science synthesis products to assist management actions, inform the public and guide the evolution of monitoring priorities for the next 20 years.
5) Enhance connections between, and integration of, monitoring projects and within the Gulf Watch Alaska and Herring Research and Monitoring (HRM) programs.
6) Leverage partnerships with outside agencies and groups to integrate data from a broader monitoring effort than that funded by the Trustee Council.

The Gulf Watch Alaska program is composed of integrated program management, data services, science synthesis, conceptual modeling, and outreach efforts (five projects), as well as the 15 ecosystem monitoring projects. Field sampling for most projects occurs each year, with the exception of the projects noted below. The program is structured into the following components, with the responsible entities for each project shown. For reader clarity, this report will follow this structure with heading titles adhering to the

guidelines for contents in Section III. Annual Project Reports and Annual Status Summaries in EVOSTC Reporting Policy and reporting templates revised 1.13.2014.

Integrated program management, data services, outreach, science synthesis and modeling

- Program coordination and logistics – Prince William Sound Science Center (PWSSC) and Alaska Ocean Observing System (AOOS)
- Outreach - AOOS
- Data management –AOOS/Axiom Consulting
- Historical data management and synthesis – National Center for Ecological Assessment and Synthesis (NCEAS)
- Science coordination and synthesis – NOAA Kasitsna Bay Laboratory (KBL)
- Conceptual ecological modeling– Alaska Sea Life Center (ASLC)

Environmental drivers monitoring component

- Gulf of Alaska mooring (GAK1) monitoring – University of Alaska Fairbanks (UAF)
- Seward line monitoring – UAF
- Oceanographic conditions in Prince William Sound – PWSSC
- Oceanographic monitoring in Cook Inlet – Alaska Department of Fish and Game (ADFG-)-Kachemak Bay National Estuarine Research Reserve (KBNERR) and NOAA KBL
- Continuous plankton recorder –Sir Alister Hardy Foundation for Ocean Science (SAHFOS)

Pelagic monitoring component

- Ability to detect trends in nearshore marine birds – USNPS Southwest Alaska inventory and monitoring Network (SWAN)
- Long-term killer whale monitoring – North Gulf Oceanic Society (NGOS)
- Humpback whale predation on herring – NOAA National Marine Fisheries Service (NMFS) Auke Bay Laboratory
- Forage fish distribution and abundance – U. S. Geological Survey (USGS) Alaska Science Center
- Prince William Sound marine bird surveys – U.S. Fish and Wildlife Service (USFWS)
- Seabird abundance in fall and winter –PWSSC

Benthic monitoring component

- Nearshore benthic systems in the Gulf of Alaska – USGS Alaska Science Center/ USNPS SWAN, Coastal Resources Associates
- Ecological Communities in Kachemak Bay – UAF

Lingering oil component

- EVOS oil exposure of harlequin ducks and sea otters – USGS Alaska Science Center
- Oil level and weathering tracking – NOAA/NMFS Auke Bay Laboratory

SUMMARY OF WORK COMPLETED

PROGRESS TOWARD OBJECTIVES

Work within the Gulf Watch Alaska (GWA) long-term ecosystem monitoring program during this year has focused on execution of the monitoring projects, preparation and submission of the synthesis report documents, and preparation and presentation of materials for the February 2015 joint program science conference. In addition, program principal investigators planned and attended the annual meeting, developed year 4 proposals, and presented program overviews and program summaries at the EVOS

Trustee Council and Public Advisory Committee meetings, and the 2015 Alaska Marine Science Symposium. In writing the synthesis document, investigators worked collaboratively both within the GWA program and with Herring Research and Monitoring program investigators to integrate data for analyses and demonstrate linkages between various projects within and between both programs. Program investigators also continue to revise and improve the program website, develop new outreach tools such as community film programs and informative handouts, and improve data access tools. Program administration and management has proceeded as expected during this year.

Specific accomplishments related to the program objectives include:

Objective 1. Sustain and build upon existing time series in Prince William Sound, lower Cook Inlet and adjacent Gulf of Alaska coast.

- Successfully completed all planned field work for all projects this year. QA/QC (For specific milestones accomplished by project, see Individual project reports, Appendix A).
- Continued to add to data sets available on the GWA Ocean Workspace; completed metadata for all projects; and published data through the data portal for both historic and ongoing work.

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

- Provided a Gulf Watch Alaska program information webinar to management agency staff members describing the program and projects as well as demonstrating access to outreach materials and data.
- Developed infrastructure to document provenance relationships in syntheses of GWA data and future synthesis work.
- Synthesized and visualized 40 archived datasets.
- Continued to improve the program website (www.gulfwatchalaska.org), including adding a *Resources* page with available photos, videos, presentations, and reports. Continued to improve tools for describing and publishing data to the AOOS Gulf of Alaska data portal, including attribute definition tables, automated publication, and revision of tags.
- Provided outreach workshops and seminars at public events in Cordova, Valdez and Homer.
- Principal Investigators gave multiple presentations and posters at scientific conferences. Science Team lead, Kris Holderied, presented program summaries at the Alaska Marine Science Symposium and four presentations at two separate meeting events for the EVOSTC and EVOSTC PAC.

Objective 3. Develop improved monitoring for certain species and ecosystems.

- Worked across projects, components, and programs to develop recommendations for cost efficient approaches for pelagic species monitoring (see Lindeberg et al., *in review*).
- Completed analyses of historic nearshore marine bird data and developed recommendations to improve sampling efficiencies (see Coletti and Wilson, *in review*).
- Completed forage fish monitoring methods assessment and developed recommendations for continuation of forage fish monitoring in conjunction with other pelagic species (see Arimitsu and Piatt, Forage Fish project report).

Objective 4. Develop science synthesis products to assist management actions, inform the public and guide the evolution of monitoring priorities for the next 20 years.

- Completed the year three science synthesis report for the GWA program:

Hoem Neher, T., B. Ballachey, K. Hoffman, K. Holderied, R. Hopcroft, M. Lindeberg, M. McCammon, and T.Weingartner, editors. *In review*. Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Gulf Watch Alaska program science synthesis report. Submitted to the Exxon Valdez Oil Spill Trustee Council, December 1, 2014.

- Completed conceptual sub-models for the Nearshore component and identified three conceptual sub-models for working groups to be developed in 2015.
- Presented program and project summaries and recommendations at the EVOSTC joint science workshop with the Herring Research and Monitoring program.

Objective 5. Enhance connections between and integration of monitoring projects and between the Gulf Watch Alaska and Herring Research and Monitoring (HRM) program.

- Worked closely with the HRM program Science Coordinator in compiling, writing, and presenting synthesis report documents to address cross-program integration and science questions.
- Facilitated collaborative monitoring activities including sharing of data, vessel time, and aerial survey time between GWA and HRM projects.

Objective 6. Leverage partnerships with outside agencies and groups to integrate data from a broader monitoring effort than that funded by the Trustee Council.

- Held several discussions within the annual program meeting and at the AMSS to identify the types of data needed and outside sources that could be obtained to build on analyses of environmental conditions related to ecological indices.
- Continued partnerships with vessels of opportunity projects (Bishop, Batten, Kuletz)
- Worked with agency and NPRB scientists to share information and address parallel goals.
- Worked within the AOOS framework to incorporate information and modeling from the entire Gulf of Alaska region to the program data portal.
- Conducted a work session following the 2014 Community-Based Monitoring (CBM) Workshop to discuss opportunities to collaborate with and enhance existing CBM activities within the GWA region.

Deliverable/Milestone	Status
Conduct project field data collection surveys	Completed.
Submit annual work plan for review	Completed September 1.
Conduct annual program meeting and periodic conference calls/ short meetings to coordinate administrative needs and provide forum for collaboration	Completed January, May, July, and November 42014 and January 2015 at AMSS.
Plan and collaborate with HRM for joint science program	Synthesis report submitted 1 December 20142014, successful joint science workshop held February 2015.
Provide outreach and data access tools for the program	Continue improvements and revisions to website and data portal, developed new outreach materials.
Complete annual report	Completed.

NOTEWORTHY ISSUES AND FINDINGS WITHIN PROGRAM

Outside of continuation of the monitoring projects under the program, completion of the GWA science synthesis report has been the major focus of this year's work. This report highlighted the value of the long-

term monitoring work in understanding the effects of the EVOS to injured resources in the context of ecological changes induced by climate, weather, and ecological drivers. The program continues as proposed, with minor changes made with approval of EVOSTC staff and Trustees. The following summarizes noteworthy issues and findings for each project.

PROGRAM COORDINATION AND LOGISTICS – HOFFMAN (PWSSC, 12120114-B)

PWSSC issued and managed sub-award contracts for all non-Trustee Agency Gulf Watch Alaska (formerly Long-term monitoring program) Year 3 projects. PWSSC monitored spending, fulfilled sub-award invoices, and completed the annual audit in November 2014. We contracted with Marilyn Sigman (UAF) to support outreach programming and coordination and extended outreach funding as directed by McCammon and the outreach steering committee. We submitted the semi-annual program report and the Year 4 EVOSTC work plans that were due by September 1, 2014. Principal investigator meetings were held on a roughly quarterly basis as field seasons and PI schedules permitted. PWSSC coordinated logistics and processed expenses for the annual LTM PI meeting, which was held in Anchorage on November 18, 19 and 20, 2014. That fall meeting was coordinated in collaboration with the EVOSTC-funded Herring Research and Monitoring program annual meeting held November 21. Program component leads gave presentations on overall progress at the annual PI meeting and teams collaborated across projects and components to finalize content for the synthesis report. We also coordinated logistics for the January 19, 2015 LTM meeting at the Alaska Marine Science Symposium. We submitted all financial and project reports to NOAA and the EVOSTC as required.

The LTM Program Management Team, consisting of Molly McCammon, Kris Holderied, Katrina Hoffman and Tammy Neher, actively managed the program throughout the reporting year. The PMT met more than once per month, usually via teleconference. The PMT presented to the EVOS Public Advisory Committee on October 16, 2014 and the EVOS Trustee Council on November 19, 2014. As needed, PMT teleconferences included members of the LTM Science Coordinating Committee (Hopcroft; Weingartner; Ballachey; Lindeberg) and data management team (Bochenek).

OUTREACH– MOLLY MCCAMMON (AOOS, 12120114-B)

The Outreach and Community Involvement Steering Committee (which includes key outreach staff from AOOS, the PWSSC, Kachemak Bay National Estuarine Research Reserve, Alaska SeaLife Center, North Pacific Research Board, COSEE Alaska, NOAA and USGS) met informally throughout the year, and formally July 9 and August 5, 2014. During this reporting period, additions were made to the website, www.gulfwatchalaska.org and data portal, which serve as the primary outreach mechanism for the LTM program and data. Profiles of all LTM components were developed and printed, and will be available on the website as PDF documents. As a follow-up to the Community-Based Monitoring (CBM) Workshop held April 1-2, 2014 and organized by AOOS and Alaska Sea Grant, a half-day work session was held April 3 with participants from the GWA region to discuss opportunities for CBM in the region. Participants included representatives of most of the currently active CBM projects, as well as village representatives. More than 30 people attended, and largely agreed that existing programs could be supported and enhanced before starting up any new programs. An informational webinar held in September 2014 about the LTM Program targeted Trustee Council agencies as part of an effort to reach out to management agencies. KBNERR sponsored three public Discovery Labs in Homer on August 6, 8 and 9, 2014 highlighting the impacts of lingering *Exxon Valdez* oil and attended by 243 people. The PWSSC continued to host program researchers in its lecture series, this year featuring GWA researchers John Moran and Mark Carls. The GWA Program was highlighted in several articles in the summer 2014 edition of Delta Sound Connections. A new program to develop community-based films by local schools was piloted in Nanwalek and Tatitlek. Seventh – 12th grade students were trained in film-making skills and created 3 – 5 minute documentary films

centered around themes of ocean health and natural and cultural impacts of the *Exxon Valdez* Oil Spill, and cultural practices related to ocean sciences and sustainability. Community-wide film screenings were held in both communities as a culminating event of the film workshops. The Outreach Committee approved contracting with the Alaska SeaLife Center to develop a kiosk display, program videos and a Virtual Field Trip in the coming year. Those activities are just beginning.

DATA MANAGEMENT– MCCAMMON/BOCHENEK (AOOS/AXIOM, 12120114-D)

Project investigators continue to provide core data management oversight and services for the Gulf Watch Alaska LTM program and all milestones have been met for this reporting period. The focus has shifted more to development of easily accessible data visualization tools using the LTM program data. Examples of some possible tools were demonstrated at the 2015 joint science workshop and the data management team will be working with members of the program to develop beta tools for several of the projects this year. Data management PIs have participated in regular GWA meetings, including the in-person meeting in November 2014 and the February 2015 joint science workshop and are coordinating activities between the RMHRM and GWAGWA programs. In addition, the Ocean Workspace metadata editor was expanded to provide detailed definitions of attributes in tabular data in response to feedback from GWA program management. Additionally, Axiom data analysts worked with GWA program management to develop best practices for archiving and visualizing GWA datasets while standardizing CTD data for conversion to netCDF. Improvements have also been made to the full Gulf of Alaska data portal, including an addition of 167 new data layers (a 61.5% increase in the number of data layers from 2013), and improved project and file metadata displays.

HISTORICAL DATA MANAGEMENT AND SYNTHESIS – JONES (NCEAS, 12120120)

Duties shifted from data archiving to initiation of various synthesis activities during this reporting period. While data archiving was completed in the previous year, as planned, project personnel have continued to maintain and update datasets as needed and continue to develop data management infrastructure. Syntheses of archived data as well as additional data have begun and will continue through the next few years. Data outreach and collection was finalized although delayed conversations extended this work into FY14. Three projects were added to the Gulf of Alaska (GOA) Data Portal post-completion and numerous projects have been edited and updated to enhance detailed metadata as researchers provide additional information. The complete historical dataset now contains 97 data packages. In addition, the Gulf of Alaska Historical Data Portal is undergoing improvements to enable reproducible science. This new provenance infrastructure allows users to track data inputs and outputs, store and document software and show data derivation history for objects. Finally, data from similar and overlapping Gulf Watch Alaska projects have been synthesized for further analysis. Synthesized datasets include oceanographic data, chlorophyll data, zooplankton data, algal cover and habitat data, seabird data, and marine mammal data. Eight synthesized datasets compile data from 39 historic and GWA datasets. Syntheses use provenance structures to document data inputs, manipulations, and outputs.

SCIENCE COORDINATION AND SYNTHESIS – HOLDERIED (NOAA KBL, 12120114-H)

This was a very busy writing and editing year for the science synthesis project investigators, including authoring, compiling, and editing the program Year 2 and Year 33 annual reports, Year 4 work plan, and the GWAGWA science synthesis report. In addition, we provided editorial review for several different outreach materials, including extensive coordination with PIs and the outreach team on developing project profile factsheets for every project. We continued to work closely with the data management team to update the GWA website and data portal and helped facilitate use of online program resources by state and federal agency personnel as well as the general public. Finally, we presented GWA program information and monitoring highlights to scientific audiences, agency managers, and the public through science conference

presentations, NOAA, ADFG and BOEM agency briefings, a webinar for agency managers, and public outreach events.

CONCEPTUAL ECOLOGICAL MODELING – HOLLMEN (ASLC, 12120114-I)

This reporting period has focused on presenting and publishing results from the first two years of method development and modeling. Our first manuscript based on conceptual modeling development for the Gulf Watch Alaska program was submitted in 2014 and is currently in revision to address reviewer comments. Development and refinement of a semi-quantitative expert knowledge rating tool was presented at the Alaska Marine Science Symposium in January 2015. In addition, PIs have worked on development of a framework and working groups for a suite of sub-models to explore and represent key hypotheses relating to the components of our program: environmental drivers, nearshore, pelagic, and lingering oil. Our team has also worked to develop visual aids to represent ecosystem structure and monitoring efforts related to the program components for the completion of the program synthesis report in December 2014.

GULF OF ALASKA MOORING (GAK1) MONITORING – WEINGARTNER (UAF, 12120114-P)

All field sampling thus far has been completed as proposed during this reporting period. Our sampling activities this past year include quasi-monthly CTD casts at station GAK 1 (September, November, December, and January). PIs coauthored the LTM-program synthesis chapter for the environmental drivers component, including analyses completed by Dr. Weingartner's graduate student, James Kelly. Mr. Kelly used the GAK 1 data sets to investigate sea level variability in Seward. The goal here was to determine the causes for sea level variations and eventually to determine if Seward Sea level can be used as a proxy for current variations in the ACC. We found that the annual cycle of sea level variations at Seward are in-phase with dynamic heath (vertically-integrated density) at GAK 1. At periods of days to ~1 month the sea level variations are significantly coherent with and in-phase with the along-shore winds over the Gulf of Alaska shelf, especially in fall, winter, and early spring. Given that the wind is also coherent with ACC transport at these periods, it appears that Seward Sea level anomalies at these periods may be useful as an index of ACC transport. Mr. Kelly incorporated this work into his thesis and will graduate with an MS degree in spring 2015.

SEWARD LINE MONITORING – HOPCROFT (UAF, 12120114-J)

The fall 2014 cruise was conducted during one of the largest warm-water anomalies observed in the North Pacific during the past 50 years. Unusually warm surface waters were observed at GAK 12 & 13 (14.3°C), as well as >13°C within most of the Alaska Coastal Current waters extending as deep as 40m. Our average upper-100m temperatures for the inner GAK stations were 2.1-2.6°C above the mean for those stations, and 0.6-1.06°C at the offshore end. This made the entire line the warmest on record: 0.5°C above the next-warmest and 1.06°C above the long-term September mean. Unusual weather patterns the prior winter, a weak El Nino, and a shift in the sign of the PDO all contributed to this unique situation that will likely impact 2015 as temperatures in the GoA remain nearly 2°C above normal. Although zooplankton composition appeared typical during the May cruise, by September significant numbers of southern (i.e. California Current) copepods were detected along the Seward Line. In most cases, although their abundances were low compared to the entire copepod community, they were the highest observed over the 18 years of study along the Seward Line. Finally, the Seward Line continues to provide logistical opportunities for a number of other projects, from ocean acidification work to fisheries projects, adding value to the time-series.

OCEANOGRAPHIC CONDITIONS IN PRINCE WILLIAM SOUND – CAMPBELL (PWSSC, 12120114-E)

The three planned surveys of Prince William Sound were conducted during the reporting period and all 12 standard stations were occupied. All CTD data have been processed, and seasonally de-trended anomalies of temperature and salinity at selected depths in central PWS have been analyzed. In central PWS,

temperatures were generally above average in 2014, with the largest anomalies at depth (~100 m); the anomalies were fairly large, but not record-setting like the anomalies observed in the Gulf of Alaska this year (see Hopcroft and Weingartner reports, individual reports appendix package). Salinity in central PWS was above average in the first half of 2014, but consistently lower than average for the latter part of the year, presumably reflecting a warmer than average summer throughout Alaska.

Plankton, nutrient, and chlorophyll-a samples were collected from all stations with no incidents. As of January 2014, all plankton samples have been enumerated from this project (Lower Cook Inlet samples will be done in Q1 of 2015), and all chlorophyll-a filters have been run (chlorophyll analysis is done immediately after each cruise to minimize storage artifacts). Analysis of the nutrient samples continues to lag behind expectations – protocols for capillary electrophoretic (CE) analysis of macronutrients were in development by a chemistry technician at PWSSC for much of 2014, with limited success. All nutrient samples are being kept in frozen storage, and are stable indefinitely (they are 0.2 μm filtered prior to freezing). Catching up on the backlog is a priority, and given the lack of progress with the CE methodology, we began working through the backlog using standard wet-chemical techniques in Q3 of 2014. A proposal for the purchase of an automated nutrient analyzer is in progress, and a technician is expected to be hired in 2015 to assist with working through the backlog. The AMP mooring was retrieved in July due to equipment malfunctions reported previously, and the controller housing was sent back to the manufacturer to be repaired. It is currently operational.

OCEANOGRAPHIC MONITORING IN COOK INLET – DOROFF (ADFG KBRR) AND HOLDERIED (NOAA KBL, 12120114-G)
Oceanographic and plankton sampling was conducted monthly in Kachemak Bay and quarterly in lower Cook Inlet. We sampled a total of 391 vertical oceanographic stations with conductivity-temperature-depth (CTD) profilers and conducted 93 zooplankton tows and surface phytoplankton sampling. All planned transects were surveyed, with the exception that stormy winter conditions prevented sampling at some Cook Inlet stations in February 2014 and only CTD data was collected in January 2015. We leveraged funding from the NOAA Integrated Ocean Observing Program/Alaska Ocean Observing System to conduct additional along-bay surveys in Kachemak Bay in March and May 2014, as well as an intensive small boat CTD survey during August 2014, to better assess tidal and spatial variability of marine conditions in the bay. The anomalously warm 2014 weather conditions in the Gulf of Alaska were reflected in warm water temperatures at the KBRR water quality station at Seldovia, with July temperatures above 12 degrees C and a monthly average temperature of nearly 12 C. Water temperatures have not been observed to be this warm since the summer of 2005. Monthly averaged water temperatures were warmer than the 2004-2014 average for all months in 2014, with anomalies of greater than 1.5 C in January, August and November 2014. We are partnering with NOAA and UAF to validate a Cook Inlet ocean circulation model and oceanographic and plankton data are being used in NOAA studies to understand triggers of paralytic shellfish poisoning events.

We conducted an initial comparison of estuary conditions within Cook Inlet and Kachemak Bay with marine conditions on the adjacent Gulf of Alaska shelf at the GAK1 mooring (Weingartner project). Results are provided in an article authored by Holderied and Weingartner in the GWA science synthesis document submitted to EVOSTC in December 2014, entitled "Linking Variability in Oceanographic Patterns Between Nearshore and Shelf Waters Across the Gulf of Alaska". One interesting result was that the water temperature time series at the Seldovia water quality station and in near-surface waters at GAK 1 are coherent for time periods greater than three months, but independent at shorter time scales. The similarity of inner shelf and estuary temperature series at low frequencies has potential implications for a more synchronous response of the Gulf of Alaska marine system to inter-annual and basin-scale climate forcing, while spatial variability in ocean conditions at shorter periods could drive spatial heterogeneity in

primary and secondary production, as well as in forage fish populations. Spatial variability also has implications for determining ongoing monitoring needs for ocean conditions within the region.

CONTINUOUS PLANKTON RECORDER – BATTEN (SAHFOS, 12120114-A)
All of the CPR transects were completed during this year. We did begin the sampling season earlier this year, in March, since conditions were unusually warm in early 2014 and we wanted to capture the start of the spring increase. The final sampling was therefore a little early, at the very end of August, instead of September. At this time, data are finalized for March to June samples, and still provisional for the July and August samples. The warm spring was clearly evident in data from the temperature logger attached to the CPR, with temperatures across the shelf generally higher than in previous years, particularly in May. This likely led to unusually high spring and summer zooplankton abundances, outside the range seen before from 2000 to 2013, which were biased (at least for copepods which are identified to species) towards smaller species.

We are also working on some collaborative publications with findings from this work. Annual anomalies of diatom abundance, as well as microzooplankton abundance, from the shelf CPR sampling (excluding Cook Inlet) were significantly correlated with measurements of first year growth in juvenile herring during the 10 year period of overlap of the time series. A manuscript is being prepared in collaboration with researchers from the Herring Research and Monitoring group, but the evidence suggests that indices of food quantity and quality from the CPR dataset help explain the interannual variability in juvenile herring growth.

ABILITY TO DETECT TRENDS IN NEARSHORE MARINE BIRDS – COLETTI (USNPS SWAN, 12120114-F)
Due to the inability to find a suitable contractor for the work under this project, we completed the initial analyses in-house at the National Park Service. Preliminary findings are discussed in the GWA program science synthesis report cited below. In summary, our recommendations for survey work are:

1) Reduce the scope of the monitoring program by focusing our efforts in specific habitats;

2) Increase the number of transects sampled;

3) Change the spatial grain of sampling (sample unit size);

4) Consider more complex model structures in a fully Bayesian framework;

5) Refine monitoring objectives and consider: spatial extent of analysis, spatial grain of analysis, target species, hypothesized population drivers, and feasible courses of action (e.g. management or conservation) if change is detected.

Coletti, H, and T. Wilson. In review. Nearshore Marine Bird Surveys: data synthesis, analysis and recommendations for sampling frequency and intensity to detect population trends. In Neher et al. editors. Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Science Synthesis Report for the Gulf Watch Alaska Program. Submitted to the Exxon Valdez Oil Spill Trustee Council, December 1, 2014.

LONG-TERM KILLER WHALE MONITORING – MATKIN (NGOS, 12120114-M)
All fieldwork occurred for this project from May through October of 2014. During 67 days of fieldwork on the *Natoa* and 12 days of time contributed by other vessels, we logged 52 encounters with killer whales, 41 with residents, 1 with AT1 transients, 11 with Gulf of Alaska transients and none with offshores. Survey tracklines totaled 4922 km and we traveled 1084km with the whales. We emphasized photoidentification over other aspects of the study this year because we did not have complete photographic coverage of some

groups from recent years. This focus was in part successful and we had much more complete coverage than in recent years, however, some groups seem to have de-emphasized portions of their range where we focus our work. Some pods have split and the resulting new groups no longer focus activities in the same portions of the range. In the future, it will likely be necessary to examine population dynamics using matrilineal groups, rather than pods. .

Field equipment was cleaned and stored during the latter half of this reporting period. PIs coauthored and presented work at the annual LTM program meeting in November. We also updated numerous databases at NGOS with 2014 field data including survey and encounter database (Access) and biopsy and tagging summaries. We filtered tagging data and constructed maps and tracks and associated dive data for tagged whales. Initial analysis was completed for preparation of a paper on habitat use and pod range based on tagging location and encounter data. In October 2014 samples of tissue and scales were sent to NWFSC for analysis. We supplied our humpback whale photo-identification and encounter data to the LTM humpback whale project and Facebook and web sites were updated. Photo analysis was completed during this period and included frame by frame identification of all individuals.

HUMPBACK WHALE PREDATION ON HERRING – MORAN (NOAA, NMFS AUKE BAY LABORATORY) AND STRALEY (UAS, 12120114-N)

April 2014 Survey: Higher whale numbers were seen than during previous spring surveys. Although krill were present, whales focused primarily on herring as prey. Both whales and herring schools were highly mobile, moving daily between Port Fidalgo and Port Gravina. The prolonged staging period by herring may have led to increased predation rates.

July 2014 Survey: Overall whale numbers were lower in July than our fall and winter PWS surveys, with only10 unique whales identified. Three days of forage fish aerial surveys during our trip confirmed low whale numbers, with only one humpback seen near Smith Island.

By joining forces with the Forage Fish Project, age 0 to 2+ herring were identified as being prey for humpback whales in the Green Island area. Several humpback were specifically targeting schools of age 0 herring (confirmed with scales), associated with feeding flocks of gulls and murrelets. Three to four fin whales and one Minke whale were seen feeding in Montague Strait. This is the first time either species has been seen on our surveys.

September 2014: A second two vessel survey working the Forage Fish and Winter Sea Bird groups to assess predator-prey interactions prey in PWS was completed. As in previous years, southern Montague Strait was the fall hotspot for whales and herring. Age 0 pollock seemed to be unusually abundant across the Sound. Adult herring sampled near Latouche Island had very high energy densities (30 kJ/g dry mass).

December 2014 Survey: The trend of declining humpback whale numbers in Port Gravina observed last December continued. No whales or adult herring were found in Port Gravina. Most whales were located at the south end of Latouche Island, were they were seen in Sept. /Oct. Warm water or a response whale predation may explain the shift in herring movements.

Anecdotal observations suggested that YOY herring were very abundant across the Sound, while other forage species were scarce relative to previous surveys.

FORAGE FISH DISTRIBUTION AND ABUNDANCE – (USGS ALASKA SCIENCE CENTER, 12120114-O)

The new aerial-acoustic survey design implemented in July 2014 is logistically feasible and repeatable, uses statistically sound sampling design theory, and takes into account what is known about the species-specific behavior of the forage fish in Prince William Sound.

Humpback whales are efficient predators of our target species (forage fish, krill). In Southern Montague Strait we observed changes in whale prey distribution between July and September 2014. In July there were few whales, and only a thin layer of krill and dispersed age 1 capelin at100 m depth. In September there dozens of whales that co-occurred with thick scattering layers of krill, adult herring and walleye pollock below 100 m. Southern Montague Strait is a seasonally important biological hotspot where of whales, marine birds, forage fish and krill aggregate in fall.

PRINCE WILLIAM SOUND MARINE BIRD SURVEYS – IRONS/KULETZ/KALER (USFWS ALASKA REGION, 12120114-K)
We successfully completed our planned Prince William Sound (PWS) marine bird survey, conducted 30 June to 27 July 2014. Prior to beginning the field season, a project leader (Kaler), two boat operators, and six observers were hired. We arranged field logistics, contractual agreements, and prepared four 25-foot survey vessels and the necessary field and boat equipment. Following three days of observer and boat captain training in Whittier, Alaska, we collected information on marine bird and mammal observation 3-26 July.

SEABIRD ABUNDANCE IN FALL AND WINTER – BISHOP (PWSSC, 12120114-C)
Three late-fall/ early winter surveys were conducted during this reporting period by two observers (Jessica Stocking and Anne Schaefer) with the Prince William Sound Science Center (PWSSC) covering a total of 2041 km. An additional survey was conducted in summer (July) 2014 as part of a joint-pilot survey with NOAA and USGS. The July survey developed methods for characterizing multispecies predator-prey aggregations, specifically interactions between humpback whales, forage fish, and forage flocks of seabirds. The ships of opportunity used for the 2014 surveys included vessels surveying Pacific herring (EVOS Herring Research Monitoring PWSSC), spot shrimp (Alaska Dept. Fish & Game), and humpback whales (EVOS Gulf Watch Alaska NOAA). We also surveyed marine birds concurrently with the annual maintenance of the Ocean Tracking Network (OTN) acoustic arrays that are stationed across the major entrances and southwest passages of PWS and serviced by the PWSSC.

Several publications were completed during this reporting period as well as preparation of multiple sections for the LTM program synthesis report. These include:

Bishop, M.A., J. Watson, K. Kuletz, and T. Morgan. 2015. Pacific herring consumption by marine birds during winter in Prince William Sound, Alaska. Fisheries Oceanography 24(1):1-13.

Dawson, N., M.A. Bishop, K. Kuletz and A. Zuur. 2015. Using ships of opportunity to assess winter habitat associations of seabirds in subarctic coast Alaska. *Northwest Science*. *In press*. Accepted October 2014.

Bishop, M.A. 2014. Long-term monitoring of seabird abundance and habitat associations during late fall and winter in Prince William Sound. Pages 3:70-78 in T. Neher et al. Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Science Synthesis Report for the Gulf Watch Alaska Program.

NEARSHORE BENTHIC SYSTEMS IN THE GULF OF ALASKA – BALLACHEY (USGS ALASKA SCIENCE CENTER), COLETTI (USNPS SWAN) AND DEAN (COASTAL RESOURCES ASSOCIATES, 12120114-R)
There is evidence of broad synchrony across the GOA in densities of mussels, and relatively high settlement of mussels in the 2014 season; however, site-scale variation is of major importance in determining mussel abundance. We have also conducted an analysis of static attributes (e.g., substrate, slope, exposure, freshwater input) at nearshore rocky intertidal sites, finding evidence that indicated that static attributes are important in determining nearshore community structure. Finally, sea stars were surveyed for wasting disease (as widely observed in lower latitudes of the NE Pacific) but no observations of diseased stars were made in the northern GOA:

(http://science.nature.nps.gov/im/units/swan/assets/docs/reports/resourcebriefs/GWA_2014_SeaStarWasting_RB.pdf)

ECOLOGICAL COMMUNITIES IN KACHEMAK BAY – IKEN AND KONAR (UAF, 12120114-L)

Field sampling for this project was successfully completed during the previous reporting period. Currently, we are now working with our Nearshore Gulf Watch colleagues from Prince William Sound, Kenai Fjords National Park, and Katmai National Park and Preserve to produce a manuscript on the influence of static habitat attributes on local and regional biological variability in rocky intertidal communities of the northern Gulf of Alaska. The analysis and initial writing for this work was initiated during this reporting period, and a draft of this paper was included in the Gulf Watch synthesis report. The preliminary results that we present in this manuscript are as follows:

We have found that although there were significant differences in intertidal rocky communities among regions and between the two sampling years, most of the variation in the biological data occurred at local scales, such as between strata and among sites within regions. While we know that there are significant differences among intertidal strata in the Gulf of Alaska (Konar et al. 2009), the importance of the role that local-scale habitat drivers play across the Gulf is significant and new.

EVOS OIL EXPOSURE OF HARLEQUIN DUCKS AND SEA OTTERS – BALLACHEY (USGS ALASKA SCIENCE CENTER, 12120114-Q)

Our findings from the 2014 analyses show that Harlequin ducks showed no evidence of elevated exposure to lingering *Exxon Valdez* oil in March 2014, consistent with findings from March 2013. We also found that lingering oil was observed to persist in specific locations in PWS and along the Alaska Peninsula, in Katmai National Park and Preserve. The details of the wildlife recovery from oil spills are discussed in the program synthesis report:

Esler, Dan, Jim Bodkin, Brenda Ballachey, Dan Monson, Kim Kloecker, and George Esslinger. In review. Timelines and Mechanisms of Wildlife Recovery Following the Exxon Valdez Oil Spill. In Neher et al. editors. Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Science Synthesis Report for the Gulf Watch Alaska Program. Submitted to the Exxon Valdez Oil Spill Trustee Council, December 1, 2014.

OIL LEVEL AND WEATHERING TRACKING – CARLS (NOAA/NMFS AUKE BAY LABORATORY, 12120114-S)

We completed the biomarker retrospective analyses and report during this past year. We will sample oiled sites during the summer of 2015 for the program. The following abstract highlights the findings from the retrospective analyses report.

Abstract from the biomarker retrospective study. Over the past quarter century, biomarkers persisted in sequestered oil in Prince William Sound and the Gulf of Alaska and remained useful for source forensics. Pattern matching indicated the presence of Alaska North Slope crude oil over the entire observation period at most sites (7 of 8) and distinguished this source from several other potential sources. Biomarkers were conserved relative to other constituents, thus concentrations (per g oil) in initial beach samples were greater than those in fresh oil because they were lost more slowly than more labile oil constituents such as straight-chain alkanes and aromatic hydrocarbons. However, biomarker concentrations consistently declined thereafter (1989 to 2014), though loss varied substantially among and within sites. Isoprenoid loss was substantially greater than tricyclic triterpane, hopane, and sterane loss. Loss rates of the largest steranes tended to be least.

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8. Information and Data Transfer: *See,* Reporting Policy at III (D) (8).

A) Gulf Watch Alaska principal investigators published information in peer-reviewed journals, reports, newspapers, and magazines about their projects (Table 2) and participated in a wide variety of conferences and workshops. Principal investigators also participated in a variety of public outreach events and programs, including Discovery labs in Homer, and community lectures in Cordova (see McCammon Outreach and Community Involvement Appendix A for further detail). All of the monitoring projects have published 2013 data and are now in the process of publishing 2014 data to the program's data portal.

Gulf Watch Alaska and Herring Research and Monitoring program principal investigators collaborate for shared vessel time, equipment, and monitoring information. Humpback whale and marine bird abundance and diet data has been used to develop hypotheses about what may be limiting herring recovery. Data from the environmental drivers team has been used to develop hypotheses on recruitment limitations for herring. Cook Inlet oceanography data are being used by NOAA and UAF researchers to validate an ocean circulation model and by NOAA researchers to help identify triggers for paralytic shellfish poisoning events. We look forward to continuing to investigate ecological linkages to use in aiding management decisions as process study funding becomes available.

Table 2. Publications and documents produced by GWA principal investigators year 3.

Authors	Title	Journal/Status
Ballachey, B. E., J.L. Bodkin, and D.H. Monson.	Quantifying long-term risks to sea otters from the 1989 Exxon Valdez oil spill: Reply to Harwell & Gentile (2013).	Marine Ecology Progress Series 488:297-301. doi:10.3354/meps10498
Ballachey, B., D. Monson, G. Esslinger, K, Kloecker, J. Bodkin, L. Bowen and K. Miles	2013 Update on Sea Otter Studies to Assess Recovery from the 1989 Exxon Valdez Oil Spill, Prince William Sound, Alaska.	U.S. Geological Survey Open-File Report 2014-xxxx, 40 p., http://dx.doi.org/10.3133/ofr2014xxxx.
Ballachey, B.E., J.L. Bodkin, D. Esler and S.D. Rice.	Lessons from the 1989 *Exxon Valdez* oil spill: a biological perspective. (2014)	In: J.B. Alford, M.S. Peterson and C.C. Green, Eds. Impacts of Oil Spill Disasters on Marine Habitats and Fisheries in North America. CRC Marine Biology Series. Pp. 181-198.
Ballachey, B.E., J.L. Bodkin, K.A. Kloecker, T.A. Dean, and H.A. Coletti	Monitoring for Evaluation of Recovery and Restoration of Injured Nearshore Resources. (2015)	*Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 10100750), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.
Ballachey, B.E. and J.L. Bodkin.	Challenges to sea otter recovery and conservation. 2015	*In* Sea Otter Conservation, edited by J. Bodkin. S. Larson and G. VanBlaricom. Elsevier. Published January 2015. Pp 63-96.
Bodkin, J.L.	Historic and Contemporary Status of Sea Otters in the North Pacific. 2015	*In* Larson SE, Bodkin JL, VanBlaricom GR. Eds. Sea Otter Conservation. Academic Press, Boston. Pp 43-61.
Bodkin, J.L., D. Esler, S.D. Rice, C.O. Matkin, and B.E. Ballachey.	The effects of spilled oil on coastal ecosystems: lessons from the Exxon Valdez spill. 2015	In: B. Maslo and J.L. Lockwood, Eds. Coastal Conservation. Cambridge University Press. Pp. 311-346.

Coletti, H.A., Dean, T.A., Kloecker, K.A., and Ballachey, B.E.	Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2012. (2014)	Natural Resource Technical Report NPS/SWAN/NRTR—2014/843. National Park Service, Fort Collins, Colorado. http://science.nature.nps.gov/im/units/swan/publications.cfm?tab=2
Dean, T.A., Bodkin, J.L., and Coletti, H.A.	Protocol Narrative for Nearshore Marine Ecosystem Monitoring in the Gulf of Alaska, Version 1.1. (2014)	Natural Resource Technical Report NPS/SWAN/NRTR—2014/756. National Park Service, Fort Collins, Colorado.
Larson, S., Bodkin, J.L., and VanBlaricom. G.R.	Sea Otter Conservation.	Academic Press, Boston. 447 p
Monson, D.H. and Bowen, L.	Evaluating the Status of Individuals and Populations: Advantages of Multiple Approaches and Time Scales.	Chapter 6 in Larson SE, Bodkin JL, VanBlaricom GR, Eds. Sea Otter Conservation. Academic Press, Boston. Pp 121-158.
Batten, Sonia	Large Ships, Little Critters	Delta Sound Connections newspaper, 2013
Bishop, M.A. and K.J. Kuletz.	Seasonal and Interannual Trends in Seabird Predation on Juvenile Herring. Exxon Valdez Oil Spill Restoration Project Final Report	Project 10100132-H, Prince William Sound Science Center, Cordova, Alaska.
Bishop, M.A., J. Watson, K. Kuletz, and T. Morgan	Pacific herring consumption by marine birds during winter in Prince William Sound, Alaska.	Fisheries Oceanography 24(1):1-13.
Bodkin, J.L., D. Esler, S.D. Rice, C.O. Matkin, and B.E. Ballachey.	The effects of spilled oil on coastal ecosystems: lessons from the Exxon Valdez spill.	Pp. 311-346 in B. Maslo and J. L. Lockwood, eds. Coastal Conservation. Cambridge University Press.
Campbell, Rob	Oceanographic Change	Delta Sound Connections newspaper, 2013
Coletti, H. A., T.A. Dean, K.A. Kloecker and B.E. Ballachey.	Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2012.	Natural Resource Technical Report NPS/SWAN/NRTR—2014/756. National Park Service, Fort Collins, Colorado.
Coyle, K.O., Gibson, G.A., Hedstrom, K., Hermann, A.J., Hopcroft, R.R.	Zooplankton biomass, advection and production on the northern Gulf of Alaska shelf from simulations and field observations.	J. Marine systems, 128, 185-207. 2013
Dawson, N., M.A. Bishop, K. Kuletz and A. Zuur.	Using ships of opportunity to assess winter habitat associations of seabirds in subarctic coast Alaska.	Northwest Science. In press. Accepted October, 2014.
Dean, T.A., J.L. Bodkin and H.A. Coletti	Protocol Narrative for Nearshore Marine Ecosystem Monitoring in the Gulf of Alaska, Version 1.1.	Natural Resource Technical Report NPS/SWAN/NRTR—2014/756. National Park Service, Fort Collins, Colorado.
Doubleday, A.J., Hopcroft, R.R.,	Seasonal and interannual patterns of larvaceans and pteropods in the coastal Gulf of Alaska, with relationships to pink salmon survival	Journal Plankton Research, submitted
Esler, D. and B. Ballachey	Long-term Monitoring: Lingering Oil Evaluating Chronic Exposure of Harlequin Ducks and Sea Otters to Lingering Exxon Valdez Oil in Western Prince William Sound. Exxon Valdez Oil Spill Trustee Council Restoration Project Final Report	Project 12120114-Q, Pacific Wildlife Foundation and Centre for Wildlife Ecology, Simon Fraser University, Delta, British Columbia, Canada.
Fisheries Oceanography Accepted, pending revisions.	Winter habitat associations of seabirds in subarctic Alaska.	In review, Arctic.
Hollmen T. and S. A.	Conceptual ecological models to synthesize, organize, and prioritize research in socioecological systems.	In prep.
Irvine, G.V., D.H. Mann, M.G. Carls, L. Holland, C. Reddy, R.K. Nelson, and C. Aeppli.	Lingering oil on boulder-armored beaches in the Gulf of Alaska 23 years after the Exxon Valdez oil spill	Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 11100112), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska. 2014
Matkin, C.	30 Years of tracking Killer Whales	Delta Sound Connections newspaper, 2013
Saulitis, E.	Into Great Silence	Book, published, Beacon Press. 2013.
Saulitis, E.	The Woman Who Loves Orcas	Cover article, OnEarth Magazine, March 2013.

