

Exxon Valdez Oil Spill
Long-Term Monitoring Program (Gulf Watch Alaska) Final Report

Program Management I – Program Coordination and Science Synthesis
Program Management II – Administration, Science Review Panel, PI Meeting Logistics,
Outreach, and Community Involvement

Exxon Valdez Oil Spill Trustee Council Project 21120114-A&B
Final Report

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June 2023

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Study History: The Gulf Watch Alaska program was initiated in 2012 in response to an invitation for proposals from the *Exxon Valdez* Oil Spill Trustee Council for a long-term monitoring program that would monitor the recovery of resources from the initial injury and monitor how factors other than oil may inhibit full recovery or adversely impact recovered resources. The program required a management team to coordinate the activities of a large team of scientists from diverse disciplines and multiple agencies and organizations. During the first five years of funding (fiscal years 2012-2016), program management was divided into two projects, one for program coordination and science synthesis (16120114-H) and one for administration, logistics, outreach, and community involvement (16120114-B). During the second five years of funding (fiscal years 2017-2021), these projects were combined into one program management project (with separate budgets). Program management coordinates joint activities among Gulf Watch Alaska principal investigators (including team meetings, outreach activities, and community involvement), leads science synthesis reporting and publications, oversees the program's Science Review Panel, and provides fiscal management of non-Trustee Agency subawards. Based on the success of the first 10-year period, the Gulf Watch Alaska program teamed with the Herring Research and Monitoring program to submit a proposal to the *Exxon Valdez* Oil Spill Trustee Council to continue ecosystem monitoring and research as the Gulf Watch Alaska-Long Term Research and Monitoring program for 2022-2031.

Abstract: The impact of large, integrated research programs that involve the contributions of many scientists are amplified by a strong program structure, program coordination, and program oversight. These programmatic services were provided to Gulf Watch Alaska, the long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council, by a dedicated program management team along with internal and external advisors. Here we describe how effective program management resulted in powerful science synthesis efforts that identify barriers and pathways to recovery of species still listed as injured by the spill, along with dozens of peer-reviewed publications and published data sets. Information generated by Gulf Watch Alaska is highly valued by stakeholders, including natural resource management agencies, with key findings also shared with local communities, the general public, and visitors. These science coordination efforts, along with an administrative emphasis on fiscal accountability, reporting, regular meetings, and outreach, ensured that all aspects of this five-year program were truly integrated, and objectives were met.

Key words: Community engagement, *Exxon Valdez* oil spill, fiscal administration, Gulf of Alaska, Kachemak Bay, Katmai, Kenai Fjords, lower Cook Inlet, monitoring, Prince William Sound, program coordination, science synthesis

Project Data: This project did not include data collection. Data collected for the projects that contributed to the Gulf Watch Alaska program are available through the Alaska Ocean Observing System Gulf of Alaska Data Portal: https://gulf-of-alaska.portal.aos.org/#search?type_group=all&tag|tag=evos-gulf-watch-projects&page=1

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Data are archived by Axiom Data Science, a Tetra Tech Company, 1016 W. 6th Ave., Anchorage, AK 99501.

There are no limitations on the use of Gulf Watch Alaska data, however, it is requested that the authors be cited for any subsequent publications that reference Gulf Watch Alaska data. It is strongly recommended that careful attention be paid to the contents of the metadata file associated with these data to evaluate data set limitations or intended use.

Citation:

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Program Management I – Program Coordination and Science Synthesis
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EXECUTIVE SUMMARY

The Gulf Watch Alaska (GWA) long-term ecosystem monitoring program was developed in response to Invitations for Proposals from the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC). The Program Management (PM) projects were proposed to fulfill the requirements of providing oversight of all operations, including scientific monitoring (PM I), and administrative and non-Trustee Agency fiscal management. PM I was conducted by the National Atmospheric and Atmospheric Administration (NOAA) Auke Bay Laboratories and PM II was conducted by the Prince William Sound Science Center (PWSSC). Early in this five-year funding cycle, the EVOSTC Science Panel requested the two program management projects be combined into one project to reflect their inherent integration in carrying out program management objectives.

The overarching goal of the GWA program was to provide sound scientific data and products to 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. Program activities included collecting and analyzing long-term ecological monitoring information from the Gulf of Alaska (GOA) EVOS affected region; making results and monitoring data publicly available for use by stakeholders, managers, and in integrated analyses; and assessing monitoring data holistically to better understand the range of factors affecting the ecosystem and individual species recovery. The objectives of the PM I and PM II projects included providing program management, science coordination and synthesis; fiscal administration such as administering the program's NOAA grant; meeting and scientific review logistics; and outreach and community involvement, including maintaining the program website, public outreach, and engagement with spill-affected communities.

Program Management included four personnel, the Program Lead, Science Coordinator, Administrative Lead, and Program Coordinator working approximately 2.5 full-time equivalent total for GWA. The team provided oversight for 12 projects, more than 40 PIs and team members, five Science Review Panel members, and ensured efficiency in operations (e.g., grant administration), troubleshooting (e.g., adapting to the COVID-19 pandemic), reporting (e.g., review and formatting), and product delivery (e.g., science synthesis and outreach).

During this second 5-year reporting period, GWA greatly expanded its integrated products. Science synthesis efforts increased its NOAA Ecosystem Status Report contributions by 3-fold to 21 annually. These are GWA's signature time series to indicate the annual state of the GOA physical and biological environment. We produced four high-level publications (one lead by the Program Management) integrating across GWA, Herring Research and Monitoring, and our

many external collaborators to describe how the Gulf of Alaska and EVOS injured resources responded to the largest marine heatwave observed in modern times. In 2021, 7-years after the first heatwave, EVOS injured resources are just now returning to pre-heatwave levels (herring), while others have possibly suffered even greater setbacks where almost 30-years of post-spill recovery was lost (killer whales). We led two special issue journals for peer-reviewed publications of GWA authors and collaborators, one that was initiated during this first 5-year period and one originating from this funding cycle. Program management also gave over 20 presentations to technical science audiences, communities, resource managers, and the general public. We led the development of the 10-year proposal, integrating GWA and Herring Research and Monitoring for the 2022-2031 EVOSTC request for proposals focused on long-term research and monitoring of EVOS injured resources.

Program Management communicated GWA monitoring activities and findings to Trustee Agencies and other resource managers through presentations, meeting participation, a newsletter, and development of graphics for each of the components. We developed and widely distributed a newsletter titled *Quarterly Currents*. During this 5-year funding period, Program Management and GWA PIs enhanced relationships with Trustee Agencies and demonstrated the value of our long-term monitoring program. By enhancing these relationships and building new partnerships, we have greatly increased funding from sources outside of EVOSTC.

Acting as the fiscal agent for the non-Trustee organizations within GWA is among our most important roles in fiscal management through the PWSSC. Without PWSSC as the fiscal agent, EVOSTC would need to administer separate contracts with each non-Trustee organization. PWSSC provides this service through a NOAA grant, improving efficiency and greatly reducing administrative work for the EVOSTC. In all five years of this funding cycle, we issued and managed subaward contracts for all non-Trustee Agency projects. Annual audits were completed in every program year. Project spending for all subawards was monitored and assistance was provided to the program overall with budget reconciliation, tracking of cumulative spending, and requests for line-item transfers or transfers between projects.

Program Management oversaw outreach and community involvement during this funding cycle. The GWA website was the primary outreach tool based on the initial proposal requirements. Project pages were updated annually with recent findings and brief interpretations of the findings. A “Latest News” section was added to the website. This section was updated as GWA program scientists and projects were highlighted in local or national news or on agency news releases or website profiles. During the funding cycle, 48 articles were added. The website was also updated regularly with GWA publications and reports.

Program Management led the many GWA article contributions to Delta Sound Connections, a newspaper style periodical produced annually by the PWSSC and distributed widely throughout PWS, the Copper River Delta, and adjacent areas. Delta Sound Connections is available free on Alaska state ferries and at the Ted Stevens Anchorage International Airport, Mudhole Smith

Airport in Cordova, Begich Boggs Visitor Center at Portage Glacier, and a variety of sites in Girdwood, Glenallen, Copper Center, and Valdez. Article topics ranged from what we do, new findings, and highlights to the value of long-term research and monitoring in understanding ecosystem change and recovery of EVOS injured resources.