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

B) The GWA team currently does not formally collaborate with other EVOSTC funded projects outside of the Herring Research and Monitoring program

C) The GWA team works with staff from the NPRB, Alaska Sea Grant, AOOS, and CIRCAC to find collaborative opportunities and partnerships through our outreach committee and agency PIs. We continue to participate in informal and formal meetings with agencies, NGOs and the public and invite members of trustee agencies, other state and federal agencies, and NGOs to program meetings and workshops. This year, we held a program information webinar for trustee agency staff members and other managers. In addition, many of the projects within the program are conducted by trustee agency staff members with required internal scientific review of all documents in addition to the GWA program's science review team and the EVOSTC science panel. We also collaborate with the members of our program science review team, including Dr. Hal Batchelder (PICES), Dr. Leslie Holland Bartell (USGS emeritus), Dr. Jeep Rice (NOAA, retired), Dr. Terrie Klinger (University of Washington), and Mr. Eric Volk (ADFG). All science review team members participate in program meetings and provide review of reports and documents.

9. Coordination and Collaboration: *See,* Reporting Policy at III (D) (9).

The program investigators held two all-hands conference calls, and two in-person meetings during this reporting period to facilitate communication between team members and coordinate administrative activities. In addition, the management team also held numerous conference calls with the Science Coordination Committee to ensure that administrative and science needs were met within the program components.

Program investigators continue the collaboration outside program members, including hosting members of the NCEAS working groups to present at the GWA program annual meeting. Drs. Ole Shelton and Tim Wooten presented the proposals for both NCEAS working groups at the annual program meeting, and members of the GWA program are also participating on both working groups. Please also see above sections for additional coordination and collaboration details.

Finally, program principal investigators continue to expand cross program collaborations with the Herring Research and Monitoring program. Team leads from both programs attended annual program meetings in November and March. In addition, GWA principal investigators shared vessel time (Bishop, Piatt/Arimitsu), plankton data (Campbell) and aerial tracking information (Piatt/Arimitsu).

<u>Community Involvement/TEK and Resource Management Applications</u>

Several new outreach and community involvement tools were developed and used during this past year. The outreach and science teams continue to update the program website and data portal. A new program of community film-making was piloted in Nanwalek and Tatitlek schools. A workshop to explore potential use of community-based monitoring was held following the 2014 statewide Community-Based Monitoring Workshop. In addition, outreach committee members have begun working on the first of two virtual field trips for teachers to use to introduce marine science in their classrooms as well as to be displayed at the Alaska Sea Life Center.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (D) (10).

No comments were received for the Year 2 program annual report submitted in March 2014.

In reference to comments for the Year 4 program proposal (FY2015) we provide the following information:

Inclusion of fundamental information:

"The Panel would like to see the inclusion of fundamental information regarding the 1) approach, design and analysis of studies and 2) explicit statements of how analyses are answering major questions. This key information is essential to evaluating proposals, and we expect to see brief descriptions included in the next proposals…."

This comment highlights two needs for the program and EVOSTC staff. The first is a need for revision of the proposal/work plan form that elicits the necessary information for adequate review for each year. We have been working on this with EVOSTC staff and will continue with an added effort specific to items 1 and 2 above. The second need illustrated by this comment is the need for working out an approach that will allow for more stream-lined access and cross-walking between the annual reports and the work plans. The information requested for each project was provided in the Year 2 annual report. The February 2015 joint science workshop produced many good discussions with EVOSTC staff and science panel members and we look forward to working with EVOSTC staff to provide relevant information to the science panel.

Coordination, Collaboration, and Synthesis:

"…However progress in these areas will need to be more explicit and more fully developed, and details provided to the Panel were too limited to be able to truly evaluate progress in this area. We look forward to seeing synthesis (integrated data synthesis, not just conceptual synthesis) both within and across projects at the February synthesis meeting and view this as a critical checkpoint to assess progress of the program toward a synthetic understanding."

The GWA and HRM program synthesis reports and joint science workshop highlighted synthetic projects, both within and across the programs. Additional details could also be found in the Year 2 annual report. Some examples include:

- Use of Dr. Batten's and Dr. Campbell's zooplankton and environmental conditions data and analyses to develop hypotheses regarding herring recruitment success.
- Use of the Humpback whale diet and abundance information to develop hypotheses regarding herring survival and sustainability of the fishery.
- Use of environmental condition information to develop hypotheses regarding mussel bed abundance and size.

As we move forward with the parallel programs and building on the cross-program discussions at the February joint science workshop, we see exciting opportunities to continue expanding collaborations between the GWA and HRM programs. Bottom-up and top-down drivers of forage fish populations and multi-species aggregations in consistent spatial locations were two topic areas that emerged during the science workshop and we look forward to growing collaborations in those areas and others.

11. Budget: *See,* Reporting Policy at III (D) (11).

Many of the individual projects actual cumulative spent deviated from the proposed spending budgets for a variety of reasons that ranged from organizational billing practice delays to changes in awarding of contracts. Please see Section 11 of each individual report for specific details. See the attached program workbook for specific figures.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$1,212.5	$1,440.7	$1,462.2	$1,342.7	$1,323.1	$6,781.2	$3,569.1
Travel	$123.9	$108.5	$247.5	$242.9	$122.0	$844.8	$294.0
Contractual	$708.0	$544.0	$659.8	$649.3	$474.4	$3,035.5	$1,206.5
Commodities	$150.6	$130.7	$154.5	$122.4	$126.5	$684.7	$291.4
Equipment	$304.4	$27.8	$27.8	$20.3	$22.6	$402.9	$335.1
Indirect Costs (*will vary by proposer*)	$165.6	$202.3	$194.8	$194.0	$138.4	$895.2	$381.8
SUBTOTAL	$2,664.9	$2,454.1	$2,746.7	$2,571.7	$2,207.0	$12,644.3	$6,077.8
General Administration (9% of subtotal)	239.8	220.9	247.2	231.5	198.6	1138.0	547.0
PROGRAM TOTAL	**$2,904.74**	**$2,674.92**	**$2,993.88**	**$2,803.16**	**$2,405.61**	**$13,782.31**	**$6,624.78**
Other Resources (In-Kind Funds)	**$1,784**	**$1,738**	**$1,823**	**$1,902**	**$1,536**	**$8,714**	

COMMENTS: All amounts are give in dollars.

FY12-16

Program Title: 15120114 and 15120120
LTM - Long Term Monitoring
Team Leader:
Hoffman/McCammon/Holderied

SUMMARY

Note: includes change of $24,987. between NCEAS and Axiom per Gulf Watch Management Team memo dated July 5, 2012
Note: includes addition of $102,100. Ballachy and Esler - Lingering Oil for Harlequin Duck for FY14

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

*Please refer to the Reporting Policy for all reporting due dates and requirements.

1. Program Number: *See,* Reporting Policy at III (C) (1).

12120114-B

2. Project Title: *See,* Reporting Policy at III (C) (2).

Program coordination and logistics & outreach

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

Molly McCammon, Alaska Ocean Observing System (AOOS) & Katrina Hoffman, Prince William Sound Science Center (PWSSC)

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

Program Coordination and Logistics

PWSSC issued and managed sub-award contracts for all non-Trustee Agency Long-term Monitoring (LTM) Year 3 projects. PWSSC monitored spending, fulfilled sub-award invoices, and completed the annual audit in November 2014. We contracted with Marilyn Sigman (UAF) to support outreach programming and coordination and extended outreach funding as directed by McCammon and the outreach steering committee. We submitted the semi-annual program report and the Year 4 *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) work plans that were due by September 1, 2014. Principal Investigator (PI) meetings were held on a roughly quarterly basis as field seasons and PI schedules permitted. PWSSC coordinated logistics and processed expenses for the annual LTM PI meeting, which was held in Anchorage on November 18, 19 and 20, 2014. That fall meeting was coordinated in collaboration with the EVOSTC-funded Herring Research and Monitoring program annual meeting held November 21, 2014. Program component leads gave presentations on overall progress at the annual PI meeting and teams collaborated across projects and components to finalize content for the synthesis report. We also coordinated logistics for the January 19, 2015 LTM meeting at the Alaska Marine Science Symposium. We submitted all financial and project reports to NOAA and the EVOSTC as required.

The LTM Program Management Team, consisting of Molly McCammon, Kris Holderied, Katrina Hoffman and Tammy Neher, actively managed the program throughout the reporting year. The PMT met more than once per month, usually via teleconference. The PMT presented to the EVOS Public Advisory Committee on October 16, 2014 and the EVOS Trustee Council on November 19, 2014. As

needed, PMT teleconferences included members of the LTM Science Coordinating Committee (Hopcroft; Weingartner; Ballachey; Lindeberg) and data management team (Bochenek).

Outreach and Community Involvement

The Outreach and Community Involvement Steering Committee (which includes key outreach staff from AOOS, the PWSSC, Kachemak Bay Research Reserve, Alaska SeaLife Center, North Pacific Research Board, COSEE Alaska, NOAA and USGS) met informally throughout the year, and formally July 9 and August 5, 2014. Marilyn Sigman, a marine educator with Alaska Sea Grant is now providing some additional staff support to outreach efforts. During this reporting period, additions were made to the website, www.gulfwatchalaska.org and data portal, which serve as the primary outreach mechanism for the LTM program and data. Profiles of all LTM components were developed and printed, and will be available on the website as PDF documents.

As a follow-up to the Community-Based Monitoring (CBM) Workshop held April 1-2, 2014 and organized by AOOS and Alaska Sea Grant, a half-day work session was held April 3 with participants from the GWA region to discuss opportunities for CBM in the region. Participants included representatives of most of the currently active CBM projects, as well as village representatives. More than 30 people attended, and largely agreed that existing programs could be supported and enhanced before starting up any new programs. An informational webinar held in September 2014 about the LTM Program targeted Trustee Council agencies as part of an effort to reach out to management agencies.

KBRR sponsored three public Discovery Labs in Homer on August 6, 8 and 9, 2014 highlighting the impacts of lingering *Exxon Valdez* oil and attended by 243 people. Dr. Terri Klinger gave a public lecture in conjunction with the labs attended by 27 people. The PWSSC continued to host program researchers in its lecture series. Lectures this year featured GWA researchers John Moran and Mark Carls. Podcasts and radio programs are delayed due to some revisions in the program and staff turnover, but should be on track this coming year. The GWA Program was highlighted in several articles in the summer 2014 edition of Delta Sound Connections.

A new program to develop community-based films by local schools was piloted in Nanwalek and Tatitlek. Contracted by the PWSSC, Marie Acemah of See Stories (www.seestoriesconsulting.org) led youth film workshops in Nanwalek (December 2014) and Tatitlek (January 2015) and worked with ~7 middle and high school students in each school. She trained 7^{th} – 12^{th} grade students in film-making skills and supported each student in the creation of a 3 – 5 minute documentary film centered around themes of ocean health and natural and cultural impacts of the *Exxon Valdez* Oil Spill, and cultural practices related to ocean sciences and sustainability. Acemah also organized community-wide film screenings in both communities as a culminating event of the film workshops.

The committee approved contracting with the Alaska SeaLife Center to develop a kiosk display, program videos and a Virtual Field Trip in the coming year. Those activities are just beginning.

Deliverable/Milestone	Status
Subaward contract management & monitoring of spending	Contracts issued and managed to six organizations for nine subaward projects. All spending monitored.

Timely submission of narrative and financial reports	All reporting deadlines to EVOSTC and NOAA met in program year.
Conduct annual audit	Conducted at PWSSC in November 2014
Attend annual PAC meeting	Program management team members attended and presented at PAC meeting in October 2014
Formation of Science Review Panel	Completed during Year 3
Administration of travel expenses for annual PI meeting	Fulfilled by PWSSC
Administration of expenses for activities directed by the Outreach and Community Involvement committee	Fulfilled by PWSSC
Conduct annual PI meeting	Coordinated and held in November 2014
Attend AMSS	Robust attendance by GWA PIs & PI meeting held
Conference on community-based citizen science monitoring potential	Completed
Develop data visualizations for website	Website updates ongoing and visualizations and data accessible through Gulf of Alaska Data Portal.
Conduct Outreach & community involvement activities	Ongoing

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

Item 8A) The involvement of the outreach entities active in the GWA region as well as the Program Management Team and Herring Research and Monitoring PI ensures that these activities are well coordinated within the GWA Program and with the HRM Program.

Item 8B) Outreach efforts are not directly coordinated with other EVOSTC funded projects, but we will reach out to them to explore possible synergies. Administration and logistics does not coordinate with other EVOSTC funded projects although we do stay peripherally informed of their activities due to our attendance of PAC and Trustee Council meetings.

Item 8C) Two trust agencies (NOAA and DOI) are active participants in the Outreach and Community Involvement Steering Committee and ensure that GWA activities are coordinated with other outreach activities conducted by their agencies. PWSSC regularly reports to and coordinates with NOAA for grants management purposes.

9. Information and Data Transfer: *See*, Reporting Policy at III (C) (9).

- Program update delivered by Holderied to a plenary audience at AMSS in Anchorage, January 20, 2015.
- Two-page spread on Gulf Watch Alaska in the 2014 science news magazine *Delta Sound Connections*
- GWA data available on Gulf of Alaska Data Portal at http://data.aoos.org/maps/search/gulf-of-alaska.php
- Program information available on the Internet at http://www.gulfwatchalaska.org/.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

After review of the previous year's processes, we worked collaboratively with EVOSTC staff to ensure that our Year 4 proposals and synthesis report were responsive to EVOSTC staff direction and Science Panel requests. We continue to work closely with EVOSTC staff to refine reporting requirements as needed and seek clarity and streamlining around reporting requirements.

11. Budget: *See,* Reporting Policy at III (C) (11).

Several categories are underspent by more than 10% of the originally anticipated amount. Explanations are as follows:

Salaries: There have been multiple staffing transitions of administrative staff at PWSSC who implement this program, including the bookkeeper and administrative assistant. Some small gaps in spending occurred when a position was vacant. Additionally, new staff are earning at a lower rate than outgoing experienced staff. We anticipate spending as expected in this category.

Travel: Travel for outreach in the first three years of the program was light. Now that there are more results to report on, we expect that both scientists and outreach experts will disseminate the results of the work in relevant communities and at relevant scientific meetings. Additionally, the program's science review team was not convened in Year 1 as originally anticipated, but in Year 3. Travel and participation for those individuals will ramp up now that they are fully engaged in the program. Multiple outreach meetings have occurred virtually such as by teleconference in lieu of a face-to-face meeting.

Supplies: In anticipation of the need to purchase more expensive support items such as a server, funds were underspent in the first 3 years and spending is now catching up as those support items are purchased and installed.

Contractual: The majority of these funds are allocated to Outreach purposes. While outreach spending was lighter in the first 3 years, several major projects are now underway, including the community-based film making program led by See Stories, as well as kiosk display, program video and Virtual Field Trip creation by the Alaska SeaLife Center in the coming year. Those activities are just beginning and will represent major expenses in this category.

Subawards: Several of the subawards have not been billing on the schedule required by PWSSC. PWSSC has notified the University of Alaska Fairbanks (UAF) has not invoiced us for any expenses since the period ending in May 31, 2014 for Contracts 12-81-03(Weingartner), 12-81-06 (Konar) and March 31, 2014 for Contract 12-81-07 (Hopcroft). They have informed us that they are remedying the situation. Similarly, SAHFOS has failed to bill us for two consecutive years of work for Contract 12-81-04, LTM Monitoring of Zooplankton Populations. We have been informed that this is due to a

communication deficit on the part of the SAHFOS finance office, which did not notify PICES that payment was due on a quarterly basis. We have been informed that they will rectify this situation immediately. Lastly, the University of California Santa Barbara has neglected to bill us since January of 2014 for Contract 12-81-01, LTM - Collaborative Data Management to PI Matt Jones. Upon notification, they have indicated that they are putting a new system in place to ensure this oversight will not occur again and they promise to bill quarterly as agreed upon. The scientific work has been conducted by all the scientists represented by these three institutions. Once these three institutions rectify their outstanding invoicing situations, we expect cumulative expenses to be tracking as budgeted.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$118.8	$122.4	$130.4	$127.3	$129.9	$628.8	$306.8
Travel	$48.3	$51.6	$55.6	$59.7	$61.7	$276.9	$23.8
Contractual	$69.5	$75.0	$84.5	$81.2	$70.2	$380.5	$96.1
Commodities	$5.0	$3.0	$3.4	$1.0	$2.5	$14.9	$6.9
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (*will vary by proposer*)	waived	waived	waived	waived	waived	waived	waived
SUBTOTAL	$241.6	$252.1	$273.9	$269.2	$264.3	$1,301.1	$433.6
General Administration (9% of subtotal)	$21.7	$22.7	$24.7	$24.2	$23.8	$117.1	$39.0
PROJECT TOTAL	$263.3	$274.7	$298.6	$293.4	$288.1	$1,418.2	$472.6
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	0

COMMENTS: PWSSC proposes a flat rate in lieu of its federal recognized IDC rate. This $200K itemized budget includes expenses that would normally be charged to IDC, and ALSO INCLUDES travel and meeting setup costs that are direct program charges.

FY12-16

Program Title: 15120114-B Administration and Meeting Travel/Logistics
Team Leader: Hoffman

SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

14120114D

2. Project Title: *See*, Reporting Policy at III (C) (2).

Gulf Watch Alaska Program - Data Management

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Rob Bochenek

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

https://workspace.aoos.org/group/5186/projects

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

Project investigators continue to provide core data management support and services to Gulf Watch Alaska (GWA), an EVOSTC-funded long-term monitoring (LTM) program. The focus continues to be on refining protocols for data and metadata transfer, data formatting and metadata requirements, improving search and discovery services, and salvage of historic data, for both those data funded by the *Exxon Valdez* Oil Spill Trustee Council and ancillary historic data from other projects.

PIs have participated in regular GWA Program PI meetings, including the in-person meeting in November 2014 and the January 2015 meeting at the Alaska Marine Science Symposium, and are coordinating activities between the Herring Research and Monitoring (HRM)and GWA programs. PIs also worked with the Program Management Team to follow up on recommendations developed through the January 29-30, 2014 Data Review Workshop.

The AOOS Ocean Research Workspace, rolled out to PIs in Year 1, continues to be used as the internal staging area for PI data and work products, with individual PI user and group profiles created and further refined. Axiom staff continue to provide training via webinars and support through email and in person meetings. GWA Program PIs continue to use the system to organize and consolidate their project level data. Software engineers at Axiom provide support for the Workspace, resolve bugs and implement new functionality in response to user feedback.

The GWA project data is a key component of the Alaska Ocean Observing System's Gulf of Alaska Data Portal. The portal showcases GWA project data once it becomes public alongside other environmental data sets ingested by the project team.

Table 1. Project Milestone Status

Objective/Deliverable/Milestone	Status
Objective 1: Provide data management oversight & services, including data structure optimization, metadata generation & data transfer. Audit data and restructure and reorganize for public access.	Ongoing All 2012 and 2013 data posted on Workspace.
Objective 2: Consolidate, standardize, and provide access to study area data sets that are critical for retrospective analysis, synthesis, and model development.	Ongoing
Objective 3: Develop tools for user groups to access, analyze, and visualize information produced by the GWA effort.	File level metadata exposed in the GWA portal. Portal search is currently being rebuilt. 4D visualization system in the planning stages. Initial GWA data sets being converted to netCDF for early 4D demo and long term preservation.
Objective 4: Integrate all data & metadata into AOOS data system and Gulf of Alaska Data Portal for long term storage and public use.	Ongoing Historical data portal is a DataONE member node. With new additional funding in 2015, will work to make full AOOS data portal a DataONE node.

Objective 1

The primary results produced by this project include the acquisition and documentation of GWA PI-produced data sets and the aggregation of ancillary environmental data sets for integration into the AOOS Gulf of Alaska Data Portal. Investigators continue to improve the Ocean Workspace in response to user feedback. The increase in use by PIs is represented in the following figures. All 2013 data are now posted on the Workspace, per the Program Management data sharing protocols.

The Ocean Workspace is used by Gulf Watch Alaska program managers and investigators to facilitate many of the logistical, curatorial, and preservation-oriented aspects of data collection and management. Improvements to the Workspace, while not explicitly funded as a part of the GWA Data Management project, will continue to be made based on feedback from users. In 2014, the Workspace metadata editors were expanded in response to a request from GWA program management to include new tool to provide detailed definitions of attributes used in tabular data files. This year, Axiom engineers developed and released a new tool to automatically read in tabular CSV data files, recognize column headings in the file, and provide metadata fields for defining those headers in standards compliant elements. The tool is shown below in Figure 4. Immediately below, figures 1-3 summarize Ocean Workspace use by GWA PIs in FY2014, followed by a description of the Ocean Workspace.

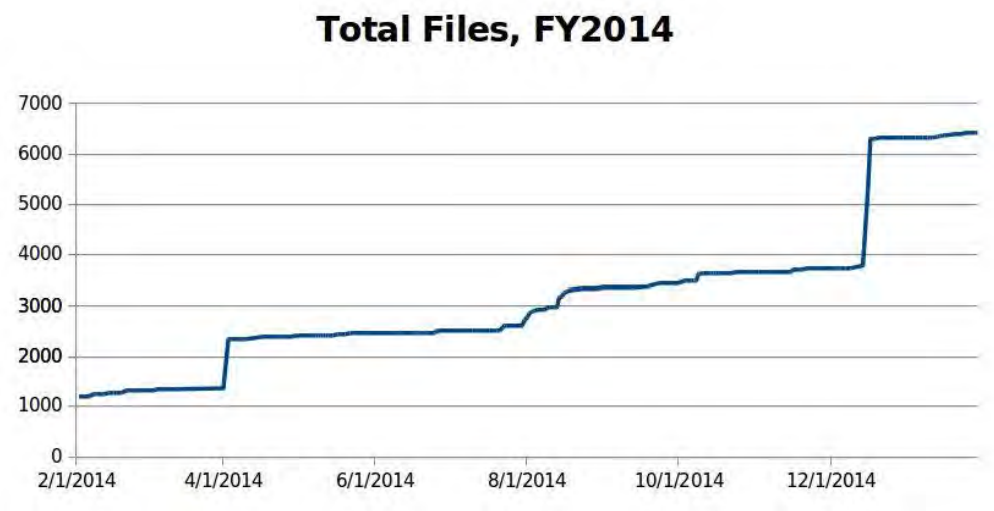


Figure 1. The number of files uploaded by GWA team members in FY 2014.

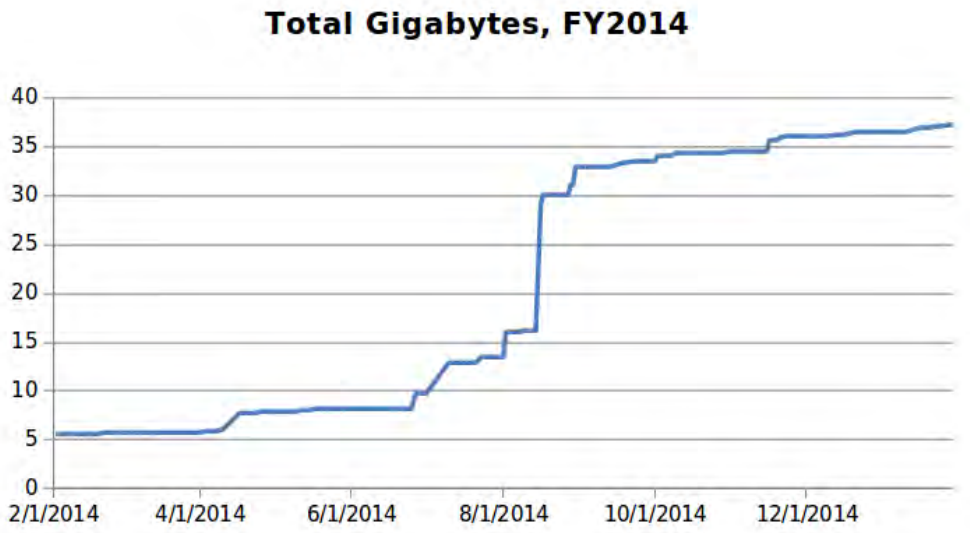


Figure 2. The amount of total storage in Gb used by GWA team members in FY 2014.

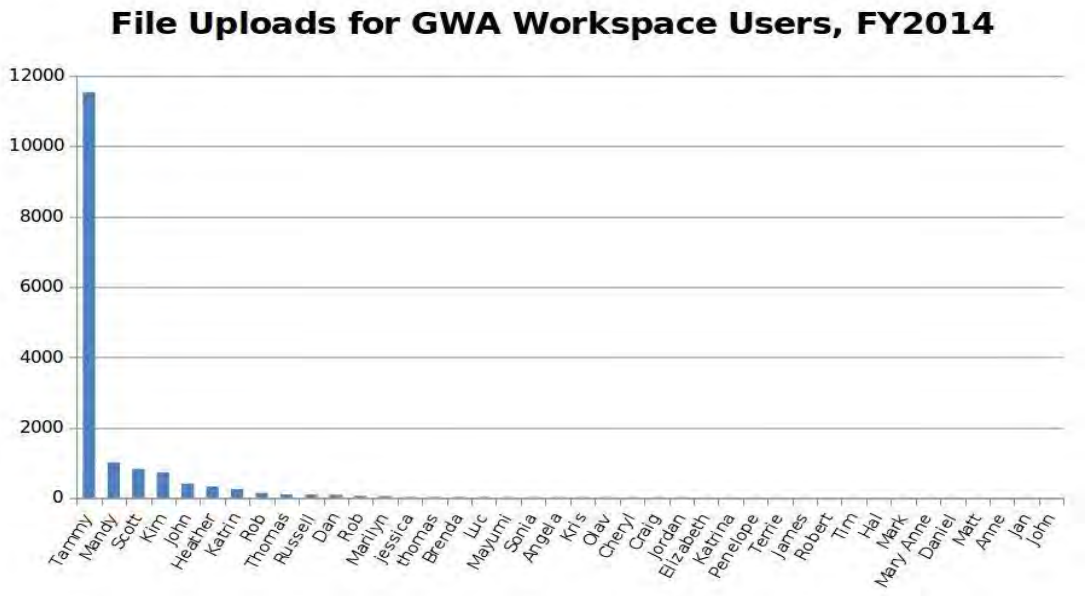


Figure 3. The distributions of file upload effort across individual GWA users.

The Ocean Workspace

The Ocean Workspace is a web-based data management application built specifically for storing and sharing data among members of scientific communities as an internal staging area prior to public release of data on a completely public portal. In addition to the Gulf Watch Alaska program, more than twenty regional, national, and private research groups currently use the Workspace, which has over 350 active individuals sharing thousands of digital files. The Workspace provides users with an intuitive, web-based interface that allows scientists to create projects, which may represent scientific studies or particular focuses of research within a larger effort. Within each project, users create topical groupings of data using folders and upload data and contextual resources (e.g., documents, images and any other type of digital resource) to their project by simply dragging and dropping files from their desktop into their web-browser. Standard, ISO 19115-2 compliant metadata can be generated for both projects and individual files. Users of the Workspace are organized into campaigns, and everyone within a campaign can view the projects, folders and files accessible to that campaign. This allows preliminary results and interpretations to be shared by geographically or scientifically diverse individuals working together on a project or program before the data is shared with the public. It also gives program managers, research coordinators and others a transparent and front-row view of how users have structured and described projects and how their programs are progressing through time. The Workspace has the following capabilities:

Secure group, user, and project profiles — Users of the Workspace have a password protected user profile that is associated with one or more disciplinary groups or research programs. The interface allows users to navigate between groups in which they are involved through a simple drop down control. Transfer of data and information occur over Secure Socket Layer (SSL) encryption for all interactions with the Workspace. The Workspace supports authentication through Google accounts, so if users are already logged into their Google account (e.g., Gmail, Google Docs, etc.), they can use the Workspace without creating a separate username and password.

Metadata authoring — Metadata elements currently available to researchers in the Workspace are common to the Federal Geographic Data Committee (FGDC) designed Content Standard for Digital Geospatial Metadata (CSDGM) and the ISO 19115 standards for geospatial metadata, extended with the biological profiles of those standards. Axiom also developed an integrated FGDC biological profile extension editor that allows users to search the ~625,000 taxonomic entities of the Integrated Taxonomic Information System (ITIS) and rapidly generate taxonomic metadata. Because the Workspace is a cloud-based service, researchers can move between computers during the metadata generation process in addition to allowing team members and administrators to simultaneously review and edit metadata in real time.

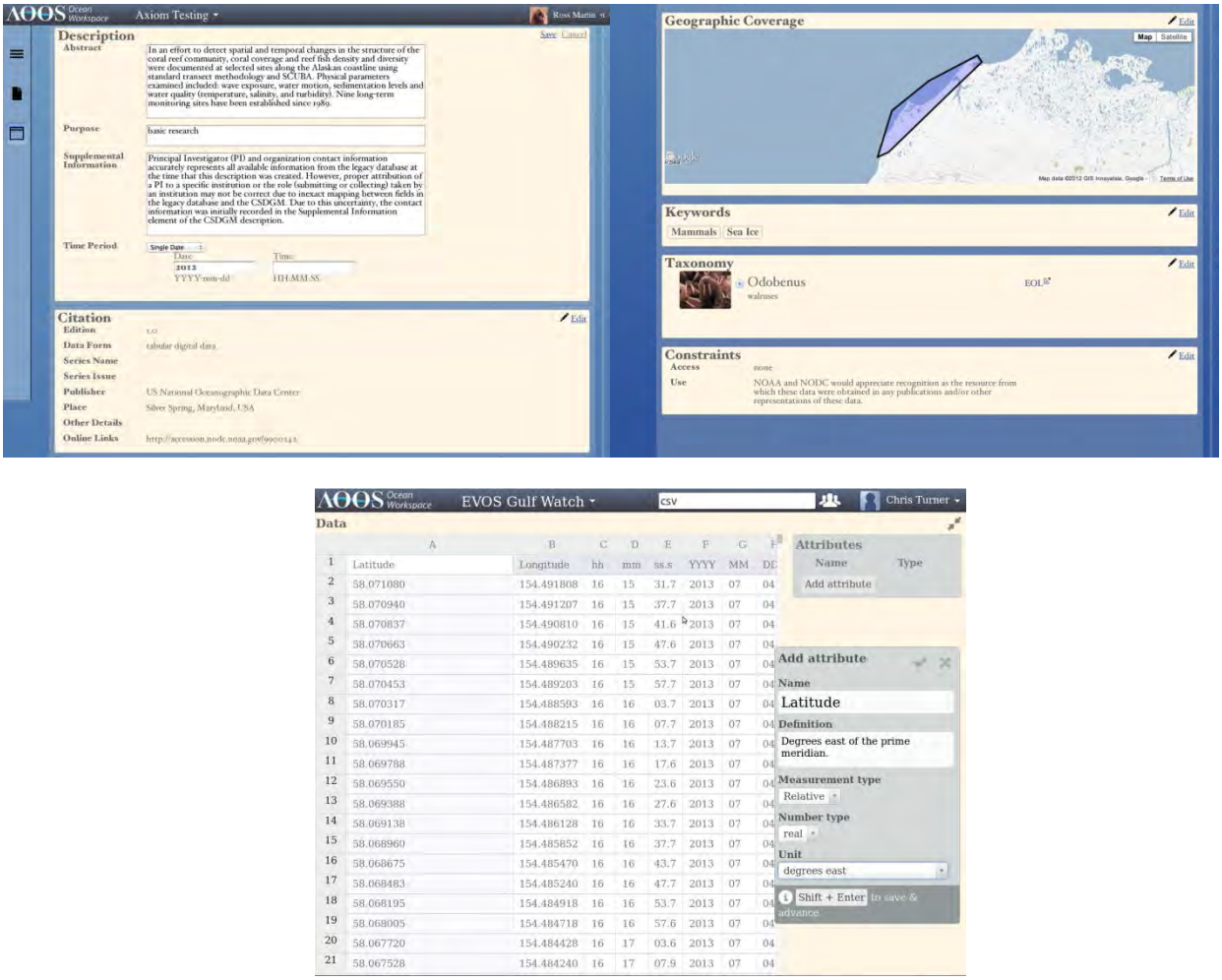


Figure 4. Screenshots of the Workspace metadata interface, clockwise from top-left: the interface to author basic descriptive and citation metadata fields, a tool which allows researchers to describe the geographic extent of the project, keywords, taxonomic information and data constraints, the new tool for editing attributes in tabular data files.

Advanced and secure file management — A core functionality of the Workspace is the ability to securely manage and share project-level digital resources in real-time with version control among researchers and study teams. Users of the Workspace are provided with tools that allow them to bulk upload files, organize those documents into folders or collections, create projects with predefined and user-created context tags, and control read and write permissions on files within projects. The

Workspace also has the ability to track file versions: if a user re-uploads a file of the same name, the most current version of the file is displayed, but access is provided to past versions as well.

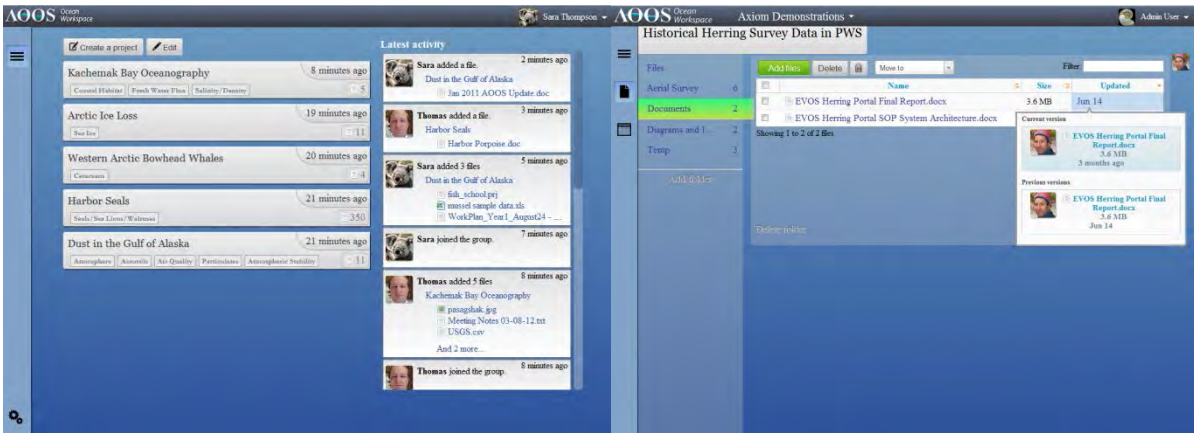


Figure 5. Screenshots of project and file management in the Workspace. The first screenshot shows a list of projects to which the example user has access rights. The second screenshot displays the interface a researcher would use to organize independent files into folders, and the way two versions of the same file are tracked by the Workspace.

Objective 2.

Consolidating, standardizing, and providing simple access to relevant study area datasets that are not part of the GWA effort adds value now and beyond the life of the GWA effort. By leveraging the work done by other research, modeling, and monitoring efforts in the Gulf of Alaska, the GWA project contributes to a deeper understanding of the Gulf of Alaska ecosystem. In 2014, Axiom data analysts added more than 160 additional data layers to the Gulf of Alaska portal. Many of these new data layers expand on or update existing datasets in the portal, such as the new Shorezone and Environmental Sensitivity Index layers describing the concentrations of sensitive resources along sections of the Cook Inlet shoreline, and the new Aquarius satellite Version 3.0 measurements of sea surface salinity and sea surface winds,

Objectives 3 & 4.

In 2013, the data management team released the Alaska Ocean Observing System's Gulf of Alaska data portal, which integrates data and project information produced by GWA researchers with 260 additional GIS, numerical modeling and remote sensing data resources specifically for the Gulf of Alaska region. The team leveraged the AOOS portal, which was developed using other funding and had these additional features: an integrated search catalog which allows users to search by category or key word, ability to preview data before downloading files, and advanced visualization tools. Once the program's monitoring data has been ingested into the Ocean Workspace, quality controlled, and approved as final, then it is ingested into the Gulf of Alaska Data Portal for full public access.

During 2014, a number of updates were made to the AOOS data system, the benefits of which are shared by the EVOS GWA program and the other research groups supported by or working with

AOOS. These improvements are separated below into work completed in 2014, and work begun in 2014 and still underway.

Table 2. Gulf Watch Alaska and Herring Research and Monitoring programs: Data life cycle.

	PIs	Program Mgmt Team	AXIOM	NCEAS	EVOSTC & Trustee agencies
Data collection & any telemetry	PI/agency responsibility; established sampling protocols for each component.	Review & maintain sampling Standard Operating Procedures (SOPs). Coordinate, with Science Coordinating Committee, consistency in sampling across the program.	Store current Standard Operating Procedures within Ocean Research Workspace.		Fund data collection projects and programs. Establish basic requirements: quality data, well documented, publicly accessible, archived.
QA/QC	PI responsibility based on agency or entity requirements. Documentation of instrument calibration & data QA/QC procedures to be included in sampling SOPs & project metadata.	Review QA/QC documentation before accepting data. Limited QA/QC performed on metadata to ensure it has required information (e.g. date, time, location, etc.) and data fields are appropriately documented (e.g. units in column headers).	Working with GULFWATCH program coordinator (Tammy Neher), specific datasets are aggregated together and reviewed for problems to prepare for synthesis efforts. Mostly rely upon PI for QA/QC.	For historical data, limited QA/QC (e.g., columns, domain, units) is performed and provided in metadata documentation to ensure it has required information. If original PIs are unavailable then any issues are simply noted in metadata.	Establish clear requirements for program and coordinate on agency data standards.
Metadata	PI responsibility to provide metadata according to agency and team standards.	Works w/PIs & data team to develop requirements. Assists PIs & reviews project level and file level metadata files.	Metadata can be created through the Workspace on the project level or file level using the ISO suite of protocols with taxonomic extensions (ITIS). Other metadata formats can be incorporated as well.	For historical data projects, NCEAS researches data and provides metadata as available to reconstruct the data set. Metadata are extracted from reports, papers, and other available materials. Metadata are provided in EML format using tools developed at NCEAS (web entry, and Morpho entry).	Coordinate on agency metadata requirements and standards.
Internal data access and staging	Post data on Ocean Research Workspace as soon as possible, but no later than 1 year after collection.	Keeps records of data availability. Assists PIs in posting data on Ocean Research Workspace. Coordinates with Axiom/AOOS and NCEAS on user requirements for Workspace.	Provide Workspace as internal staging area for use by team. Work w/team to develop additional functionality for team use. Workspace is highly leveraged tool that is password protected.	Use Redmine ticket system to track the lengthy process of finding, acquiring, and processing historical data. As data are processed, they are inserted as private objects into the GoA Member Node, and then made public as the documentation is completed.	
Data security			Data are archived on AOOS server in Anchorage & at mirror site in Portland OR.	Historical data are archived on the NCEAS GoA Member Node, replicated to DataONE, and a copy is made on the AOOS data servers. DataONE checks	Provide requirements, if any, for agency data archive.

				validity of content through rolling audit.	
Data analysis, synthesis & visualization	Produce data analyses, synthesis documents and data visualizations from project data.	Coordinates with PIs, AOOS, Axiom and NCEAS to produce synthesis and visualization products and reports.	Provides team with full access to all data for potential applications. Provide team access to all ancillary AOOS data & tools. Provide time series animations & syntheses on request from science team & outreach team.	Historical data are made publicly available via the GoA Member Node, and can be accessed from the web, analytical environments like R, and workflow systems like Kepler and VisTrails.	
Data discovery (search function)	Ensures that data are complete, QA/QCd & have complete metadata records.	Determines when data & metadata are ready to be published to public AOOS portal.	Incorporates data & metadata into AOOS GoA data search catalog w/additional GWA & historical EVOSTC tags. Setting up process for connecting to DataONE.	Historical data are listed on the AOOS GoA data portal, and are searchable on the DataONE portal as well as the KNB.	
Public data delivery	Reviews published data on data portal for accuracy.	Reviews published data on data portal for accuracy. Keeps track of program data delivery status.	When data meet all above requirements, publish data & metadata into the AOOS Gulf of Alaska portal for broader public access & use.	Historical data and metadata can be downloaded from AOOS GoA Data Portal, the GoA DataONE member node, and DataONE replica servers.	Public data access is required.
Long-term archive			AOOS data system is being used for long-term storage. With other funding, now developing methods for automated delivery to national archives (e.g., NODC) and to DataONE nodes.	Provide linkages to DataONE to replicate data across diverse institutions to protect against funding and policy failures. Historical data have 3 replicas nationally, working with Axiom on replication processes for current data streams.	Long-term archiving required by trustee agencies.

Work Completed

Axiom software engineers redesigned the display in the gulf of Alaska Data Portal of metadata created in the Ocean Workspace and imported into the portal. Upon initial release of the portal, project metadata created in the Workspace was visible as an HTML webpage and file-level metadata from the Workspace was available in the portal as raw, unstyled JSON documents. In the time since the launch of the portal, the metadata editors in the Ocean Workspace have been harmonized to provide the same interface and fields for project and file metadata, and have expanded to provide new metadata fields. This year, Axiom's interface designer created a new stylesheet to display the both the project and file level metadata from the Workspace in a much more human-readable form. The design of the metadata pages in the portal underwent several design iterations based on user feedback before settling into their current form.

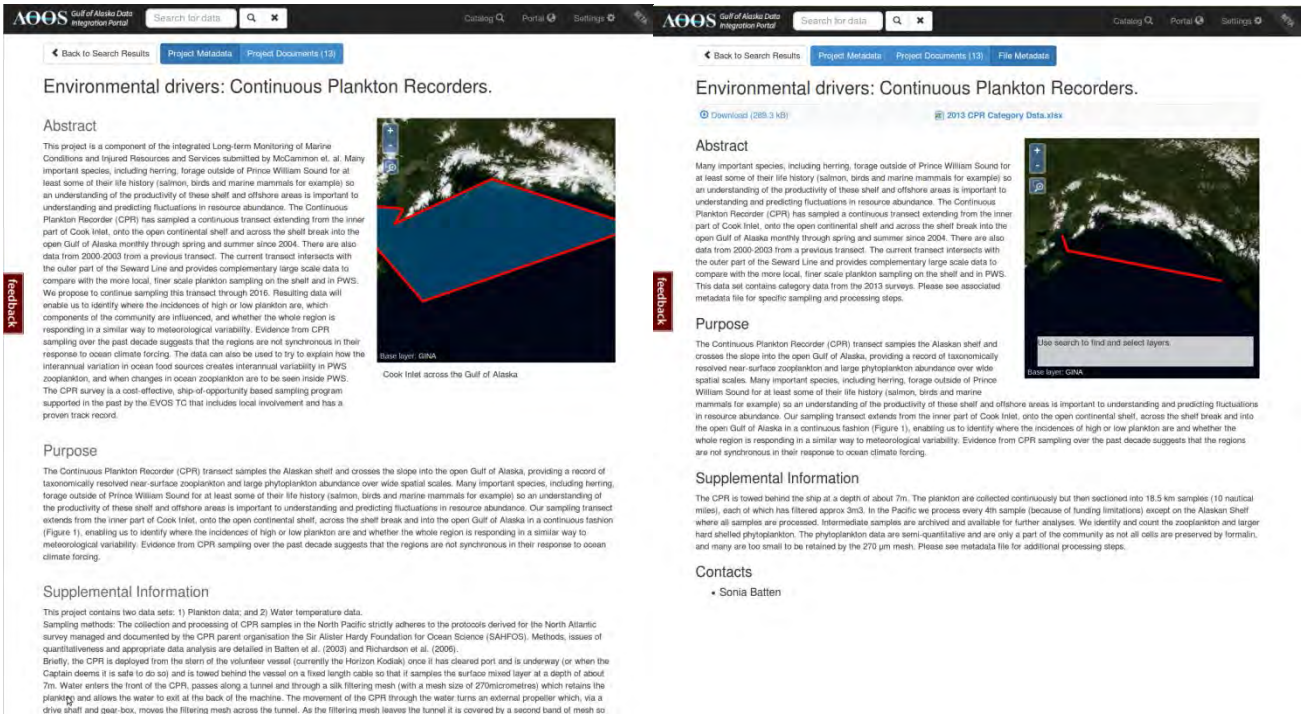


Figure 6. Screenshots of metadata imported from the Ocean Workspace into the public Gulf of Alaska Data Portal. On the left: project metadata for the Continuous Plankton Recorder (CPR) project; on the right: metadata for a single data file within the CPR project.

Work Underway

Axiom software architects and engineers have begun work to improve the Gulf of Alaska Data Portal's data catalog user interface and portal visualization capabilities. Improvements currently underway to the user interface include rebuilding the search tool to improve the precision and relevancy of search results, and indexing datasets' spatial and temporal metadata to allow advanced catalog searches. These upgrades to the data system are motivated by feedback received from GWA managers as well as external sources. Improvements to the catalog search tool will expand the range of material indexed for search to include file-level metadata and the text content of files imported into the Gulf of Alaska data portal from the Workspace. It will also suggest synonymous terms for users to search based on their search queries, e.g. - the new search tool would suggest 'sea surface temperature' when a user searched 'water temperature'. Indexing spatial and temporal metadata will allow users to limit the results of their searches to show only the data in the area selected during the time span indicated. Users will be able to set these limits by drawing a polygon on a map, inputting a spatial bounding box, and/or using a time slider to set a time range.

Data visualization is limited by the underlying data structures used by the data collectors. Axiom and AOOS are at work on a next-generation data portal based on a 4-dimensional data model enabled by the netCDF data format. This system is in the very early stages of development by Axiom software architects, but data analysts have already begun converting targeted datasets into the netCDF format. NetCDF is a well documented, open, and self-describing format that was designed with the needs of long term preservation in mind. Once these conversions are complete, the datasets can be more robustly visualized along standardized parameters while being ready for archiving in a long term preservation

environment. From the GWA project, Axiom analysts have worked with program management to convert three seasons of CTD data into netCDF files that will be used to create rich, 4D visualisations once the conversion is complete. An example of a preliminary visualization of netCDF data for another program, is below in Figure 7.

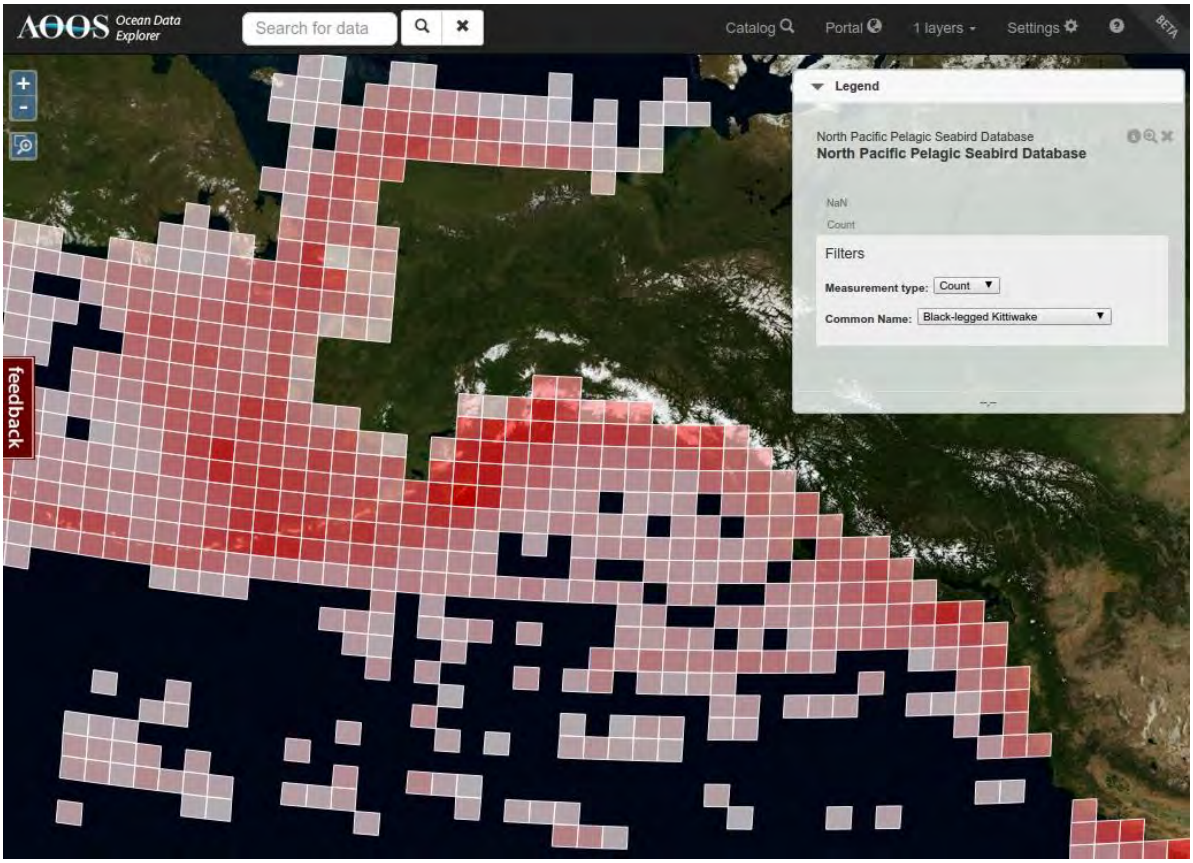


Figure 7. Screenshot of AOOS Gulf of Alaska Data Portal with the North Pacific Pelagic Seabird Database layer loaded. Color represents raw counts of Black-legged Kittiwake in the waters surrounding Alaska.

Responsibilities over the Data Lifecycle

The following table was created by the project team and GWA program management to make explicit and summarize the responsibilities of the various parties involved in planning or implementing data collection, management, and publication tasks during the data lifecycle.

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

A. Collaboration and coordination both within your program and between the two programs:

The data management tools and services provided to the EVOSTC LTM and Herring programs are coordinated and collaborative by their very nature. As users of a central data management system, both programs provide useful feedback that informs the features Axiom develops and implements for the Ocean Workspace and the Gulf of Alaska Data Portal. Through ingesting, synthesizing, and prioritizing feedback and feature requests from both programs, the project team coordinates the needs of each program into a set of tools useful to both. Similarly, by making data from each program available in the Gulf of Alaska Data Portal, the project team helps the two programs collaborate to provide a comprehensive, holistic portrait of the conditions monitored in the Gulf of Alaska by both programs.

B. Coordination with other EVOSTC funded projects: None

C. Coordination with our trust agencies:

The project team provides data management visualization, and preservation services, including providing access to and facilitating the use of the Ocean Workspace, to a number of other programs that receive funding from or are administered or are overseen by representatives from the trustee agencies. Some of these programs and their associated trustee agencies are given on the table below.

Table 3. Collaborating projects and trust agencies

Arctic Marine Biological Observation Network (AMBON)	BOEM
Arctic Ecosystem Integrated Synthesis (Arctic EIS)	BOEM
Marine Arctic Ecosystem Study (MARES)	BOEM
IOOS Systems Integration	NOAA
Beluga Sightings Database Visualization	NMFS
Alaska Ocean Observing System (AOOS) Data Management	NOAA
Central and Northern California Ocean Observing System (CeNCOOS) Data Management	NOAA
Gulf of Alaska Integrated Ecological Research Program (GOAIERP)	NMFS
Russian-American Long-term Census of the Arctic (RUSALCA)	NOAA

Spatial Tools for Arctic Mapping and Planning (STAMP)	NOAA
Alaska Data Integration working group (ADIwg)	USGS

9. Information and Data Transfer: *See*, Reporting Policy at III (C) (9).

Publications produced during the reporting period: None completed.

Conference and workshop presentations and attendance during the reporting period:

The AOOS data team at Axiom Data Science attended the GWA PI meeting in November 2014, and the team meeting in January 2015 at the Alaska Marine Science Symposium (AMSS). The team participated in the webinar held in September 2014 to educate agency managers. Throughout the year, the project team keeps in contact with the GWA program management team with regular email and phone calls. Beyond the scope of just the GWA effort, Axiom Data Science held a user feedback meeting in the summer of 2014 to better understand how users browse and search in the portal. Tammy Neher, GWA Science Coordinator, called in to this meeting.

Demonstrations of the Ocean Workspace have been given to a wide variety of users including GWA PIs. Demos have also been given to PIs with the North Pacific Research Board's Gulf of Alaska Integrated Ecosystem Research Program, the BOEM-funded Arctic Ecosystem Integrated Survey, the Distributed Biological Observatory, and many other related research programs for which AOOS or Axiom also provides data management or visualization services. The AOOS Gulf of Alaska Data Portal, featuring GWA data sets, was demonstrated at AMSS during several workshops and was on display at the AOOS booth during the AMSS poster session.

10. Response to EVOSTC Review, Recommendations and Comments: *See*, Reporting Policy at III (C) (10).

Science Panel 2014 Comments

It was encouraging for the Science Panel to hear via a conference call with Kris Holderied, Tammy Neher, and Scott Pegau that the standardized forms for metadata submission had been recently modified, and that a more refined version is now available to investigators. The Panel is hopeful that this will facilitate all investigators' compliance on submission of both metadata and data in a timely manner (within one year of collection) as agreed upon when accepting funding from EVOSTC.

Data Management Team Response

In 2015, the project team will work with the GWA program management team to continue to track what data has been delivered, which PI is responsible for the dataset, and the status of data preparation, processing and metadata development.

11. Budget: *See,* Reporting Policy at III (C) (11).

Axiom's budget for data management support originally included 9.2K for equipment to purchase a storage array for Gulf Watch data. Axiom was able to leverage the AOOS data system at no cost for storage of Gulf Watch data. The surplus funds were utilized by personnel budget line instead resulting in improved services and support for investigators.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$138.5	$118.0	$122.300	$122.3	$121.3	$622.4	$392.3
Travel	$0.0	$0.0	$0.000	$0.0	$0.0	$0.0	$0.0
Contractual	$0.0	$0.0	$0.000	$0.0	$0.0	$0.0	$0.0
Commodities	$0.0	$0.0	$0.000	$0.0	$0.0	$0.0	$0.0
Equipment	$5.1	$4.8	$0.000	$0.0	$0.0	$9.9	$0.0
Indirect Costs (*will vary by proposer*)	$31.4	$27.1	$28.129	$28.1	$27.9	$142.7	$82.4
SUBTOTAL	$175.0	$149.9	$150.429	$150.4	$149.2	$774.9	$474.7
General Administration (9% of subtotal)	$15.8	$13.5	$13.5	$13.5	$13.4	$69.7	$42.7
PROJECT TOTAL	$190.8	$163.4	$164.0	$164.0	$162.6	$844.7	$517.4
Other Resources (in kind Funds)	$683.0	$640.0	$620.0	$500.0	$500.0	$2,943.0	$1,943.0

Leveraged Funding Sources
AOOS - Data management Activities (FY12 - 500K, FY13 - 500K, FY14 - 500K, FY15 - 500K, FY16 - 500k)
PWSSC -Project level data management system (FY12 - 48K)
Northern Forum/USFWS - North Pacific Seabird Data System (FY12 - 50K, FY13 - 50K, FY14 -50K)
ADF&G/AOOS - Data integration partnership/sharing (FY12 - 60K, FY13 - 90K, FY14 -70K)
CIRCAC - Regional Data Management Support for CI (FY12 - 25K)
Kenai Fish Habitat Partnership: FY15-28K
NPRB GOAIERP- FY15-80k
USFWS Seabird program: FY15- 50k

FY12-16

Program Title: 15120114-D Data Maanagement
Team Leader: Rob Bochenek, AOOS

SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

*Please refer to the Reporting Policy for all reporting due dates and requirements.

1. Program Number: *See*, Reporting Policy at III (C) (1).

12120120

2. Project Title: *See*, Reporting Policy at III (C) (2).

Collaborative Data Management and Holistic Synthesis of Impacts and Recovery Status Associated with the Exxon Valdez Oil Spill

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Matthew B. Jones

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

Duties shifted from data archiving to initiation of various synthesis activities. While data archiving was completed in the previous year, as planned, project personnel have continued to maintain and update datasets as needed and continue to develop data management infrastructure. Syntheses of archived data as well as additional data have begun and will continue through the next few years.

Archive Maintenance

Data outreach and collection was finalized although delayed conversations extended this work into FY14. Three projects were added to the Gulf of Alaska (GOA) Data Portal post-completion and numerous have been edited and updated to enhance detailed metadata. Metadata and datasets are updated as researchers provide additional information. The complete historical dataset now contains 97 data packages

Provenance

The Gulf of Alaska Historical Data Portal is undergoing improvements to enable reproducible science. This new provenance infrastructure allows users to track data inputs and outputs, store and document software and show data derivation history for objects.

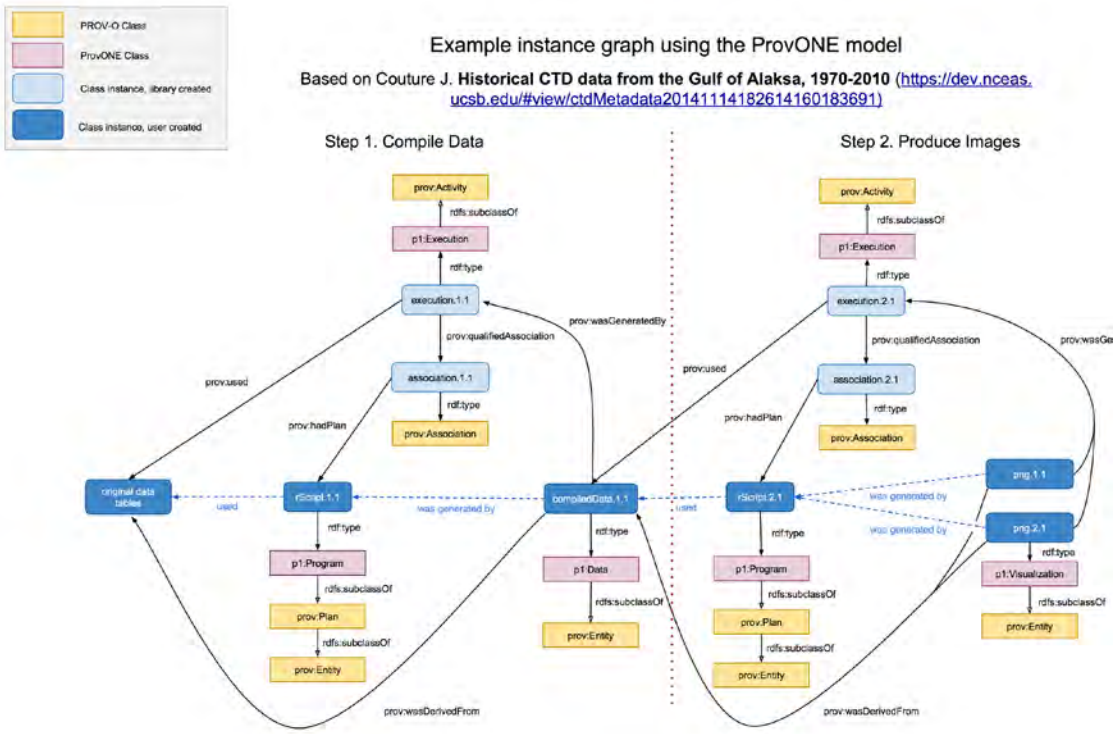


Figure 1: Provenance infrastructure tracks and documents complex interactions between objects and actions in data synthesis (step 1) and image generation (step 2), for example.

Development is occurring in parallel with DataONE provenance infrastructure and users will be able to chose from a web interface, Matlab, or R tools for generating provenance. Relationships are displayed in a clean user-friendly interface within the data portal (figure2). Design, documentation and structure models for this software were completed in this year and a functional developmental version currently documents Gulf Watch Alaska (GWA) data syntheses and visualizations.

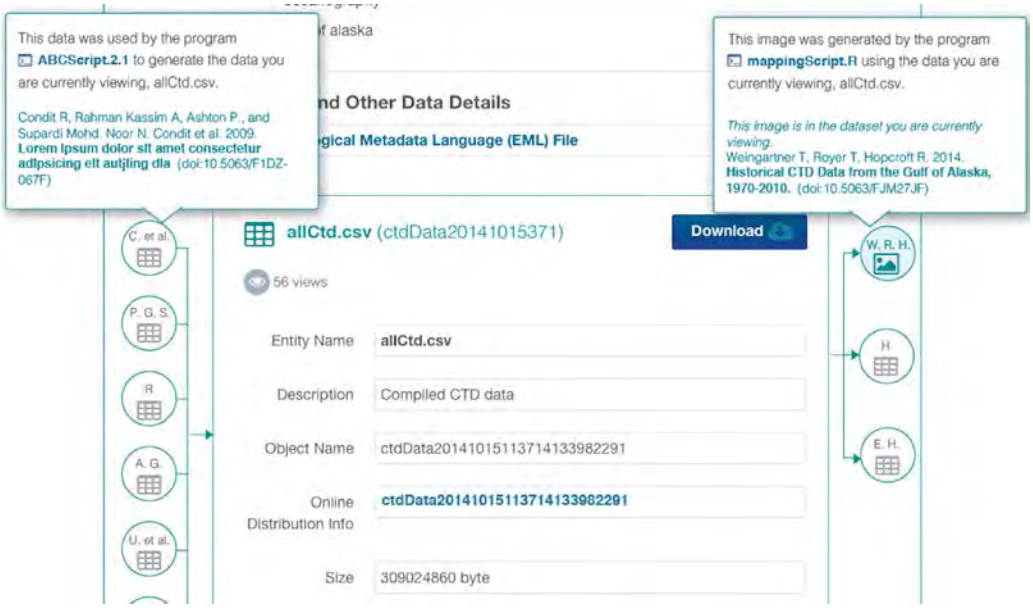


Figure 2: Web display showing Provenance relationships within the metadata portal. Inputs and outputs for each object are defined with documented with timestamp and versioning.

Data Syntheses

Data from similar and overlapping Gulf Watch Alaska projects have been synthesized for further analysis. Synthesized datasets include oceanographic data, chlorophyll data, zooplankton data, algal cover and habitat data, seabird data, and marine mammal data. Eight synthesized datasets compile data from 39 historic and GWA datasets. Syntheses use provenance structures to document data inputs, manipulations, and outputs.

Synthesized data have also been visualized to represent spatial and temporal extents. Images include mapped sampling locations, summary graphs and animated maps to show data availability over time. Additional visualizations summarize data availability that cannot be accurately synthesized into one data table. These include spatial and temporal ranges of marine mammal and marine bird data.

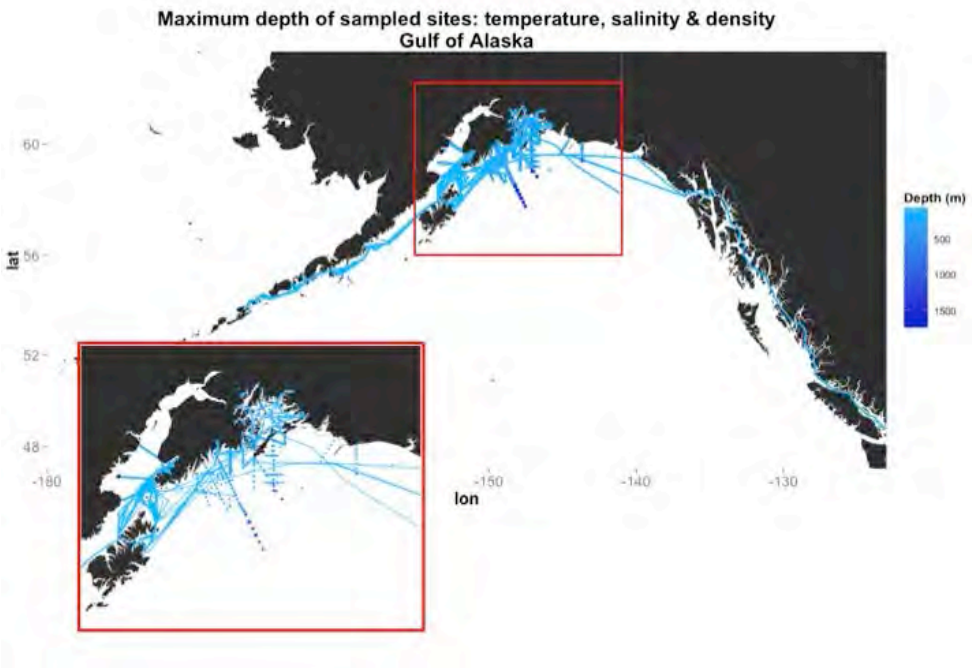


Figure 3: Spatial distribution of CTD data sites with depth of deepest sample represented in shade of blue. These data are available in one synthesized dataset with documented provenance relationships.

Broad Synthesis Activities

Requests for proposals were advertised, submissions were review and two working groups were selected to conduct additional analyses of the GOA ecosystems based on the 25 years of data collected since the Exxon Valdez oil spill. These same steps were taken to recruit two post-doctoral researchers to participate in the working groups and conduct further analyses of the GOA systems. All of these efforts are planned to commence in 2015. The selected working groups will look at social-ecological relationships in the GOA and the effects of diversity on the stability of the GOA ecosystem. These projects are entitled *Understanding changes in the Coastal Gulf of Alaska Social-Ecological System: Analysis of Past Dynamics to Improve Prediction of Future Response to Natural and Anthropogenic Change* (Okey et al.) and *Applying portfolio effects to the Gulf of Alaska ecosystem: did multi-scale*

diversity buffer against the Exxon Valdez oil spill (Marshall et al.), respectively. Both groups have held organizational meetings and scheduled work to begin in early in 2015.

Social-ecological systems**:** This project will first investigate the possible connections between social and ecological systems in the Gulf of Alaska through statistical analyses of a variety of elements. Social foci include impacts on fishing communities, human health, education, and regional demographics. Principal Component Analysis will be used to quantitatively identifying key community vulnerabilities and using existing frameworks, this working group will quantify non-monetary effects of the spill such as changes in culture or education. These quantified impacts will help to inform two existing Ecopath models of the Prince William Sound and GOA ecosystems. These models will be updated to be able to simulate different scenarios in order to predict responses to changes in the future.

Applying portfolio effects to the GOA: This group will assess the ecological portfolios and stability of populations and communities. Population stability will be assessed by looking at spatiotemporal data, investigating life history trait portfolios, and spatial variation portfolios.

Additionally, they are interested in fishery catch portfolios comparing pre and post spill catch compositions. At the community level, the group will investigate evidence for changing species interactions and community resilience using multispecies models applied to plankton, fish, and Steller sea lions in Prince William Sound and the GOA.

Table 1: Status of project milestones for year 3

Deliverable/Milestone	Status
Select NCEAS working group projects, begin organization	October 2014
Hire post-doctoral researchers	October 2014
Participate in LTM program PI Meeting	November 2014
Complete data syntheses of historical EVOS data	November 2014
Provenance prototype released and employed for syntheses of historic EVOS data	December 2014

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

A) This project continues to be highly collaborative within GWA and between programs. The continued management and addition of data are done in coordination with AOOS and Axiom Consulting, along with the GWA group. Additionally syntheses and visualizations are shared on the AOOS data platforms and include data from various projects.

Both NCEAS working groups selected include members from the GWA and/or HRM groups as well as various local and governmental agencies: Alaska Department of Fish and Game, NOAA Alaska Fisheries Science Center, US Geological Survey.

B) This year we collaborated directly with the marine birds research group to assist with data inventory, summaries and visualizations. Summaries represent datasets from various EVOSTC funded projects as well as external agencies. Similarly, additional syntheses, outlined above, are collaborations of various projects and research programs. These visualizations and synthesized data help inform the new NCEAS working group analyses.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

In addition to continued data maintenance and sharing through the historic EVOS data site, this year's data and progress were shared at conferences, meetings and through the internal GWA project workspace. Data syntheses and visualizations were presented at small group meetings throughout the year as well the GWA annual meeting in Anchorage. Here we updated the group on our provenance developments, and synthesis products. Combined datasets and spatial and temporal representations of data available is also shared with the GWA and HRM groups through the internal AOOS workspace. In addition, we have initiated work to collate data for the two NCEAS synthesis groups, with a major effort on collating fisheries independent data from large regions of the Gulf of Alaska from the Alaska Department of Fish and Game. These data will be collated and made accessible through either a ADFG portal or through the historical data portal, and will be integrated for use in the synthesis analysis and modeling efforts.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

None required.

11. Budget: *See,* Reporting Policy at III (C) (11).

Please see the associated budget form. The projected budget for 2015 is as originally budgeted, with some minor changes in personnel details. Expenditures for 2014 were significantly less than budgeted because, as expected, the synthesis working groups and synthesis postdocs were selected during 2014 but did not start activities until January, 2015. We expect to rollover these expenses so that the postdocs and working groups will take place in years 4 and 5 (rather than years 3 + 4 as originally planned). In addition, we have not been utilizing the software engineering funds after our initial work on provenance was completed as we need a more effective plan to integrate with AOOS and Axiom infrastructure. We plan to expend the software engineering funds in years 4 and 5 after another discussion with Axiom about how to best continue to collaborate.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$294.2	$329.1	$148.6	$153.7	$41.5	$967.1	$513.1
Travel	$2.8	$2.8	$121.0	$121.0	$2.8	$250.3	$8.1
Contractual	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.4
Supplies	$6.5	$6.5	$1.4	$1.4	$9.5	$25.3	$8.5
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (will vary by proposer)	$78.9	$88.0	$70.5	$71.8	$14.0	$323.1	$123.0
SUBTOTAL	$382.4	$426.3	$341.4	$347.9	$67.8	$1,565.8	$655.1
General Administration (9% of subtotal)	$34.4	$38.4	$30.7	$31.3	$6.1	$140.9	$59.0
PROJECT TOTAL	$416.8	$464.7	$372.1	$379.2	$73.9	$1,706.7	$714.1
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	0

COMMENTS:

FY12-16

Program Title:12120120 Collaborative Data Management and Holistic Synthesis of Impacts and Recovery Status Associated with the Exxon Valdez Oil Spill
Team Leader:Matthew B. Jones

FORM 3A
NON-TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

12120114-H

2. Project Title: *See*, Reporting Policy at III (C) (2).

Science Coordination and Synthesis

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Kris Holderied and Tammy Hoem Neher

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

Through much of this year, we focused significant efforts on developing the Gulf Watch Alaska (GWA) program Year 3 science synthesis report (Hoem Neher et al. *in review*) and planning for the joint program science workshop that was held Feb 4-6, 2015. Synthesis report preparation included developing the structure of the report with the science coordinating committee (SCC) and principal investigators (PIs), writing the executive summary, introduction and recommendation chapters, and coordinating, compiling and editing the monitoring component summaries and articles. The annual PI meeting in November 2014 was focused on finalizing the synthesis report and we held multiple work sessions with the program management team and SCC before and after the meeting. We coordinated with EVOSTC staff and the Herring Research and Monitoring (HRM) program lead to plan the joint science workshop with the EVOSTC science panel and developed presentations for both the EVOSTC public advisory council and science panel.

We continued to develop integration and visualization tools both for within and outside the program, and improved access to program information and data through the GWA website and Gulf of Alaska data portal hosted by the Alaska Ocean Observing System (AOOS). We continued to expand coordination with other organizations, including sharing information with the North Pacific Research Board (NPRB) Gulf of Alaska Integrated Ecosystem Research Program and the HRM program. Below is a summary of science coordination and synthesis work performed during the reporting period by project objective, Table 1 highlights the project milestones and deliverables met during this reporting period.

Objective 1. Improve communication, data sharing and coordinated field work planning between principal investigators of the individual monitoring projects, as well as with other agencies and research organizations

Two teleconferences were held with PIs and the SCC for Gulf Watch Alaska in May and July 2014. Most investigators attended the teleconference meetings and those that did not received meeting notes and held short discussions with the science coordinator and management team members. The annual program meeting was attended by all PIs (or representatives) in November and a second in-person meeting was held in conjunction with the Alaska Marine Science Symposium in January 2015, with all PIs present in person or by phone. Meeting agendas, summaries and other materials are posted on the internal AOOS GWA program workspace. The SCC and program management team met formally via teleconference in May, July, October, and December 2014, with extensive additional coordination by phone and in person, to plan and discuss layout, content, and authorship of the synthesis document, provide input on needed data management services, and address on-going program coordination issues.

The marine birds working group (led by Kuletz and Esler and composed of investigators from the two seabird monitoring projects, harlequin ducks, conceptual modeling, and nearshore monitoring projects) met by conference call in March 2014 to discuss progress on the group's action items for the synthesis report and finalize products. Final products for the synthesis report included a discussion of the value of marine bird monitoring to understand ecological changes along with several research summaries authored by working group members.

The environmental drivers working group (composed of all component PIs) coordinated before and during the November 2014 PI meeting to develop the component chapter, with a focus on regional variability in marine conditions and linkages between estuary (Prince William Sound and Cook Inlet) and shelf waters. The chapter introduction addressed coordination between different sampling protocols in long-term time series, spatial and temporal variability in oceanographic data, and ecological implications of observed trends. Research summaries were contributed for all component projects.

We continue to make changes to the Ocean Workspace, GWA website, and data portal to facilitate communication between PIs and data access. We worked with our partners at Axiom to develop new functions on the Workspace and portal, which included the ability to define attributes within the Workspace metadata tool and to convert oceanographic data to the more easily archived netCDF format. Project-level metadata is available on the portal with all project descriptions and file-level metadata is provided with all data files published to the portal.

Finally, in partnership with the NOAA Kasitsna Bay Laboratory, we developed an interactive intranet Google Site for the program management team and PIs to share program updates, field highlights, and research discussions. To improve program coordination, the site is also linked to Google Drive folders and the GWA Google calendar.

Objective 2. Improve and document integration of science monitoring results across the LTM program - working with the PIs, data management and modeling teams as well as other agencies and research organizations.

We have seen substantial progress in integration between the GWA-HRM programs this year that was recognized by EVOSTC science panel members at the February 2015 joint science workshop (referring to Pete Peterson's comment that the two programs are slowly becoming one). PIs are closely

coordinating across the programs on field activities, process studies, modeling, and working groups. Examples include integrated work between the HRM program with three of the environmental drivers component projects and humpback whales, marine birds, and forage fish projects that was presented during the January 2015 AMSS and February 2015 EVOSTC joint science workshop and described in the synthesis reports from both programs.

The conceptual modeling project developed a series of sub-models to assist with understanding of ecology by focusing on various drivers of ecosystem function. These models are being used to facilitate discussion within the program teams and for outreach. One sub-model completed this year was a conceptual figure for the nearshore component provided for the synthesis report and several presentations. Three additional sub-models are in progress and are centered on: 1) top-down processes, such as whale predation; 2) bottom-up processes such as the effects of temperature and nutrients on plankton production; and 3) "lynch-pin" processes, such as the key role of forage fish in the ecological processes in the Gulf of Alaska.

Objective 3. Improve communication of monitoring information to resource managers and the public through data synthesis and visualization products and tools – working with the data management, conceptual ecological modeling and outreach teams, as well as other agencies and research organizations.

We continued developing and enhancing a variety of tools to communicate monitoring program information between PIs and to a broader audience of resource managers, other researchers, and the general public. In September of this year, we held an open webinar on the GWA program, aimed at informing resource managers around the state about the program. The workshop introduced the program and projects, showed data access tools, and asked for input on tools that would be useful for management needs. In addition, we routinely update and add information to the public access website and data access portal, with the primary update completed in spring. Finally, we are planning on partnering with Axiom to apply data visualization tools they have been developing (with our input on usability) to data from several GWA projects this year.

Deliverable/Milestone	Status
Coordinate development of year 3 science synthesis report. Assist in initial planning of joint science workshop between GWA and HRM programs.	Synthesis report was completed and submitted Dec 1 2014. The report will be finalized after EVOSTC comments are received and incorporated. Coordinated GWA program attendees and presentations for the joint science workshop held Feb 4-6th.
Develop an example interactive data visualization tool in coordination with data management and conceptual ecological modeling teams.	Assisted AOOS/Axiom with development and testing of online data visualization tools on the AOOS data portal. Reviewed data files from all projects are loaded and available for access.
Submit year 4 work plan.	Year 4 work plans were prepared or edited as needed and were provided Sept. 2 to Trustee Council staff. Workplans were approved during the November EVOSTC meeting.
Facilitate annual PI meeting	The program management team and SCC planned the meeting agenda, conducted the meeting, and coordinated associated work group discussion sessions.
Conduct annual PI meeting	Meeting was held in November 2014 and focused on final synthesis report preparation and planning for the February 2015 joint science workshop.
Attend Alaska Marine Science Symposium and provide update to GWA program	Kris Holderied presented an update on monitoring program highlights from the GWA program at AMSS in January 2015.
Submit report on synthesis of all available historical data from LTM projects	The NCEAS project is submitting a progress report on the historical data collection in conjunction with this annual report.
Submit annual project report	This document constitutes report submission.

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

As described above in the summary of work performed, many of the objectives and tasks performed under this project are efforts to build and facilitate coordination both within the GWA program and between the GWA and HRM programs as well as outreach information to other entities. To summarize:

- Planned program meetings, teleconferences, and workshops
- Attended HRM annual meeting, work closely with HRM science coordinator
- Worked closed with the data management team to provide program information and data on the website, Workspace, and public data portal
- Worked with GWA outreach committee to develop new outreach products and showcase
- Coordinated preparation of GWA program synthesis report, annual reports, and work plans
- Presented program materials at numerous meetings, workshops, and conferences

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

We are in the process of assisting the outreach team in updates to the program website. Program PIs and their staff have participated in two public outreach events: public Discovery Labs at the Kachemak Bay Research Reserve in Homer, Alaska in August 2014 and the International Shorebird Festival in Cordova, Alaska in May 2014. Additionally, we worked with the outreach team (Eric Cline at TerraGraphica), to design and print outreach packets for distribution at public events. The packets contain single-page project descriptions of all the GWA projects, bookmarks, program fliers, and program folders. The science synthesis team worked with the program PIs to provide content and editorial review. We continue work to improve and update the program website, outreach materials, and data portal.

Publications: We submitted the program science synthesis report in December 2024 to EVOSTC. The report is currently in review and will be finalized after comments from EVOSTC are received, reviewed with the PIs and science review team, and incorporated.

Hoem Neher, T., B. Ballachey, K. Hoffman, K. Holderied, R. Hopcroft, M. Lindeberg, M. McCammon, and T.Weingartner, editors. *In review*. Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Gulf Watch Alaska program science synthesis report. Submitted to the Exxon Valdez Oil Spill Trustee Council, December 1, 2014.

Conference and workshop presentations and attendance: Multiple public presentations were made in a variety of venues on the integrated Gulf Watch Alaska program during this year. Kris Holderied gave Gulf Watch Alaska program overview talks at the April 2014 Community-based Monitoring workshop in Anchorage, September 2014 NOAA ecological forecasting webinar in Anchorage, October 2014 EVOSTC PAC meeting, November 2014 EVOSTC meeting, and January 2015 Alaska Marine Science Symposium. Tammy Hoem Neher gave Gulf Watch Alaska program overview presentations at the Herring Research and Monitoring program meeting in March 2014, and the Igniting Knowledge of Coastal and Marine Research in Kachemak Bay symposium in April 2014. The program hosted an information webinar for resource managers in September, 2014 that presented an overview of the program and how to access GWA data. The science synthesis team also supported outreach for the GWA program during a Kachemak Bay Research Reserve Discovery Lab on the program, with over 300 people attending on three separate days. Topics included monitoring program results, history of the EVOS and information on resources and ecosystems injured by the spill.

Data and or Information products: Efforts to develop information products this year were focused on planning, writing, discussing, reviewing, and editing the GWA program synthesis report submitted to the EVOSTC in December 2014. In addition, we have improved several aspects of the program metadata tool, allowing attribute information to be automatically assigned and automated loading of materials from the workspace to the data portal. We also worked with the data management team to improve how oceanographic datasets can be efficiently converted to netCDF format as well as traditional flat files.

Project data uploaded to program data portal: Not applicable to this project.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

None for this project

11. Budget: *See,* Reporting Policy at III (C) (11).

Project spending from prior years is slightly delayed, with less than a 10% difference from cumulative proposed amounts for years 1-3. Computer purchases were not completed with project funding due to a change in our agency IT acquisition policies (a computer has been provided in-kind by NOAA for the science coordinator). Requirements for data visualization software are being re-evaluated, based on discussions with the data management team on emerging technology. Travel obligations were delayed by federal travel restrictions in prior years. We expect to complete obligation of prior year contract and commodity funds by the end of federal FY15.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$90.0	$111.6	$115.2	$117.6	$121.2	$555.6	$316.8
Travel	$10.8	$9.4	$11.4	$9.9	$11.4	$52.9	$25.4
Contractual	$7.5	$5.5	$5.5	$5.5	$5.5	$29.5	$8.1
Commodities	$1.0	$1.0	$1.0	$1.0	$1.0	$5.0	$0.7
Equipment	$4.0	$0.0	$3.0	$0.0	$0.0	$7.0	$0.0
Indirect Costs (*will vary by proposer*)							
SUBTOTAL	$113.3	$127.5	$136.1	$134.0	$139.1	$650.0	$351.0
General Administration (9% of subtotal)	$10.2	$11.5	$12.2	$12.1	$12.5	$58.5	$31.6
PROJECT TOTAL	$123.5	$139.0	$148.3	$146.1	$151.6	$708.5	$351.0
Other Resources (in kind Funds)	$13.0	$13.0	$13.0	$13.0	$13.0	$65.0	$39.0

In-Kind contributions: NOAA Kasitsna Bay Laboratory salary for Kris Holderied ($65K total for FY12-16, $13K/year).

FY12-16

Program Title: 15120114-H Coordination & Synthesis
Team Leader: Kris Holderied
Agency: NOAA

FORM 4A
TRUSTEE AGENCY
SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

12120114-128102

2. Project Title: *See*, Reporting Policy at III (C) (2).

Long-term Monitoring: Synthesis and Conceptual Modeling - Conceptual Ecological Modeling

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Tuula E Hollmen (Principal Investigator)

Suresh A Sethi (Collaborator)

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

A general conceptual synthesis model for Gulf Watch Alaska program was developed during the first phase of the modeling project. In the current reporting period, work has focused on four areas:

1. Publishing results from the first two years of method development and modeling.
2. Development of a framework and working groups for a suite of submodels to explore and represent key hypotheses relating to the components of our program: environmental drivers, nearshore, pelagic, and lingering oil.
3. Development of visual aids to represent ecosystem structure and monitoring efforts related to the program components.
4. Development of a framework to consider monitoring priorities and management relevance to assist long term programmatic planning efforts.

Our first manuscript based on conceptual modeling development for Gulf Watch Alaska program was submitted in 2014 and is currently in revision to address reviewer comments. Development and refinement of a semi-quantitative expert knowledge rating tool was presented at the Alaska Marine Science Symposium in January 2015. Details about these publications and presentations are given in section 9.

Our conceptual modeling continues with development of a series of sub-models to explore hypotheses among the key program components: nearshore (Sub-model 1), pelagic (Sub-models 2, 3), and environmental drivers (Sub-model 4).

Sub-model 1: Key Trophic Linkages in Nearshore Northern Gulf Ecosystems

The benthic nearshore model will examine the impact of changes in invertebrate prey fields on consumers of interest as measured by a suite of behavioral and demographic performance metrics. The overall goals of the modeling effort are to organize understanding about trophic linkages in the nearshore system, and the strength of relationships between invertebrates and consumers of interest, provide semi-quantitative simulation models to forecast consumer population outcomes/effects on consumer performance metrics

resulting from changes in invertebrate prey fields, identify data gaps, and prioritize research to fill data gaps. A unique aspect of this modeling approach is that considerable empirical, quantitative information exists on diet compositions for the consumers of interest and energetic requirements may also be available for consumer taxa. We have developed the predator response metrics and prey data input framework. Prey data compilation is in progress.

Sub-model 2: Ecological Linchpin with Forage Fish Abundance

This conceptual sub-model focuses on the dynamics of a suite of forage fishes found in the Northern GOA. The sub-model examines linkages among forage fish prey, a suite of selected forage fish species, and higher trophic species populations. Salmon and other pelagic, marine forage fishes such as capelin, sand lance, and herring play important roles in the marine food web as predators, competitors, and prey. These connections, when examined through functional groups or shared similarities (i.e. examining loss of shared prey items across multiple species) can provide unique insights into food web dependencies and future management considerations. The working group of experts is identified and planning for a modeling workshop is in progress.