Engagement with Alaska native communities affected by the spill was a priority during this funding cycle. The GWA program outreach team planned to visit communities in Kachemak Bay during 2018 and PWS in 2020. Project teams visited Seldovia and Port Graham in Kachemak Bay as scheduled but were unable to visit Chenega or Tatitlek in PWS because of the coronavirus pandemic. Chugachmiut Heritage Preservation local education coordinators held meetings with PWS and Kachemak Bay village elders and other community members in conjunction with the Kachemak Bay Science Symposium, and Chugachmiut local education coordinators and elders attended the conference. Members GWA Program Management and several GWA scientists attended these gatherings to learn about ecosystem change from Tribal members, hear what questions Tribal members had about recovery from the spill and ecosystem change since the spill, and answered questions asked of them by Tribal members.

The combined PM I and II projects demonstrate how a small and integrated leadership team can help scientists collaborate, synthesize their findings, and share their knowledge with a diverse array of stakeholders.

INTRODUCTION

The Gulf Watch Alaska (GWA) long-term ecosystem monitoring program was developed in response to Invitations for Proposals (Invitations) from the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC or Council) under the Focus Area “long-term monitoring of marine conditions and injured resources.” The EVOSTC established the Focus Area in their 2010 Invitation and continued the Focus Area in their 2015 Invitation because, after more than two decades following the *Exxon Valdez* oil spill (EVOS) in March 1989, it had “become apparent that the ecosystem can undergo profound changes and that such changes may hinder a return to pre-Spill conditions” (EVOSTC 2015).

The 2010 and 2015 Invitations requested ecosystem component projects related to environmental drivers (monitoring oceanographic conditions), pelagic species (killer and humpback whales, marine birds, and forage fish), and nearshore benthic ecosystems (habitats and species in the intertidal zone) to meet the Council’s goals to monitor the recovery of resources from the initial injury and monitor how factors other than oil may inhibit full recovery or adversely impact recovering resources. As required by the invitations, we established a small and efficient administrative structure to manage funds, projects, and EVOSTC reporting requirements, including: (1) Program leadership to communicate with the Council, be responsive to the Council’s objectives and requirements, facilitate the most cost-effective and scientifically-supported stream of funding in a manner that minimizes administrative costs; (2) Science

coordination to integrate data from individual projects to inform the program as a whole; (3) a program level Science Review Panel (SRP) to review projects and give guidance and oversight on the program's design and implementation, scientific peer review of final reports; (4) a plan for individual project compliance with reporting and data submission policies; (5) a structure to establish contracts and distribute funds to investigators outside of Trustee agencies; and (6) a public outreach plan.

The Program Management (PM) I and II projects were proposed to fulfill the requirements of the Invitations. PM I was conducted by the National Atmospheric and Atmospheric Administration (NOAA) Auke Bay Laboratories and included the Program Lead and the Science Coordinator. PM II was conducted by the Prince William Sound Science Center (PWSSC) and included the Administrative Lead, Program Coordinator (who transitioned from NOAA to PWSSC during the five-year period), and subcontracted Outreach Coordinator.

Early in the five-year funding cycle, the EVOSTC Science Panel requested the two program management projects be combined into one project to reflect the inherent integration of the projects and the personnel carrying out program management objectives.

OBJECTIVES

The overarching goal of the GWA program was to provide sound scientific data and products to inform management agencies and the public of changes in the environment and the impacts of these changes on EVOS injured resources and services. Specifically, the goals included the following:

1. Collect and analyze long-term ecological monitoring information from the Gulf of Alaska (GOA) EVOS affected region
2. Make monitoring data publicly available for use by stakeholders, managers, and in integrated analyses
3. Assess monitoring data holistically to better understand the range of factors affecting individual species and the ecosystem

In the original proposals to EVOSTC, the PM I and PM II projects listed separate objectives in separate proposals. For this final report, because the projects were joined into one project, the objectives have been combined and reorganized for clarity but not changed from their original intent. The objectives are presented within three broad categories related to GWA program oversight. Objectives were as follows:

- Program Management
 - Program coordination – provide communication and data sharing within the GWA program

- Science coordination and synthesis – provide and document integration of monitoring results across the program
- Communicate monitoring information – provide communication of monitoring information to Trustee Agencies and other resource managers
- Coordinate with other programs – provide communication and coordination with the EVOSTC Herring Research and Monitoring (HRM) and Data Management programs
- Fiscal administration
 - Grant administration – provide fiscal management and reporting for the program’s NOAA grant
 - Logistics – provide financial and logistical support for the SRP and GWA principal investigator (PI) meetings
- Outreach and Community Involvement
 - Maintain website – continue maintenance and updates of the GWA website
 - Outreach – facilitate and coordinate GWA scientist outreach to the public
 - Engagement with spill-affected communities – conduct outreach engagement activities in spill-affected communities, particularly related to traditional knowledge

Based on proposals received in response to the Invitation, EVOSTC made the following changes:

- EVOSTC funded two lingering oil projects; one included in HRM (project 21170111, Genomic Mechanisms that Underlie Lack of Recovery of Prince William Sound Herring Following the 1990s Collapse) and one in GWA (project 21200114-P, Long-term Monitoring of Lingering Oil in Prince William Sound).
- EVOSTC did not fund any cross-program publication groups.

Because of these modifications by EVOSTC, GWA removed these programs from our original objectives for coordination.

METHODS

Program Management

This project served as program management oversight and coordination for the 12 monitoring projects comprising the GWA program, meaning the methods were management focused and not scientific. The program management project was organized and staffed based on the needs to oversee a large scientific program comprised of multiple agencies and organizations (Fig. 1). The program required an overall lead who understood operations and legal responsibilities of

EVOSTC funding, and the scientific monitoring required to meet the obligations of the EVOSTC Restoration Plan (EVOSTC 1994). Because program participants included Trustee Agencies (NOAA and Department of Interior agencies) and non-Trustee organizations (universities and non-profits), administrative oversight needed to include a structure that could receive EVOSTC funds through a NOAA cooperative agreement grant and provide fiscal management of the funds and subcontracts to non-Trustee organizations. Based on the requirements of the Invitation, program management also required a qualified individual to provide scientific coordination, a scientist with management skills to provide program coordination, and an individual with public outreach experience to provide outreach coordination.

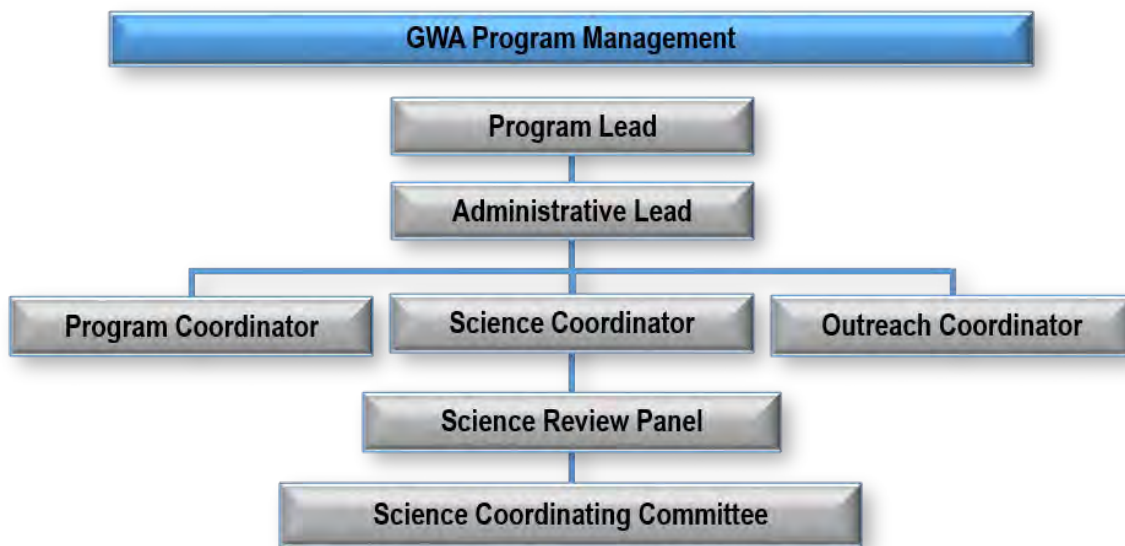


Figure 1. Organizational structure for the Gulf Watch Alaska (GWA) program during the fiscal years 2017-2021 funding cycle.