Sub-model 3: Top-down Control with Humpback Whale Predation

Much speculation regarding controlling factors for schooling and highly fecund fishes, such as Pacific herring, has focused on bottom up factors including availability of prey and suitable habitat. An alternative hypothesis with supporting evidence suggests that increasing predator populations may be acting as a top down controlling agent for these fish. This conceptual sub-model explores the relationships between humpback whale prey types and seasonal patterns that can lead to a better understanding of the influence that predation may have on suppressed, economically important fisheries. Current understanding about the processes affecting herring-whale dynamics in the Northern GOA was explored in a sub-model exercise rating properties of linkages in a zooplankton-herring-whale sub-model system. The pelagic team has explored movements and distribution of humpback whales in Prince William Sound, represented in a conceptual model.

Sub-model 4: Bottom-up Control with Environmental Forcing on Plankton Populations

This conceptual sub-model focuses on plankton production and the various environmental conditions that are thought to act as drivers of primary and secondary production in the northern GOA. Levels of primary production are related to nutrient availability and solar input. Factors that influence these aspects include levels of stratification and mixing related to freshwater input, wind mixing, topography, and upwelling of nutrients. The sub-model will explore ecosystem responses to changing climate and, because plankton production is a primary source of energy conversion for higher trophic levels, the sub-model will have key ties to other models addressing higher trophic levels and associated management needs for coastal communities. A working hypothesis relating to effect so potential pathways of effect of water stratification on phytoplankton bloom has been visualized in a conceptual model template.

Development of visualization tools continued. We have developed a graphic template for visual representation of Gulf of Alaska ecosystem in program Adobe Illustrator. The template may be modified to provide visualization tools for Gulf Watch program components (environmental drivers, nearshore, pelagic, lingering oil). We used the template to develop a visual representation of the nearshore ecosystem component and the environmental drivers component. We also developed a visual representation of the submodeling plan within the framework of the general ecosystem model developed based on input from Gulf Watch Alaska principal investigators.

Structured decision support tools are used to develop an adaptive framework to guide monitoring efforts in long term, and link monitoring efforts with management objectives. We develop decision models to identify a suite of potential scenarios and impact pathways, and construct an adaptive framework to guide scientific study and monitoring efforts to support management of resources based on indicators of change. The framework will offer adaptive guidance to monitoring data collection, based on learning contribution by the monitoring conducted by the Gulf Watch Alaska program. Our conceptual modeling efforts will contribute to the development of the adaptive framework by characterizing current understanding of linkages between drivers and responses, and predicted effects and indicators of change. Input from scientific experts and resource managers will be incorporated into the framework. We will develop the structure and template for

the adaptive framework using conceptual and decision modeling tools during 2015-2016, and the process will form a planning tool and framework for the program over the next two decades.

Deliverable/Milestone	Status
Continue development of conceptual models (component submodels, management applications, stakeholder objectives)	In progress. Framework for nearshore model developed, data input in progress. Concepts for models on management applications in development. Framework for considering long term monitoring priorities in development.
Continue development of interactive data visualization tools	In progress. Conceptual model based visualization tools for nearshore and environmental drivers components developed.
Attend annual PI meetings and Alaska Marine Science Symposium	Completed, November 2014 and January 2015. Presented a project update at Alaska Marine Science Symposium.

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

A. The current goals of the conceptual modeling effort focus on development of submodels representing components and integrated hypotheses about ecosystem dynamics in our study area in the Gulf of Alaska. The process of developing component submodels involves close internal coordination and collaboration within and among Gulf Watch program components. Forage fish submodel will also involve coordination and collaboration between eth two programs.
B. Current coordination is focusing on collaboration within Gulf Watch Alaska program and between Gulf Watch Alaska and Herring Research Program.
C. Current coordination is focusing on collaboration within Gulf Watch Alaska program and between Gulf Watch Alaska and Herring Research Program.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

- Conference presentation: Hollmen, TE and Sethi SA. Conceptual models are flexible tools for research planning, prioritization, and communication. Alaska Marine Science Symposium, Anchorage, Alaska January 2015.
- Manuscript in revision: Conceptual ecological models to synthesize, organize, and prioritize research in socioecological systems.
- Data and/or information products developed during the reporting period: Visualization of submodel structure, nearshore ecosystem submodel, and environmental drivers submodel.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

N/A

11. Budget: *See,* Reporting Policy at III (C) (11).

There is a difference of >10% from the amount proposed and the amount spent to date for several categories of this project. This is due to differences in personnel costs expended as contracts, and there is lag in the sum total due to university invoicing cycles. Also, we are recruiting a postdoc to work with us, so all carryover is anticipated to be expended in personnel over the next two years.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$10.0	$14.4	$19.200	$20.1	$21.0	$84.7	$5.0
Travel	$5.7	$5.7	$5.700	$5.7	$5.7	$28.5	$10.0
Contractual	$38.4	$40.2	$42.000	$29.2	$30.6	$180.4	$97.0
Commodities	$4.0	$4.0	$0.000	$0.0	$0.0	$8.0	$5.0
Equipment	$0.0	$0.0	$0.000	$0.0	$0.0	$0.0	$0.0
Indirect Costs (*will vary by proposer*)	$18.1	$20.0	$20.800	$17.1	$17.8	$93.8	$39.0
SUBTOTAL	$76.2	$84.3	$87.700	$72.1	$75.1	$395.4	$156.0
General Administration (9% of subtotal)	$6.9	$7.6	$7.9	$6.5	$6.8	$35.6	$14.0
PROJECT TOTAL	$83.1	$91.9	$95.6	$78.6	$81.9	$431.0	$170.0
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	0

COMMENTS:

FY12-16

Program Title: 15120114-I Conceptual Modeling
Team Leader: Tuula Hollmen

SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

13120114-P

2. Project Title: *See*, Reporting Policy at III (C) (2).

Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK 1

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Thomas Weingartner

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

February 10, 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org and http://www.ims.uaf.edu/gak1/

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

Our sampling activities include 1) quasi-monthly CTD casts at station GAK 1 (periods of sampling given in table below) and the recovery and re-deployment of a string of 6 temperature-conductivity-pressure (TCP) recorders on a mooring at GAK 1. This mooring is recovered and re-deployed annually in March of each year. After the mooring is recovered the TCPs are sent to Seabird for post-calibration.

Deliverable/Milestone	Status
February 2014 CTD cast at GAK 1	Completed
March 2014 mooring recovery and re-deployment at GAK 1	Completed
March 2014 CTD cast at GAK 1	Completed
April 2014 CTD cast at GAK 1	Completed
May CTD cast at GAK 1	Completed
June CTD cast at GAK 1	Completed
September CTD cast at GAK 1	Completed
November CTD cast at GAK 1	Completed
December CTD cast at GAK 1	Completed
January 2015 CTD cast at GAK 1	Completed

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

- Publications produced during the reporting period: **none**
- Conference and workshop presentations and attendance during the reporting period: Weingartner attended the Gulfwatch PI meeting in November 2013, the Alaska Marine Science Symposium in January 2014 and the EVOSTC Science Meeting in February 2015. The following talk was given at the AKMSS meeting in January 2015.

Kristine Holderied, kris.holderied@noaa.gov; Molly McCammon, mccammon@aoos.org; Katrina Hoffman, khoffman@pwssc.org; Stanley Rice, jeep.rice@noaa.gov; Brenda Ballachey, bballachey@usgs.gov, Thomas Weingartner, tjweingartner@alaska.edu ; Russell Hopcroft, rrhopcroft@alaska.edu

- Data and/or information products developed during the reporting period, if applicable:
  Dr. Weingartner's graduate student (James Kelly) has used the GAK 1 data sets to investigate sea level variability in Seward. The goal here is to determine the causes for sea level variations and eventually to determine if Seward Sea level can be used as a proxy for current variations in the ACC. We find that the annual cycle of sea level variations at Seward are in-phase with dynamic heath (vertically-integrated density) at GAK 1. At periods of days to ~1 month the sea level variations are significantly coherent with and in-phase with the along-shore winds over the Gulf of Alaska shelf, especially in fall, winter, and early spring. Given that the wind is also coherent with ACC transport at these periods it appears that Seward Sea level anomalies at these periods may be useful as an index of ACC transport. Mr. Kelly will graduate with an MS degree in spring 2015.
- Data sets and associated metadata that have been uploaded to the program's data portal.

All Data through 2013 has been uploaded to www.gulfwatchalaska.org and http://www.ims.uaf.edu/gak1/

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

There have been 37 publications that have used the data from GAK1 of which we are aware. These include data sets for several student theses, for use in peer-reviewed papers, and by the North Pacific Management Council in their Groundfish Stock Assessment and Fishery Evaluation Reports

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

No recommendations provided

11. Budget: *See,* Reporting Policy at III (C) (11).

Please see attached budget form for details. This project is behind in spending due to a number of factors. The State of Alaska fiscal years are offset, with billing showing through July 2014. Additionally, this project is a continuation of previously awarded EVOS funding, and during year 1, was spending the balance of previous funding packages.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$52.7	$55.1	$57.5	$60.1	$62.8	$288.2	$94.75
Travel	$1.4	$1.5	$1.5	$1.6	$1.7	$7.8	$1.95
Contractual	$22.9	$22.9	$22.9	$22.9	$22.9	$114.6	$33.07
Commodities	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.91
Equipment	$10.0	$10.0	$10.0	$10.0	$10.0	$50.1	$15.43
Indirect Costs (will vary by proposer)	$13.4	$13.8	$14.2	$14.5	$14.9	$70.8	$22.55
SUBTOTAL	$100.5	$103.2	$106.2	$109.2	$112.4	$531.5	$168.65
General Administration (9% of subtotal)	$9.0	$9.3	$9.6	$9.8	$10.1	$47.8	NA
PROJECT TOTAL	$109.5	$112.5	$115.7	$119.1	$122.5	$579.3	$168.65
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	

COMMENTS: *The General Administration line item is distributed to the management agency and is not part of the project's annual fiscal reporting. Actual expeditures are those through July 31, 2013

FY12-16	**Program Title: 15120114-P GAK1** **Team Leader: T. Weingartner**	**FORM 3A** **NON-TRUSTEE AGENCY SUMMARY**

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

13120114-J

2. Project Title: *See*, Reporting Policy at III (C) (2).

Long term monitoring: Environmental drivers component - The Seward Line: Marine Ecosystem monitoring in the Northern Gulf of Alaska.

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Russell R Hopcroft

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

Feb 4, 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org and http://www.ims.uaf.edu/gak1/https://www.sfos.uaf.edu/sewardline/

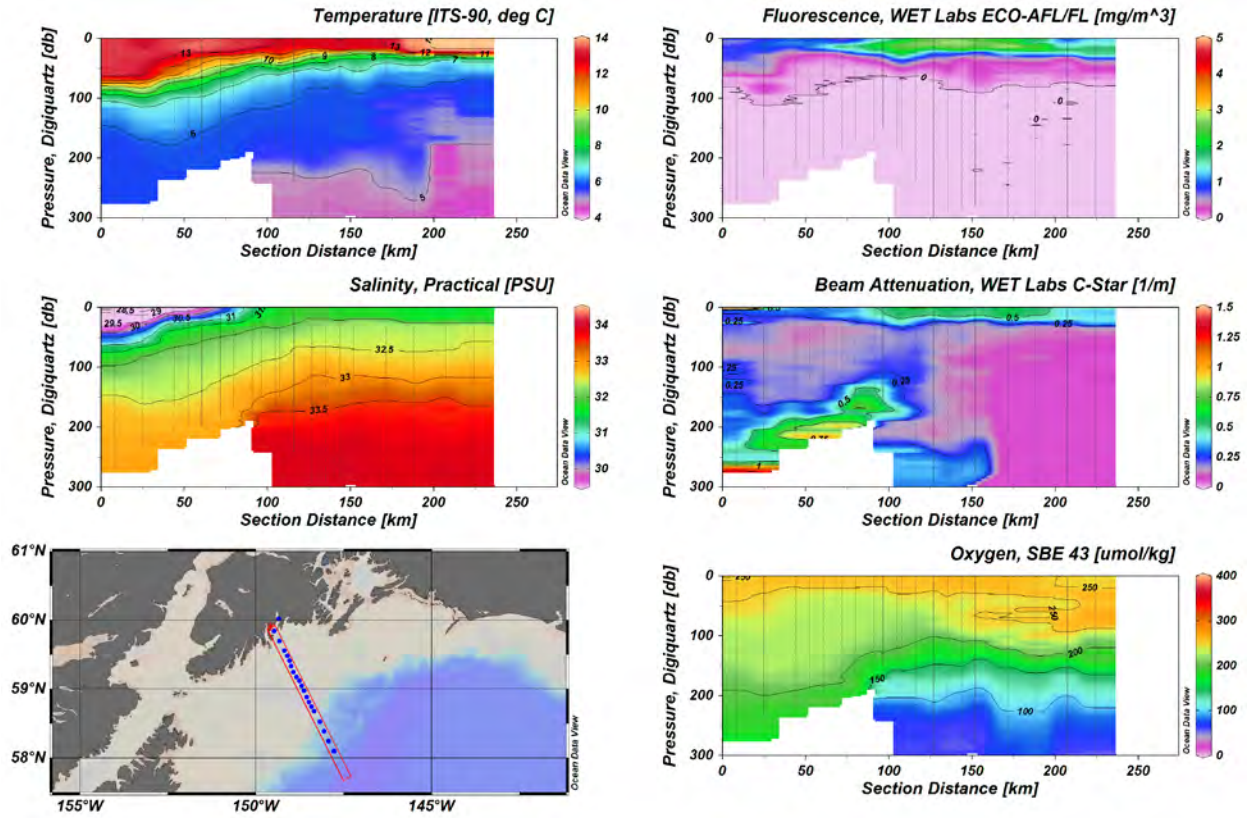
7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

This project revolves around executing multidisciplinary oceanographic cruises along the Seward Line and in PWS each May and September. The objectives that are met each cruise are:

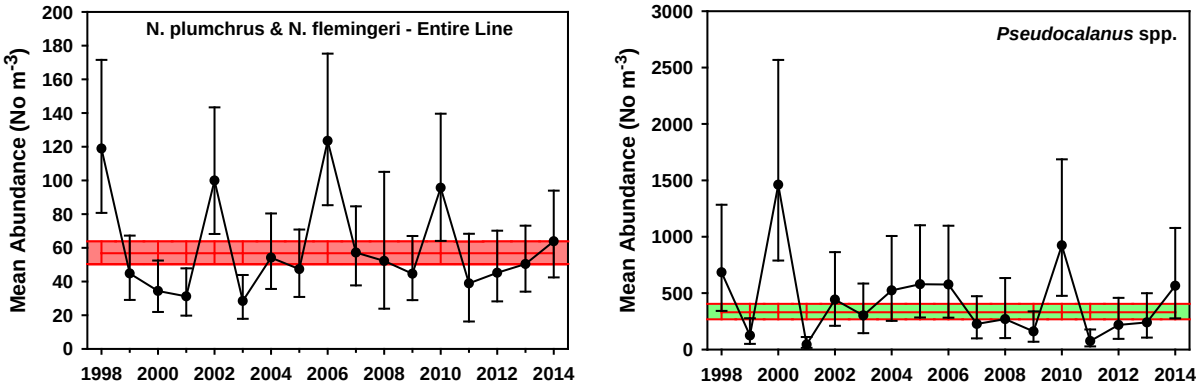
- Determine thermohaline, velocity, and nutrient structure of the Seward Line across the Gulf of Alaska shelf, and at stations throughout PWS
- Determine phytoplankton biomass and size distribution (chlorophyll)
- Determine the distribution and abundance of micro-zooplankton (starting in 2014)
- Determine the distribution and abundance of meta-zooplankton
- Opportunistically, determine rates of growth and egg production of selected key zooplankton species .
- Support determination of carbonate chemistry (i.e. ocean acidification)
- Determine distribution and composition of seabirds (& marine mammals) along the Seward Line, PWS and Kenai coastline
- Provide at-sea experience for graduate students within the University of Alaska

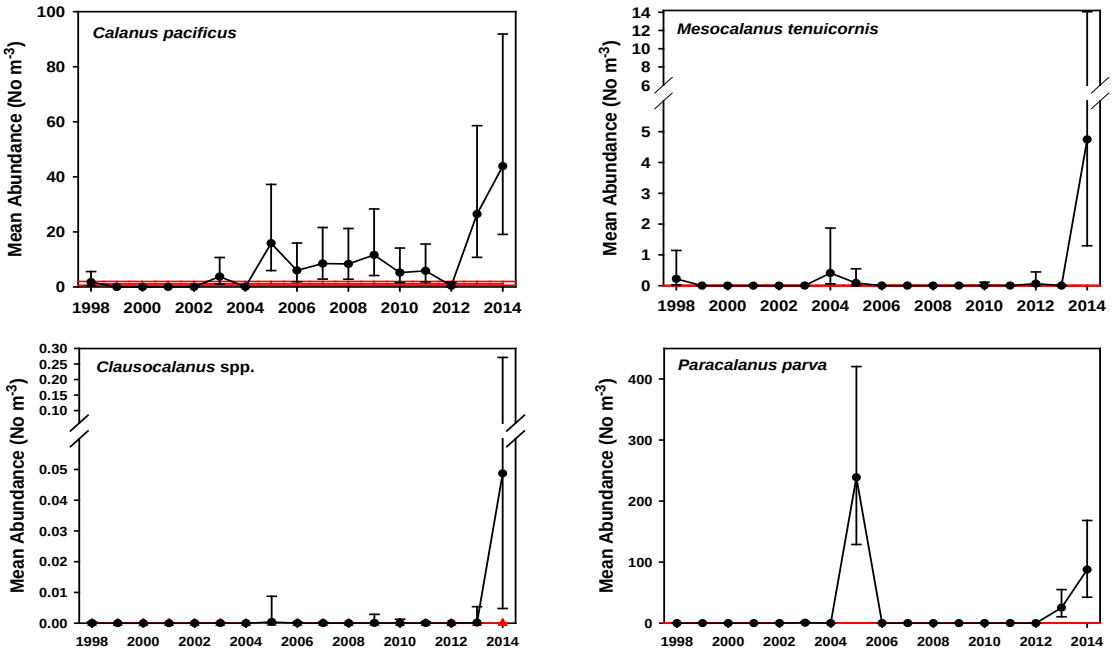
Deliverable/Milestone	Status
Execute May 2014 cruise	Completed
Execute September 2015 cruise	Completed
Attend PI meeting and AMSS to present results	Completed

The fall 2014 cruise was conducted during one of the largest warm-water anomalies observed in the North Pacific during the past 50 years. Unusually warm surface waters were observed at GAK 12 & 13 (14.3°C), as well as >13°C within most of the Alaska Coastal Current waters extending as deep as 40m! (below) Our average upper-100m temperatures for the inner GAK stations were 2.1-2.6°C above the mean for those stations, and 0.6-1.06°C at the offshore end. This made the entire line the warmest on record: 0.5°C above the next-warmest and 1.06°C above the long-term September mean. Usual weather patterns the prior winter, a weak El Nino, and a shift in the sign of the PDO all contributed to this unique situation that will likely impact 2015 as temperatures in the GoA remain nearly 2°C above normal.



Although zooplankton composition appeared typical during the May cruise (see below), by September significant numbers of southern (i.e. California Current) copepods were detected along the Seward Line. In most cases, although their abundances were low compared to the entire copepod community, they were the highest observed over the 18 years of observations along the Seward Line.





In 2014, the Seward Line provided the logistical foundation for NOAA deploying gliders and Wave-riders during May in the projects operational area, and recovering them in September, that are providing a wealth of information on physical and chemical oceanography (OA) at no cost to the project

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

8.A.:

- Dr. Hopcroft interacts with other PIs within Environmental drivers on a regular basis
- Dr. Hopcroft serves on the Gulf Watch Alaska Science Coordination committee

8.C.:

- Dr. Hopcroft is involved in other major activities in the Gulf funded by NRPB and NOAA

9. Information and Data Transfer: *See*, Reporting Policy at III (C) (9).

- 2013 datasets delivered to workspace, 2014 draft CTD data placed on workspace immediately after each cruise
- Presentations related to Seward Lime wer made at AMSS, and Ocean Science meeting in Hawaii
- Four publication arising from Seward Line sampling are in review for a special issue on the Gulf of Alaska

10. Response to EVOSTC Review, Recommendations and Comments: *See*, Reporting Policy at III (C) (10).

There were no recommendations for this project.

11. Budget: *See*, Reporting Policy at III (C) (11).

Attached – no deviations from proposed.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$28.8	$35.3	$68.8	$71.8	$75.1	$279.7	$130.0
Travel	$2.5	$2.6	$1.4	$1.5	$1.6	$9.5	$7.3
Contractual	$49.0	$3.0	$1.5	$1.5	$1.5	$56.5	$7.0
Commodities	$1.2	$3.0	$2.1	$1.5	$0.9	$8.7	$8.5
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (will vary by proposer)	$8.6	$11.0	$18.4	$19.1	$19.8	$76.9	$38.2
SUBTOTAL	$90.0	$54.9	$92.2	$95.4	$98.8	$431.4	$191.1
General Administration (9% of subtotal)	$8.1	$4.9	$8.3	$8.6	$8.9	$38.8	$17.2
PROJECT TOTAL	$98.1	$59.9	$100.5	$104.0	$107.7	$470.2	$208.3
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	

COMMENTS:

FY12-16

Program Title: 15120114-J Seward Line
Team Leader: R. Hopcroft

FORM 3A
NON-TRUSTEE AGENCY
SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See,* Reporting Policy at III (C) (1).

12120114-E

2. Project Title: *See,* Reporting Policy at III (C) (2).

Long term monitoring of oceanographic conditions in Prince William Sound

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

Robert W. Campbell

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

Feb. 1 2014 – Jan. 31 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

February 2014

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatch.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

The six planned surveys of Prince William Sound were conducted during the reporting period (table 1), and all 12 standard stations (fig.1) were occupied. All CTD data has been processed, and seasonally detrended anomalies of temperature and salinity at selected depths in central PWS are shown in fig. 2 and 3. In central PWS, temperatures were generally above average in 2014, with the largest anomalies at depth (~100 m); the anomalies were fairly large, but not record-setting like the anomalies observed in the Gulf of Alaska this year (see Hopcroft and Weingartner reports). Salinity in central PWS was above average in the first half of 2014, but consistently lower than average for the latter part of the year, presumably reflecting a warmer than average summer throughout Alaska.

Plankton, nutrient, and chlorophyll-a samples were collected from all stations with no incidents. As of January 2014 All plankton samples have been enumerated from this project (Lower Cook Inlet samples will be done in Q1 of 2015), and all chlorophyll-a filters have been run (chlorophyll analysis is done immediately after each cruise to minimize storage artefacts). Analysis of the nutrient samples continues to lag behind expectations – protocols for capillary electrophoretic (CE) analysis of macronutrients were in development by a chemistry technician at PWSSC for much of 2014, with limited success. All nutrient samples are being kept in frozen storage, and are stable indefinitely (they are 0.2 µm filtered prior to freezing). Catching up on the backlog is a priority, and given the lack of progress with the CE methodology, we began working through the backlog using standard wet-chemical techniques in Q3 of 2014. A proposal for the purchase of an automated nutrient analyzer is in progress, and a technician is expected to be hired in 2015 to assist with working through the backlog.

Spring deployment of the AMP profiling mooring was delayed somewhat by delays in the delivery of new syntactic foam insulation, and a new 1.5 kW battery from Bluefin Robotics (a software malfunction in 2013 completely discharged the battery and destroyed the cells); the mooring was deployed on April

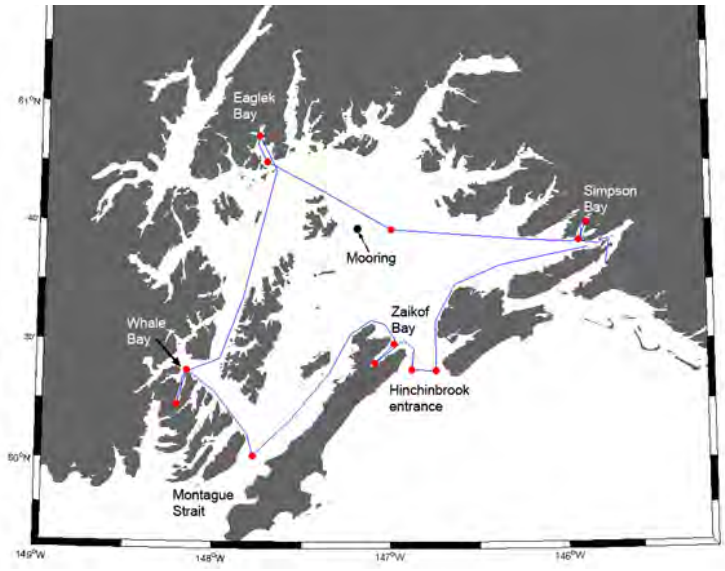
21. Following a number of very slow casts followed by a winch malfunction, the mooring was serviced on April 30th to adjust ballast and to provide more buoyancy. The system was in place for most of May and June, conducting daily casts from ~60 m to the surface. The last cast was done June 24th, after which the system was disabled by corrosion in a faulty bulkhead connector that severed the power connection. The mooring was retrieved, and the controller housing was sent back to the manufacturer in July to be repaired. It is currently operational.

The daily profiles show the setup of the seasonal thermocline as surface heating was mixed downward by wind mixing events (fig. 4). Profiles of chlorophyll-a (fig. 5) and nitrate (fig. 6) however show that the main bloom had already occurred by late April (low chlorophyll and low surface nitrate). Examination of the MODIS surface chlorophyll-a record suggests that the bloom in the central sound was very early in 2014, starting in late March and into April (fig. 7); prior observations of the bloom (e.g. Eslinger et al 2001, Fish. Oceanogr. 10[suppl. 1] :81-96) have observed it occurring well into April. The AMP system did capture several smaller productivity events that corresponded to wind mixing events in June that were visible in both the chlorophyll-a and nitrate profiles (and the satellite record). It is planned to deploy the AMP system much earlier in 2015 (mid March) to try to better capture the spring bloom.

Table 1: Status of project milestones for FY14.

Deliverable/Milestone	Status
PWS Survey, Deploy mooring	Conducted 14-15 April 2014
Mooring service	Conducted 21 April 2014
Re-deploy mooring	Conducted 30 April 2014
PWS Survey / service mooring	Conducted 15/16 May 2014
PWS Survey / service mooring	Conducted 24-25 June 2014
Retrieve mooring	Conducted 15 July 2014
PWS Survey	Conducted 19-20 August 2014
PWS Survey	Conducted 1-2 October 2014
PWS Survey	Conducted 25-26 November 2014
CTD data processed	Completed December 2014
Chlorophyll-a samples processed	Completed December 2014
Plankton samples enumerated	Completed January 2014 (this project)/ March 2015 (Doroff)

Figure 1: Map of the standard cruise track and stations, and the location of the AMP mooring.



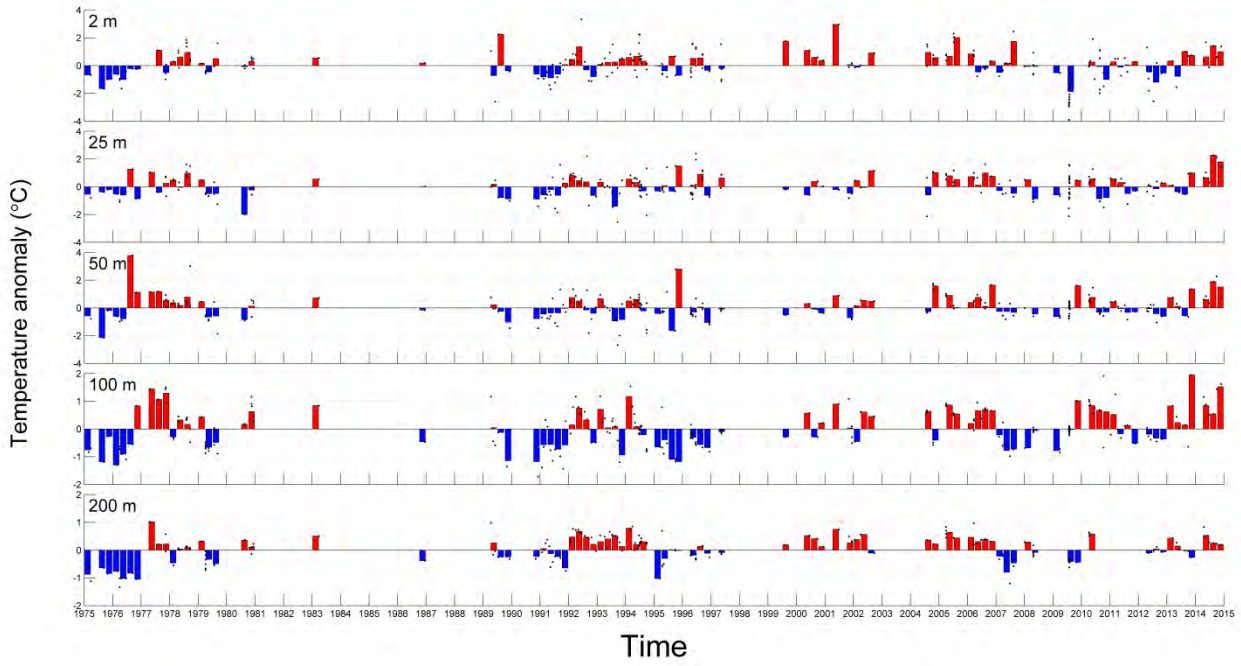


Figure 2: Temperature anomaly time series at selected depths in central Prince William Sound. Anomalies were calculated as the residual from a second order cosine fit to Julian day (for all years data) and thus represent seasonally detrended values. Vertical bars indicate quarterly average anomalies, and black dots represent individual observations.

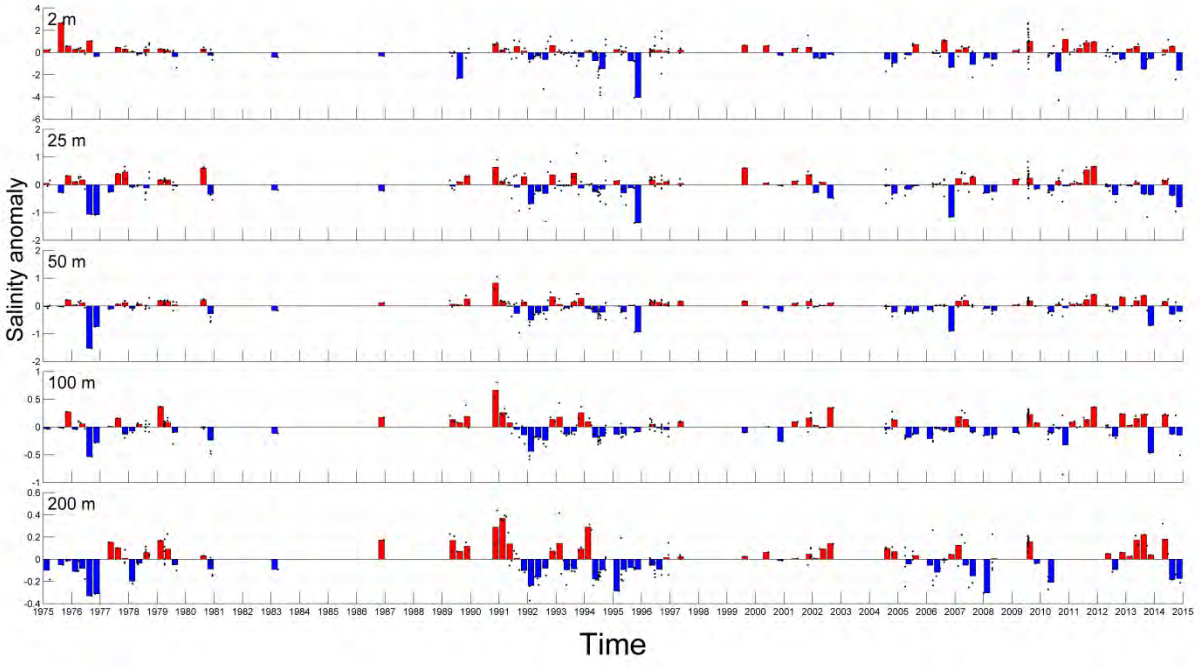


Figure 3: Salinity anomaly time series at selected depths in central Prince William Sound. Anomalies were calculated as described in fig. 2.

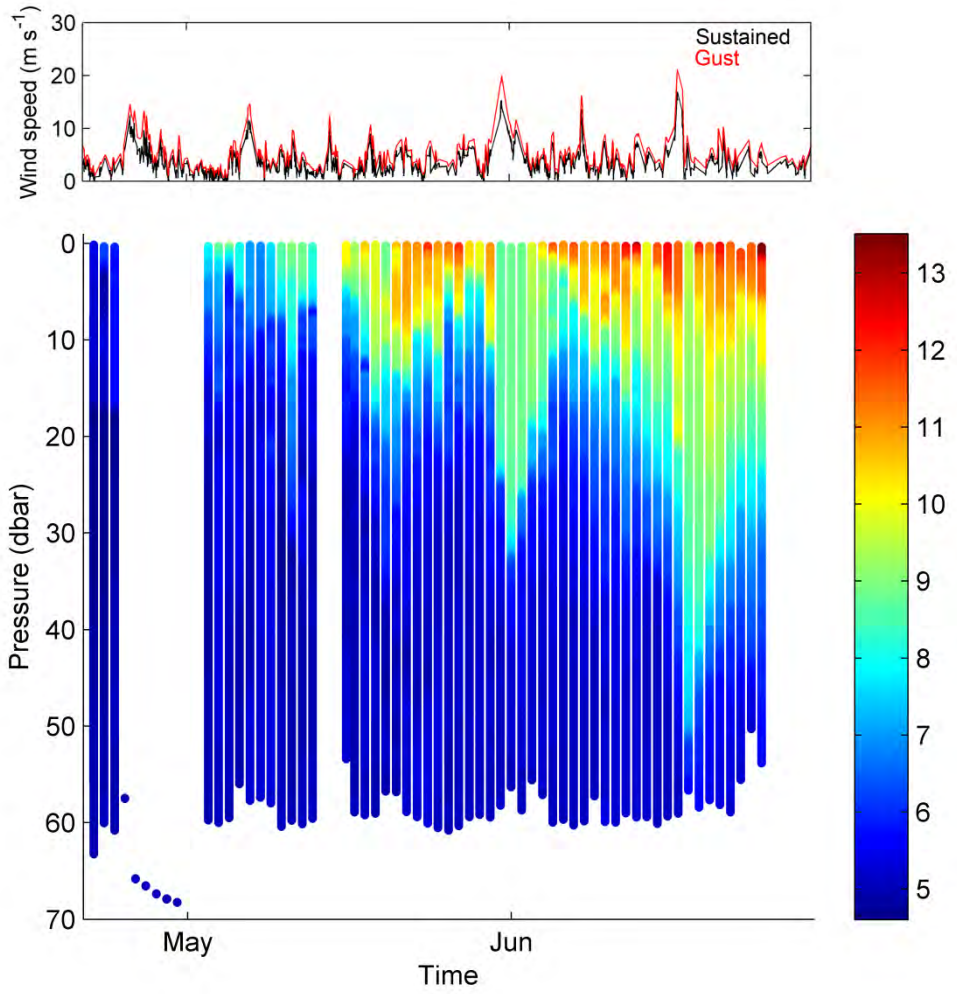


Figure 4: Top panel: Sustained (black) and gust (red) wind speeds at NDBC buoy 46060 in central PWS, 2014. Bottom Panel: Temperature profiles conducted by the AMP system during the same period. Each colored dot corresponds to the temperature scale to the right, no smoothing or interpolation was done.

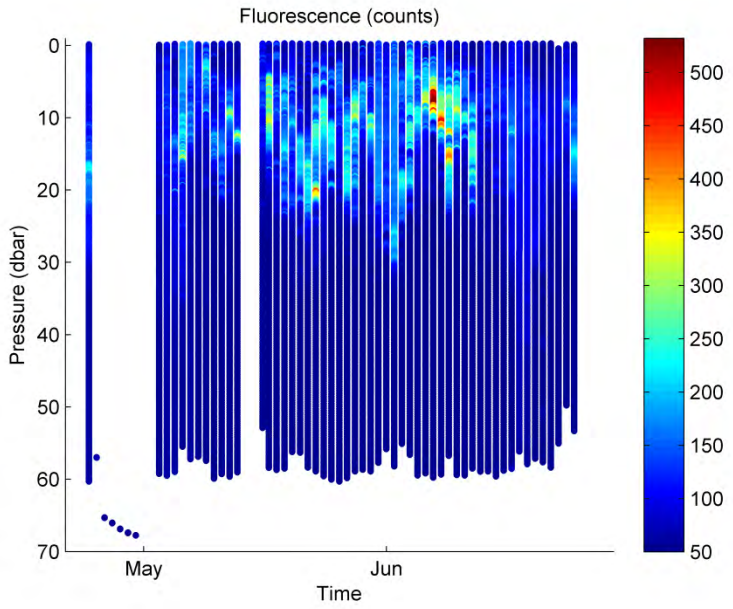


Figure 5: Fluorescence profiles at the AMP site (same axes as fig. 4). Fluorescence is given in digital counts, which are linearly proportional to cholorphyll concentration.

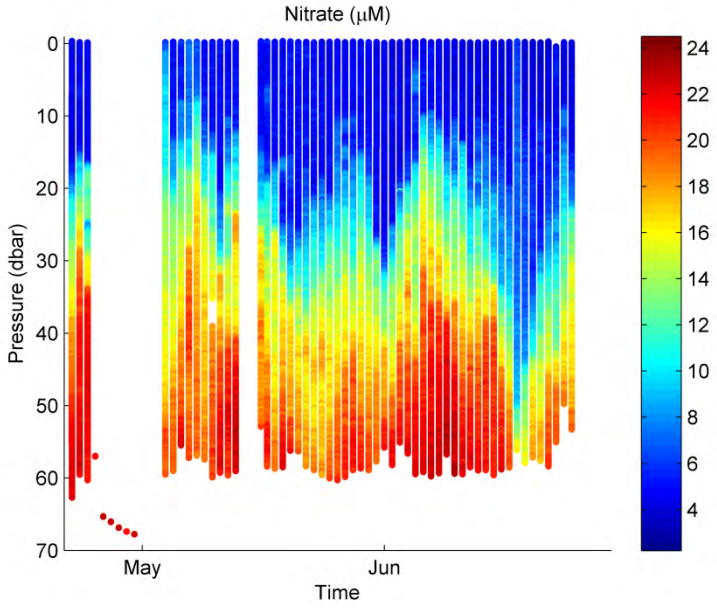


Figure 6: Profiles of nitrate concentration (μM) at the AMP site (same axes as fig. 4 and 5).

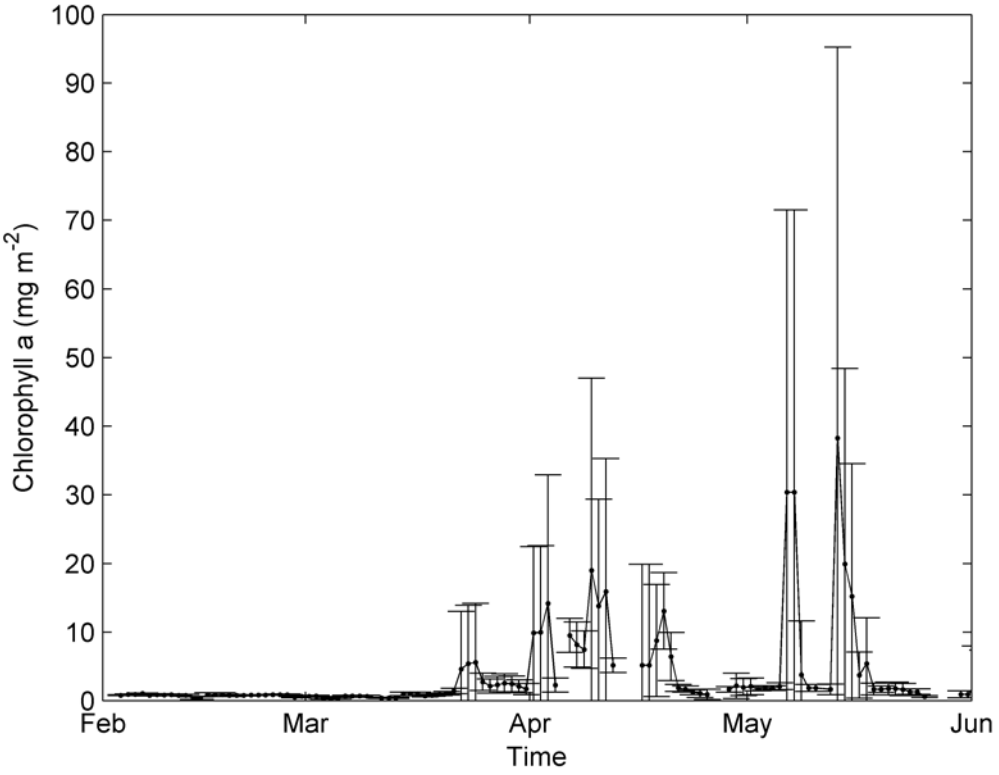


Figure 7: Surface chlorophyll time series in central Prince William Sound, spring 2014. Three day MODIS Aqua composite chl-a products were downloaded from the NOAA Coastwatch West Coast Regional Node (see http://coastwatch.pfeg.noaa.gov/infog/MB_chla_las.html for more information). Data were subsetted to a square grid in central Prince William Sound (147° 16.2' W < longitude < 147° 40.2' W and 60° 29.4'N < latitude < 60° 40.2'N). and mean (point) and standard deviations (bars) calculated for all extant pixels (i.e. ignoring cloud-obscured pixels).

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

8.A. Within the GWA and Herring Research and Monitoring program:

- All plankton samples collected as part of project 12120114G ("Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay") are processed and identified by this project.
- Plankton samples for herring disease studies (PI: Paul Hershberger) were collected from several locations during 2014 surveys.

8.B. With other EVOSTC funded projects: NA

8.C. With trustee agencies:

- Additional plankton samples were sent to the USGS Marrowstone group for tests for the presence of *Ichthyophonus* life stages.
- Photos were taken at two long term study locations for Alan Mearns (NOAA).
- Water samples were collected during several surveys to test for isotopes stemming from the 2011 Fukushima nuclear accident (project website: http://www.ourradioactiveocean.org/).

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

- Campbell, R.W. 2014. State of the Sound: Trends in the surface oceanography of Prince William Sound. Poster presented at Alaska Marine Science Symposium, January 2014.
- Campbell, R.W. 2015. Recent trends in the oceanography of Prince William Sound. Poster presented at Alaska Marine Science Symposium, January 2015.
- Joint presentation: Environmental drivers. Gulfwatch AK PI meeting, November 2014.
- All CTD, chlorophyll-a, and zooplankton data collected in FY14 have been uploaded to the ocean workspace.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

The operational protocols for this project have been revised following comments from the advisory committee and re-uploaded to the workspace.

11. Budget: *See,* Reporting Policy at III (C) (11).

Spending on personnel has been slightly behind schedule because Campbell's salary was largely covered by other projects in FY12 and 13 that needed to be spent down. The unspent salary is currently being drawn down and will also be used for additional technician time for nutrient analysis.

Travel spending has been over budget due to a miscommunication over budgeting during the proposal process. Campbell has been attending both the annual PI meeting in November, and the Alaska Marine Science Symposium in January, which has slightly exceeded the $1000/year budgeted.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$12.4	$121.6	$125.4	$131.2	$136.3	$526.8	$192.8
Travel	$0.0	$1.0	$1.0	$1.0	$1.0	$4.0	$3.8
Contractual	$1.0	$43.7	$43.7	$43.7	$43.7	$175.8	$78.5
Commodities	$0.0	$11.0	$11.0	$11.0	$11.0	$44.0	$22.7
Equipment	$205.0	$0.0	$0.0	$0.0	$0.0	$205.0	$224.3
Indirect Costs (will vary by proposer)	waived	waived	waived	waived	waived	waived	
SUBTOTAL	$218.4	$177.3	$181.1	$186.9	$192.0	$955.6	$522.10
General Administration (9% of subtotal)	$19.7	$16.0	$16.3	$16.8	$17.3	$86.0	$46.99
PROJECT TOTAL	$238.1	$193.2	$197.3	$203.7	$209.3	$1,041.6	$569.09
Other Resources (Cost Share Funds)	$23.3	$23.3	$23.3	$145.0	$135.0	$349.9	$46.60

COMMENTS: The Science Center waives Indirect Costs for this project due to its administration of the overall proposal. PWSSC provides a CTD profiler (SBE model 25plus) with several auxiliary sensors (chlorophyll fluorometer, backscatter turbidometer, oxygen sensor, solid state active fluorometer and nitrate analyser), which is used for all field surveys, and to cross-calibrate with the profiler (value ~$75K). Extracted chlorophyll-a is read on a Turner Designs TD-700 fluorometer (replacement cost ~$10K). As well as the moored profiler, PWSSC provides a pair of acoustic releases, and a 1-m diameter syntactic foam float with upward and downward looking RDI ADCP current profilers (value ~$50K). The Alaska Ocean Observing System has also contributed $10K in FY14 for surveys in PWS.

FY12-16

Program Title: 15120114-E PWS Oceanographic monitoring
Team Leader: Robert Campbell

FORM 3A
NON-TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

13120114-G

2. Project Title: *See*, Reporting Policy at III (C) (2).

Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay to understand recovery and restoration of injured near-shore species

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Angela Doroff (Kachemak Bay Research Reserve) and Kris Holderied (NOAA/National Ocean Service/National Centers for Coastal Ocean Science/Kasitsna Bay Laboratory)

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

March 1 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

Introduction (see annual work plans for more details on methods):

oceanographic surveys in lower Cook Inlet (Transects 3, 6, and 7) and Kachemak Bay (Transects 4 and 9) (Figure 1). We survey the outer Kachemak Bay and lower Cook Inlet transects quarterly with a chartered vessel and the mid-Kachemak Bay transect (Transect 9) monthly from NOAA Kasitsna Bay Laboratory small boats. Given the limits of charter vessel time funded for this project and challenging weather conditions in lower Cook Inlet, we prioritize data collection along the northern (Transect 3 – to monitor freshwater input from the upper inlet) and southern (Transect 6 – to monitor connections with the shelf) Cook Inlet transects, with sampling also conducted on the middle line (Transect 7) when conditions allow. Oceanographic data is collected at vertical stations with conductivity-temperature-depth (CTD) profilers (shown as dots on Figure 1), using Seabird Electronics 19plus CTD profilers. Plankton sampling is conducted at three of the stations along each transect. Vertical zooplankton tows are conducted with 333 µm bongo nets and surface water is filtered through 20 µm nets for phytoplankton sampling. Oceanographic and plankton sampling, including instrument calibration, data collection, sample processing, quality control, and quality assurance, are conducted in accordance with the project sampling protocols (available on the Ocean Workspace). To provide more temporal resolution, continuous oceanographic measurements are made year-round at Kachemak Bay Research Reserve (KBRR) System Wide Monitoring Program (SWMP) water quality stations at the Seldovia and Homer harbors as well as in ice-free months from a buoy in Bear Cove (Figure 1). Nutrient and chlorophyll measurements are made monthly at these stations, with concurrent testing of a chlorophyll probe for a continuous measurement capability. We continued to coordinate on oceanographic and

zooplankton sampling protocols with other principal investigators (PIs) through Environmental Drivers component group meetings. Following up on the sampling protocol discussions, we concurrently sampled zooplankton with two different net sizes (150 µm in addition to 333 µm) at some stations this year. We participated in the group effort to write the Environmental Drivers component chapter and wrote a research summary article for the Gulf Watch Alaska (GWA) program science synthesis report.

Field Sampling: Oceanographic and Plankton Surveys

Oceanographic and plankton sampling was successfully conducted monthly in Kachemak Bay and quarterly in lower Cook Inlet this year, with CTD profiler sampling at total of 391 stations. Zooplankton and phytoplankton were sampled at 84 stations, with a total of 93 zooplankton tows (two nets used at some stations) and 84 surface phytoplankton samples. The photo in Figure 2 shows an example of a zooplankton sample from October 2014. All planned transects were surveyed, with the exception that adverse winter conditions (see photo in Figure 3) prevented sampling along part of Transect 7 and all of Transect 6 in Cook Inlet in February 2014 and only CTD data was collected along Transect 9 in January 2015. We leveraged funding from the NOAA Integrated Ocean Observing Program/Alaska Ocean Observing System (AOOS) to conduct additional along-bay surveys in Kachemak Bay in March and May 2014, as well as an intensive small boat CTD survey during August 2014, to better assess tidal and spatial variability of marine conditions in the bay. The sample collection dates and locations to date for this project are summarized in Table 1.

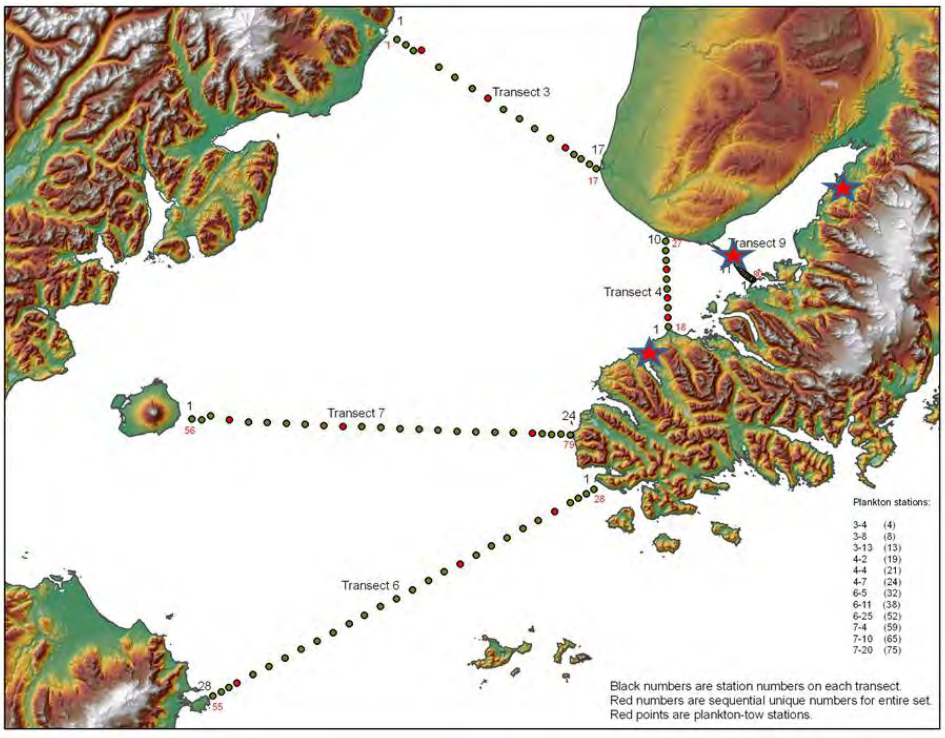


Figure1. Lower Cook Inlet and Kachemak Bay transects and sampling station locations for oceanographic sampling by CTD (all stations marked with dots) and phytoplankton and zooplankton sampling (red dots). Transects 3, 4, 6, and 7 are sampled quarterly and Transect 9 is sampled monthly. Stars indicate the location of water quality and nutrient monitoring stations in Kachemak Bay at the Homer and Seldovia Harbors and seasonally in Bear Cove.

	Table 1. Data and samples collected during 2012-2015 in Lower Cook Inlet (Transects 3, 6 and 7) and in Kachemak Bay (Transects 4 and 9) for the Environmetnal Drivers Gulf Watch Alaska Program.																				
			CTD				ZOOPLANKTON					PHYTOPLANKTON					OCEAN ACIDIFICATION				
			Transect No.				Transect No.					Transect No.					Transect No.				
Month	Year	3	4	6	7	9	3	4	6	7	9	3	4	6	7	9	3	4	6	7	9
April	2012					10					4					2					
May	2012	16	10	27	18	21	3	3	3	3	6	3	1	3	3	12	1	1	1	3	
June	2012					20					6					6					1
July	2012	16	10	28	12	11	3	3	3	2	3	3	3	3	2	3	2	2	3	2	
August	2012					10					3										
October	2012	15	10	28	17	10	1		3	3	3	1		3	3	3		1	5	4	
	Σ=	47	30	83	47	82	7	6	9	8	25	7	4	9	8	26	3	4	9	9	1
January	2013					10					3					3					
February	2013		10			11					3		3			3		2			
March	2013					10					3					2					2
April	2013	16	10	23	24	10	3	3	3	3	3	3	3	3	3	2	2	1	4	3	1
May	2013					10					3					3					3
July	2013	16	10	28	23	10	3	3	3	3	3	3	3	3	3	3			4	4	
August	2013					10					3					3					
September	2013					10					3					3					
October	2013		10			10		4			3		7			9					2
November	2013	16		20			3		3			3		3							
December	2013					10					3					3					
	Σ=	48	40	71	47	101	9	10	9	6	30	9	16	9	6	34	2	3	8	7	8
January	2014					10					3					3					
February	2014	16	10		12	10	3	3		3	3	3	3		3	4					
March	2014					9					5					3					
April	2014	16	10	28	23	10	3	3	3	3	3	3	3	3	3	3					
May	2014					9					3					3					1
June	2014					11					3					3					
July	2014	17	10	27	22	12	3	4	7	6	3	3	3	3	3	3	2	2	6		1
August	2014		10			19		3			5		3			6					
October	2014	16	10	22	22	10	3	3	3	3	3	3	3	3	3	3	2	2	4	2	2
November	2014					10					3					2					
December	2014					10					3					3					
January	2015					10					0					0					
	Σ=	65	50	77	79	130	12	16	13	15	37	12	15	9	12	36	4	4	10	2	4

Table 1. Lower Cook Inlet and Kachemak Bay transects and sampling station frequency for CTD, phytoplankton, zooplankton, and water samples for ocean acidification sampling for project years 2012-2014.

Figure 2. Angela Doroff with zooplankton sample taken during October 2014 Cook Inlet survey.

Figure 3. Brad Garasky waits for next CTD station during February 2014 Cook Inlet oceanographic survey.

Oceanographic survey monitoring:

Oceanographic profile data were processed with standard Seabird Electronics algorithms, exported to Excel spreadsheets, entered in an Access database and visualized in graphs of salinity, temperature, density profiles, along-transect contour maps and anomaly time series plots (used in publications and presentations listed in Section 8 of this report). We are leveraging the CTD data collected as part of this study and the KBRR SMWP station data to validate hindcasts of the newly developed National Ocean Service (NOS) Coast Survey Development Laboratory ocean circulation model of Cook Inlet and Kachemak Bay. The validation effort is being conducted by KBRR and University of Alaska Fairbanks with additional grant funding. The figures below provide two examples of initial observation-model comparisons for 2012 surveys along Transect 3 in central Cook Inlet (Figure 4) and along Transect 4 in outer Kachemak Bay (Figure 5).

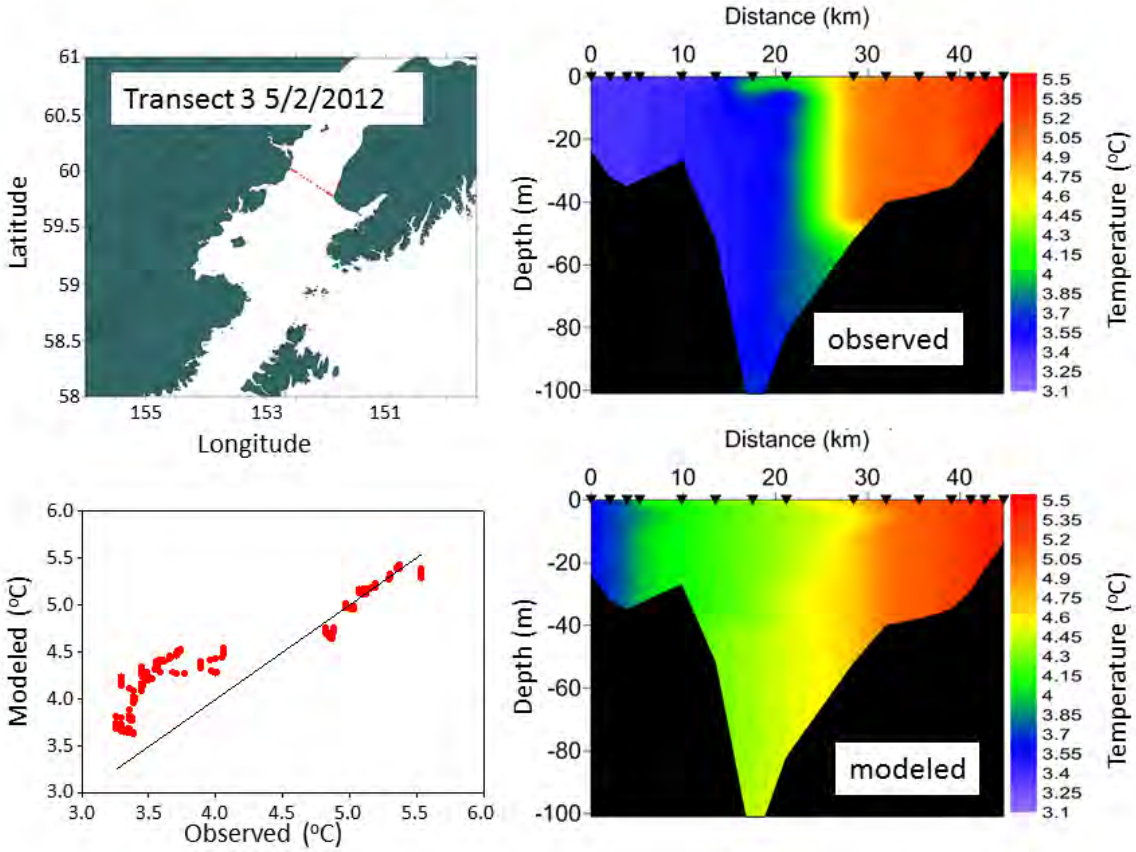


Figure 4. Comparison of observed and modeled water temperatures along Transect 3 in central Cook Inlet in May 2012. Map shows transect location. Contour plots on right show observed (top) and modeled (bottom) temperatures from surface to bottom and east (left) to west (right) across the transect. Note observational evidence of vertical mixing and strong horizontal temperature gradients during this survey. Scatter plot at lower left compares model and observed data at the same locations.

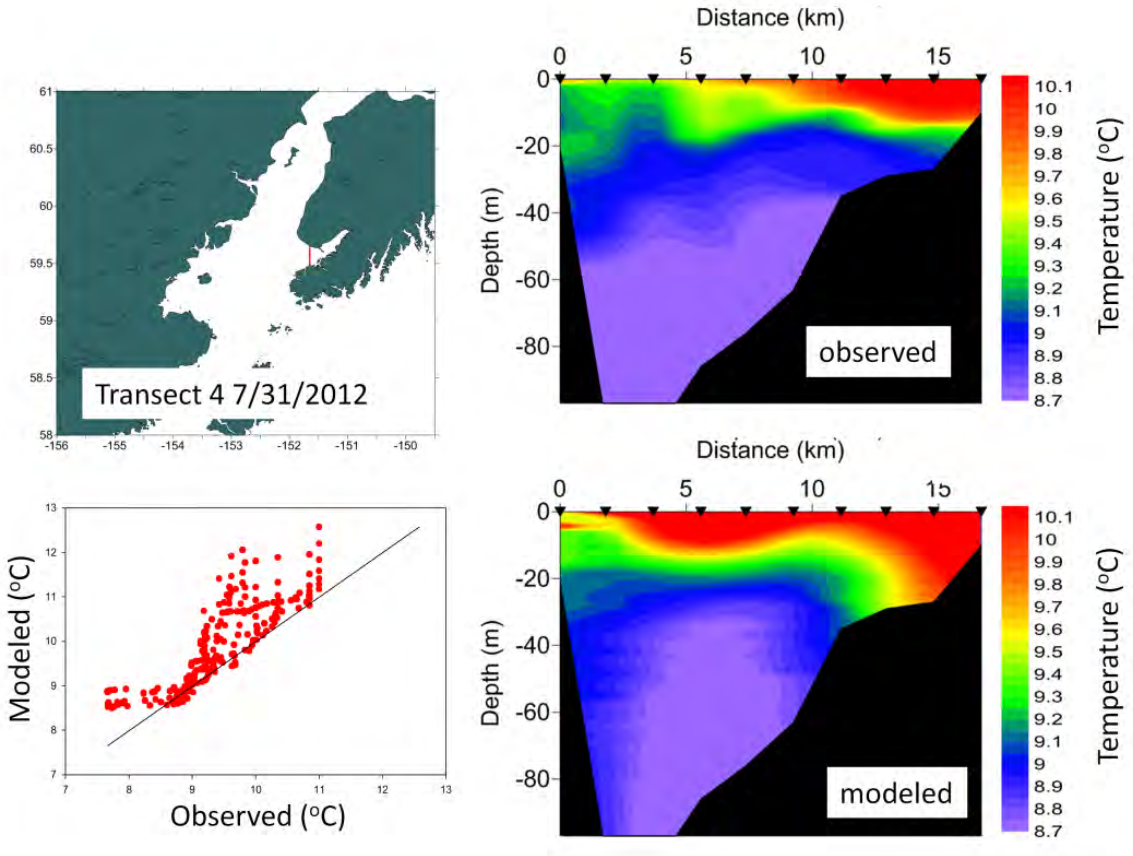


Figure 5. Comparison of observed and modeled water temperatures along Transect 4 in outer Kachemak Bay in July 2012. Map shows transect location. Contour plots on right show observed (top) and modeled (bottom) temperatures from surface to bottom and south (left) to north (right) across the transect. Note observational evidence of vertical temperature stratification during this survey. Scatter plot at lower left compares model and observed data at the same locations.

Water Quality Monitoring

Continuous data collection and reporting continued throughout year 3 for the KBRR SWMP stations for meteorological, water quality, and monthly nutrient samples; all data are being quality controlled and archived through the NERR's Central Data Management Office, with near real-time access to provisional water quality station data in Seldovia and Homer. A YSI moored buoy system was used to deploy an additional oceanographic data sonde in Bear Cove from late March to November 2014. During ice-free months in Kachemak Bay, all three surface data sondes also monitor chlorophyll-a. The Bear Cove mooring data were telemetered to provide researchers and local oyster farmers real-time access to the water quality data. Near real-time data access was provided through the AOOS data portal.

Zooplankton Sampling

During this reporting period, 93 zooplankton samples were collected (Table 1), preserved, and are being analyzed at the Prince William Sound Science Center (PWSSC) in collaboration with Rob Campbell and his GWA oceanography monitoring project in the Sound. Sample analyses are complete through February 2014 and all remaining year 3 samples have been delivered to PWSSC. For 2013, Figure 6

provides a seasonal comparison of zooplankton species presence and relative abundance. Our next steps with the data are to 1) complete sample analysis for 2014, 2) stratify the zooplankton samples by day and night time periods, 3) coordinate sample analyses across studies sites with other Gulf Watch Alaska projects, 4) analyze supplementary samples collected using a 150 micron mesh size net to assess potential capture of early life stages of small and large copepods, 5) evaluate zooplankton sampling relative to the water stratification identified in the CTD at each collection site, and 6) evaluate the sampling location along the transect for the zooplankton samples with respect to potential convergence zones based on bathymetry.

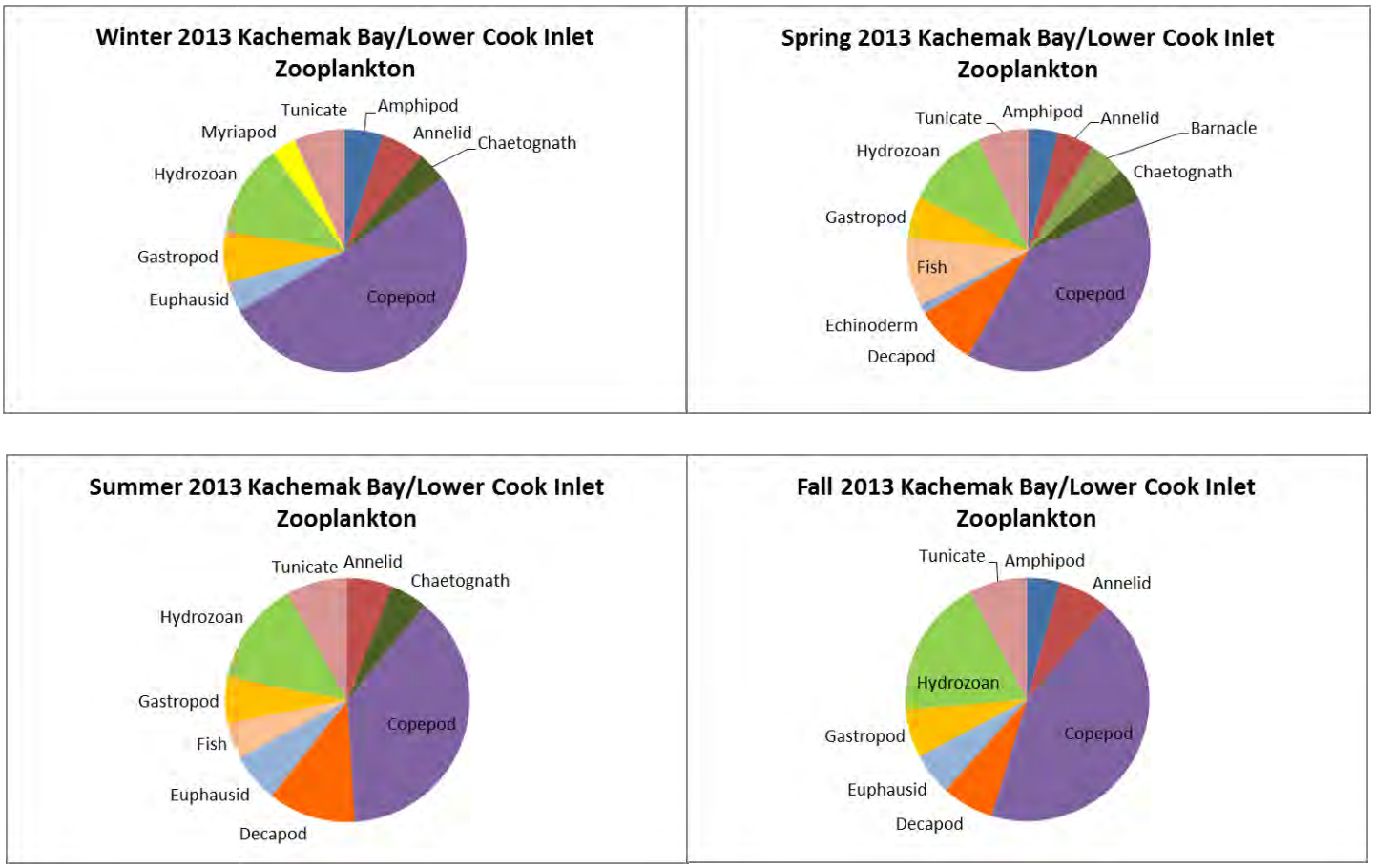


Figure 6. Seasonal zooplankton species presence and relative abundance in 2013 from Kachemak Bay and Cook Inlet surveys.

Phytoplankton Sampling

In year 3, we collected and processed 84 phytoplankton samples from filtered surface water samples collected, preserved, and analyzed during our sampling efforts in lower Cook Inlet and Kachemak Bay. Phytoplankton samples were collected during all monthly and quarterly shipboard surveys, at the same stations where zooplankton sampling was conducted. Phytoplankton samples were visually identified and enumerated using a light microscope and volumetric Palmer counting cells at NOAA Kasitsna Bay Laboratory. A subset of the samples was also analyzed at the NOAA/NOS/National Centers for Coastal Ocean Science (NCCOS) laboratory in Beaufort NC, using the more sensitive molecular technique of quantitative polymerase chain reaction assay (qPCR).

This project has improved the time series and geographic scope for existing phytoplankton monitoring for harmful algal species conducted by KBL and KBRR. The phytoplankton species that cause paralytic shellfish poisoning, Alexandrium fundyense, were found at all Kachemak Bay sampling locations throughout the summer, although at relatively low concentrations. A. fundyense concentrations were found to be significantly correlated with both water temperature and salinity conditions.

Recent Results and Scientific Findings

The anomalously warm 2014 weather conditions in the Gulf of Alaska were reflected in warm water temperatures at the KBRR water quality station at Seldovia, with July temperatures above 12 degrees C and a monthly average temperature of nearly 12 C (Figure 7). Water temperatures have not been observed to be this warm since the summer of 2005. Monthly averaged water temperatures were warmer than the 2004-2014 average for all months in 2014, with anomalies of greater than 1.5 C in January, August and November 2014 (Figure 8). We are partnering with NOAA and UAF to validate a Cook Inlet ocean circulation model and oceanographic and plankton data are being used in NOAA studies to understand triggers of paralytic shellfish poisoning events. We conducted an initial comparison of estuary conditions within Cook Inlet and Kachemak Bay with marine conditions on the adjacent Gulf of Alaska shelf at the GAK1 mooring (Weingartner project). Results are provided in an article authored by Holderied and Weingartner in the GWA science synthesis document submitted to EVOSTC in December 2014, entitled "Linking Variability in Oceanographic Patterns Between Nearshore and Shelf Waters Across the Gulf of Alaska". One interesting result was that the water temperature time series at the Seldovia water quality station and in near-surface waters at GAK 1 are coherent for time periods greater than three months, but independent at shorter time scales (see synthesis report for details). The similarity of inner shelf and estuary temperature series at low frequencies has potential implications for a more synchronous response of the Gulf of Alaska marine system to inter-annual and basin-scale climate forcing, while spatial variability in ocean conditions at shorter periods could drive spatial heterogeneity in primary and secondary production, as well as in forage fish populations. Spatial variability also has implications for determining ongoing monitoring needs for ocean conditions within the region.

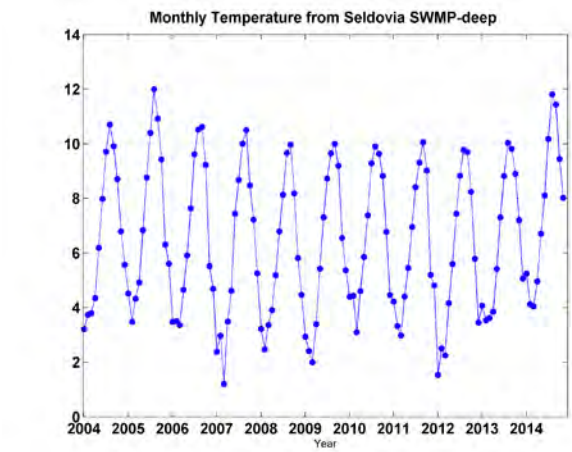


Figure 7. Monthly averaged temperature calculated from near bottom sonde at the Seldovia SWMP station from Jan 2004-Oct 2014.

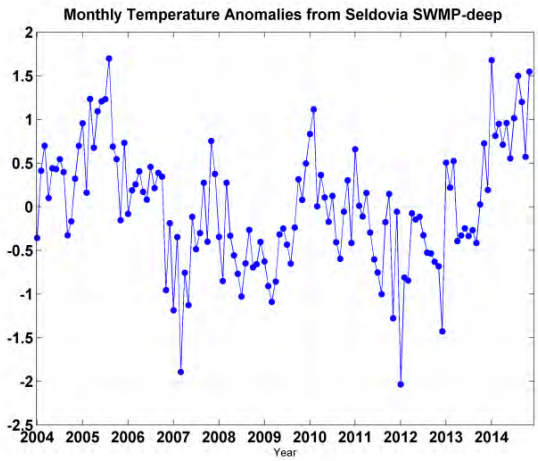


Figure 8. Monthly temperature anomalies calculated from near bottom sonde at the Seldovia SWMP station compared to Jan 2004-Oct 2014 monthly average.

Deliverable/Milestone	Status
Monthly Kachemak Bay CTD & plankton surveys	Completed. Only CTD data collected in Jan 2015.
Quarterly lower Cook Inlet/Kachemak Bay CTD & plankton surveys	Completed. February (T3,T4,T7 (partial)), April, July, Oct-Nov 2014
Annual PI Meeting and AMSS PI meeting	Completed. Holderied attended November 2014 PI meeting. Doroff and Holderied attended PI meeting at AMSS in January 2015.
Present work at Alaska Marine Science Symposium	Completed January 2015

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

a) Collaborations with the Gulf Watch Alaska and Herring Research and Monitoring programs.

1) *Environmental Drivers component*: We continued to coordinate on oceanographic and zooplankton sampling protocols and monitoring results with other Environmental Drivers component PIs (Weingartner, Hopcroft, Batten, Campbell) through teleconferences and in breakout discussions at the annual PI meeting. Following up on the sampling protocol discussions, we concurrently sampled zooplankton with two different net sizes (150 μm in addition to 333 μm) at some stations this year and will discuss those results with the group when the analyses are complete. We participated in the group effort to write the Environmental Drivers component chapter and Holderied and Weingartner wrote a research summary article for the Gulf Watch Alaska (GWA) program science synthesis report.

2) *Pelagic component*: We continued to coordinate with Kathy Kuletz of the USFWS Migratory Bird Management office to host a seabird/marine mammal observer on our quarterly Cook Inlet surveys, with the goal of improving understanding of relationships between marine conditions, primary productivity, and seabird and marine mammal populations. Starting in federal FY15, USFWS is also leveraging funding from a separate Cook Inlet project with the Bureau of Ocean Energy Management (BOEM) to support the seabird and marine mammal observing effort.

Survey Year	On Transect	Off Transect	Total
2012	64	16	80
2013	64	70	134
2014	49	43	92

Table 2. Summary of sea otter sightings on and off transect during 2012-2014 in Kachemak Bay and lower Cook Inlet concurrent with oceanographic sampling events.

3) *Herring Research and Monitoring Program*: We continue to have informal discussions on oceanographic patterns and relationships between marine conditions and plankton, herring and forage fish populations with the HRM program lead (Scott Pegau), to compare conditions between Prince William Sound and Cook Inlet.

b) Collaborations with other Trustee Council-funded projects not part of integrated programs.

N/A

c) Collaborations with Trustee or Management Agencies

1) *NOAA/National Ocean Service/National Centers for Coastal Ocean Science.* We continue to collaborate with researchers at our NOS/NCCOS Beaufort Laboratory in North Carolina to use the oceanography and phytoplankton sampling data to identify environmental triggers for increases in the phytoplankton species (*Alexandrium* spp.) that cause paralytic shellfish poisoning events.

2) *NOAA/National Ocean Service/Office of Coast Survey and University of Alaska Fairbanks*. Oceanographic data from this project and historical sampling in Cook Inlet are contributing to the validation of the ROMS ocean circulation model developed for Cook Inlet by the NOS/Coast Survey Development Laboratory. NOS provided the model code to UAF (G. Gibson) and KBRR and UAF are collaborating on a two year project to use circulation information to improve monitoring for paralytic shellfish poisoning events, entitled "Synthesis of Oceanographic Data to Aid Monitoring Programs for Harmful Algal Blooms in Kachemak Bay, Alaska".

3) *NOAA/NOS Kasitsna Bay Laboratory, Alaska Ocean Observing System (AOOS) and UAF*.

We continued to collaborate in year 3 with AOOS and UAF to quantify variability in water chemistry associated with ocean acidification in Kachemak Bay and lower Cook Inlet. We leveraged charter ship time from the EVOSTC project to periodically collect water samples at CTD stations for carbonate chemistry analysis at UAF. Coastal water chemistry changes with freshwater input from glacial watersheds and snowmelt, upwelling of ocean waters and phytoplankton blooms and understanding this variability is needed to assess how much ocean acidification may threaten nearshore species and habitats. FY14 funding ($25K) was provided to KBL by NOAA's Integrated Ocean Observing System (IOOS).

4) *NOAA Kasitsna Bay Laboratory and BOEM*:

NOAA KBL and BOEM have also initiated a collaboration to update information on marine conditions and ecological linkages in Cook Inlet, to support BOEM's environmental analysis for potential oil and gas lease sales in the region. BOEM is providing an initial $75K to conduct seasonal Cook Inlet surveys and oceanographic data analysis to support their environmental analysis needs for potential oil and gas lease sales in the region. The BOEM funding will allow us to maintain quarterly Cook Inlet cruises in Year 4, for which there was not sufficient funding available under our original EVOSTC proposal.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

a) Publications

Hoem Neher, T., B. Ballachey, K. Hoffman, K. Holderied, R. Hopcroft, M. Lindeberg, M. McCammon, and T.Weingartner, editors. In review. Quantifying temporal and spatial variability across the northern Gulf of Alaska to understand mechanisms of change. Gulf Watch Alaska program science synthesis report. Submitted to the Exxon Valdez Oil Spill Trustee Council, December 1, 2014.

Batten, S., R. Campbell, A. Doroff, K. Holderied, R. Hopcroft and T. Weingartner. In review. Chapter 2: Environmental Drivers: Regional Variability in Oceanographic Patterns across the Gulf of Alaska. In Quantifying temporal and spatial variability across the northern Gulf of Alaska to understand mechanisms of change. Gulf Watch Alaska program science synthesis report. Submitted to the Exxon Valdez Oil Spill Trustee Council, December 1, 2014.

Holderied, K. and T. Weingartner. In review. Linking Variability in Oceanographic Patterns Between Nearshore and Shelf Waters Across the Gulf of Alaska. In Quantifying temporal and spatial variability across the northern Gulf of Alaska to understand mechanisms of change. Gulf Watch Alaska program science synthesis report. Submitted to the Exxon Valdez Oil Spill Trustee Council, December 1, 2014.

b) Conference/workshop presentations and attendance

Kibler, S and D. Hondolero. 2014. "Harmful Algal Blooms: Better Tools for Detection and Quantification". Public talks in Seldovia, AK and Homer AK. August 2014.

Holderied,K. 2014. Oral presentation on Gulf Watch Alaska program, Cook Inlet oceanography and plankton monitoring and implications for developing decision support tools for paralytic shellfish poisoning events. NOAA Ecological Forecasting Webinar in Anchorage, AK. September 2014.

Holderied, K.,M. McCammon, K. Hoffman, T. Neher, T. Weingartner, R. Hopcroft, M. Lindeberg and B. Ballachey. 2015. “Gulf Watch Alaska: Monitoring the Pulse of the Gulf of Alaska’s Changing Ecosystems”. Oral presentation at Alaska Marine Science Symposium, Anchorage AK. Jan 2015.

Hondolero D. and K. Holderied. 2015. “Monitoring Phytoplankton in Kachemak Bay, Alaska”. Poster presentation at Alaska Marine Science Symposium, Anchorage AK. Jan 2015.

c) Data/information products

No formal data products have been developed beyond those produced for the publications and presentations listed above. However for the synthesis report discussions and AMSS and EVOSTC joint science workshop, numerous graphics have been produced of oceanographic time series plots, time series anomalies, comparisons of temperatures between different regions (e.g. GAK1 and Seldovia), and along-transect vs depth contour plots (e.g. Figures 7 and 8 in this report).

d) Data sets uploaded to the data portal

- CTD data sets and associated metadata from 2012, 2013 and part of 2014 have been uploaded to the AOOS Ocean Workspace. 2012 data has been published on the Gulf Watch Alaska data

portal, and we are currently working with Axiom to revise CTD data formats for the data portal and streamline provision of data in both csv and netCDF file formats for all our data.

- Zooplankton data and associated metadata that has been analyzed through 2013 have been posted on the AOOS Ocean Workspace but have not yet been uploaded to the data portal.
  SWMP water quality data from Bear Cove, Homer and Seldovia water quality data sondes and associated metadata through 2013 have been uploaded to the Ocean Workspace and are published on the Gulf Watch Alaska data portal. Data are also publicly available through 2014 on the NOAA National Estuarine Research Reserve site: http://cdmo.baruch.sc.edu/

10. Response to EVOSTC Review, Recommendations and Comments: *See*, Reporting Policy at III (C) (10).

N/A for this project.

11. Budget: *See*, Reporting Policy at III (C) (11).

See attached budget sheets for Doroff (ADFG/KBRR) and Holderied (NOAA/KBL) in the consolidated GWA budget spreadsheet.

KBRR Budget Narrative: In Year 1 of the project, KBRR leveraged our LTM grant to obtain $102K for new water quality monitoring equipment to have Chl_a probes at each of the water quality monitoring sites in Kachmak Bay. In kind annual contributions are as follows: $120K KBRR SWMP; $5K KBRR CTD use. Overall, the KBRR portion of the grant was 30% underspent at the close of project year 3; outstanding contracts for ship charter time are the primary reason. Budget Line items over 10% are as follows: Personnel (0.01) underspent; Travel (1.46) underspent; PI was unable to attend the Nov 2014 PI meetings in project years 2 & 3 due to schedule conflicts; Contractual (1.60) underspent; funds will be applied to ship charter time Feb, Apr, Oct in project year 4; Equipment (0.64) underspent in project year 3 (we did not yet calibrate the CTD or replace probes on the YSI sonde and will be incurring those costs early in project year 4 of the study). Application of carry over funding to ship charter time will allow quarterly sampling (up to 4 surveys in year 4 and 2 surveys in year 5) without requesting additional EVOSTC funding. Underspending to date is largely due to additional grant funds ($102K) in project year 1that have resulted in carry over funding.

NOAA/KBL Budget Narrative: In-kind contributions from KBL include CTD equipment ($5.0K/year, $15K total for years 1-3), KBL laboratory staff salary ($25K/year, $75K total for years 1-3). Additional leveraged funding includes $25K funding from AOOS for Kachemak Bay oceanographic monitoring ($75K total for years 1-3) and $75K funding received from BOEM in FY15 to sustain Cook Inlet oceanographic monitoring. Spending on this project has been significantly delayed due to our ability to leverage other funding for some boat operations, which will enable us to sustain seasonal monitoring longer into years 4 and 5 of the project than had been planned in our original proposal. In addition, planned purchases of new oceanography sensors were delayed due to better than expected equipment endurance and purchase of a field computer was not completed due to a change in IT acquisition policies (the computer has been provided in-kind by NOAA). Overall the project is underspent by $52.5K ($25.7 in commodities, $12.7K in equipment, $7.5K in contracts and $3.9K in travel). We proposed in our Year 4 work plan to use some savings from prior year commodity purchases and travel (limited by federal travel restrictions) to establish contracts for nutrient, carbonate chemistry and data analysis contracts in FY15. We also expect to apply computer purchase savings to acquire new oceanographic equipment in FY15.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$66.0	$69.3	$72.8	$64.2	$63.2	$335.5	$103.8
Travel	$7.8	$7.8	$7.8	$12.7	$7.8	$44.1	$12.8
Contractual	$52.3	$54.3	$54.3	$28.3	$14.3	$203.5	$66.5
Commodities	$21.1	$23.6	$17.8	$17.4	$14.5	$94.4	$24.0
Equipment	$28.8	$7.7	$0.0	$0.0	$0.0	$36.5	$12.0
Indirect Costs (*will vary by proposer*)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
SUBTOTAL	$176.0	$162.7	$152.7	$122.7	$99.8	$714.0	$219.2
General Administration (9% of subtotal)	$15.8	$14.6	$13.7	$11.0	$9.0	$64.3	$19.7
PROJECT TOTAL	$191.9	$177.4	$166.5	$133.7	$108.8	$778.2	$238.9
Other Resources (Cost Share Funds)	$180.0	$180.0	$180.0	$255.0	$155.0	$950.0	$540.0

COMMENTS:
NOAA Kasitsna Bay Laboratory: In kind contribution: CTD equipment ($5K for year 3, $25K total for FY12-16); NOAA KBL laboratory staff salary ($25K for year 3, $125K total for FY12-16). Additional leveraged funding: $25K funding received from AOOS ($100K total for FY12-FY15) for Kachemak Bay oceanography and ocean acidification monitoring. $75K funding received from BOEM in FY15 for Cook Inlet oceanographic monitoring.
KBRR: In kind annual contributions: $120K KBRR SWMP, $5K CTD. We leveraged our LTM grant to obtain $102K for new water quality monitoring equipment to have Chl_a probes at each of the water quality monitoring sites in Kachemak Bay in Yr1 of the study.
The combined in kind contributions from KBRR & KBL to date for this project have been $567K.