NOAA provided the Program Lead and Science Coordinator and PWSSC provided the Administrative Lead. The Program Coordinator transitioned from NOAA to PWSSC during the five-year funding cycle. The Outreach Coordinator was a subcontractor to PWSSC. The Program Lead, Science Coordinator, Administrative Lead, and Program Coordinator made up the program management team (PMT). The salary for the Program Lead was paid for by NOAA through base funds and the Science Coordinator transitioned to NOAA base funding during the last two years of the funding cycle. In their new role at NOAA, the Science Coordinator was able to maintain a portion of their GWA duties and used the GWA Science Coordinator funding to hire a postdoctoral scholar to conduct additional science synthesis analyses. Table 1 lists the roles and responsibilities of PMT members and Outreach Coordinator.

Table 1. Primary responsibilities of Gulf Watch Alaska (GWA) Program Management Team (PMT) members.

Role	Primary Responsibilities
Program Lead ^a	<ul style="list-style-type: none"> • Primary point of contact for the <i>Exxon Valdez</i> Oil Spill Trustee Council (EVOSTC) • Responsible for all aspects of program • Overall coordination with program components and science synthesis • Overall responsibility for meeting deliverables and milestones • Communication with Trustee Agencies and resource managers • Coordination with Herring Research and Monitoring and Data Management • Oversee Science Coordinator and Program Coordinator • Coordination of Science Review Panel (SRP)
Administrative Lead	<ul style="list-style-type: none"> • Manage National Oceanic and Atmospheric Administration grant for Prince William Sound Science Center (PWSSC) and non-Trustee agency subcontracts, including fiscal and semi-annual reporting • Provide fiscal oversight for PWSSC and non-Trustee organization subcontracts, including conducting federal single audits annually • Coordinate with PMT on deliverables and milestones • Provide logistics support for SRP and program meetings • Facilitate outreach with spill-affected communities • Oversee Outreach Coordinator
Science Coordinator ^b	<ul style="list-style-type: none"> • Lead integration and synthesis of data collected under the program • Provide technical reviews, editing, and writing of program documents • Work directly with SRP and Science Coordinating Committee • Seek partnerships between GWA and external programs
Program Coordinator	<ul style="list-style-type: none"> • Provide administrative assistance to the program and principal investigators • Compile, technical edit, and coordinate peer and quality control reviews for annual and final reports • Compile and review budgets, budget amendments, and cumulative spending • Track deliverable and milestone progress and program accomplishments • Assist PMT members with meeting logistics, meeting facilitation, and communications • Coordinate website updates • Participate in outreach activities

Role	Primary Responsibilities
Outreach Coordinator	<ul style="list-style-type: none"> • Make updates to GWA website with Program Coordinator • Coordinate outreach activities with the Program Coordinator and Administrative Lead

^aSalary provided by National Oceanic and Atmospheric Administration (NOAA) base funds.

^bSalary transitioned from EVOSTC to NOAA base funding during the 2017-2021 funding cycle.

The PMT coordinated with GWA program PIs and team members through a Science Coordinating Committee (SCC) and oversaw the work of the SRP. The SCC consisted of the lead of each component (Environmental Drivers, Pelagic, and Nearshore) and was the guiding science body for the program. SCC members volunteered their time coordinating their respective components through their agency or organization base funding. The SCC worked with the PMT to ensure work conducted within and between components was performed in line with approved statements and goals of the projects and the program. The SRP consisted of distinguished scientists with extensive research and publication experience in fisheries, oceanography, marine ecology, and intertidal ecosystems. SRP members volunteered their time to provide peer review and strategic thinking for project deliverables and the program.

Program coordination

Program coordination entailed ensuring all members of the GWA program had all the information they needed to complete program requirements on schedule, providing opportunities for project scientists to share current findings and collaborate within and between components, and providing reviews of work plans and reports to EVOSTC to make sure deliverables consistently met or exceeded the expectations of EVOSTC staff and Science Panel.

The PMT conducted quarterly PI meetings (Table 2) and annual PMT huddles, provided schedules for program milestones and deliverables, coordinated with the Data Management program on data deliverables for monitoring projects, conducted quality control reviews of EVOSTC deliverables, and coordinated with the program SCC and SRP.

Table 2. Annual schedule of principal investigator meetings for Gulf Watch Alaska scientists. Quarters correspond to the Exxon Valdez Oil Spill Trustee Council fiscal year: quarter 1 February 1 – April 30, quarter 2 May 1 – July 31, quarter 3 August 1 – October 31, and quarter 4 November 1 – January 31.

Quarter	Meeting Type	Purpose
1	PMT Huddle	Program Management Team (PMT) meeting to review program goals and objectives, assess program performance, track five-year planning, evaluate opportunities, plan for upcoming year
1	Teleconference	Principal Investigator (PI) meeting to provide general updates on program management team activities, upcoming deliverables, and data management, with opportunities for project scientists to share recent observations and findings
2	Teleconference	
3	Multi-day in person	PI meeting to share in-depth project findings and observations with opportunity to discuss emerging issues in the northern Gulf of Alaska; individual project scientist meetings with Data Management program team members on data deliverables; discuss upcoming deliverable requirements and strategies; conduct side meetings to discuss cross project and cross component collaborative efforts; held in a spill affected community or Anchorage
4	In person	PI meeting held during the Alaska Marine Science Symposium in January; provide general updates and opportunities for project scientists to collaborate on recent observations and findings

Science coordination and synthesis

The science coordination and synthesis objective was developed to meet several mandatory and preferred requirements outlined in the Invitation (EVOSTC 2015), including (1) a Joint Science Workshop, and accompanying reports, with the GWA, HRM, and Data Management programs that allows Council staff, Trustee Agency staff, and the EVOSTC Science Panel to review progress during the third year of the funding cycle; (2) processes to provide scientific peer review and approval of final reports, and continual reassessment of the program’s progress and relevancy that includes consideration of newly available technologies; (3) an understanding and synthesis of existing scientific literature, research results, and scientific knowledge that includes outcomes of prior Council work; and (4) establishing appropriate collaborations with other organizations and experts, achieving the most efficient use of funds, and taking advantage of existing infrastructure.

Communicate monitoring information to Trustee Agencies and other resource managers

Long term monitoring information is valuable to resource management agencies, managers, and decision makers. The PMT developed new opportunities to communicate GWA data and findings to a wide variety of agencies, organizations, and decision-making entities. The intent was for these agencies and organizations to have GWA information and data to further scientific endeavors and inform resource management decisions.

Coordinate with other EVOSTC programs

In addition to GWA, the Council funded two separate but related programs, HRM and Data Management. Coordination among these programs was critical to fully understand the long-term effects of the spill on injured resources and to meet requirements of the EVOSTC.

GWA and HRM collaborated through team email communications, by holding joint meetings, and by providing opportunities for project PIs to meet and share information.

The Data Management program was integral to the functioning of the GWA program. The Alaska Ocean Observing System (AOOS) hosted the GOA Data Portal where annual data were published and Axiom Data Science provided the Research Workspace where projects saved and shared data for publication and archiving and where the PMT saved documents available to all program team members. Data Management program team members were included in all program correspondence and were invited to present on data management topics at all PI meetings. The GWA PMT also provided time and meeting space for Data Management team members to meet one on one with project teams and PIs about data deliverables during fall meetings.

Fiscal Administration

One of the values of EVOSTC funding a program instead of individual projects was the ability to have one organization act as the fiscal agent for non-Trustee organization projects within the program, improving contracting efficiencies and minimizing the work of EVOSTC staff who, without the NOAA grant and fiscal administrator, would be required to draft and solicit individual contracts for each funded project. PWSSC, as the Administrative Lead, provided this function. PWSSC's fiscal administration included two functions: administration of the NOAA grant and logistical support for meetings and the program SRP.

Grant administration

Based on the funding decisions by the Council, PWSSC applied for and received the cooperative agreement grant from NOAA. For non-Trustee organizations within the program, PWSSC was the single point of contact with the NOAA grant administrator, issued subcontracts to non-Trustee organizations, managed invoicing during the funding cycle, submitted SF-424A financial reporting forms to NOAA, managed annual financial audits, and completed semi-annual and final reporting requirements for the NOAA grant.

Logistics

PWSSC provided financial and logistical support for GWA PI meetings and for the program SRP. Financial support included providing the conference call and video software for quarterly PI meetings, paying for in-person meeting venues and meals provided during the meetings, and paying for travel for SRP members and guest speakers to attend and participate in in-person meetings. Logistical support included reserving meeting space and blocks of hotel rooms, arranging and scheduling food vendors for in-person meetings, and arranging travel for SRP members and guest speakers to attend meetings.

Outreach and Community Involvement

The Invitation (EVOSTC 2015) called for a public outreach plan, stated that outreach efforts should focus on developing and maintaining accurate and timely content for the program's website as a primary source of information, limited the cost of outreach efforts for the program to no more than \$30,000 per year, and requested a detailed plan for local and Alaska Native community involvement in the program. GWA developed its outreach and community involvement methods around these requirements.

Maintain website

The GWA program developed a website (<https://gulfwatchalaska.org/>) during the first five-year funding cycle. During the FY17-21 funding cycle, the Program Coordinator and Outreach Coordinator worked together to update the website annually with project updates, reports, publications, and staffing changes. The PMT added a section for "Latest News" with links to GWA PI activities that reached local or national news media or provided other public outlets for videos, stories, and articles that included GWA data.

Outreach

The PMT facilitated and coordinated GWA scientist outreach to the public. Fall in-person meetings held in spill-affected communities were open to the public and the PMT scheduled and advertised evening presentations by GWA scientists that were geared to general audiences. The PMT encouraged GWA scientists to present their observations and findings to the public whenever possible. PMT members also presented to the public as opportunities arose. The GWA team also published articles in PWSSC's annual paper publication *Delta Sound Connections*, which is freely available in many locations (including airports), thereby reaching residents and tourists across southcentral Alaska and spill-affected communities.

Engagement with spill-affected communities

The GWA proposal included plans to engage with Alaska Native communities in Kachemak Bay and PWS during the funding cycle. The plan included having a roundtable type symposium and engagements during which scientists and community members could exchange information about different ways of knowing.

RESULTS AND DISCUSSION

With PMT leadership, GWA met the administrative, fiscal management, reporting, outreach, and science synthesis objectives and generated a high level of success in communicating program data and information to the scientific community and the public.

Program Management

Program coordination

During the FY17-21 funding cycle, the GWA program included 12 projects, more than 40 PIs and team members, and five SRP members, making communication and information sharing an important aspect of program management to ensure all program members had accurate and timely information. The Program Coordinator managed overall communication with program team members and maintained a GWA email distribution list and a contact list, updating information as project teams changed over time.

The PMT coordinated and shared information and documents via phone calls, emails, and cloud-based file sharing. The PMT used a shared Google Drive folder to prepare planning documents, set meeting agendas and prepare meeting notes, and track deliverables and publications. Documents important for the full GWA team and for archiving were shared through the GWA Research Workspace, as described below.

The Program Coordinator maintained communication with program team members via email communication, surveys, and polls. These methods were used to ensure team members had current information on program activities such as upcoming reporting and work plan timelines, to solicit feedback on the best meeting dates, and to allow program participants to provide input on process improvement.

Program meetings

The Program Coordinator set quarterly and annual meeting dates and times based on the greatest availability of GWA team members. The Program Coordinator worked with PMT members and the Data Management program to establish agendas for each meeting. Because these meetings provided important and relevant information, PIs and other team members prioritized them whenever possible and a high number of projects had representation at each meeting (Fig. 2). The Program Coordinator maintained notes from each meeting and agendas, notes, and presentations from meetings were saved to the Research Workspace. Table 2 provides an overview of the general subjects covered at quarterly meetings.

Spring and summer meetings were held via teleconference and winter meetings were held in person, with teleconferencing capabilities, in conjunction with the Alaska Marine Science Symposium (AMSS) held in Anchorage each January. Each of these meetings was generally an hour and a half long and focused on important news for project team members and recent observations or findings from project teams. Fall meetings were held in person over two or three days and moved between spill affected communities and Anchorage from year to year.

A primary purpose of the quarterly PI meetings, in particular the multi-day annual PI meeting held in the fall, was to bring project scientists together to present and discuss their findings and recent observations. During quarterly teleconference calls projects provided brief updates on observations from the field and during annual meetings each project presented to program participants with time for discussion. The Science Coordinator invited scientists from outside the program to present on topics related to long term monitoring in the GOA and related oceanographic regions to generate synthesis and integration discussion (Table 3). Component Leads and PIs were encouraged to hold side meetings within and across components during annual meetings and time and meeting space was set aside for this purpose.



Figure 2. Gulf Watch Alaska group photos from fall Principal Investigators meetings in Homer at the Alaska Islands and Ocean Visitor Center in 2019 (top) and virtually in 2020 (bottom).

Table 3. Guest speakers and presentations at Gulf Watch Alaska Principal Investigators meetings. Guest speakers were intended to facilitate scientific discussions leading to synthesis and integration within and outside the program.

Meeting Date and Location	Guest Speaker	Speaker Affiliation	Presentation Topic
November 15, 2017, Cordova	Sam McClatchie	National Oceanic and Atmospheric Administration (NOAA), Southwest Fisheries Science Center	California Cooperative Oceanic Fisheries Investigations (CALCOFI, established 1949) & California Current Ecosystem Long Term Ecological Research site
November 16, 2017, Cordova	Stephani Zador	NOAA, Alaska Fisheries Science Center	Gulf of Alaska Marine Ecosystem Considerations: Data, Assessments, & Report Cards
November 18, 2020, GoToTraining	Laurie Stewart	Alaska SeaLife Center	CoRAL Network proposal
October 29, 2021, GoToMeeting	Bridget Ferris	NOAA, Alaska Fisheries Science Center	Ecosystem Status Reports
October 29, 2021, GoToMeeting	Emily Lemagie	NOAA, Pacific Marine Environmental Laboratory	NOAA Ecosystem and Fisheries-Oceanography Coordinated Investigations (EcoFOCI) Monitoring and Research in the Gulf of Alaska

In addition to the quarterly PI meetings, the PMT held annual “huddles” during spring quarter (Table 2). During the first year the PMT met in Juneau for three days and reviewed and discussed goals and responsibilities of program management and the PMT for the funding period, clarified roles and responsibilities of each PMT member, discussed the array of tools available for oversight, and scheduled activities for the FY17 fiscal year. During subsequent years the PMT met via video conference for several hours to review the activities and deliverables of the previous fiscal year, assess goals and plans for the upcoming year, and adjust oversight methods as appropriate. A few key areas of focus for the PMT included: (1) improving efficiency of PI reporting and review by providing templates, (2) coordinating with external funding partners who wanted to cooperate with GWA (e.g., BOEM), (3) develop strategies for producing impactful science synthesis products highlighting the first decade of GWA, (4)

coordinating community outreach events, and (5) develop an architecture for facilitating PI input on the design of the FY22-31 GWA Long-Term Research and Monitoring (LTRM) proposal.

Coordination with SCC

The PMT coordinated with the SCC to facilitate information transfer during PI meetings, coordinate report reviews, and help improve collaboration among the projects. SCC members facilitated and led the presentations by PIs in their components during fall PI meetings. When internal quality control reviews were needed for reports, SCC members provided reviews and helped coordinate others.