FY12-16

Project Title: 15120114-G Kachemak Bay/Cook Inlet Oceanography
Team Leaders: Angela Doroff, Kris Holderied

SUMMARY

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$66.0	$69.3	$72.8	$64.2	$63.2	$335.5	$103.8
Travel	$3.7	$3.7	$3.7	$6.1	$3.7	$20.9	$4.2
Contractual	$49.8	$51.8	$51.8	$25.8	$11.8	$191.0	$66.5
Commodities	$8.1	$16.6	$10.8	$8.4	$8.5	$52.4	$22.7
Equipment	$23.8	$0.0	$0.0	$0.0	$0.0	$23.8	$12.0
SUBTOTAL	$151.4	$141.4	$139.0	$104.6	$87.2	$623.5	$209.2
General Administration (9% of subtotal)	$13.6	$12.7	$12.5	$9.4	$7.8	$56.1	NA
PROJECT TOTAL	$165.0	$154.1	$151.6	$114.0	$95.0	$679.6	$209.2
Other Resources (In kind Funds)	$125.0	$125.0	$125.0	$125.0	$125.0	$625.0	$250.0

COMMENTS: We leveraged our LTM grant to obtain $102K for new water quality monitoring equipment to have Chl_a probes at each of the water quality monitoring sites in Kachemak Bay in Yr1 of the study. In kind annual contributions for Year 3: $120K KBRR SWMP, $5K KBRR CTD.

FY12-16

Project Title: 15120114-G Kachemak Bay/Cook Inlet Oceanography
Team Leader: Angela Doroff

FORM 4A
TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

12120114-A

2. Project Title: *See*, Reporting Policy at III (C) (2).

Continuous Plankton Recorder Sampling

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Sonia Batten

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

and information on the whole North Pacific CPR survey available at:

http://pices.int/projects/tcprsotnp/default.aspx

www.sahfos.org

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

There were no issues with the sampling during 2014 and all six transects were sampled successfully. We did begin the sampling season earlier, in March, since conditions were unusually warm in early 2014 and we wanted to capture the start of the spring increase. The final sampling was therefore a little early, at the very end of August, instead of September. The table below gives the actual sampling dates. At this time, data are finalized for March to June samples, and still provisional for the July and August samples.

Deliverable/Milestone	**Status**
February 2014 Set up for start of field season, ship equipment to west coast ports	• Completed
March 2014 • First transect	• Sampled 22-24 March, data available
April 2014 • Second transect	• Sampled 24-26 April, data available
May 2014 • Third transect	• Sampled 24-26 May, data available

June 2014 • Fourth transect	• Sampled 26-28 June, data available
July 2014 • Fifth transect	• Sampled 26-28 July, data available
August 2014 • Sixth transect	• Sampled 28-30 August, preliminary data available

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

8a. Within Gulf Watch Alaska, the main collaborative focus has been understanding how the physical environment influences the plankton variability. This work was included in the Environmental drivers sections of the Synthesis Report, was presented at AMSS 2015, and is also included in a manuscript in preparation. We have also focused in the last few months on integrating the plankton data with herring larvae growth measurements made within the Herring Research and Monitoring program. Again, a manuscript is in preparation, and an example is given below in the highlights section.

8b and c. At this time there is no coordination with other EVOS TC funded projects, or other Trustee Agencies.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

Publications produced during the reporting period: None published during the year.

Conference and workshop presentations and attendance during the reporting period:

- Dr Batten gave 2 talks at the North Pacific Marine Science Organisation (PICES) Annual Meeting, One was given in the general Biology session: "*Pseudo-nitzschia* diversity in the North Pacific from Continuous Plankton Recorder surveys" and one talk was given in a session devoted to plankton time series: "The North Pacific CPR Survey; History, evolution and lessons learned".
- Dr Batten gave a talk at the January 2015 Alaska Marine Science Symposium entitled "Interannual variability in lower trophic levels on the Alaskan Shelf"

Data and/or information products developed during the reporting period, if applicable:

- Contribution to the NOAA Ecosystem Considerations report, http://access.afsc.noaa.gov/reem/ecoweb/index.cfm.
- Data sets and associated metadata have been uploaded to the program's data portal.
- Finalised 2013 plankton data were uploaded, together with the metadata (2014 will be uploaded later in 2015 when all 2014 data have been finalized).
- 2014 along-transect temperature data were uploaded.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

N/A

11. Budget: *See,* Reporting Policy at III (C) (11).

No deviations in spending from the proposed budget, see attached.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$0.0	$31.8	$32.7	$33.8	$35.0	$133.3	$65.0
Travel	$0.0	$1.0	$1.0	$1.0	$1.1	$4.1	$2.0
Contractual	$0.0	$7.2	$7.4	$7.5	$7.9	$30.0	$15.0
Commodities	$0.0	$4.5	$4.7	$4.8	$4.8	$18.8	$9.0
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (will vary by proposer)		$16.8	$17.3	$17.8	$18.3	$70.2	$34.0
SUBTOTAL	$0.0	$61.3	$63.1	$64.9	$67.1	$256.4	$125.00
General Administration (9% of subtotal)	$0.0	$5.5	$5.7	$5.8	$6.0	$23.1	$11.25
PROJECT TOTAL	$0.0	$66.8	$68.8	$70.7	$73.1	$279.5	$136.25
Other Resources (in kind Funds)	$0.0	$94.7	$148.0	$180.8	$169.0	$592.5	$242.70

COMMENTS:The North Pacific CPR survey is supported by a Consortium managed by the North Pacific Marine Science Organisation, of which the EVOS TC is a member. Costs included here are 40% of the full costs of acquiring data along the north-south transect. The remining funds come from the consortium which currently includes the NPRB ($30,000 in FY2014), Canadian Dept Fisheries and Oceans ($25,000 in FY 2014) and SAHFOS ($39,700 in FY2014).

FY12-16

Program Title:15120114-A CPR
Team Leader: S. Batten

FORM 3A
NON-TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See,* Reporting Policy at III (C) (1).

12120114-F

2. Project Title: *See,* Reporting Policy at III (C) (2).

Data synthesis, analysis and recommendations for sampling frequency and intensity of nearshore marine bird surveys to detect trends utilizing existing data from the Prince William Sound, Katmai and Kenai Fjords coastlines.

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

Heather Coletti

Collaborators: David Irons, James Bodkin, Brenda Ballachey, Tom Dean

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

The original objective of the marine bird surveys was to estimate long-term trends in the seasonal abundance of seabirds and sea ducks, which can be difficult when data are highly variable. Initially, we planned to summarize data annually, and acknowledged that trends should be estimated after 10 years of data collection. The goal of the surveys was to be able to detect a significant decline (>50%) after 10 years of data collection. As we conducted annual data summaries, questions arose: 1) Is current survey intensity adequate to detect trends? 2) How do we account for imperfect detection? and 3) How do we correlate changes in abundance and distribution of marine birds with the other metrics being collected by the nearshore component of GWA?

Early analyses of Katmai National Park and Preserve (KATM) and Kenai Fjords National Park (KEFJ) survey results showed high between year variation in density estimates, making trend detection difficult. These early analyses resulted in CVs well over 0.50 (CV range: 1.27 to 4.00) for all taxa. Therefore confidence intervals for almost all species in all years encompassed zero, constraining our ability to detect trends over time at our current sampling intensity.

Data on harlequin ducks (*Histrionicus histrionicus*) at KATM were used for the test case occupancy analysis because harlequins are common and relatively evenly distributed along the KATM coast.

We found that transect length was the most important predictor of both detection and occupancy, occurring in all models with AIC < the no-covariate model. Both detection and occupancy increased with increasing transect length. There was weak evidence of heterogeneity in occupancy with sites with different habitat types. Although there was much variation, protected and semi-protected sites had a slightly lower probability of being occupied than exposed sites. A slight latitudinal gradient was observed, where the probability of occupancy increased with increasing latitude. The model-averaged proportion of sites occupied was 0.87 (90% CI = 0.77 - 0.97).

Because a unit of occupancy is spatially defined, we also assume we will be able to quantify metrics such as prey availability, habitat type, exposure, shoreline complexity, water quality parameters, etc. to that same spatial unit(s). Changes or shifts in site occupancy could theoretically be correlated to other physical or biological drivers of the system. This becomes particularly important in the face of climate change as potential stressors to a system increase. Understanding how a species or community is responding to those stressors through changes in distribution will be informative for resource managers to implement appropriate management actions.

This preliminary analysis indicated that allocation of survey effort is critical. In the initial design, transects were 5 km long. However, during standard skiff surveys, depending on tide height, conditions and the abilities of the skiff driver, transects could be significantly more or less than 5 km in length. This equates to variable effort per transect. While standardizing length would be ideal, it is not feasible. We suggest effort is modeled rigorously. This could include time on transect or actual length travelled during a single transect survey. There was also high model-selection uncertainty (all models have nearly the same AIC). This indicates that there is still some un-modeled heterogeneity and this may be improved by calculating more appropriate habitat covariates (e.g., shoreline type and bathymetry).

Sample size was also an issue in the preliminary analysis. Although we had five (5) replicate encounter histories, there were large uncertainties associated with estimates. Essentially, the limited number of transects does not capture the level of heterogeneity in the existing data. Despite this, the current sampling protocol represented the maximum effort that can be expended on surveys, given logistical constraints. Further discussion and analysis may lead to: 1) reducing the scope of the monitoring program by focusing our efforts in specific habitats; 2) increasing the number of transects sampled; 3) changing the spatial grain of sampling (sample unit size); 4) considering more complex model structures in a fully Bayesian framework. The optimal course of action will depend on refinement of monitoring objectives. For example, the estimated proportion of sites occupied was close to one, and near the upper boundary of that considered to be “meaningful” for occupancy analysis (MacKenzie et al. 2006). Reducing the sample unit size could remedy this problem for harlequin ducks, but may reduce the effectiveness of the sampling design for a species that is less common. A discussion of objectives should address the following: spatial extent of analysis, spatial grain of analysis, target species, hypothesized population drivers, and feasible courses of action (e.g. management or conservation) if change is detected.

MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. H. Pollock, L. A. Bailey, and J. E. Hines. 2006. Occupancy modeling and estimation. Academic Press, San Diego, California, USA.

Deliverable/Milestone	Status
Finalized proposal (statement of work for contract)	Completed, June 2013
Contract Package submitted to NPS	Completed, July 2013
Contract Award	No bids were submitted for evaluation and award
Data collection	Annual summer surveys continue under the Nearshore component (Ballachey et al.) in KATM and KEFJ. This data will be amended to existing data sets to strengthen analysis
Data Analysis	Subset of data analysis completed with NPS collaborator for GWA synthesis report -Fall 2014
Synthesis	Completed Fall 2014

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

- We continue to provide updates to the GWA PIs as well as to the GWA marine bird subgroup. We also continue to collaborate closely with the nearshore component, as nearshore skiff-based survey data are collected each summer along the Katmai and Kenai Fjords coastlines, during the Nearshore component fieldwork.

9. Information and Data Transfer: *See*, Reporting Policy at III (C) (9).

Publications & Reports:

Coletti, H.A., Dean, T.A., Kloecker, K.A., and Ballachey, B.E. 2014. Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2012. Natural Resource Technical Report NPS/SWAN/NRTR—2014/843. National Park Service, Fort Collins, Colorado. http://science.nature.nps.gov/im/units/swan/publications.cfm?tab=2

Dean, T.A., Bodkin, J.L., and Coletti, H.A. 2014. Protocol Narrative for Nearshore Marine Ecosystem Monitoring in the Gulf of Alaska, Version 1.1. Natural Resource Technical Report NPS/SWAN/NRTR—2014/756. National Park Service, Fort Collins, Colorado.

Konar, B., K. Iken, H. Coletti, T. Dean, and D. Monson. 2015. Static habitat attributes influence biological variability in intertidal communities in the central Gulf of Alaska. Alaska Marine Science Symposium. Anchorage, AK, January, 2015. Poster

Monson, D., T. Dean, M. Lindeberg, J. Bodkin, H. Coletti, D. Esler, K. Kloecker, B. Weitzman, and B. Ballachey. 2015. Inter-annual and spatial variation in Pacific blue mussels (*Mytilus tross*ulus) in the Gulf of Alaska, 2006-2013. Alaska Marine Science Symposium. Anchorage, AK, January, 2015. Poster

Meeting attendance: January 2015 Alaska Marine Science Symposium: Ballachey, Coletti, Doroff, Esler, Kloecker, Lindeberg, Monson, Shephard, Weitzman.

November 2013 Gulf Watch PI meeting, Anchorage: Ballachey, Bodkin, Coletti, Dean, Doroff, Esler, Kloecker, Lindeberg, Monson, Shephard.

Data & metadata uploaded to data portal: In cooperation with the nearshore benthic group, marine bird and mammal survey data for KATM and KEFJ was uploaded to the workspace (raw count data and metadata in form of description of project and methods).

10. Response to EVOSTC Review, Recommendations and Comments: *See*, Reporting Policy at III (C) (10).

There were no recommendations for changes to this project component in the recent EVOSTC reviews.

11. Budget: *See*, Reporting Policy at III (C) (11).

Budget forms submitted separately. This project has been delayed since the initial funding of year 1 due to contracting issues and the inability to solicit a suitable contractor. We therefore initiated work in-house through NPS this past year, charging personnel costs. A subset of our results are presented in the GWA synthesis report. Results indicate it will be difficult to fit existing data into an occupancy data analysis framework. However, this tool could certainly be used in future study designs to maximize resources. To date, NPS does not require any additional financial support from GWA. The remaining funds will be expended during years 4 and 5 in order to complete optimization of survey design for nearshore reliant species such as sea ducks.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$15.0
Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Contractual	$30.0	$0.0	$0.0	$0.0	$0.0	$30.0	$0.0
Commodities	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
							$0.0
SUBTOTAL	$30.0	$0.0	$0.0	$0.0	$0.0	$30.0	$15.0
General Administration (9% of subtotal)	$2.7	$0.0	$0.0	$0.0	$0.0	$2.7	$1.4
PROJECT TOTAL	$32.7	$0.0	$0.0	$0.0	$0.0	$32.7	$16.4
Other Resources (Cost Share Funds)	$20.0	$0.0	$0.0	$0.0	$0.0	$20.0	$20.0

COMMENTS: We initated work in-house through NPS. A subset of our results are presented in the GWA synthesis report. Results indicate it will be difficult to fit existing data into an occupancy data analysis framework. However, this tool could certainly be used in future study designs to maximize resources. To date, NPS does not require any additional financial support from GWA. In-kind contributions will be for the staff time, primarily from NPS (approximately 2 months of a GS12), to gather and analyze the data as well as provide expertise as to ecosystem processes and provide assistance in the compile and report on results.

FY12-16

Program Title: 15120114-F Seabird Synthesis
Team Leader: H. Colletti

FORM 4A
TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

1. Program Number: *See,* Reporting Policy at III (C) (1).

12120114-M

2. Project Title: *See,* Reporting Policy at III (C) (2).

Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

Craig O. Matkin

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

March 1, 2014

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.whalesalaska.net

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

February–April 2014. The current killer whale photographic reference catalogue was updated with 2013 field data. Matriline diagrams were updated as well. The updated catalogue was provided electronically to all tour boat operators and to the Kenai Fjords National Park. Initial analysis and preparation of a paper on habitat use and pod ranges was completed. Preparation for field work also occurred in this period. Updated databases were uploaded to the Gulf Watch Alaska work site.

May-October 2014. All fieldwork occurred during this period. During 67 days of fieldwork on the Natoa and 12 days of time contributed by other vessels. We logged 52 encounters with killer whales, 41 with residents, 1 with AT1 transients, 11 with Gulf of Alaska transients and none with offshores. Survey tracklines totaled 4922 km while searching for whales and we traveled 1084km during encounters with whales.

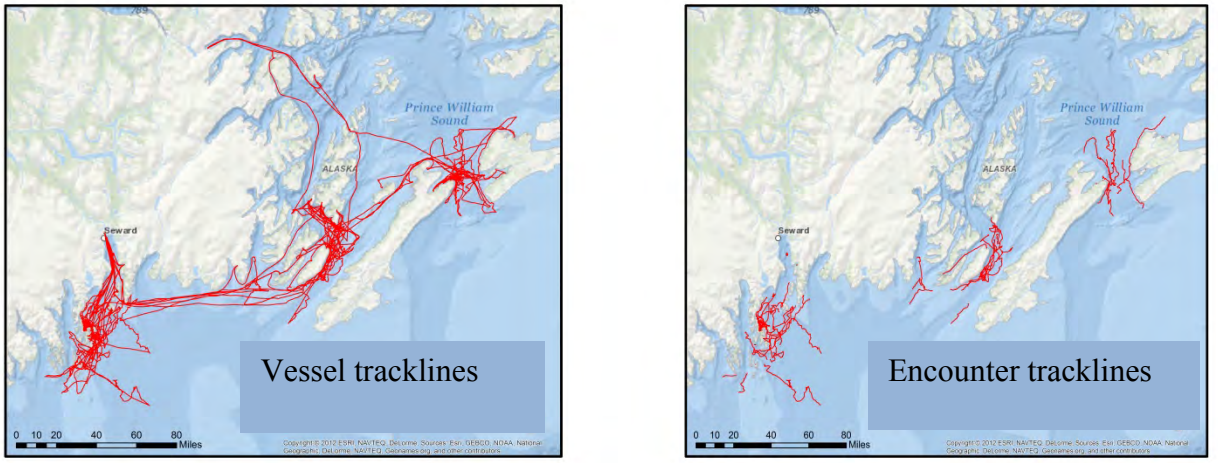


Figure 1. Vessel and encounter tracklines for sampling in 2014

We emphasized photoidentification over other aspects of the study this year because we did not have complete photographic coverage of some groups in recent years. This focus was in part successful and we had much more complete coverage than in recent years, however, some groups seem to have de-emphasized portions of their range where we focus our work. Some pods have split and the resulting new groups no longer focus activities in the same portions of the range. In the future, it will likely be necessary to examine population dynamics using matrilineal groups, rather than a pods.

AB pod, including the AB17 matriline that was not photographed last year, was encountered on five occasions. There was no change in the AB17 matriline; however the fin of the adult male AB35 has collapsed. A new calf (AB78) was born to AB53 in 2014, and AB45 (a 23 year old male orphaned at the time of the spill) was again missing and confirmed dead. The number of whales in AB pod remains at 20. Only the AT2,3 and 4 matriline and AT6 were photographed from the AT1 population this year. Because it would seem unlikely for the entire AT9,10 and 18 matriline to die in the same year, we have not yet considered them dead or missing. However, we are concerned with the lack of encounters with this group. For now the number of whales in the AT1 group is still considered to be seven.

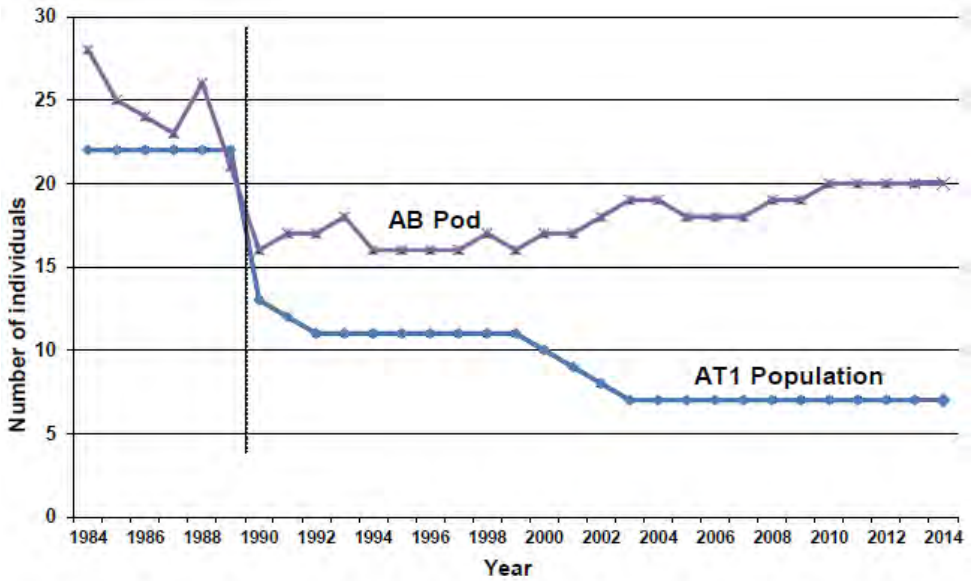


Figure 2. Number of whales in AB pod and AT1 population from 1984 to 2014

We collected 6 biopsy samples in 2014; one from a stranded juvenile, and one from a whale of uncertain haplotype (both these samples important for genetics). The other four samples were collected in the early season (May-June) with a focus on lipid/stable isotopes for ongoing feeding studies. All samples are sequenced for mtDNA, and analyzed for lipid, stable isotope and contaminant analysis. Analysis of 2013 samples is complete and in database held at NWFSC as well as in the NGOS database.

We attached Spot 5™ location only tags to two whales (AY11, AX110), and a Mk10 ™ time/depth/location tag on one whale (AT179) in 2014. The attachment to AY11 was only the second on an AY pod whale-a pod frequently observed in Kenai Fjords. The range of this whale was very similar to another individual in the pod (AY 07, tagged in 2011) and indicates the adherence of this pod to a general range, at least over that period of years (Figure 3A). AX110 tagged in 2014 also confirmed the range for AX 48 pod established by tags applied to AX 111 in 2009 and to AX106 in 2007 (Figure 3B.) The two pods have differing ranges, AY focused in Kenai Fjords and north of Kodiak, and AX48 stretching from Kodiak across to the Copper River Delta and well into Prince William Sound.

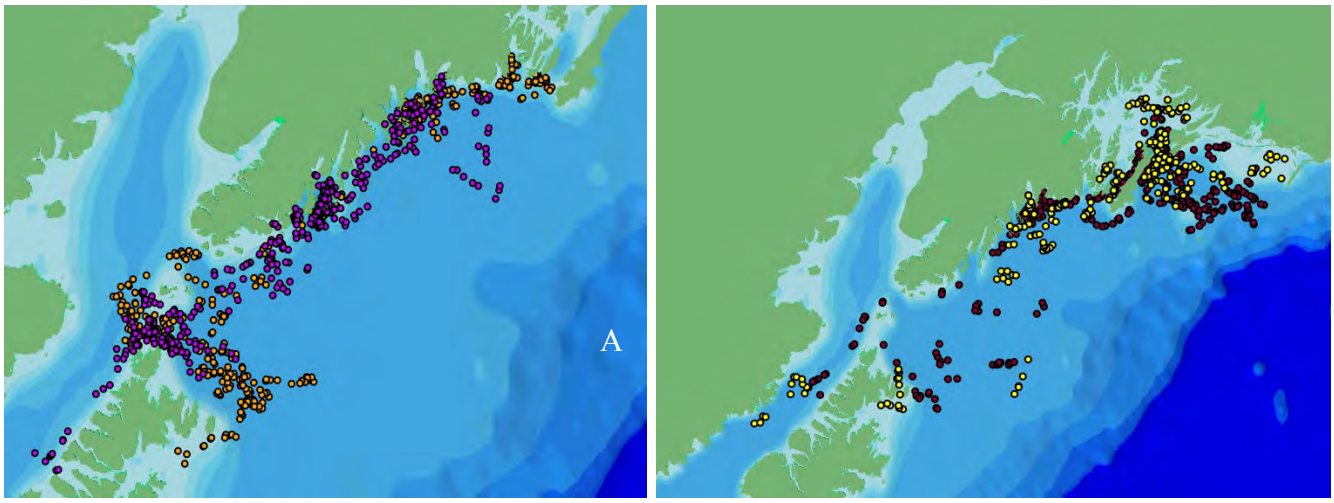


Figure. 3 A. Transmission locations for AY7 (gold) tagged in 2011 and for AY11 (purple) tagged in 2014 indicating a similar range for this pod, at least during the May-July period. B. Transmission locations for AX110 (yellow) in 2014 and AX111 in 2009 and AX106 in 2007 (both maroon) indicating the similarity in range of AX48 pod from 2007-2014 at least during May-July

The attachment of a time-depth-recorder (TDR) Mk 10 ™ tag to AT 179 was the first applied to a member of the Gulf of Alaska transient population. The whale moved through Prince William Sound over a couple days and then headed offshore near the shelf break before moving in along the shallow Copper River delta. It was surprising that the whale made regular dives to over 50 meters and occasional dove to over 100 meters and as deep as 175 meters. Since its primary prey are marine mammals (sea lion, harbor seals, Dall's porpoise), this suggests they may at times forage at depth when their prey are occupied with foraging and compromised by a finite supply of oxygen. A similar pattern was observed by Miller et al. (2010) in examining diving of West Coast transient killer whales using TDR tags. They noted that the large body size of the killer whale may enable them to exceed the aerobic diving capacities of their prey. Although transient killer whales may ambush prey at the surface as we have also observed, attacking prey at depth may be an additional foraging strategy.

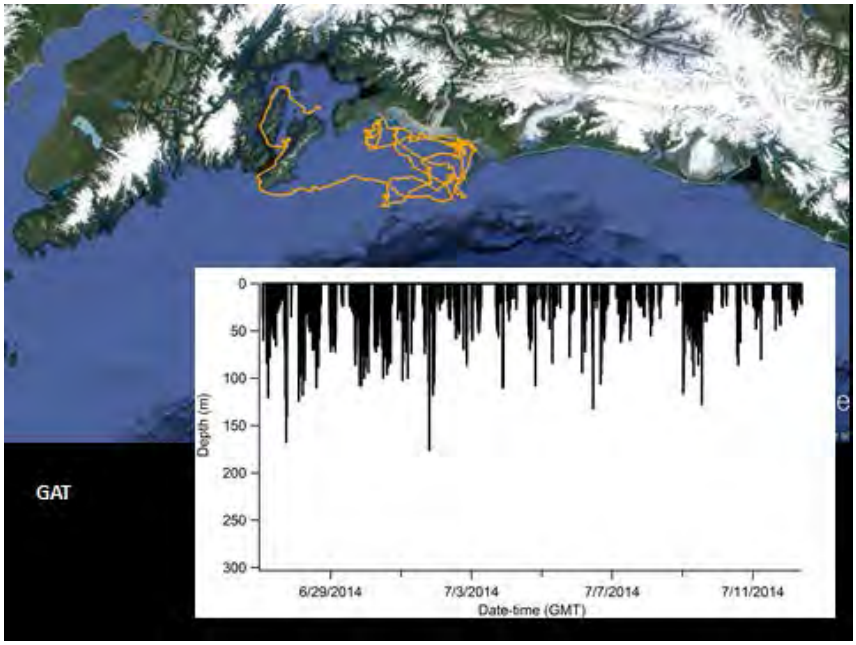


Figure. 3 Track line for AT179 and dive depth data over time of the attachment

Unfortunately the feeding aggregations of resident type killer whales that occur during September and October in southwestern Prince William Sound and often include all of AJ pod and AB pod did not form this year. Smaller groups of whales did occasionally forage through the area. It appeared from late season encounters and tags that most of the fall 2014 feeding activity occurred in the Port Bainbridge area and outside waters where poor weather precluded activity.

October 2014-January 2015. Field equipment was cleaned and stored. Preparation was made Gulf Watch meeting in November. We updated numerous databases at NGOS with 2014 field data including survey and encounter database (ACCESS) and biopsy and tagging summaries. We filtered tagging data and constructed maps and tracks and associated dive data for tagged whales. Initial analysis was completed for preparation of paper on habitat use and pod range based on tagging location and encounter data. In October 2014 samples of tissue and scales were sent to NWFSC for analysis. We supplied our humpback whale photo-identification and encounter data to Project 12120114-N (Humpback Whale Predation on Herring in Prince William Sound). Facebook and web sites were updated. Photo analysis was completed during this period which included frame by frame identification of all individuals. Tables indicating individuals present in each encounter created annually were updated. Dr. Matkin also attended Gulf Watch Meeting in November.

We followed our list of objectives as stated in the original proposal, although in some cases of tagging we are using the new time/depth recording Mark 10 tags instead of location only tags. With limited field time and the single vessel it was difficult to complete all aspects of project, especially sampling prey during deep diving bouts when prey are infrequently brought to the surface and focal follows are required. Because of poor photographic coverage of pods in some recent years, photo-identification had to be emphasized this year.

Outreach included the creation of a Facebook site for the North Gulf Oceanic Society that allows quicker posting of events and more direct interaction than the website. We will have databases on the Gulf Watch site updated by the beginning of the field season in May 2015.

Table 1. Status of project milestones for year 2

Deliverable/Milestone	Status
Initial analysis for paper on resident KW range and habitat use	Completed November 2014
Update of photographic catalogue, population database, mapping database, NWFSC tissue analysis	Completed May 10 2014 (for 2013 data)
Field work: PhotoID, behavioral observations, biopsy, prey sampling, tagging.	07 May through 1 October 2014
Annual meeting Gulf Watch AMSS Poster (Resident KW Population Dynamicsand impact on fish.)	November 2014 January 2015

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

A. Collaborated closely with Humpback Whale and Herring Predation project (Moran/Straley). Our field work provided photographic and other data from 36 humpback whale encounters with humpback whales photos and we received data from 5 killer whale encounters from their project. Collaboration with Nearshore component included receiving photographs from several killer whale encounters (via Dan Monson) and providing information to Angie Doroff for Discovery program at Islands and Oceans Center, Homer, AK.

B. There was no coordination with other EVOS projects outside of the Gulf Watch program

C. We annually provide our data to the National Marine Fisheries Service to update the killer whale stock assessments for Alaska and we provide a review of current Alaska stock assessments, in part based on data collected in this project. We contribute our analytical data annually to the genetic and environmental contaminant laboratory where they become part of a larger database open for analysis by others. Genetic samples/ data generated by this project is also provided to Southwest Fisheires Science Center (Phil Morin) for examination of worldwide stock structure.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

- Publication of Journal Article (Marine Mammal Science) on resident killer whale population dynamics in Prince William Sound/Kenai Fjords
- Expansion of North Gulf Oceanic Society Facebook page with field updates and other information regularly posted
- Article for High Country News on residual oil spill effects after 25 years (March 2014)
- Production of film segment on our research for Kenai Fjords National Park (in collaboration with North Shore Productions, May 2014)
- Presentation to Kenai Fjords Tour Boat Association
- Article for Delta Sound Connection, annual publication of PWSSC
- Contribution of written and photographic material to book “To the Arctic” by Florian Schultz
- Two chapters were contributed to “Encylopedia of the Killer whale (Orca)” edited and translated by Hiroya Minakuchi and published in Japan

- Article requested and contributed to "On Earth" magazine on wild and captive killer whales based on 30 years of fieldwork (July 2014)
- Collaboration with Angie Doroff for program at Gulf Watch Discovery Lab, August 2014
- Week long seminar at St Catherine University centering on NGOS book "Into Great Silence" and our results from 30 years of fieldwork duri (September-October 2014)
- Presentations at ORCA program in Everett WA for 80 pre-college students (October 2014)
- Presentations at Whale Museum, Friday Harbor during symposium on Southern Resident Killer whales (October 2014)
- Presentation at "Wildlife Wednesday" UAF, Juneau, Alaska (Oct 2014)
- Data sets on Gulf Watch site updated for 2013 field season

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

We have responded to all past comments and recommendations

11. Budget: *See,* Reporting Policy at III (C) (11).

Our budget and billing typically runs about 6 months behind the EVOS/Prince William Sound schedule because of our offset with fiscal year (the NGOS fiscal year ends June 1). This has been the case for many years.

Attached budget form reflects the notification and acceptance of changes in annual budget category amounts and proposed changes in the next fiscal year (FY2016). There was no change in total project budget. At this time there has not been more than 10% deviation in budget categories for FY14.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$0.0	$34.3	$37.0	$37.0	$37.0	$145.3	$55.2
Travel	$0.0	$1.7	$2.7	$2.7	$2.7	$9.8	$2.1
Contractual	$0.0	$38.5	$41.5	$44.5	$44.5	$169.0	$55.0
Commodities	$6.0	$35.6	$29.2	$26.2	$26.2	$123.2	$43.5
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (will vary by proposer)	$0.6	$11.0	$11.0	$11.0	$11.0	$44.6	$15.1
SUBTOTAL	$6.6	$121.4	$121.4	$121.4	$121.4	$491.9	$170.9
General Administration (9% of subtotal)	$0.6	$10.9	$10.9	$10.9	$10.9	$44.3	$15.4
PROJECT TOTAL	$7.2	$132.3	$132.3	$132.3	$132.3	$536.1	$186.3
Other Resources (In kindFunds)	$23.5	$23.5	$23.5	$23.5	$23.5	$117.5	$70.5

Comment: Other resources include 15,000 in donated vessel time by NGOS, Approximately 5000 in equipment funds from Norcross Foundation and solicited donations. Approximately 5000 of analytical service is provided annually by Northwest Fishery Science Center, Environmental Contaminant Laboratory.

FY12

Program Title: 15120114-M Long Terrm Killer Whale Monitoring in Prince William Sound/Kenai Fjords
Team Leader: Craig Matkin

FORM 3A
NON-TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

13120114-N

2. Project Title: *See*, Reporting Policy at III (C) (2).

Long-term Monitoring: Pelagic Monitoring Component - Long-term monitoring of humpback whale predation on Pacific herring in Prince William Sound.

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

John R. Moran (NOAA) and Janice M. Straley (UAS)

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

Feb. 2014-Jan. 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

Feb 17, 2014

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

All work during 2014 proceeded as planned. During the reporting period four whale surveys of Prince William Sound were completed (April 2014, Sept. /Oct. 2014, July 2014 and Dec. 2014). In addition to our three scheduled surveys, a July survey was conducted using NOAA funds. These same funds allowed for a second vessel on the Sept. survey (see Coordination/Collaboration).

All obligations to the Synthesis Report and Trustee meetings were met.

Deliverable/Milestone	Status
April 2014 Survey	completed
Sept. 2014 Survey	completed
Dec. 2014 Survey	completed
Data entry	Data entry completed, QA/QC in progress.

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

8A. Killer whale and humpback whale photos were exchanged with Craig Matkin. This collaboration expands the temporal and spatial scope of both projects.

- Winter Seabird Survey observers were present on whale surveys.
- The Gulf Watch Alaska pelagic team PIs (Moran, Straley, Arimitsu, Piatt and Bishop) collaborated to facilitate a broader understanding of humpback whale and seabird foraging dynamics and forage fish availability in Prince William Sound.

8B. There was no collaboration with other Trustee funded projects.

8C. Forage fish are being collected during a February 2015 acoustic survey of PWS by the NOAA vessel Oscar Dyson. These samples will provide mid-winter energetics data for whale prey.

- Pollock were collected during whale surveys for the AFSC recruitment energetics project.
- Brand resights and haulout photos of Steller sea lions were provided to ADF&G.
- Data on whale locations and prey quality was given to the review Steller Sea Lions Critical Habitat Workshop held in Seattle, January 2015.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

Outreach

PWSSC Community Lecture Series, Field Notes radio program, Gulf Watch Alaska Virtual Field Trip, Gulf Watch Project brochure, and a KCAW Public Radio Interview.

Presentations

Moran. *Living in a Humpback World.* Lecture at University of Eastern Finland, Joensuu, Finland.

Moran. *Challenges of Photo ID during the Alaskan Winter.* Photo ID Workshop, Joensuu, Finland.

Moran, Straley, and Arimitsu. *Humpback Whales as indicators of Herring Movements in PWS*.

AMSS, Anchorage Alaska.

Data

The PWS humpback whale catalog has been made available to public via GWA workspace..

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

N/A

11. Budget: *See,* Reporting Policy at III (C) (11).

At this time we are 6% under budget for this reporting period. Travel was 22% higher than proposed due to addition surveys made possible by non-EVOSTC funds. Commodities are 28% under budget because we have yet to replace supplies used duing FY14.

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Project Number: *See,* Reporting Policy at III (C) (1).

12120114- O

2. Project Title: *See,* Reporting Policy at III (C) (2).

LTM Program – Monitoring long-term changes in forage fish distribution, abundance, and body condition in Prince William Sound

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

Mayumi Arimitsu and John Piatt

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

Feb 13, 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

As originally proposed, the objectives of this work are to 1) identify robust indices for monitoring forage fish populations over time and devise a sampling strategy for long term monitoring of those indices, 2) assess the current distribution, abundance, species composition, and body condition of forage fishes (other than herring) in selected areas of Prince William Sound at selected times of the year, and 3) relate abundance and distribution of forage species to abiotic characteristics of the marine environment.

During this reporting period we made significant progress on a new aerial-acoustic survey design that takes into account the advantages and limitations of previous forage fish work. We worked closely with a commercial herring spotting pilot, ADF&G biologists familiar with aerial surveys for fish and other taxa, and the herring program lead. The new sampling grid is based on 2010-2012 school density (Fig. 1) and is meant to simplify the aerial data collection and processing effort, increase certainty in aerial-derived species ID through on-the-ground validation, and estimate biomass of schools in the water with hydroacoustics. This plan was submitted to the workspace in June and reviewed by the GWA science review team.

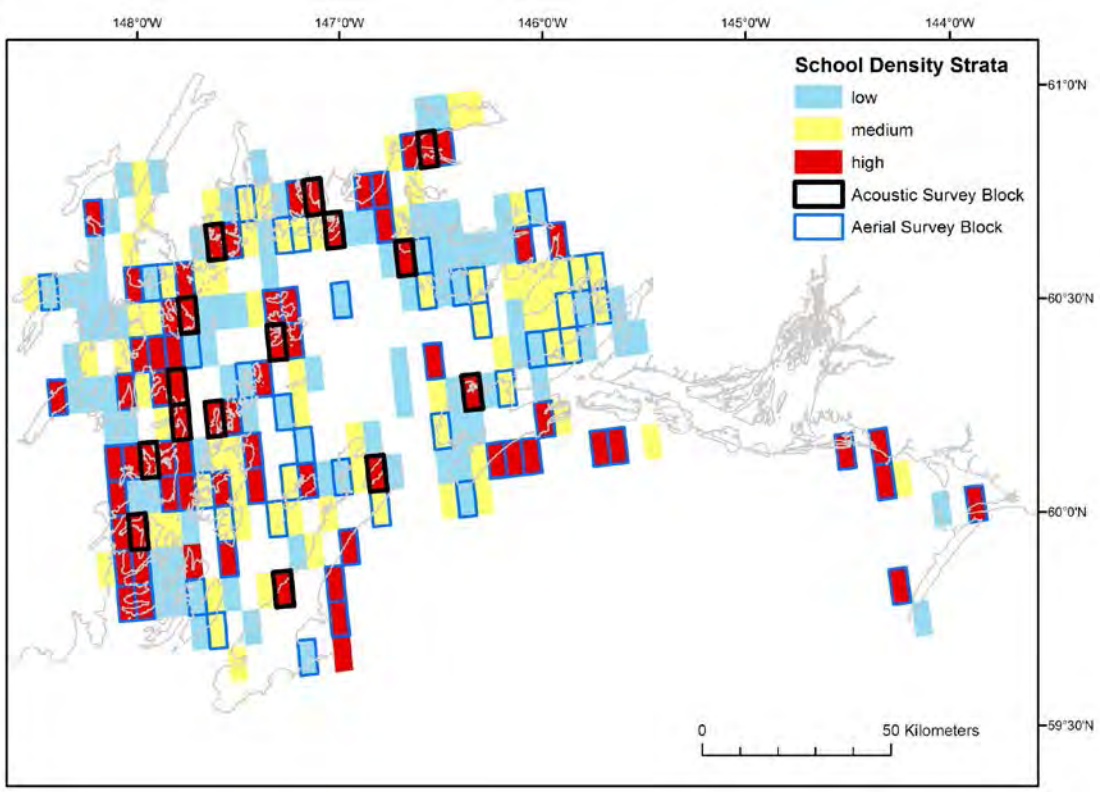


Figure 1. Density strata showing the distribution of forage fish schools (colored blocks are the number of schools/km flown, weighted by persistence over time) during July shoreline aerial survey counts in 2010-12 (E. Brown, unpublished data). Forage fish aerial survey blocks (outlined in blue) were randomly selected for sampling based on variability of density within each strata. Acoustic survey blocks (outlined in black) were randomly selected for sampling from the high density stratum.

We provided survey equipment and technical support during the juvenile herring surveys in June (Fig. 2). We also conducted the aerial-acoustic forage fish survey in July. Working closely with the PWSSC aerial survey team, we counted fish schools within 107 low-high density sample boxes and ran hydroacoustic transects in 15 high density sample boxes located throughout the Sound. We used several methods to verify species ID for aerial surveys and hydroacoustics including midwater trawl, cast nets, jigs, purse seines and underwater cameras. We also coordinated with the whale survey crew to estimate distribution and density of whale prey near Montague Strait, Green Island and Port Chalmers in July. This work motivated us to look for and subsequently quantify krill and capelin near feeding predators. We also documented humpback whales feeding on young of the year herring near Montague Island. In September, when humpback whale numbers tend to increase in the Southern Montague area, we conducted an additional survey with the whale crew. We documented considerable differences in whale prey density and depth distribution between July and September 2014.