The SCC coordinated and facilitated meetings within and between the components. These meetings were used to coordinate field work and collaborate on similar data streams and information syntheses. For example, SCC leadership resulted in the formation of an internal bird group involving the Pelagic and Nearshore components to compare survey areas and methods, data collection tools, and ways to analyze data across projects from intertidal to offshore areas; among other things, this collaboration resulted in updated software for data collection by multiple projects and increases in data contributions to the Pacific Seabird Database maintained by the U. S. Geological Survey (USGS). The SCC also was key to developing the science synthesis report and workshop presentations discussed in the Science Coordination and Synthesis section below.

Oversight of SRP

SRP members during the FY17-21 funding cycle included Hal Batchelder (PICES), Rich Brenner (ADF&G), Leslie Holland-Bartels (USGS, retired), Terrie Klinger (University of Washington); and Jeep Rice (NOAA, retired). Dr. Holland-Bartels retired from the SRP during the funding period and was replaced by Ron Heintz (NOAA, retired). Dr. Batchelder retired at the end of the funding period and will be replaced during the next funding cycle.

The PMT coordinated with and oversaw the work of the SRP. SRP members provided valuable insights and objectivity for the conduct of the GWA program, synthesis of data collected across the program, and improvements to individual projects and their outcomes. SRP members attended quarterly and annual PI meetings, sharing their observations and suggesting paths forward. The SRP provided quality control (QC) reviews of proposals and reports and helped shape the performance of the program.

Program deliverables and milestones

The EVOSTC required specific deliverables from the GWA program which were tracked and overseen by the PMT (Table 4). In addition, based on EVOSTC requirements that the program communicate monitoring information to Trustee Agencies and other resource management organizations, the PMT developed additional deliverables (Table 4).

Table 4. Summary of deliverables produced by Gulf Watch Alaska (GWA) scientists during the 2017-2021 funding cycle. Deliverables to the Exxon Valdez Oil Spill Trustee Council were required. Other deliverables were additional and value-added to the GWA program.

Delivered Products	Type	Description	Total
Annual work plans and budgets	Required	Proposals outlining planned work for the following year, including budgets with any funding change requests	52
Annual reports	Required	Reports of previous year's findings including cumulative spending from the beginning of the funding cycle	81
Annual public datasets	Required	Quality control reviewed data from each monitoring project posted to the Gulf of Alaska data portal	47
Science synthesis report	Required	Report detailing major findings across multiple projects and components	1
Final reports	Required	Reports summarizing findings from the five-year funding cycle including cumulative spending for the full funding period	14
Maintained website	Required	https://gulfwatchalaska.org/	1
Special issue journal articles	Additional	Peer reviewed articles in a Gulf of Alaska themed issue published in Deep Sea Research Part II including findings from GWA and other scientific programs such as the Gulf of Alaska Integrated Ecosystem Research Program	14
Synthesis publications	Additional	Peer reviewed publications from the chapters of the science synthesis report	4
Peer reviewed publications	Additional	Peer reviewed journal articles, book chapters, and graduate student theses and dissertations published by GWA scientists and using GWA data during the funding period	63
Annual Ecosystem Indicators	Additional	GWA time series published in the National Oceanic and Atmospheric	21

Delivered Products	Type	Description	Total
		Administration's annual Gulf of Alaska Ecosystem Status Report; the number of GWA time series increased three-fold during the funding period	
Scientific presentations	Additional	Scientists associated with the GWA program presented at workshops and conferences worldwide	215
Public presentations	Additional	GWA program scientists presented to the public in a wide variety of venues in the spill-affected area, elsewhere in Alaska, and worldwide, including scheduled "science nights," naturalist trainings, school-group presentations, cruise ship naturalist talks, and elsewhere	39
Popular articles	Additional	Popular articles include those written by GWA scientists for publications such as <i>Delta Sound Connections</i> and those written by journalists about GWA-related work	23

Program milestone and deliverable tracking

The GWA program included a variety of deadlines common to all projects that included report, work plan, and data submissions. Most deadlines occurred annually, except for the science synthesis report and workshop with the EVOSTC science panel that occurred during the middle of the five-year funding period. The Program Coordinator developed a variety of methods to track milestones and deliverables and to track the submission, reviews, and completion of reports and work plans. A "dates to remember" calendar included all important dates, deadlines, and activities and was updated quarterly for program participants. The calendar included three tables: one providing a brief overview of major activities occurring annually (Table 5); one with details associated with major categories including fiscal year, data management, science synthesis, and the FY22-31 Invitation; and one that included the same detailed information in chronological order. The major categories were color coded for easier tracking.

Table 5. Recurring fiscal year activities table shared with Gulf Watch Alaska project teams to help track dates for milestones and deliverables common to all projects. Additional tables provided greater detail.

Quarter	Date	Activity
	Feb 1 - Jan 31	<i>Exxon Valdez</i> Oil Spill Trustee Council (EVOSTC) fiscal year
1		Annual reports due for previous fiscal year
	Mar 1	Annual data published to data portal
		Semi-annual National Oceanic and Atmospheric Administration (NOAA) semi-annual report due
	Mar/Apr	Quarterly teleconference
2	Jun/Jul	Quarterly teleconference
3	Aug ~15	For those requesting scope/funding changes: work plans due for following year's work
	Aug 30	Semi-annual NOAA report due
	Sep	Alaska Marine Science Symposium abstract submission period
	Sep/Oct	Work plan review by EVOSTC Science Panel and Public Advisory Committee
3/4	Oct/Nov	Herring Research and Monitoring and Gulf Watch Alaska principal investigator meeting and program review
	Dec 1	Annual data and metadata due to Workspace
4	Late Jan	Alaska Marine Science Symposium and PI meeting
	Jan 31	Articles due for <i>Delta Sound Connections</i>

Monitoring deadlines and milestones was important because many of the time periods overlapped or occurred when projects were busy with field work. When deadlines and milestones were particularly overlapping and tight, the PMT prepared timeline graphics (Fig. 3) to help GWA team members visualize what was required. Tables and timeline graphics always included scheduled periods for QC and grammatical/formatting reviews to ensure quality and consistent deliverables.

GWA Program: Science Synthesis Timeline

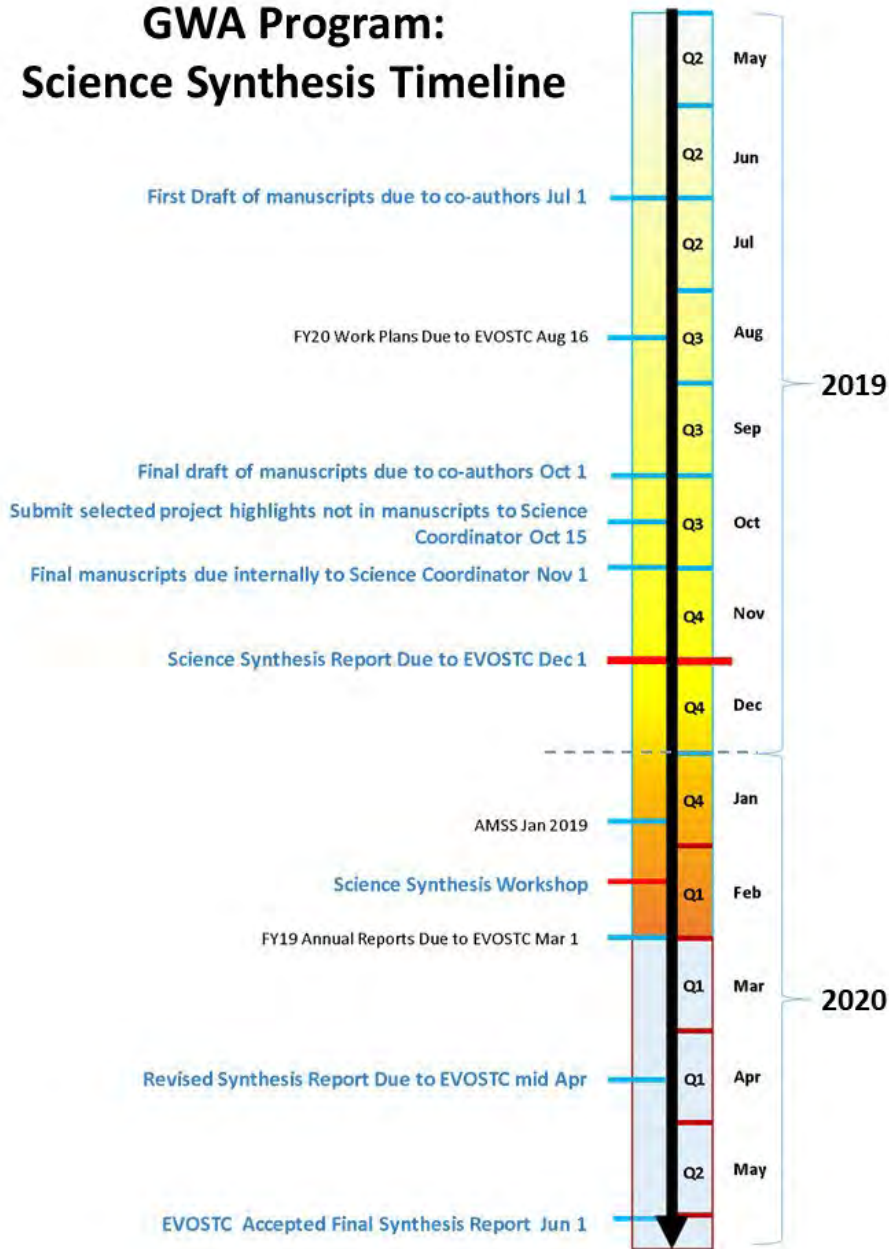


Figure 3. Example of a timeline graphic used to aid Gulf Watch Alaska team members in visualizing overlapping deliverable and deadline requirements.

The Program Coordinator developed a spreadsheet for each deliverable that tracked submission, reviews, and acceptance of draft reports from each project. The spreadsheets allowed the PMT to know the status of each project’s report or work plan to ensure the program submitted deliverables to EVOSTC on or before required deadlines. The Program Coordinator

communicated with GWA PIs frequently to make sure they understood deadlines and submitted drafts and revisions within required timeframes.

Deliverable reviews

The PMT ensured high quality, readable, consistent, and timely deliverables to the EVOSTC. The PMT took numerous steps to ensure deliverables from all projects within the program met with these standards: Use of standardized report templates, internal QC reviews, internal technical reviews, and maintenance of deliverable schedules presented above.

EVOSTC staff provided templates for work plans, annual reports, and budgets. The Program Coordinator updated the templates to current versions of Word and Excel and incorporated Word “Styles” for headings, paragraph text, and table and figure captions to make it easier for PIs, reviewers, and EVOSTC staff to navigate, revise, make documents consistent, and ensure finalized documents met the EVOSTC reporting policy. The Program Coordinator worked with EVOSTC staff to develop the updated templates and to create new templates for science synthesis and final reports to ensure the documents followed the EVOSTC reporting policy and the Alaska Resources Library and Information Services. This attention to detail improved workflow efficiency and became critical with the retirement of the EVOSTC librarian.

Internal QC reviews were provided by the Program Lead, Science Coordinator, SCC, SRP, and outside scientists when conditions warranted. Initial project proposals were reviewed by the SRP to ensure methods for data collection, analysis, and results reporting met scientific standards. Subsequent annual work plans were reviewed by the Program Lead and Science Coordinator. Annual reports were reviewed by the Program Lead and Science Coordinator and sent to a member of the SCC or SRP to resolve specific questions. Outside scientists were engaged on questions outside the scope of SCC or SRP members, though this was rare. Final reports were reviewed by the Program Lead, Science Coordinator, and at least one SRP member. Reviews were conducted in Word using tracked changes and comments functions. Reviews were submitted to project PIs who were responsible for resolving comments to the satisfaction of QC reviewers.

The Program Coordinator provided technical reviews for all deliverable documents, which included document formatting and grammatical and consistency reviews. The Program Coordinator ensured all projects responded adequately to each section of a proposal, work plan, or report form. The EVOSTC Science Coordinator appreciated the technical reviews to the extent that the Program Coordinator was asked to perform a similar role for HRM deliverables.

The PMT coordinated submissions of work plans and annual reports with EVOSTC staff and ensured that all work plans and annual reports were submitted on time. Once annual reports were accepted by EVOSTC staff, we posted them on the GWA website (<https://gulfwatchalaska.org/resources/reports/>).

Budget submissions

EVOSTC provided standard budget spreadsheets to develop project budgets during the proposal phase, request budget adjustments each summer with work plan submissions, and report cumulative spending with annual report submissions. EVOSTC appropriations were based on the submitted budget spreadsheets, so accuracy was of utmost importance.

The Program Coordinator was responsible for compiling all project budgets into a master workbook, reviewing spreadsheets and the workbook for accuracy, and receiving budget adjustments and cumulative spending for each deliverable. Because the GWA program included 12 projects, some with co-PIs associated with Trustee Agencies and Non-Trustee organizations that used different budget forms (Non-Trustee organizations included a row to calculate indirect costs that did not pertain to Trustee Agencies), the GWA workbook was substantive and included 21 separate spreadsheets. Two of the spreadsheets rolled up the annual and total spending for the projects, one by category and one by project. The workbook relied on the integrity of multiple formulas in each spreadsheet, and the Program Coordinator maintained responsibility for the accuracy of the formulas and reporting errors to the Program Lead and EVOSTC staff.

Before submitting the originally proposed budget, budget adjustment requests, and cumulative spending to EVOSTC, the PWSSC Finance Director provided a QC review of formulas and numbers, and the Program Coordinator and Program Lead performed a QC review of project totals by year.

Science coordination and synthesis

The PMT led the integration and synthesis of monitoring across the GWA program and coordinated with the HRM program, in addition to research and monitoring programs in the northern GOA not funded by the EVOSTC. Integration and synthesis took the form of project presentations during PI meetings, annual reports, the science synthesis report to EVOSTC during the third year of the funding cycle, coordinated peer-reviewed publication of science synthesis results, and coordination with other organizations on the publication of a special issue associated with research and monitoring in the northern GOA, among other synthesis activities. The results of each of these integration and synthesis activities are discussed below.

Integration of multi-disciplinary monitoring throughout the northern GOA

Multiple agencies and organizations outside the GWA program conduct long-term monitoring in the GOA and other regions of the Pacific Ocean. The Science Coordinator took a lead role in connecting with these other marine research and monitoring programs to share and integrate data and findings.

Scientists from other programs were invited to attend and present at fall GWA PI meetings (Table 3). Speakers included individuals from long-term monitoring programs with more than 50 years of data collection, recently formed or reformed monitoring programs, scientists developing

methods to present complex datasets to resource management decision makers, and others. The speakers sparked conversation and collaboration, and instigated development of key time series from each project for use in management and decision making (see below).

The GWA PMT and PIs from the North Pacific Research Board (NPRB)-funded Gulf of Alaska Integrated Ecosystem Research and Monitoring Program (GOAIERP) co-convened a workshop entitled “To unpathed waters, undreamed shores: Current and future marine research in the Gulf of Alaska” at the Ocean Sciences Meeting in Portland, Oregon in February 2018. The workshop included three interrelated sessions: new findings from the GOA, climate variability and ecosystem responses, and future directions for GOA research. Half of the 20 presenters were from GWA, signifying the breadth of GWA investigations and its important contribution to GOA monitoring going forward. The workshop contributed to the planning of a special issue published in Deep Sea Research Part II (DSRII; see below).

Data synthesis across projects and components

GWA was uniquely positioned to understand ecosystem-level changes during one of the most significant climate events in the GOA in recent decades. The 2014-2016 Pacific marine heatwave was the longest lasting heatwave globally in recent decades (Hobday et al. 2018), occurring in GWA’s first 5-year period. The second 5-year period covered in this report included shorter duration heatwaves along with cooling periods. These unique events provided a unifying theme for the GWA Science Coordinator and PIs to evaluate ecosystem response and recovery to these major perturbations. We demonstrated in four synthesis publications (described below) that effects, both positive and negative, were evident throughout the food webs, from offshore to intertidal domains, and that many responses persisted after heatwaves subsided (Fig. 4).