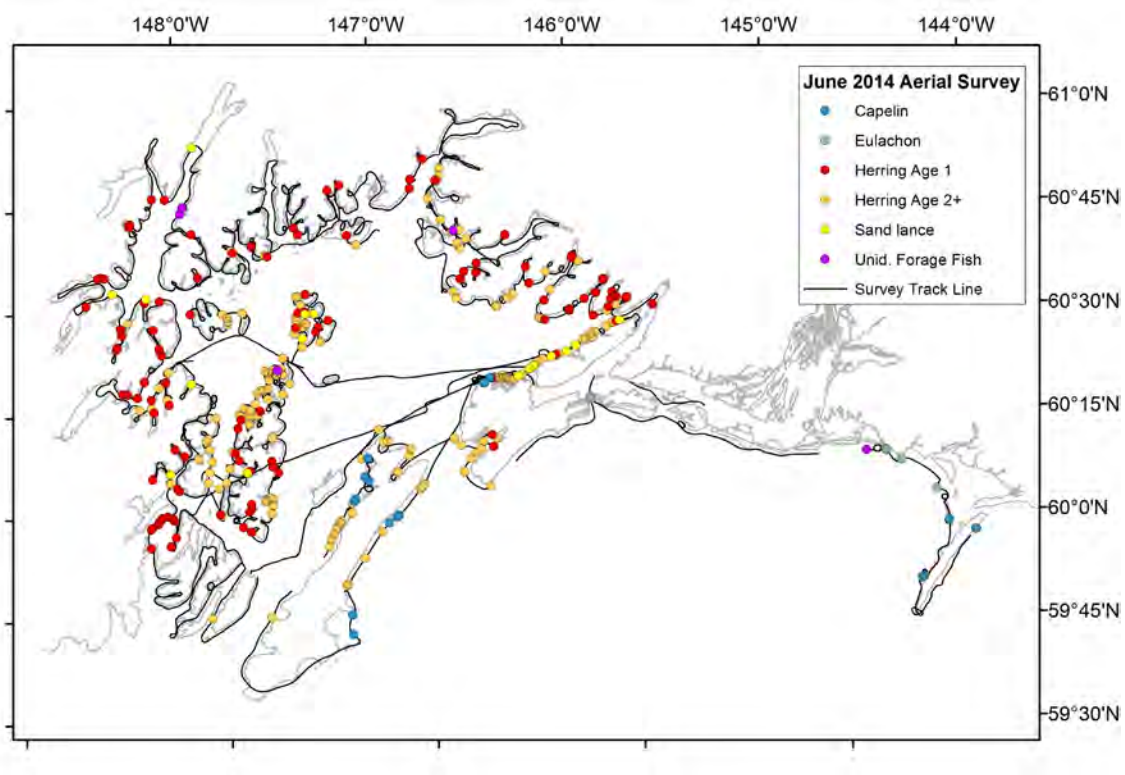


Figure 2. Distribution of age 1 herring and other forage fish during June 2014 shoreline aerial survey.

We provided several written reports, presentations and interviews during this reporting period. In addition to project annual reports and work plans (Feb 2014, Aug 2014), we participated in the Gulf Watch Alaska synthesis effort by summarizing historical and current information on forage fish throughout the EVOS affected area (including APEX, SEA and HRM work in Cook Inlet, Kenai Peninsula, Prince William Sound, and Gulf of Alaska). We worked with the pelagic team and program leads to summarize recommendations for future work at the GWA PI meeting in Novemeber. We uploaded 2013 dataset to the AOOS workspace and also updated the Morpho metadata. We also provided updates and slides for the EVOSTC joint science workshop. We presented two posters at the Alaska Marine Science Symposium on our field work. We were interviewed for a Gulf Watch Alaska curriculum unit by education specialists at the Alaska Sealife Center, and by a University of Oregon journalism student for a climate change study.

Deliverable/Milestone	Status
Submitted 2013 annual report	completed
Submitted proposed protocol changes and study plan	completed
2013 data with morpho metadata uploaded to workspace	completed
Juvenile herring aerial survey support	completed
Forage fish aerial-acoustic survey	completed

Year 4 project plan	completed
Humpback Whale prey hydroacoustic survey	completed
GWA Synthesis – forage fish chapter	completed
PI meeting in Anchorage	completed
PI Meeting at AMSS	completed
Poster presentations at AMSS	completed

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

We coordinated closely with Scott Pegau, HRM program coordinator, to conduct aerial surveys in summer 2014. We provided data recorders, cameras, and technical support for June age 1 herring survey, and July aerial-acoustic survey for forage fish.

We collaborated with John Moran and Jan Straley, the humpback whale PIs, and Mary Anne Bishop, a seabird survey PI, to estimate prey density and depth distribution with hydroacoustics-trawl sampling in July and September 2014. Using a NOAA chartered vessel (F/V Montague) along with the usual whale research platform (M/V Auklet), USGS portable SIMRAD EK60 38-120 kHz hydroacoustic system, and PWSSC Aluette trawl system, we sampled prey (juvenile and adult herring, krill) near large groups of feeding whales and feeding marine birds from Montague Strait to Port Gravina. Greater collaboration between the humpback whale, herring, marine bird and forage fish programs facilitate greater efficiency in data collection and improved understanding of the pelagic system in Prince William Sound.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

- Arimitsu, M and J Piatt. 2014. Forage fish populations in Prince William Sound: Designing efficient monitoring techniques to detect change. Pp. 3-35 to 3-46 *in*: (Hoem Neher, T., B. Ballachey, K. Hoffman, et al., eds.) Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Science synthesis report for the Gulf Watch Alaska Program.
- Arimitsu, M and J Piatt. 2014. Influence of tidewater glaciers on marine ecosystems. Public seminar for the Alaska Coastal Rainforest Center Lecture Series. Juneau, AK. Mar 12, 2014.
- Arimitsu, M. 2014. Coastal marine ecosystem research in the Gulf of Alaska. Lecture for University of Alaska Southeast undergrad seminar. Juneau, AK. Mar 28, 2014.
- Arimitsu, M. and J Piatt. 2014. Forage fish synthesis overview. GWA Principle Investigators meeting, Anchorage, AK, Nov. 18, 2014.
- Pegau, W, M Arimitsu, and M Collins. 2015.Aerial surveys provide age-1 herring and forage fish indices for monitoring in Prince William Sound. Poster presentation at the Alaska Marine Science Symposium. Anchorage, AK. Jan 19, 2015.
- Moran, J, J Straley, and M Arimitsu. 2015. Humpback whales as indicators of herring movements in Prince William Sound. Poster presentation at the Alaska Marine Science Symposium. Anchorage, AK. Jan 19, 2015.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

There were no recommendations for this project.

11. Budget: *See,* Reporting Policy at III (C) (11).

Current expenditures of some line items exceed ± 10% deviation from the originally-proposed amount in cases where reporting accounts lagged behind actual expenses, inconsistency between federal and EVOS fiscal year start date, and because the USGS budget system categories (particularly commodities and equipment) differ from those shown in the EVOS proposal. However, all expenditures are all within keeping to our planned budget, despite significant changes to survey design (as discussed above). We expect to use all proposed funds by the end of the project.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$2.0	$2.0	$2.0	$2.0	$0.0	$8.0	$6.1
Travel	$5.4	$5.4	$5.4	$5.4	$1.8	$23.4	$19.8
Contractual	$103.5	$104.8	$114.7	$116.5	$46.1	$485.6	$302.9
Commodities	$6.0	$6.0	$6.0	$6.0	$2.0	$26.0	$12.9
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (*will vary by proposer*)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
SUBTOTAL	$116.9	$118.2	$128.1	$129.9	$49.9	$543.0	$341.7
General Administration (9% of subtotal)	$10.5	$10.6	$11.5	$11.7	$4.5	$48.9	$30.8
PROJECT TOTAL	$127.4	$128.8	$139.6	$141.6	$54.4	$591.9	$372.5
Other Resources (In kind Funds)	$83.5	$74.7	$75.0	$78.5	$25.0	$336.7	$233.2

COMMENTS: In-kind contribution from NOAA - $25K/year in salary for Moran. An addition $58.5K in FY12 , $49.7K in FY13, $50.0K in FY14,and $54.9K in FY15 of NOAA ship time was used to increase survey effort.

FY12-16

Program Title: 15120114-N Humpback Whale Monitoring
Team Leader: Moran/Straley

SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See,* Reporting Policy at III (C) (1).

13120114-K

2. Project Title: *See,* Reporting Policy at III (C) (2).

Long-term Monitoring: Pelagic Monitoring Component - Continuing the Legacy: Prince William Sound Marine Bird Population Trends

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

David Irons, Kathy Kuletz, and Robb Kaler

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

1 February 2014- 31 January 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

24 February 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

We successfully completed our planned Prince William Sound (PWS) marine bird survey, conducted 30 June to 27 July 2014. Prior to beginning the field season, a project leader (Kaler), two boat operators, and six observers were hired. We arranged field logistics, contractual agreements, and prepared four 25-foot survey vessels and the necessary field and boat equipment. Following three days of observer and boat captain training in Whittier, Alaska, we collected information on marine bird and mammal observation 3-26 July.

Despite several mechanical and electrical issues with the survey fleet, most of which have been in service for >30 years, we safely and successfully completed the entire survey, which includes over 2000 linear kilometers of coastal and pelagic waters. We are completing post-season data quality and assurance checks and will begin preliminary analysis by March 2015. Using the statistical methods described in our project plan, and following additional analyses developed by Dan Cushing during his graduate research using the 1989 to 2012 data set, we will generate abundance estimates for the group of marine bird taxa described in the plan, as well as look at community-wide changes in marine birds of PWS.

Deliverable/Milestone	Status
Hire Project Leader/co-Principle Investigator to oversee 2014 survey	Completed March 2014

Hire and train two motor boat operators	Completed May 2014
Collect PWS marine bird data	Completed July 2014
Gulf Watch PI annual meeting, AOOS office	Attended November 2014
Gulf Watch PI, AMSS meeting	Attended (Kuletz) January 2015
Data management, QA/QC	In progress, to be completed by March 2015
Data analysis, 2014 abundance estimates	In progress, to be completed by May 2015
Boat maintenance and repair	In progress, to be completed by September 2015

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

8A: Collaboration and coordination both within the pelagic program and between the two programs

- Kathy Kuletz, David Irons, and Robb Kaler have been participating in discussions and meetings on opportunities to integrate the pelagic components of the Long-Term Monitoring effort.
- Kathy Kuletz and Mary Ann Bishop (PWS Science Center) continue to collaborate on marine bird surveys from November to March, in conjunction with the Herring Project and the whale surveys.
- Collaboration within the pelagic program (forage fish, humpback whale, killer whale, and marine bird) and between the pelagic and herring programs continued. In particular, we have been in discussions about potential study designs for areas where whales and seabirds were found to overlap in time and space.

8B: Collaboration and coordination with other EVOSTC funded projects

- Marine bird data collected near the Naked Island group during the Sound-wide PWS marine bird surveys will be used to help evaluate the pigeon guillemot restoration effort there.

8C: Coordination with trust agencies

- Kathy Kuletz completed a third season of marine bird and mammal surveys in Lower Cook Inlet in cooperation with NOAA and the Kachemak Bay Research Reserve. The survey contributes to the long-term Gulf Watch Alaska monitoring project and provides information on the marine regions affected by the Exxon Valdez oil spill. The marine bird component of the Lower Cook Inlet project was funded in 2014 and 2015 via an inter-agency agreement (IA) between Bureau of Ocean Energy Management (BOEM) and USFWS/MBM. As part of this IA, the USFWS will be collating historic data and providing BOEM with potential sampling plans for more extensive examinations of marine bird trends in the region.
- Kathy Kuletz received a grant from the North Pacific Research Board (NPRB) to conduct marine bird and mammal surveys as part of the long-term monitoring program for the northern Gulf of Alaska (a.k.a. the 'Seward Line'), which is part of the multi-agency, UAF, and NPRB 'Gulf Watch Alaska' Program.
- The marine bird surveys all use the same survey protocol, data processing, and archiving (for use in the North Pacific Pelagic Seabird Database). Thus, the marine bird survey data from the Sound-wide PWS July surveys, the winter PWS surveys, the Seward Line surveys, and the

Lower Cook Inlet surveys will be comparable across projects, allowing regional comparisons and broad-scale analyses.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

- 2012 PWS marine bird survey data were uploaded to the Ocean Workspace in January 2014.
- November 2014, Kathy Kuletz, David Irons, Dan Cushing, and Robb Kaler participated in Gulf Watch PI Meeting.
- January 2015, Kathy Kuletz participated in Gulf Watch PI Meeting.
- Thesis completed: Cushing, D. 2014. Patterns of distribution, abundance, and change over time in the marine bird community of Prince William Sound, Alaska, 1989-2012. Oregon State University thesis (send requests to: daniel.cushing[at]oregonstate.edu).
- Cushing, D., D. Roby, and D. Irons. 2015. Pattern of change over 23 years in the marine bird community of Prince William Sound. *Oral presentation* at the Willamette Valley Bird Symposium, 24 January 2015.
- Cushing, D., D. Roby, and D. Irons. 2015. Temporal changes in a subarctic marine bird community that experienced simultaneous effects of a major oil spill and climate variability. *Oral presentation* at the 42nd annual meeting of the Pacific Seabird Group, 19-21 February 2015, in San Jose, CA.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

We are making the suggested edits as provided for our sampling protocol. A final revised protocol will be completed by April 2015.

11. Budget: *See,* Reporting Policy at III (C) (11).

The actual cumulative totals deviate over or under 10% for most budget categories. Specifically, for Personnel, costs deviate outside of the 10% proposed budget because we have been fortunate to have several excellent volunteers return each survey year, which has reduced overall personnel costs. Travel and Contractual deviates > than 10% of the proposed budget because we have been unable to locate vendors willing to contract with the FWS for housing resulting in payment for housing using government credit cards (and thus treated as 'travel') rather than contractual agreements. Additionally, we have not been able to find an adequate charter vessel that can accommodate our fuel needs which has also reduced our Contractual obligations and increased our 'travel' costs. Equipment deviated >10% of the proposed budget owing to greater than expected maintenance and repair of our survey fleet. Commodities are within 10% of the proposed budget. Overall, despite these deviations, we will be at or under the Total Proposed amount for this project.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$100.0	$22.2	$100.0	$22.2	$100.0	$344.3	$154.4
Travel	$11.8	$0.0	$11.8	$0.0	$11.8	$35.4	$44.2
Contractual	$37.1	$0.0	$37.1	$0.0	$37.1	$111.3	$12.0
Commodities	$34.6	$0.0	$38.8	$0.0	$43.0	$116.3	$68.8
Equipment	$6.0	$0.0	$6.0	$0.0	$6.0	$18.0	$16.8
SUBTOTAL	$189.4	$22.2	$193.6	$22.2	$197.8	$625.3	$296.22
General Administration (9% of subtotal)	$17.0	$2.0	$17.4	$2.0	$17.8	$56.3	$26.66
PROJECT TOTAL	$206.5	$24.2	$211.1	$24.2	$215.7	$681.6	$322.88
Other Resources (Cost Share Funds)	$56.0	$22.0	$56.0	$22.0	$56.0	$212.0	$134.00

COMMENTS: In-kind contribution from USFWS includes $11K/year in salary for Irons and $11K/year in salary for Kuletz. We proposed to hire a Project Leader in FY 13 but had difficulty filling the position due to the federal hiring freeze. In March 2014, we received approval of a hiring request waiver and were able to hire Project Leader (Robb Kaler).

FY12-16

Program Title: 15120114-K Continuing the Legacy: Prince William Sound Marine Bird Population Trends.
Team Leader: Robert Kaler

FORM 4A
TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

14120114-C

2. Project Title: *See*, Reporting Policy at III (C) (2).

Long-term monitoring of seabird abundance and habitat associations during late fall and winter in Prince William Sound.

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Mary Anne Bishop, Ph.D., Prince William Sound Science Center

Report prepared by: Anne Schaefer

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2014 – January 31, 2015

5. Date of Report: *See*, Reporting Policy at III (C) (5).

February 17, 2015

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

http://pwssc.org/research/birds-2/seabirds/

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

The objectives of this project are:

1. Characterize the spatial and temporal distribution of seabirds in PWS during late fall and winter.
2. Relate seabird presence to prey fields identified during hydroacoustic surveys.
3. Identify critical biological and physical habitat characteristics for seabirds across PWS within and between winters.
4. Utilize increased temporal sampling resolution to improve our estimates of consumption of herring by seabirds during the winter.

For this FY14 report we provide preliminary results that address objectives 1, 3 and 4. Objective 2 will be addressed as hydroacoustic survey data becomes available from the juvenile herring surveys.

2014 Field Work and Preliminary analyses

During FY14 (1 February 2014-31 January 2015), two observers (Jessica Stocking and Anne Schaefer) with the Prince William Sound Science Center (PWSSC) performed seven marine bird surveys in PWS covering a total of 2041 km (Table 1). Six surveys occurred during fall and winter months while a seventh survey was conducted in summer (July) 2014 as part of a joint-pilot survey with NOAA and USGS. The July survey developed methods for characterizing multispecies predator-prey aggregations, specifically interactions between humpback whales, forage fish, and forage flocks of seabirds. The ships of opportunity used for the 2014 surveys included vessels surveying Pacific herring (EVOS Herring

Research Monitoring PWSSC), spot shrimp (Alaska Dept Fish & Game), and humpback whales (EVOS Gulf Watch NOAA). We also surveyed marine birds concurrently with the annual maintenance of the Ocean Tracking Network (OTN) acoustic arrays that are stationed across the major entrances and southwest passages of PWS and serviced by the PWSSC.

All surveys followed the established U.S. Fish and Wildlife Service protocols (USFWS 2007). Briefly, the observer recorded the number and behavior of all marine birds and mammals within a 300 m fixed-width strip (150 m on either side of the vessel) into a GPS-integrated data entry program (dLOG). Observers identified species to the lowest taxonomic unit possible. For each 3-km segment of the surveyed trackline, we calculated bird density (birds/km^2) for 11 species or species groups (Table 2).

Comparison of 2013/2014 and 2014/2015 winters. Although this reporting period only covers surveys completed in 2014, we present data summaries for the 2013/14 winter (n = 5) and the 2014/15 winter (up to December 2014, n = 4), with emphasis placed on the 2014 surveys (n=6). Due to the unique nature of the July survey, it is not included in any summary data in this report, unless specifically noted.

During the 2014 surveys we observed 34 avian species during 1917 km of survey effort (excluding July), with an average density of 10.99 ± 32.62 (SD) per square km. When we analyzed by winter, during the 2013/14 winter, 33 species were observed over 1348 km of surveyed tracklines, with an average density of 8.59 ± 16.30 (SD) marine birds per square kilometer. Birds were observed in the greatest densities in December. To date for the 2014/15 winter, we have observed 31 species in 1363 km of survey effort. Average density for the four cruises (Sept., Oct., Nov., Dec.) has been 11.38 ± 36.71 (SD) marine birds per square kilometer with the highest density recorded during September.

We observed pronounced temporal patterns in species occurrence over both winters, emphasizing the importance of not characterizing the nonbreeding season as a single time period when describing seabird communities (Fig. 1, Table 2). During the two winters, we observed the highest densities of *Brachyramphus* murrelets in December (2013/14 winter) and November (2014/15 winter). The lowest densities of *Brachyramphus* murrelets were recorded in September (2014) and October (2013 and 2014) when murrelets emigrate from PWS to complete their pre-basic molt. Across both winters, murrelets were distributed throughout PWS with the highest densities occurring in the northeastern portion of the Sound (Figs. 2, 3).

As in previous years, during 2014 common murre was the most numerous species observed during PWS marine bird surveys. Common murre was most dense in December during the 2013/14 winter and in September during the 2014/15 winter (Table 2). Similar to *Brachyramphus* murrelets, the highest congregations of murres were observed in the northeastern region of the Sound (Figs. 2, 3). Black-legged kittiwakes were broadly distributed throughout PWS in both winters (Figs. 2, 3) and had the highest observed densities of any species, peaking in September 2014. After the breeding season, kittiwakes disperse to over-wintering areas outside of PWS (McKnight et al. 2011), which was evident in the drop of observed densities during November and December both years, as well as February 2014. Loons were recorded primarily along the eastern side of PWS (Figs. 2, 3), with densities peaking in February 2014. Other notable observations made during 2014 were fork-tailed storm petrels, shearwaters, jaegers, and red-necked phalaropes, which were observed only during the September survey (with the exception of one storm petrel observation in December).

Collaborative September Montague Strait project. An analysis of the previous seven winters of marine bird surveys (2007/08 through 2013/2014) showed that Montague Strait is a "hotspot" for marine birds (Fig. 4). Similarly, the Gulf Watch NOAA Humpback Whale project identified this area as a "hotspot" for whales and the Herring Research Management (HRM) Post-spawn movements of Herring project previously has recorded acoustic-tagged herring reappearing in Montague Strait from September through December (M. Bishop unpubl. data). Based on these results, in September 2014 we collaborated with three other EVOS-funded projects (Gulf Watch NOAA Humpback Whale, Gulf Watch USGS forage fish, PWSSC (HRM) Validation project) to investigate multispecies predator-prey aggregations, specifically interactions between humpback whales, forage fish, and forage flocks of seabirds, in Montague Strait. In particular, the September survey addressed objective 4 of this project.

Humpback whales may take advantage of seabird feeding activity by using feeding flocks of marine birds as visual cues to prey concentrations. To characterize these relationships between marine predators and their prey resources, we recorded marine bird observations concurrent with humpback whale surveys and hydroacoustic transects. We focused particular attention on foraging flocks of marine birds and noted whether or not any whales were associated with the flock. In future surveys, when possible during whale/forage flock interactions, we will take repeated observations every 30 seconds and record variables such as the distance between the whale and the flock, whale behavior (traveling or diving), and the size and density of the forage flock.

During the September survey, we observed 10 foraging flocks, of which 2 were associated with humpback whales. Both encounters were recorded directly south of Knowles Bay, near Port Gravina. One flock consisted of approximately 209 marine birds, including black-legged kittiwakes (n = 170), glaucous-winged gulls (n = 20), common murre (n = 15), loons (n = 2), and pomarine jaegers (n = 2). The other forage flock consisted of 72 marine birds, including common murre (n = 55), black-legged kittiwakes (n = 14), Pacific loon (n = 1), and unidentified gulls (n = 2).

October ADFG survey between year comparison. This was our second year conducting marine bird surveys in October concurrent with the ADF&G spot shrimp survey. The design of the shrimp survey involves repeated visits to the same study sites year after year, thus the survey routes were relatively consistent spatially (Oct. 2013: 303 km surveyed; Oct. 2014: 349 km surveyed) and provided broad-scale coverage of PWS (Fig. 5A). These two surveys were consistent temporally, as well: both the 2013 and 2014 spot shrimp surveys were conducted over the same time span (October 12–23 both years). Due to the high spatial and temporal overlap, we completed a preliminary comparative analysis of community structure between these two surveys.

For species richness and diversity analyses, we removed all unidentified individuals from the dataset (with the exception of *Brachyramphus* murrelets, which were pooled). For each survey, we calculated the Menhinick's species richness index (Magurran 2004), which accounts for variation in sample size. Species diversity indices measure the degree to which the overall sample of observed birds is dominated by few species (lower diversity) or by a more even mix of species (higher diversity). We used the Shannon-Weiner index (Shannon and Weaver 1949) to quantify total species diversity for each survey and for each 3-km segment of surveyed trackline from each survey. For the latter analysis, unidentified birds and birds not assigned to a taxonomic group were excluded. We then mapped the 3-km segment diversity values to compare spatial patterns between October 2013 and October 2014.

Average marine bird densities were higher (Table 3) and relatively more broadly distributed in 2014 than in 2013 (Fig. 5B). In 2013, observations were recorded primarily in the northeastern and southwestern portions of PWS. After eliminating unidentified birds from the dataset, 572 birds were recorded in 2013 and 1013 birds in 2014. Despite the difference in total number of marine bird observations, the same number of species was observed in both surveys (n = 21). The species richness index was 0.88 in 2013 and 0.66 in 2014 and the species diversity index was 2.062 in 2013 and 1.701 in 2014. Rank abundance curves provide further insights into differences in community structure between 2013 and 2014 (Fig. 6). In October 2014, the community was dominated primarily by gulls and murres, with black-legged kittiwakes making up over 50% of all observations. In October 2013, dominance in the observations was shared by a mix of murres, gulls, goldeneyes, and storm-petrels. In 2013 the spatial distribution of diversity was concentrated primarily along the eastern side of PWS (Fig. 7). Conversely, in 2014 the spatial distribution of species diversity was scattered, with concentrations in the eastern, northern, and southwestern portions of the Sound (Fig. 7). Therefore, although birds were observed in greater densities and frequencies in 2014, the community structure recorded in 2013 was generally richer and more diverse.

With only two years of data, it is difficult to determine the reasons (biological or sampling variation) for differences in observed community structure between the two surveys. However, with continued collaboration with ADF&G on this survey, we will gain the opportunity to explore the effects of explanatory variables on the community structure of marine birds in PWS.

Analyses of 2007/2008 – 2013/2014 survey data

In spring 2014 we hired Dr. Ali Arab of Quanticipate Consulting to assist with modeling habitat associations for the first seven winters of data. While this work is still in progress, here we provide our rationale and some of the preliminary results of this analysis.

Previously we modeled habitat associations using a two-stage hurdle model (Zuur et al. 2012; Dawson et al. *in press*). A major assumption of the hurdle model is that all zeros are instances of absence, i.e. they are "true zeros". Detection is not a perfect process, particularly in the case of sampling animals; therefore, the probability of detection given presence is nearly always <1. In order to incorporate imperfect detection into our estimates of occupancy and relative abundance we transitioned to a modeling framework that allows us to incorporate some detection-level covariates into an explanation of a portion of the zero values. We use zero-inflated Poisson (ZIP) models to incorporate zeros that we suspect are due to lack of detection of birds that were present. One drawback, however, is that the interpretation of the probabilities becomes more complicated because zeros arise from more than one process including unsuitable habitat, non-detection of birds that are present, or simply part of the stochastic process (i.e. habitat, etc. was suitable but no bird was present). However, the focus of the analyses is not on the value of parameter estimates, per se, but is on changes in distribution predicted by the models.

Our exploratory analyses using the ZIP models found that of the detection covariates, glare is significantly associated with the probability of an excess zero for most species groups (Table 4) and is a significant predictor of all groups' count distributions. Bin (distance from the observer) is also consistently significant in explaining the probability of excess zeros across species groups and is significant in the count portion of the model for most groups. Our exploratory analyses also showed that

of the temporal covariates, the variables winter (survey year) and day of the season were consistently significant in driving bird distributions. Of the environment-derived covariates, the variable marine habitat type was significant in nearly all cases. Distance to shore, SST, bathymetry, and slope were not consistent across species groups, likely expressing complicated or non-linear relationships with bird distributions. Spatial variables latitude and longitude were significant for most species groups.

Deliverable/Milestone	Status
Complete fall/winter surveys	6 fall/winter surveys completed, 1 summer survey completed with NOAA/USGS collaboration
Attend annual meetings and workshops	Dr. Bishop attended the annual meeting, AMSS program meeting, and the EVOSTC joint science workshop in addition to two program conference calls.
Complete data summaries and reports	Year 4 workplan submitted in August, 2014 and approved. Research summaries for synthesis report completed. This report constitutes year 3 annual report

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

8.A. Between GWA projects and programs:

Coordination and collaboration is critical to this project as <u>all</u> our surveys require placing an observer on vessel charters associated with other projects. During FY14 we placed an observer on EVOS-sponsored *Gulf Watch Humpback Whale Systematic Surveys* (July, September, December) and *PWS Herring Research & Monitoring* program (November), as well as the Alaska Department of Fish and Game spot shrimp survey (October) and Ocean Tracking Network annual maintenance cruise (February, Table 1).

The pilot July and September 2014 surveys around Montague Strait and the southwest passages marked the first attempt to integrate Gulf Watch forage fish acoustic surveys (USGS) and HRM acoustic validation (PWSSC) with Gulf Watch humpback whale (NOAA) and our Gulf Watch marine bird surveys.

Item 8.C.

Finally, when not conducting daytime marine bird surveys, the bird observer assists the other projects when possible. During the past year, assistance has included helping set and pick shrimp pots with the ADFG survey and process their contents, helping process the catches from plankton and fish trawls, and jigging for forage fish samples (GWA forage fish project).

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

<u>Data:</u>

Datasets and associated metadata through December 2014 have been uploaded to the Gulf Watch portal.

<u>Publications:</u>

Bishop, M.A., J. Watson, K. Kuletz, and T. Morgan. 2015. Pacific herring consumption by marine birds during winter in Prince William Sound, Alaska. Fisheries Oceanography 24(1):1-13.

Dawson, N., M.A. Bishop, K. Kuletz and A. Zuur. 2015. Using ships of opportunity to assess winter habitat associations of seabirds in subarctic coast Alaska. *Northwest Science*. *In press*. Accepted October 2014.

Bishop, M.A. 2014. Long-term monitoring of seabird abundance and habitat associations during late fall and winter in Prince William Sound. Pages 3:70-78 in T. Neher et al. Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Science Synthesis Report for the Gulf Watch Alaska Program.

Popular Press:

Bishop, M.A. 2014. At-sea seabird surveys. *Delta Sound Connections* (circulation ~15,000). This annual newspaper published about the natural history of PWS and the Copper River Delta is distributed each May to airports and tourist areas in southcentral Alaska.

Meetings

Bishop participated in the Gulf Watch meeting for Principal Investigators in November 2014, Anchorage and attended the Gulf Watch meeting during January 2015 at AMSS via teleconference. Bishop also attended the quarterly teleconference meetings of GulfWatch principal investigators.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

No issues were raised by the most recent EVOSTC review.

11. Budget: *See,* Reporting Policy at III (C) (11).

The contract cost of Dr. Ali Arab of Quanticipate Consulting for conducting the habitat association analyses is coming out of money originally designated for personnel since it was not initially budgeted for. Travel to the annual PI meeting in November 2014 was charged to the project although it was not initially budgeted for.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$46.0	$70.0	$72.0	$74.3	$77.3	$339.6	$71.1
Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$1.1
Contractual	$1.4	$2.1	$2.1	$2.1	$1.8	$9.5	$1.1
Commodities	$0.0	$0.0	$0.1	$0.1	$0.1	$0.3	$0.2
Equipment	$0.0	$0.0	$0.0	$0.0	$1.1	$1.1	$0.0
Indirect Costs (will vary by proposer)	waived	waived	waived	waived	waived	waived	waived
SUBTOTAL	$47.4	$72.1	$74.2	$76.5	$80.3	$350.5	$73.5
General Administration (9% of subtotal)	$4.3	$6.5	$6.7	$6.9	$7.2	$31.5	$6.6
PROJECT TOTAL	$51.7	$78.6	$80.9	$83.4	$87.5	$382.1	$80.1
Other Resources (In kind Funds)	$10.5	$45.5	$63.5	$63.5	$63.5	$246.5	$119.5

COMMENTS: Prince William Sound Science Center waives the indirect cost on this proposal due to its administration of the overall proposal.
This project relies on using ships of opportunity to conduct seabird observations. Past & projected ship time from non-EVOSTC funds:
in-kind ship time: $140.0 Alaska Dept. Fish & Game ($3.5/d @ 10 d/yr @ 4 yrs; began 2013, projected to continue atleast through 2016)
in-kind ship time: $48.0 Ocean Tracking Network ($3.0/d @ 6 d/yr @ 3 yrs; begins Feb. 2014. projected to continue atleast through 2016)
in-kind ship time: $21.0 NOAA ($1.5/d @ 7 d/yr, since Oct 2011; depends on year on amount non-evostc funds used)

Please note that the remaining vessel costs are covered by the EVOSTC projects: PWS Herring Research & Monitoring and LTM Humpback whale project.

FY12-16

Project Title:15120114-C Long-term monitoring of seabird abundance & habitat associations during late fall & winter in PWS
Project PI: M.A. Bishop

FORM 3A
NON-TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See,* Reporting Policy at III (C) (1).

12120114-R

2. Project Title: *See,* Reporting Policy at III (C) (2).

Gulf Watch Alaska: Nearshore Benthic Systems in the Gulf of Alaska

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

B. Ballachey, J. Bodkin, H. Coletti, T. Dean, D. Esler, K. Kloecker, M. Lindeberg, B. Weitzman

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014 – January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

Our field work for year 3 (the 2014 field season, with field work from April through July) was completed with no problems or concerns, with project components completed on schedule. We conducted 5 field trips, including 1 to Katmai National Park (KATM), 1 to Kenai Fjords National Park (KEFJ), 2 to western PWS (WPWS), and 1 to eastern PWS (EPWS). At all areas, we visited and sampled nearshore sites that were established in previous years. Work completed in all areas included monitoring/sampling of rocky intertidal sites, mussel sites, and eelgrass beds. At KATM, KEFJ, and WPWS, we monitored black oystercatcher nests and collected sea otter forage data. We completed marine bird and mammal surveys in KATM and KEFJ, and sea otter carcass collections in WPWS, KATM and KEFJ. An aerial survey of sea otters in Kenai Fjords was scheduled for August 2013 but due to several factors, we were not able to complete this survey in 2013 or 2014. An aerial survey of sea otters at KATM is scheduled for July 2015.

We have continued to closely coordinate monitoring efforts with the GWA nearshore project in Kachemak Bay (KBAY; K. Iken and B. Konar; GWA Nearshore Project 12120114-L). We combined data sets from KBAY, KATM, KEFJ, WPWS, EPWS, and NPWS for an analysis of static habitat attributes at nearshore rocky sites (GWA Science Synthesis Report: Chapter 4 *Research Summary 1: Influence of static habitat attributes on local and regional biological variability in rocky intertidal communities of the northern Gulf of Alaska*) and concluded that static attributes are important in determining nearshore community structure. We also conducted and analysis of mussel data, included multiple data sets and examining the role of environmental drivers at broad spatial and temporal scales (GWA Science Synthesis Report: Chapter 4 *Research Summary 2: Inter-annual and spatial variation in Pacific blue mussels (Mytilus trossulus) in the Gulf of Alaska, 2006-2013*) and concluded that although mussel abundance and biomass vary synchronously over spatial and temporal scales, local variation at sites is significant in determining mussel abundance.

We continued collections of nearshore species including mussels, clams, and kelps for stable isotope analyses, collaborating with Dr. S. Newsome at the University of New Mexico. We collected additional mussels for two studies, to: 1) assess rates of growth at study sites across the GOA, and 2) evaluate gene expression, as a tool for monitoring long-term health of the nearshore, in collaboration with Drs. L. Bowen and K. Miles (USGS-WERC) and T. Hollmen (AK SeaLife Center).

We surveyed sea stars at our nearshore sites for the sea star wasting disease which has been widely observed in stars along the California, Oregon and British Columbia coasts. We initially cooperated with an experienced star observer from the University of California Santa Cruz (on our EPWS trip, the first of the season). Subsequently we observed over 3000 stars at our sites, ranging from EPWS to KATM, and saw no indications of diseased stars, suggesting the disease had not moved into the northern GOA. Additional surveys of stars will be done this summer, as part of our scheduled nearshore monitoring activities. Because of public interest in the topic of sea star wasting disease, we developed a "Resource Brief" to distribute to managers, educators and the public: (http://science.nature.nps.gov/im/units/swan/assets/docs/reports/resourcebriefs/GWA_2014_SeaStarWasting_RB.pdf).

Deliverable/Milestone	Status
Field work (4 trips, multiple tasks per trip to collect data on series of nearshore metrics); KATM, KEFJ, WPWS, EPWS	Completed, June - July 2014
Upload 2013 data to project website	Completed, August 2014
Preparation of Gulf Watch Alaska Synthesis Report	Completed, November 2014
PI's attend annual Gulf Watch meeting	Completed, November 2014

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

8.A.:

We are working closely with the other nearshore project (12120114-L, Ecological Trends in Kachemak Bay; B. Konar and K. Iken) to ensure that data collected in Kachemak Bay are comparable with those from other nearshore sites. We collaborated with Drs. Konar and Iken to combine data sets for analyses presented in the 2014 GWA Science Synthesis report. We also worked more closely in 2014 with the other GWA components (ED & Pelagic), to identify data sets that can be shared (e.g., ED data were used extensively in our analysis of mussel trends across the GOA, presented in the 2014 GWA Science Synthesis report).

8.C.:

In 2013, building on GWA findings, we initiated a study of annual patterns in mussel energetics and sea otter foraging at KEFJ, funded by NPS and USGS.

Our GWA nearshore data from KATM contributed to USGS and NPRB studies of the status of the SW Alaska stock of sea otters, which is listed as threatened under the Marine Mammal Protection Act.

In July 2014, during our fieldwork at KATM, we coordinated with the NPS and with Dr. Gail Irvine of USGS to sample long-term study sites on armored beaches at Katmai National Park and Preserve, which have previously been monitored for lingering oil (G. Irvine, PI; EVOSTC projects 040708, 070801, and 11100112).

In May 2014, we collaborated with NPS and USFWS to train additional personnel to increase the available pool of observers and pilots available to conduct sea otter aerial surveys.

We worked with the University of California Santa Cruz to conduct surveys of sea stars, looking for signs of sea star wasting disease

USGS and NPS provide logistical, administrative, and in-kind support for the GWA Nearshore component.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

Publications & Reports:

Ballachey, B., Bodkin, J., Coletti, H., Dean, T., Esler, D., Esslinger, G., Iken, K., Kloecker, K., Konar, B., Lindeberg, M., Monson, D., Shephard, M., and Weitzman, B. 2014. Variability within Nearshore Ecosystems of the Gulf of Alaska. Chapter 4 in Gulf Watch Alaska Science Synthesis Report, December 1, 2014 (*includes Introduction and two research summaries*).

Ballachey, B.E., J.L. Bodkin, D. Esler and S.D. Rice. 2014. Lessons from the 1989 *Exxon Valdez* oil spill: a biological perspective. In: J.B. Alford, M.S. Peterson and C.C. Green, Eds. Impacts of Oil Spill Disasters on Marine Habitats and Fisheries in North America. CRC Marine Biology Series. Pp. 181-198.

Ballachey, B.E., D.H. Monson, G.G. Esslinger, K. Kloecker, J. Bodkin, L. Bowen and A.K. Miles. 2014. 2013 update on sea otter studies to assess recovery from the 1989 Exxon Valdez oil spill, Prince William Sound, Alaska: US Geological Survey Open-File Report 2014-1030, 40p.

Ballachey, B.E., J.L. Bodkin, K.A. Kloecker, T.A. Dean, and H.A. Coletti. 2015. Monitoring for Evaluation of Recovery and Restoration of Injured Nearshore Resources. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 10100750), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

Ballachey, B.E. and J.L. Bodkin. 2015. Challenges to sea otter recovery and conservation. Chapter 4 in Sea Otter Conservation, edited by J. Bodkin. S. Larson and G. VanBlaricom. Elsevier. Published January 2015. Pp 63-96.

Bodkin, J.L. 2015. Historic and Contemporary Status of Sea Otters in the North Pacific. Chapter 3 in Larson SE, Bodkin JL, VanBlaricom GR. Eds. Sea Otter Conservation. Academic Press, Boston. Pp 43-61.

Bodkin, J.L., D. Esler, S.D. Rice, C.O. Matkin, and B.E. Ballachey. 2014. The effects of spilled oil on coastal ecosystems: lessons from the Exxon Valdez spill. In: B. Maslo and J.L. Lockwood, Eds. Coastal Conservation. Cambridge University Press. Pp. 311-346.

Coletti, H.A., Dean, T.A., Kloecker, K.A., and Ballachey, B.E. 2014. Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2012. Natural Resource Technical Report NPS/SWAN/NRTR—2014/843. National Park Service, Fort Collins, Colorado. http://science.nature.nps.gov/im/units/swan/publications.cfm?tab=2

Dean, T.A., Bodkin, J.L., and Coletti, H.A. 2014. Protocol Narrative for Nearshore Marine Ecosystem Monitoring in the Gulf of Alaska, Version 1.1. Natural Resource Technical Report NPS/SWAN/NRTR—2014/756. National Park Service, Fort Collins, Colorado.

Larson, S., Bodkin, J.L., and VanBlaricom. G.R. 2015. Sea Otter Conservation. Academic Press, Boston. 447 p.

Monson, D.H. and Bowen, L. 2015. Evaluating the Status of Individuals and Populations: Advantages of Multiple Approaches and Time Scales. Chapter 6 in Larson SE, Bodkin JL, VanBlaricom GR, Eds. Sea Otter Conservation. Academic Press, Boston. Pp 121-158.

Presentations:

Holderied, K., McCammon, M., Hoffman, K., Ballachey, B., Weingartner, T., Lindeberg, M., and Hopcroft, R. Gulf Watch Alaska – Monitoring the pulse of the Gulf of Alaska's changing ecosystems: Alaska Marine Science Symposium, Anchorage, January 2015.

Monson, D., Dean, T., Lindeberg, M., Bodkin, J., Coletti, H., Esler, D., Kloecker, K., Weitzman, B., and Ballachey, B. Inter-annual and spatial variation in Pacific blue mussels (*Mytilus trossulus*) in the Gulf of Alaska, 2006-2013: Alaska Marine Science Symposium, Anchorage, January 2015.

Konar, B., Iken, K., Coletti, H., Dean, T., and Monson, D. Static habitat attributes influence biological variability in intertidal communities in the central Gulf of Alaska: Alaska Marine Science Symposium, Anchorage, January 2015.

Lujan, S., Newsome, S.D., Coletti, H., von Biela, V., Monson, D., Ballachey, B., and Bodkin, J. Importance of micro- vs. macro-algae to Alaska marine invertebrates: Western Society of Naturalists, Tacoma, WA, November 2014.

Meeting attendance:

January 2015, Alaska Marine Science Symposium, Anchorage: Ballachey, Coletti, Doroff, Esler, Kloecker, Lindeberg, Monson, Shephard, Weitzman.

November 2013, Gulf Watch PI meeting, Anchorage: Ballachey, Bodkin, Coletti, Dean, Doroff, Esler, Kloecker, Lindeberg, Monson, Shephard.

Data & metadata uploaded to data portal:

(1) Black oystercatchers: prey and nest site data, KEFJ, KATM, WPWS; (2) Rocky intertidal sites: percent cover of invertebrates and algae, nucella, katharina, & sea star counts, slope data; KEFJ, KATM, WPWS, EPWS; (3) Invertebrates on sand/gravel beaches: counts, species, sizes, KEFJ, KATM, WPWS, EPWS; (4) mussels: counts, sizes (if > 20mm), KEFJ, KATM, WPWS, EPWS; (5) Sea otters: carcass data, KATM, WPWS, forage data, KEFJ, KATM, WPWS, EPWS, aerial survey--metadata only; (6) Water quality: mussel contaminant data, KEFJ, KATM, WPWS, EPWS, temperature data (intertidal), KEFJ, KATM, WPWS; (7) Marine bird and mammal survey data, KATM, KEFJ (raw count data and metadata in form of description of project and methods).

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

There were no recommendations for modifications to the Nearshore component of GWA in the recent EVOS reviews.