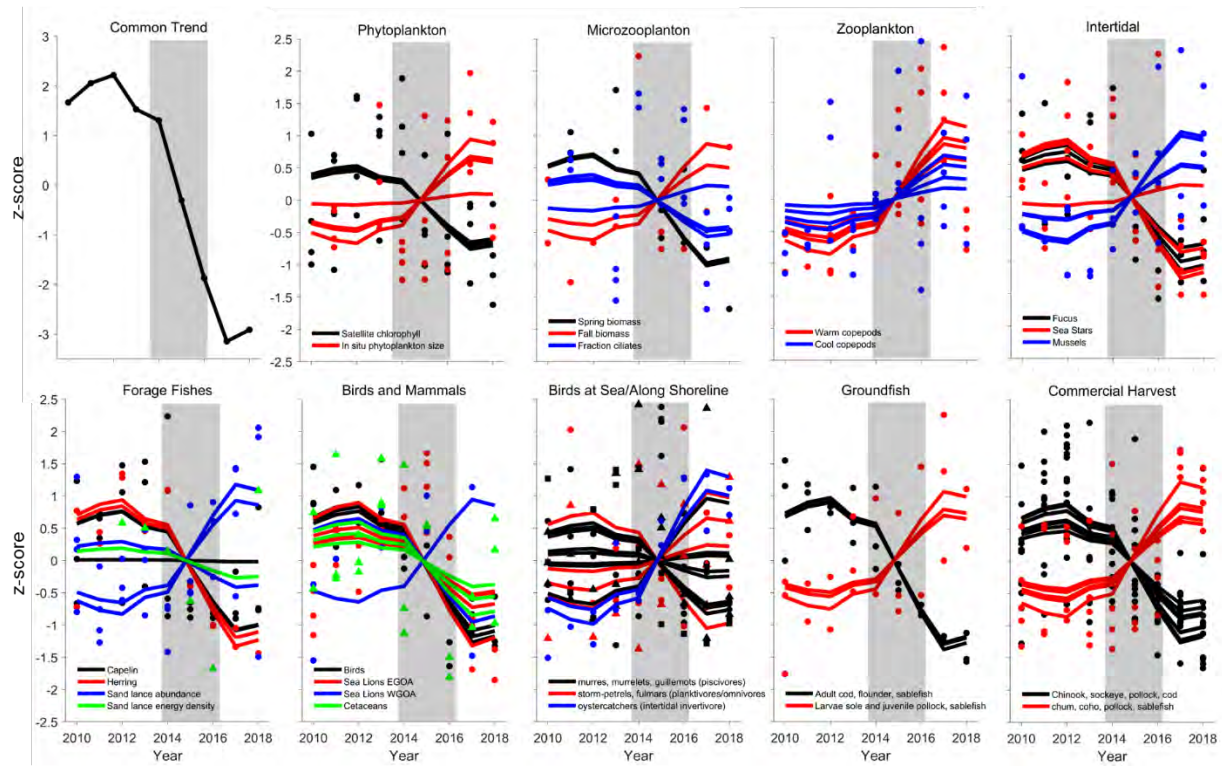


Figure 4. Trends (lines) from dynamic factor analysis fit to annual values (points) in key biological time series during the first 10 years of Gulf Watch Alaska for key taxonomic groups. Grey shading represents the 2014–2016 northeast Pacific marine heatwave. Values are z-score standardizations so the y-axis is unitless. Figures from Suryan et al. (2021).

We also identified region variation in the extent of ecosystem response to the heatwave with more prominent effects within the GWA study area, and particularly in PWS, with key indicators of herring, humpback whales, and black-legged kittiwakes still below pre-heatwave levels as of 2021 (Fig. 5).

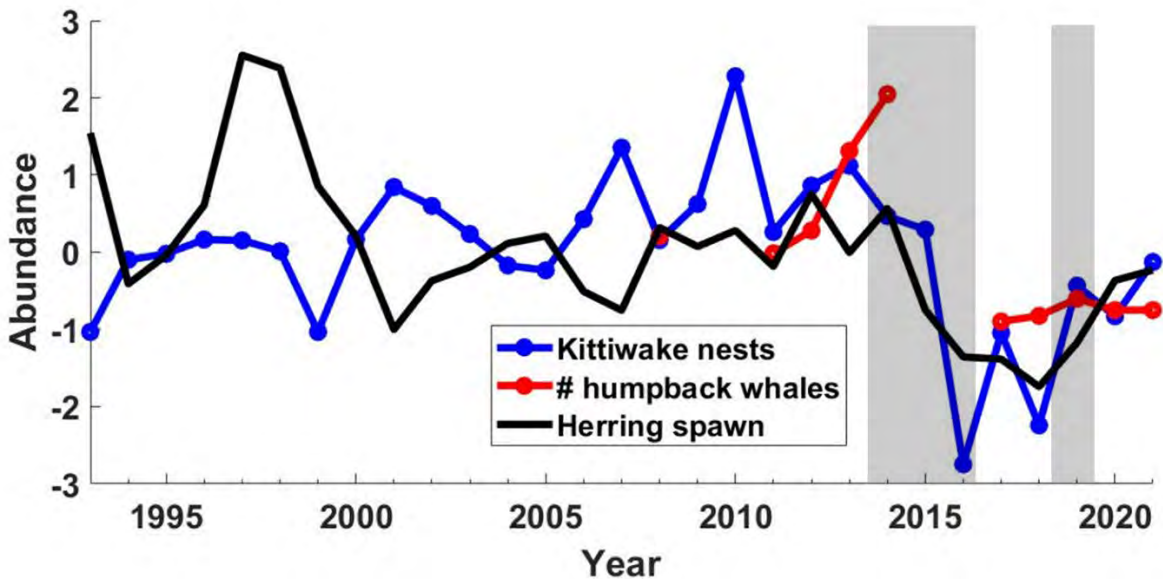


Figure 5. Long-term trends in herring and herring-dependent predators in Prince William Sound. Grey shading represents the 2014–2016 and 2019 northeast Pacific marine heatwave. Values are z-score standardizations so the y-axis is unitless. Figure modified from Suryan et al. (2021).

Data synthesis has continued with one project focused on the PWS ecosystem response and recovery timelines from heatwaves using an Ecopath with Ecosim model (<https://ecopath.org/>). This and other data synthesis efforts will continue into the 2021-2026 funding period and are led by postdoctoral scholars embedded within each component and one working across components.

Development of project time series

As a program focused on long term environmental monitoring, time series were an important method of demonstrating changes over time. One focus of the Science Coordinator was to work with each project to develop standardized time series to be updated annually and interpreted for annual reports the program website, and in collaboration with other organizations and publications (see below). Numerous GWA projects included data streams with a decade or more of observations and standardized methods to interpret and display the information (e.g., GAK1 and killer whale monitoring), other projects included long term data streams that needed support in developing the most valuable time series to repeat annually. The remainder of projects began in 2012 with the onset of the GWA program and required the first five to six years of the program to develop an understanding of the best methods to display long term time series.

By 2020, projects from all three GWA components were contributing time series (Table 6) to the annual GOA Ecosystem Status Report (see Ferris and Zador 2020), totaling 21 separate metrics, that is presented to the North Pacific Fishery Management Council (NPFMC) to help them make

science-based fishery management decisions. The contributions in 2020 were particularly significant because GWA successfully completed over half of their typical survey efforts, whereas nearly all agency cruises and fieldwork were canceled due to federal and state health mandates and restrictions associated with the coronavirus pandemic.