11. Budget: *See,* Reporting Policy at III (C) (11).

Budget forms submitted separately. Our overall budget expenditures are on target with the proposed expenditures, and are in keeping with the objectives of the project. However, our agency financial system codes categories somewhat differently than the EVOS categories, so that the total for each EVOS category sometimes varies between the proposed and the actual. Further detail, if needed, will be provided upon request.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$110.0	$160.0	$160.0	$160.0	$160.0	$750.0	$484.3
Travel	$3.5	$5.0	$5.0	$5.0	$5.0	$23.5	$38.9
Contractual	$118.5	$103.0	$125.0	$103.0	$125.0	$574.5	$230.0
Commodities	$5.1	$9.0	$9.0	$9.0	$9.0	$41.1	$41.2
Equipment	$22.0	$2.0	$5.5	$7.0	$5.5	$42.0	$16.5
Indirect Costs (will vary by proposer)							
SUBTOTAL	$259.1	$279.0	$304.5	$284.0	$304.5	$1,431.1	$810.9
General Administration (9% of subtotal)	$23.3	$25.1	$27.4	$25.6	$27.4	$128.8	$73.0
PROJECT TOTAL	$282.4	$304.1	$331.9	$309.6	$331.9	$1,559.90	$883.9
All amounts are in thousands of dollars.							
Other Resources (in kind Funds)	$274.0	$274.0	$274.0	$274.0	$274.0	$1,370.0	$548.0

COMMENTS: Annual in-kind contributions from USGS consist of staff time (Esler, Bodkin, Kloecker, Esslinger, Snedgen: $60K), reduced charter costs ($24K), use of equipment such as inflatables/outboards, GPSs, spotting scopes, field laptops, sounding equipment (eelgrass sampling), 10K. From NOAA: staff time & expenses (Lindeberg), 10K; from NPS: staff time (Coletti, Shephard, others), 120K, operations, 50K.

FY12-16

Program Title: 15120114-R Nearshore Monitoring

Team Leader: Ballachey & Dean

FORM 4A
TRUSTEE AGENCY
SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See,* Reporting Policy at III (C) (1).

13120114-L

2. Project Title: *See,* Reporting Policy at III (C) (2).

Long-term monitoring of ecological communities in Kachemak Bay: a comparison and control for Prince William Sound

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

Brenda Konar (UAF), Katrin Iken (UAF), Angela Doroff (KBRR)

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

Feb 1 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

Intertidal Monitoring

Sampling Conducted in 2014

Work during this period included intertidal field monitoring in Kachemak Bay, conducted April 27-May 2, 2014. Monitoring included four strata (high, mid, low and -1) at five rocky intertidal sites (Port Graham, Outside Beach, Cohen Island, Bluff Point, and Bishops Beach) and four seagrass sites (Homer Spit, Jakalof Bay, Pederson Bay, and Herring Island). Data collection at the rocky sites included percent cover of all sessile organisms, counts of all kelp stipes, and mobile organisms over 2 cm, and substrate classification). Limpet (*Lottia persona*) and mussel (*Mytilus trossulus*) size-frequency distributions were assessed at three of the rocky sites (Port Graham, Outside Beach, and Cohen Island). At the seagrass sites, data collected included percent cover of all sessile organisms, and counts of all seagrass plants, kelp stipes, and mobile organisms over 2 cm. All these data have been uploaded on the workspace.

Rocky Beach Comparison

We are now working with our Nearshore Gulf Watch colleagues from Prince William Sound, Kenai Fjords National Park, and Katmai National Park and Preserve to produce a manuscript on the influence of static habitat attributes on local and regional biological variability in rocky intertidal communities of the northern Gulf of Alaska. A draft of this paper was included in the Gulf Watch synthesis report. The preliminary results that we present in this manuscript are as follows:

We have found that although there were significant differences in intertidal rocky communities among regions and between the two sampling years, most of the variation in the biological data occurred at local scales, such as between strata and among sites within regions (Table 1). While we know that there are significant differences among intertidal strata in the Gulf of Alaska (Konar et al. 2009), the importance of the role that local-scale habitat drivers play across the Gulf is significant and new.

Table 1: PERMANOVA results testing differences in the biological data by year, region, stratum, and site (nested in region). Differences in the biological communities are based on Bray-Curtis similarities of square root transformed percent cover data. Largest pseudo-F values are associated with site and stratum.

Source	df	SS	MS	Pseudo-F	P(perm)
year	1	10486	10486	2.3257	0.038
region	5	4.2348E5	84696	3.9257	0.001
stratum	1	1.3568E5	1.3568E5	19.771	0.001
site (region)	24	5.4645E5	22769	19.149	0.001

Within and among regions, variation was evident, especially in the spread of sites within each region and in the separation of KBAY and KATM from other regions (Fig. 2, left panel). In some regions, such as KEFJ and EPWS, sites overlapped strongly. A CLUSTER analysis based on the biological data grouped sites into nine clusters according to biological community similarity at the 55% level. As expected, these biological clusters grouped closely on the nMDS (Fig. 2, right panel), and this grouping was regardless of region. This shows that, despite some regional structure, some sites from different regions shared common biological community elements. However, the classification "region" is foremost based on logistical and sampling design constraints and it is unclear how much this reflects differences in biology or environment. We, therefore, assessed the importance of static habitat attributes on the biological community structure and compared these results and that of the regional structure to the biological clustering (Fig. 2, right panel).

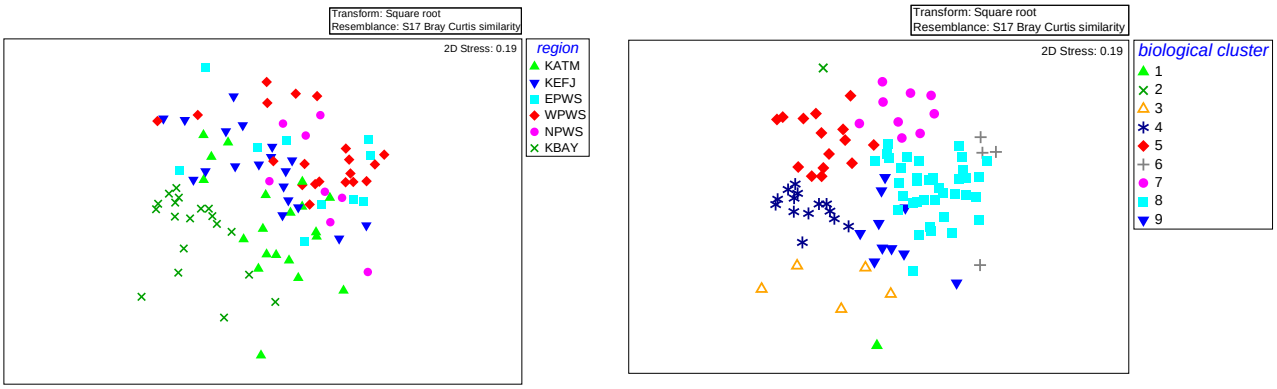


Figure 2: nMDS showing differences in biological data for each site by year and tidal stratum, color-coded by regional association of the sites (left panel), and with sites color-coded according to biological clusters (right panel).

A CLUSTER analysis performed on sites based on their static habitat attributes resulted in six clusters. When the nMDS based on biological community structure was overlaid by these habitat clusters, there still was overlap of sites from several static habitat clusters, especially static habitat clusters five and six. Static habitat clusters 1 and 3 displayed very similar patterns as those in the biological clusters, but especially static habitat clusters 5 and 6 did not separate similar to the biological associations (biological clusters 5, 7-9). Site separation based on static attributes was similar to the separation achieved by region groupings (compare Figs. 2 left panel and 3), but groupings differed. In summary, some structure in biological communities can be determined by static habitat attributes, although the variation in Fig. 3 clearly indicates that factors other than the static habitat characteristics measured here also influence rocky intertidal communities.

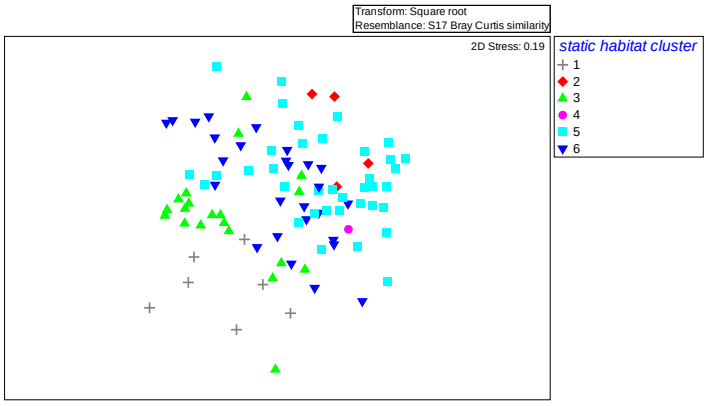


Figure 3: nMDS showing differences among sites based on static habitat clusters. Individual points are sites by year and tidal stratum.

When static attribute vectors were overlaid on the nMDS of sites based on biological clusters, tidewater glacial presence, slope, and distance to freshwater drove some clusters, while fetch, exposure, and substrate type most influenced other clusters (Fig. 4). The BIO-ENV analysis showed that when intertidal strata were combined per site, tidewater glacial presence, exposure, fetch at 200 m, and percent cover mud/sand were the most important attributes (ρ=0.410).

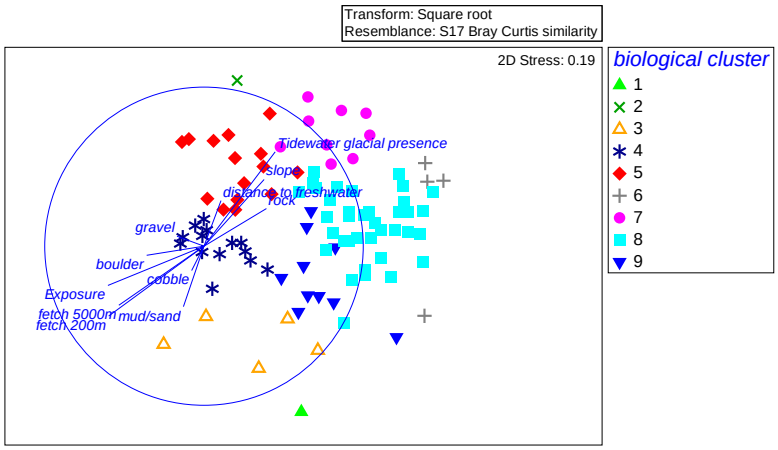


Figure 4. nMDS of sites by biological clusters with vectors of static attributes indicating variables driving separation. Individual points are sites by year and tidal stratum.

Site groupings of biological communities according to static habitat attributes also were confirmed for both intertidal strata separately (Fig. 5). Six habitat clusters were identified for both the mid and the low intertidal (at 55% similarity). Site community grouping by strata still showed some overlap, especially for habitat clusters 5 and 6. The BIO-ENV analysis showed that in the mid stratum, the five most important habitat attributes in driving biological communities were tidewater glacial presence, slope, fetch at 200 m, percent cover boulders, and percent cover gravel (ρ=0.630). In the low stratum, the four important habitat attributes structuring the biological communities included distance to freshwater, tidewater glacial presence, exposure, and percent cover mud/sand (ρ=0.523).

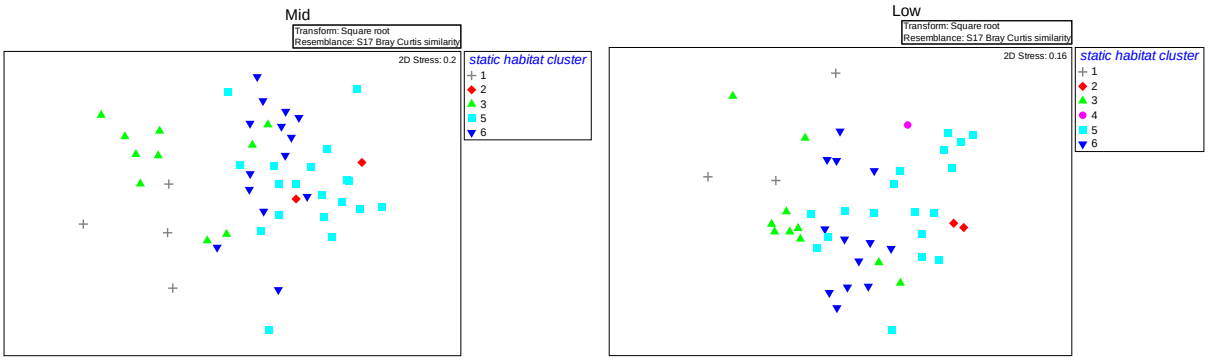


Figure 5: nMDS showing differences among site groups based on static habitat attribute clusters for the mid intertidal (left panel) and the low intertidal (right panel). Individual points are sites by year within each tidal stratum.

Overall, in the northern Gulf of Alaska, local static attributes explained some of the structure of biological communities. Static habitat attribute-based groupings differed from regional groupings, indicating that there were no consistent differences in static habitat attributes by region. This indicates that there are additional regional drivers, either static or dynamic, that are specific to each of the regions (i.e., WPWS, EPWS, NPWS, KEFJ, KATM, and KBAY). Understanding the importance of static attributes is essential to be able to tease them apart as much as possible from the role of temporally more dynamic drivers in these regions, particularly in the context of long-term monitoring of these communities and climate variation. For example, as mentioned before, some of the static attributes included in this analysis, such as distance to freshwater input and the regional presence of tidewater glaciers may be static but the amount of discharge from these sources is not. The inclusion of key static variables as covariates in future analyses of trends in community structure over time should help improve our ability to detect important temporal patterns and their causes. In addition, while the overall species pool for the more common and dominant species is probably relatively similar throughout the Gulf of Alaska, these data imply that static habitat attributes play a role in dictating species occurrence at a local/site level, contributing to site-specific differences in biological communities.

Sea Otter Monitoring

Sea Otter Population Assessment

The 2012 survey results were analyzed but are still preliminary and have not undergone formal review within U.S. Geological Survey. However, the increase in sea otter numbers is important and relevant to the community ecology within Kachemak Bay and we are working with the preliminary population estimate of 5,927 ± 672 until results are finalized. No new population abundance data are available for this area during the reporting period.

Sea Otter Mortality

The Alaska Marine Mammal Stranding Network in Homer, AK in collaboration with the U.S. Fish and Wildlife Service (FWS), Marine Mammals Management Office has been collecting year-around data on sea otter carcass recovery, causes of mortality, and managing live strandings since the beginning of this study. The local marine mammal stranding network is voluntary and the following people have been instrumental in local response to sea otter strandings, Marc Webber, Debbie Tobin, three Kachemak Bay Campus students, and Rachael Rooney. The FWS have not published the data on the number of mortalities since the Unusual Mortality Event in 2006; however, they have continued to collect and manage data on sea otter mortality in this area.

In 2014, the FWS responded to 132 sea otter strandings state-wide. Kachemak Bay and lower Cook Inlet comprised 72% of the sample and the sex and age classes are as follows: 20 were female (majority

young of the year), 30 male (adult/old adult), and 8 unknown sex. The FWS conducts forensic-level necropsies on freshly dead sea otters. From the Kachemak Bay/lower Cook Inlet region they have completed 67 necropsies to date (and in some cases, lab results are still pending and will inform reported results). Interim results indicate that while Strep Syndrome is still a primary cause of sea otter mortality in the region, this past year only 18% of the cases analyzed so far were directly related to the syndrome and most cases were unconfirmed as to whether or not the mortality was related to the Strep Syndrome. Primary causes of mortality reported to date include: blunt trauma/trauma, encephalitis/menigoencephilitis, gun shot, septicemia, and were 33% unknown (K. Worman, personal communications).

Sea Otter Prey Assessment

Student involvement:University of Alaska, Kachemak Bay Campus, Semester by the Bay student volunteer Lauren Mc Caslin and University of Alaska graduate student, Sarah Traiger contributed valuable field work and interpretation to this year's sea otter prey assessment report.

Visual Observations: All current and historical focal animal sampling data on sea otter diet were archived and sent to USGS to be included in the sea otter program's database for Gulf Watch; no independent assessments are provided in this report. Data from previous studies in Kachemak Bay can be found in this article: http://www.otterspecialistgroup.org/Bulletin/Volume29/Doroff_et_al_2012.pdf. It is important to note that the relative proportions of prey types identified in sea otter diet vary by the methods used to assess diet. Based on visual observations in Kachemak Bay we identified clam, mussel, and crab to make up 38%, 14%, and 2% respectively based on foraging dives where prey were identifiable (Doroff et al. 2012).

In order to better link the benthic sampling of seagrass beds to sea otter foraging activity, we conducted opportunistic scan samples of sea otter numbers and behaviors (resting, foraging, and swimming) for a seagrass monitoring site located in Mud Bay during September and October 2014. In September, we conducted 25 scan sample events and classified sea otter behavior for 489 sea otters; of these 1% were foraging and 97% were resting. In October, we conducted 27 scan sample events and classified behavior for 1081 sea otters; 1% were foraging and 90% were resting. Obtaining direct observations of sea otter foraging behavior in the soft sediment habitat study sites remains challenging.

Sea otter forage pit structures are regularly observed in the soft sediment benthic monitoring sites in Kachemak Bay. In 2014, we monitored pit structures and retention over the field sampling period (May – Aug) at four long-term monitoring sites on the south side of Kachemak Bay and supplemented this information with collections of bivalve shell litter at the same sites. The two known sources for pits were sea stars (*Pycnopodia helianthoides*) and sea otters. Sea otter predated bivalves have a fairly distinctive break pattern on the shell and are easily distinguishable from other sources of mortality (Kvitek et al. 1992). All shells without evidence of sea otter predation were classified as whole (sea star), bore-hole, crab cracked, or unknown mortalities. There were 13 species of bivalves identified in the shell litter but approximately 83% of the sample was *Saxidumus gigantea*. In Figure 6, we see all soft sediment monitoring sites had sea otter cracked shell litter and probable sea star predation; the size class of bivalve was larger in the older shell record than for the recent shell record in all cases with the exception of Kasitsna Bay dock in the non-otter mortality.

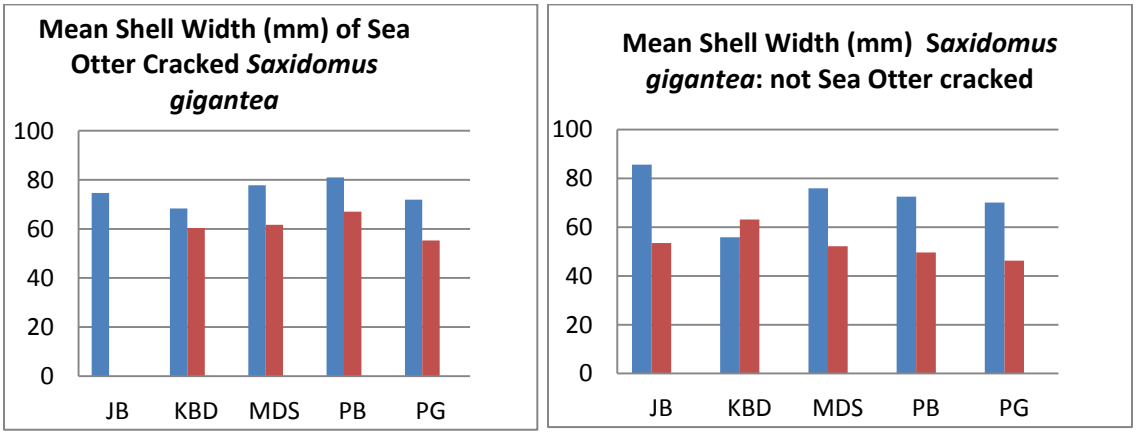


Fig. 6. Frequency of occurrence of *Saxidomus gigantea* at five sites in Kachemak Bay (JB = Jakolof Bay, KBD= Kasitsna Bay dock, MDS=McDonald Spit, PB=Peterson Bay, and PG=Port Graham) sampled May – August 2014. Dark blue indicates older shell litter (signs of shell breakdown) and red indicates more recent shell litter (no signs of shell breakdown).

Fig. 7. *Saxidomus gigantea* shell litter from Kachemak Bay 2014. **A**. indicates a recent sea otter cracked shell, **B**. indicates a non-sea otter cracked shell; probable sea star predation, and **C**. an older shell and likely is the result of crab predation

From this pilot work, we conclude the presence of pits in the sediment alone is not a particularly good indicator of the rate of foraging by bivalve predators in either intertidal or subtidal habitats. Confounding factors may include sea stars utilizing sea otter forage pits to obtain prey more readily, thus altering the structure of the pits. Having direct observations for sea otter foraging and concurrent collection of shell litter at sites where forage pits are monitored would improve how we interpret pit structures in the soft sediment habitats in our study area. Methods, results, and conclusions were presented in a poster at the Alaska Marine Science Symposium in January 2015: Traiger SB, B Konar, A Doroff, L McCaslin. Distinguishing sources of foraging pits using pit dimensions and shell litter in nearshore soft substrates.

Scat Analyses: We are collecting monthly sea otter scat samples in Little Tutka Bay, located along the south shore of Kachemak Bay, during the winter months of 2012-2014 (Fig. 8). The collection of these samples was accomplished through citizen science collaboration with the land/dock owners and the regularly scheduled mail delivery run in the area (see Doroff et al., 2012 for sample collection and methods). We collected 20 sea otter scat samples between October 2013 and December 2014, which were processed during this reporting period; sample collection is still ongoing for this winter. We worked with Dr. Deborah Tobin and Marc Webber at the UAA Kachemak Bay Campus and their students enrolled in a course on Marine Mammals to process the scat samples and summarize the data. Students and staff sorted each scat sample by prey type and assigned a percentage frequency method

using a 1 – 6 ranking (1 = 1 – 5%; 2 = 5 – 25%; 3 = 25 – 50%; 4 = 50 – 75%; 5 = 75 – 95%; 6 = 95 – 100%). To summarize the categorical data on diet from scat samples, we used the median value for each category and averaged by winter period (Fig. 8).

The relative proportion of prey types were averaged by collection day (or event) since the beginning of the project in 2008. In spring 2008 and fall 2008-09, sample locations were diverse and sample sizes were higher until collections were standardized to one site (Little Tutka Bay) and the collections limited to one per month of approximately one week's worth of sea otter scats per sampling event. The two dominant prey types evident in the scat samples in this study were blue mussels (*Mytilus trossulus*) and crab. The relative proportion of crab quantified in the diet by season ranged from approximately 22% to 52% of all prey. While there is an increasing trend in mussel present in the scat samples, the sample size has decreased since 2013 and is restricted to a single collection site. In 2011, we began to work with students to build a guide to the crab species found in sea otter scats. Thus far, known species of crab in sea otter diet at this site include: helmet crab (*Telmessus cheiragonus*), pygmy rock crab (*Glebocarcinus oregonensis*), hairy crab (*Hapalogaster mertensii*), graceful kelp crab (*Pugettia gracilis),* graceful decorator crab *(Oregonia gracilis)*, and potentially Tanner crab *(Chionoecates bairdi).* This year, our student intern, Lauren McCaslin, updated our sea otter scat species handbook for crabs. We began by collecting and photographing whole crabs during the course of other routine sampling events, dried them, and broke the exoskeletons down into sea otter scat pieces for the handbook. We field tested the handbook on the UAA Kachemak Bay Campus Marine Mammals students fall 2014 by providing them crab material from sea otter scat and the draft handbook and asked them to identify the sample to species if possible. The students provided valuable feedback that improved the utility of the handbook.

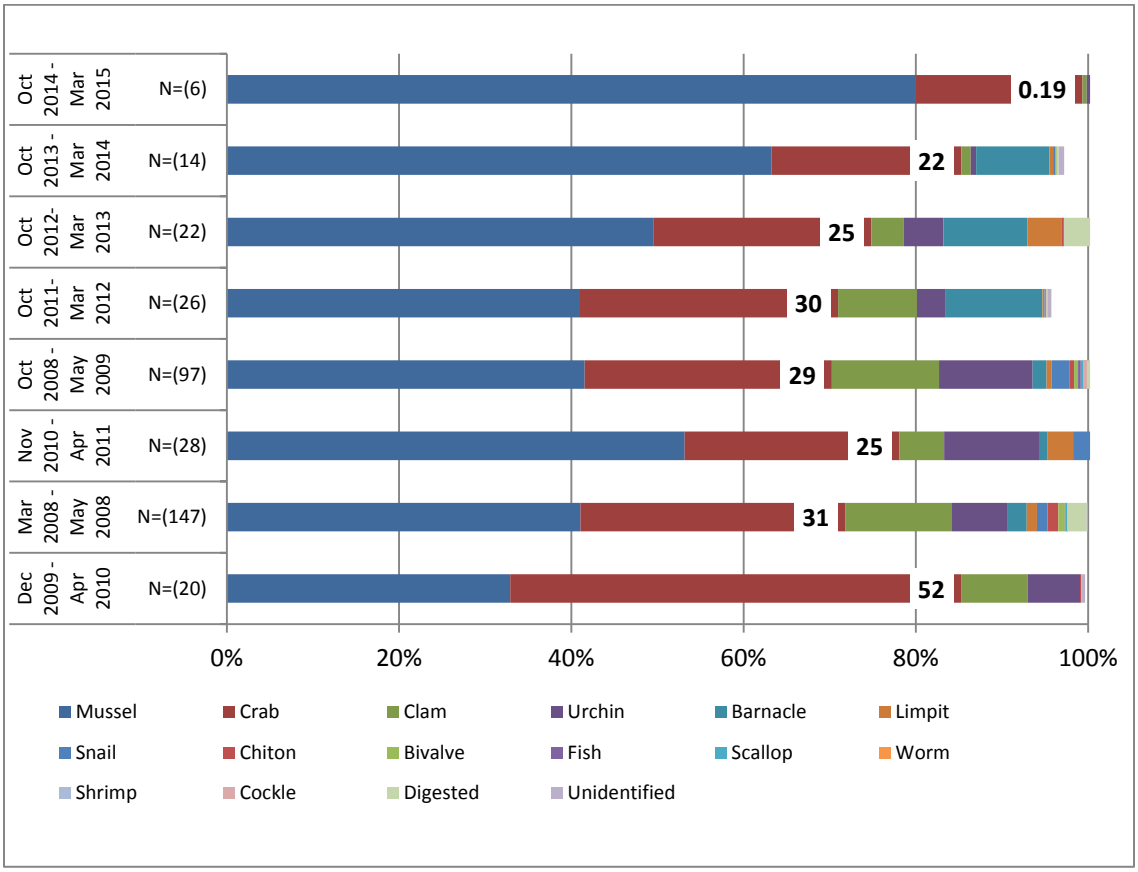


Fig. 8: Relative prey composition from sea otter scat collected during 2008-2013 during the winter months in Kachemak Bay, Alaska. Prey composition of individual scat samples was averaged by "winter period" and compared over time. In 2008-2009, scats were collected and processed from multiple sampling sites; however, 2009-2013 a single site was sampled

monthly from late fall (October or November when sea otters began to haul out) through the spring (March or April when sea otters stopped hauling out). Note that 2014-2015 is a partial year.

Kachemak Bay was one of 16 sites in a recent study that examined the interaction of intraspecific competition and habitat on individual diet specialization for sea otters (Newsome et al. 2015). The study utilized stable isotope data to quantify population and individual-level diet variation between rocky and mixed substrate habitat types. Stable isotope data were collected from 43 sea otter vibrissae and 103 sea otter prey samples from Kachemak Bay. The results of this study suggest that prey functional diversity in combination with prey diversity need to be considered when examining the causes of individual diet specialization in sea otters. In mixed or heterogeneous habitats like Kachemak Bay, sea otters may forage on a diversity of bivalves but most of the forage species are filter feeders in the soft sediment intertidal and subtidal habitats. High calorically rich (lipid rich) prey such as crabs and sea urchins are preferred but easily depleted whereas infaunal bivalves (protein rich) are reduced in size and relative abundance but have refuges from sea otter predation (burrowing depth) not available to epifaunal prey.

Literature Cited:

Doroff AM, O Badajos, K Corbell, D Jenski and M Beaver. 2012. Assessment of sea otter (*Enhydra lutris kenyoni*) diet in Kachemak Bay, Alaska (2008-2010). IUCN Otter Specialist Bulletin Vol 29:15-23.

Kvitek RG, JS Oliver, AR DeGange, and BS Anderson. 1992. Changes in Alaskan soft-bottom prey communities along a gradient in sea otter predation. Ecology 72:413-428.

Newsome SD, MT Tinker, VA Gill, AM Doroff, L Nichol, and JL Bodkin. 2015. The interaction of intraspecific competition and habitat on individual diet specialization. (Accepted Oecologia IpNV special issue).

Deliverable/Milestone	Status
Sample intertidal communities in Kachemak Bay	Completed May 2014
Collect monthly sea otter scat samples	Ongoing through the winter months
Conduct sea otter observations	Completed October 2014
Present work at Alaska Marine Science Symposium	Completed January 2015

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

Text description of needed content:

- Item 8A would cover collaboration and coordination both within your program and between the two programs: We have been coordinating with the other partners in the nearshore Gulf Watch Program. This is illustrated in the publication described above.
- Item 8B would include coordination with other EVOSTC funded projects (e.g. marine debris, harbor protection, or PIGU projects): N/A
- Item 8C would include coordination with our trust agencies: N/A

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

Stewart NL, B Konar and A Doroff. 2014. Sea otter (*Enhydra lutris*) foraging habitat use in a heterogeneous environment in Kachemak Bay off Alaska. Bulletin of Marine Science 90:921-939.

Poster presentations at the Alaska Marine Science Symposium in Anchorage Alaska in January 2015 include:

- Konar B, K Iken, H Coletti, T Dean and D Monson. Static habitat attributes influence biological variability in intertidal communities in the central Gulf of Alaska.

- Traiger SB, B Konar, A Doroff and L McCaslin. Distinguishing sources of foraging pits using pit dimensions and shell litter in nearshore soft substrates.

Poster presentation of project at AMSS that was leveraged with Gulf Watch includes:

- Konar B, K Iken, M Rogers and S Vanderwaal. Testing the use of unmanned aircraft systems for intertidal surveys- proof of concept.

Oral presentation of project at the Coastal Marine Institute Annual Review in Anchorage Alaska that was leveraged with Gulf Watch includes:

- Konar B, K Iken, M Rogers and S Vanderwaal. Testing the use of unmanned aircraft systems for intertidal surveys- proof of concept.

The 2014 data that were uploaded on workspace and linked to the data portal include: rocky intertidal community structure (species and percent cover), mussel size-frequency, seagrass shoot count and community structure (species and percent cover), limpet size-frequency, and sea otter scat data. All files included dataset metadata**.**

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

n/a

11. Budget: *See,* Reporting Policy at III (C) (11).

Actual spending differed from proposed budget by more than 10% for several reasons: In past years, we were able to leverage some personnel time and contractual services for lab fees from other projects. Some supplies that were left from previous projects were used. However, more funds will be used during the upcomong field work (April 2015, prior to end of fiscal year) for personnel time and contractual services. In addition, now that we are moving into the synthesis phase, we will use more personnel time on this project to work on syntheis products. Some of the supplies will now need to be replaced. Travel was underbudgeted (and overspent) because we only budgeted for field work travel and did not account for PI meeting travel.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$20.0	$20.7	$21.3	$22.0	$21.8	$105.8	$39.4
Travel	$1.0	$1.0	$1.0	$1.0	$1.0	$5.0	$6.7
Contractual	$6.4	$5.9	$5.2	$4.5	$4.5	$26.5	$7.4
Commodities	$2.1	$2.0	$2.0	$2.0	$1.5	$9.6	$2.1
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (will vary by proposer)	$14.6	$14.6	$14.6	$14.6	$14.7	$73.1	$27.5
SUBTOTAL	$44.1	$44.2	$44.1	$44.1	$43.5	$220.0	$83.1
General Administration (9% of subtotal)	$4.0	$4.0	$4.0	$4.0	$3.9	$19.8	$7.5
PROJECT TOTAL	$48.1	$48.2	$48.1	$48.1	$47.4	$239.8	$90.6
Other Resources (in kind Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

COMMENTS:

FY12-16

Project Title:15120114-L Kachemak Bay Intertidal
Team Leader: Konar/IkenF

FORM 3A
NON-TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See,* Reporting Policy at III (C) (1).

12120114-Q

2. Project Title: *See,* Reporting Policy at III (C) (2).

Gulf Watch Alaska: Long-term Monitoring: Lingering Oil - Evaluating Chronic Exposure of Harlequin Ducks to Lingering *Exxon Valdez* Oil

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

D. Esler, B. Ballachey

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014 – January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

In March 2014, harlequin ducks were captured in areas of western Prince William Sound that were oiled by the 1989 *Exxon Valdez* oil spill, and in nearby unoiled areas. Ducks were sedated and a liver biopsy collected for measurement of cytochrome P4501A induction, measured by EROD activity. Average EROD activity did not differ between duck sampled from oiled versus unoiled areas (see Figure 1, below). This result is consistent with EROD activities in liver samples collected in March 2013, and in contrast to liver samples collected from ducks captured in 2011 and earlier years, which showed elevated EROD activity in oiled relative to unoiled areas. Overall, these findings suggest that exposure of harlequin ducks to residual oil abated within 24 years of the spill.

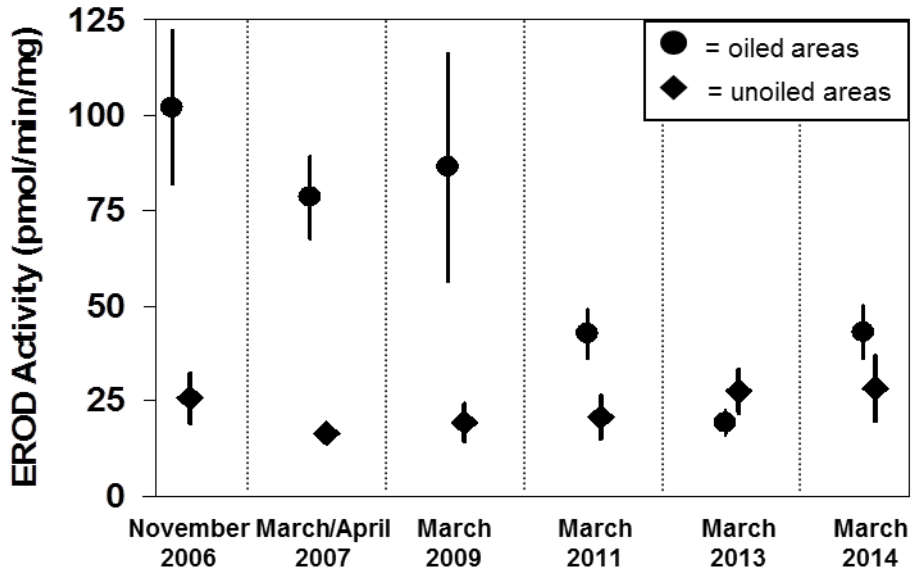


Figure 1. Average (± SE) hepatic 7-ethoxyresorufin-O-deethylase (EROD) activity (pmol/min/mg protein) of harlequin ducks captured in Prince William Sound, Alaska in from 2006 through 2014 (Esler and Ballachey 2015).

Deliverable/Milestone	Status
Capture harlequin ducks – March 2014	Completed
Conduct lab analyses and deliver data – August 2014	Completed
Analyze data and prepare report – December 2014	Completed
Submit final report – February 2015	Completed

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

8.A:

- This work is closely linked to that of the Nearshore Component of Gulf Watch Alaska.

8.C:

- This study builds on a time-series since 1998, funded by the EVOSTC and linked to other studies of nearshore vertebrate population recovery.
- USGS and NPS provide logistical, administrative, and in-kind support; this work is also linked with NOAA evaluations of lingering oil.
- In July 2014, we coordinated with the NPS and with Dr. Gail Irvine of USGS to sample long-term study sites on armored beaches at Katmai National Park and Preserve, which have previously been monitored for lingering oil (G. Irvine, PI; EVOSTC projects 040708, 070801, and 11100112). We identified patches of oil and sampled them; these have been submitted for laboratory analyses. Samples will be archived with NOAA.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

Esler, D., and B.E. Ballachey. 2014. Long-term Monitoring Program - Evaluating Chronic Exposure of Harlequin Ducks and Sea Otters to Lingering *Exxon Valdez* Oil in Western Prince William Sound. *Exxon Valdez* Oil Spill Trustee Council Restoration Project Final Report (Project 14120114-Q), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

Esler, D., Ballachey, B.E., Carls, M., and Lindeberg, M. 2014. Introduction to Lingering Oil Monitoring. Chapter 5 in Quantifying Temporal and Spatial Variability across the Northern Gulf of Alaska to Understand Mechanisms of Change: Science Synthesis Report for the Gulf Watch Alaska Program.

Esler, D., Bodkin, J., Ballachey, B., Monson, D., Kloecker, K., and Esslinger, G. 2014. Timelines and Mechanisms of Wildlife Recovery Following the Exxon Valdez Oil Spill. Chapter 5 in Quantifying Temporal and Spatial Variability across the Northern Gulf of Alaska to Understand Mechanisms of Change: Science Synthesis Report for the Gulf Watch Alaska Program.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

There were no recommendations for modifications to the Lingering Oil component of GWA in the recent EVOS reviews.

11. Budget: *See,* Reporting Policy at III (C) (11).

Budget forms submitted separately. Our overall budget expenditures are on target with the proposed expenditures, and are in keeping with the objectives of the project. However, our agency financial system codes categories somewhat differently than the EVOS categories, so that the total for each EVOS category sometimes varies between the proposed and the actual. Further detail, if needed, will be provided upon request.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$0.0	$0.0				$0.0	$142.7
Travel	$10.0	$0.0				$10.0	$33.6
Contractual	$141.9	$0.0				$141.9	$106.4
Commodities	$35.5	$0.0				$35.5	$6.8
Equipment	$0.0	$0.0				$0.0	$0.0
Indirect Costs (will vary by proposer)							$0.0
SUBTOTAL	$187.4	$0.0	$0.0	$0.0	$0.0	$187.4	$289.5
General Administration (9% of subtotal)	$16.9	$0.0	$0.0	$0.0	$0.0	$16.9	$26.1
PROJECT TOTAL	$204.2	$0.0	$0.0	$0.0	$0.0	$204.2	$315.6
All amounts are in thousands of dollars.							
Other Resources (Cost Share Funds)	$70.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

COMMENTS: USGS in-kind contributions include use of field gear and other resources, estimated at $10K. NOTE: Year three was added for this project, proposed costs are shown for year 1 on Ballachey & Esler NA yr. 3 worksheet in this workbook. Actual cumulative spent for the all years are shown on this worksheet.

FY12-16

Program Title: 15120114-Q Harlequin Ducks and Sea Otters
Team Leader: Esler & Ballachey
Agency: USGS

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TRUSTEE AGENCY SUMMARY

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel			$54.0			$54.0	NA
Travel			$3.1			$3.1	NA
Contractual			$38.0			$38.0	NA
Supplies			$7.0			$7.0	NA
Equipment			$0.0			$0.0	NA
Indirect Costs (will vary by proposer)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	NA
SUBTOTAL	$0.0	$0.0	$102.1	$0.0	$0.0	$102.1	NA
General Administration (9% of subtotal)	$0.0	$0.0	$9.2	$0.0	$0.0	$9.2	NA
PROJECT TOTAL	$0.0	$0.0	$111.3	$0.0	$0.0	$111.3	NA
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	NA

COMMENTS: USGS in-kind contributions include use of field gear and other resources, estimated at $10K.

FY12-16

Program Title: 15120114-Q Harlequin Ducks and Sea Otters
Team Leader: Esler & Ballachey
Agency: USGS

FORM 4A
TRUSTEE AGENCY SUMMARY

ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

12120114-S

2. Project Title: *See*, Reporting Policy at III (C) (2).

3. Long-term Monitoring: Lingering Oil - Extending the Tracking of oil levels and weathering (PAH composition) in PWS through time

4. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

5. Mark Carls, Mandy Lindeberg

6. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

7. February 1, 2014-January 31, 2015

8. Date of Report: *See*, Reporting Policy at III (C) (5).

February 13, 2015

9. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

10. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

- The retrospective biomarker analysis has been completed and a manuscript has been drafted and is currently in review at the author level.
- Field sample design has been completed to determine the quantity and weathering state of oil on 10 PWS beaches. Sampling is scheduled for this summer.
- Annual hydrocarbon database updates have been completed

Deliverable/Milestone	Status
Objective 1: field work	Field work is scheduled for this summer
Objective 2: supplemental analyses	No supplemental analyses have been requested by other researchers.
Objective 3: hydrocarbon database	Maintenance of the hydrocarbon database is up to date and available on Ocean Workspace/public. New data include the retrospective biomarker analyses.
Objective 4: Reporting	Reports have been submitted as required.

11. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

We continued collaboration with the bioremediation program (Boufadel et al.), PWSRCAC on potential shrimp contamination in Port Valdez, an ADF&G bird study (outside PWS), and an NOS project in the Arctic.

12. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

Draft report, Carls, Holland, Lindeberg. 2015. Biomarkers as tracers of Exxon Valdez oil.

Approved report: Irvine, G.V., D.H. Mann, M.G. Carls, L. Holland, C. Reddy, R.K. Nelson, and C. Aeppli. 2014. Lingering oil on boulder-armored beaches in the Gulf of Alaska 23 years after the Exxon Valdez oil spill, Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 11100112), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

13. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

No comments for this project

14. Budget: *See,* Reporting Policy at III (C) (11).

No line items exceeded ± 10%.

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Travel	$1.5	$1.5	$1.5	$4.2	$1.5	$10.2	$4.5
Contractual	$14.0	$9.0	$5.5	$130.0	$4.0	$162.5	$28.5
Commodities	$2.5	$1.5	$1.0	$21.0	$0.5	$26.5	$5.0
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (will vary by proposer)							
SUBTOTAL	$18.0	$12.0	$8.0	$155.2	$6.0	$199.2	$38.0
General Administration (9% of subtotal)	$1.6	$1.1	$0.7	$14.0	$0.5	$17.9	$3.4
PROJECT TOTAL	$19.6	$13.1	$8.7	$169.2	$6.5	$217.1	$41.4
Other Resources (in kind Funds)	$50.0	$50.0	$50.0	$50.0	$50.0	$250.0	$150.0

Original COMMENTS: Portions of permanent staff salaries will be donated, including Dr. Jeep Rice, Mark Carls, Marie Larsen, Larry Holland, Josie Lunasin, and Mandy Lindeberg.

FY12-16

Program Title: 15120114-S Lingering Oil Monitoring
Team Leader: Mark Carls

FORM 4A
TRUSTEE AGENCY
SUMMARY