Ecosystem Status Report contributors included: Ostle/Batten (21120114-D, 3 metrics), Danielson (21120114-I, 3 metrics), Hatch/Arimitsu (21120114-C, 5 metrics), Moran/Straley (21120114-O, 1 metric), Hopcroft (21120114-L, 2 metrics), Campbell/McKinstry (21120114-G, 1 metric), Coletti et al. (21120114-H, 2 metrics), and Holderied/Baird (21120114-J, 3 metrics). We also facilitated contributions by HRM (Pegau et al. 21120111, 3 metrics).

Additionally, Arimitsu and Hatch (21120114-C) provided a juvenile sablefish growth index from fish collected when sampling diets of rhinoceros auklets nesting on Middleton Island (Table 6). This juvenile growth index was used in the Ecosystem and Socioeconomic Profile of the sablefish stock assessment for Alaska (Shotwell et al. 2020).

Table 6. Time series indicators developed by Gulf Watch Alaska (GWA) projects for National Oceanic and Atmospheric Administration (NOAA) Ecosystem Status Reports (ESR) and Ecosystem and Socioeconomic Profiles (ESP).

	GWA Component	Ecosystem Indicator	NOAA Report
1	Environmental Drivers	GAK1 temperature	ESR
2	Environmental Drivers	GAK1 salinity	ESR
3	Environmental Drivers	Seward Line temperature	ESR
4	Environmental Drivers	Prince William Sound (PWS) surface temperature	ESR
5	Environmental Drivers	Kachemak Bay temperature	ESR
6	Environmental Drivers	Copepod community size	ESP
7	Environmental Drivers	Mesozooplankton biomass	ESP
8	Environmental Drivers	Large calenoid copepod abundance	ESR
9	Environmental Drivers	Euphausiid abundance	ESR
10	Environmental Drivers	Large diatom abundance	ESP
11	Environmental Drivers	Kachemak Bay saxitoxin in shellfish	ESR
12	Environmental Drivers	Kachemak Bay paralytic shellfish toxicity	ESR

	GWA Component	Ecosystem Indicator	NOAA Report
13	Pelagic Ecosystem	Sablefish growth index	ESP
14	Pelagic Ecosystem	Black-legged kittiwake diet	ESR
15	Pelagic Ecosystem	Black kittiwake reproductive success	ESR
16	Pelagic Ecosystem	Rhinoceros auklet diet	ESR
17	Pelagic Ecosystem	Rhinoceros auklet reproductive success	ESR
18	Pelagic Ecosystem	Pelagic cormorant reproductive success	ESR
19	Pelagic Ecosystem	PWS humpback whale encounter rate	ESR
20	Nearshore Ecosystem	Sea star densities	ESR
21	Nearshore Ecosystem	Rockweed (<i>Fucus</i>) cover	ESR

Synthesis workshop, report, and publications

The science synthesis report during the third year of the funding cycle was a major deliverable of the program and a primary responsibility of the Science Coordinator. Science synthesis reporting included developing synthesis themes evident in GWA monitoring data, collaborating with program teams to further develop the themes into report chapters, preparing a draft science synthesis report for submission to EVOSTC, conducting a science synthesis symposium with EVOSTC Science Panel members and staff, finalizing the report based on Science Panel review comments, and publishing the chapters in peer reviewed journals.

The Pacific marine heatwave that lasted from 2014 through 2016 became the resounding theme for GWA’s synthesis report (Suryan et al. 2019a). The GWA team developed four chapters and an executive summary around this theme. Following submission of the draft report, the EVOSTC science panel held a workshop with GWA PMT, PIs, and SRP to review and discuss the findings. The resulting final report and publications (Table 7) were improved by the input from the EVOSTC Science Panel.

The Science Coordinator led development of one of the chapters (Suryan et al. 2019b), which by the time of its publication included 187 time series from multiple agencies and organizations to evaluate the response of multiple species of plankton, fish, birds, and marine mammals to the marine heatwave.

Table 7. The science synthesis report submitted in the third year of the funding cycle included four chapters that fully integrated Gulf Watch Alaska monitoring components. Some chapters incorporated data from the Herring Research and Monitoring program and programs outside of Exxon Valdez Oil Spill Trustee Council funding. The report focused on a major marine heatwave in the northern Gulf of Alaska which was a major ecological perturbation affecting recovery of resources injured by the Exxon Valdez oil spill. The manuscript chapters were individually published in 2021 & 2022 and each included 50-200 times series of physical and biological metrics.

Chapter Title	Lead Author	Number Authors	Gulf Watch Alaska Components	Journal
Temperature variations in the northern Gulf of Alaska across synoptic to century-long time scales	Danielson	8	Environmental Drivers (ED), Nearshore ^a	Deep-Sea Research, Part II
Changes in rocky intertidal community structure during a marine heatwave in the northern Gulf of Alaska	Weitzman	9	Nearshore	Frontiers in Marine Science
Reduced quality and synchronous collapse of forage species disrupts trophic transfer during a prolonged heatwave	Arimitsu	22	Pelagic, ED, Herring Research and Monitoring (HRM) ^a	Global Change Biology
Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska	Suryan	49	Pelagic, ED, Nearshore, HRM ^a	Scientific Reports

^aIncluded data and/or co-authors from outside the Gulf Watch Alaska and HRM programs.

Peer reviewed special issue

A multi-disciplinary group of scientists lead by GWA completed the third installment in a series of special issues dedicated to understanding ecosystem processes in the GOA. Special Issue 1 (DSRII volume 132, Dickson et al. 2016) was a compilation of papers focused on physical processes from the initial outcomes of the GOAIERP that began in 2010. Special Issue 2 (DSRII volume 165, Dickson et al. 2019) showcased biological research and final results from GOAIERP in its synthesis phase. Special issue 3 (DSRII volume 206, Lindeberg et al. 2022)

presented new findings from GOAIERP’s final synthesis phase and complementary work from other large multidisciplinary programs in the GOA, including GWA, HRM, and the National Science Foundation’s NGA LTER. These three GOAIERP special issues compliment the first GWA-lead issue published in 2018 (DSRII volume 147, Aderhold et al. 2018). Findings from these programs and related research projects benefit the special issue by filling information gaps and contributing to conceptual synthesis, thereby increasing understanding of this large marine ecosystem. Overall, these DSRII special issues establish a significant foundation of information upon which future scientists and resource managers will rely, especially as the GOA ecosystem faces accelerating environmental change.

Lindeberg et al. (2022; Table 8) was a collaborative effort sponsored by the NPRB and EVOSTC long-term monitoring programs. Mandy Lindeberg (GWA’s Program Lead) was the managing editor, and the diverse scientific team of guest editors included Matt Baker (NPRB Science Director), David Kimmel (NOAA Alaska Fisheries Science Center [AFSC], Research Oceanographer), Olav Ormseth (NOAA AFSC, Research Fisheries Biologist), Suzanne Strom (Western Washington University, Biological Oceanographer), and Rob Suryan (GWA Science Coordinator).

Table 8. Lead authors and titles of peer reviewed papers published in a special issue of the journal Deep Sea Research Part II. The theme of the special issue was “Understanding Ecosystem Processes in the Gulf of Alaska: Volume 3.” GWA authors and data contributed to 8 of 14 papers in the special issue

Lead author	Title
Batten	Responses of Gulf of Alaska plankton communities to a marine heat wave
Budge	Foraging ecology of nearshore fishes in the Gulf of Alaska
Danielson	Thermal variability in the Northern Gulf of Alaska across years of marine heatwaves and cold spells
Gibson	Modeling in an integrated ecosystem research framework to explore recruitment in Gulf of Alaska groundfish – Applications to management and lessons learned
Gray	Winter variability in the diets of groundfish inhabiting a subarctic sound with a focus on Pacific herring and walleye pollock piscivory
Guo	Environmental factors important to high-latitude nearshore estuarine fish community structure
Kandel	Spatial and temporal variability of dissolved aluminum and manganese in surface waters of the northern Gulf of Alaska

Lead author	Title
Lindeberg	Long-term monitoring and integrated research – Understanding ecosystem processes in the Gulf of Alaska
McCabe	Influence of environmental attributes on intertidal community structure in glacial estuaries
McKinstry	Influence of the 2014–2016 marine heatwave on seasonal zooplankton community structure and abundance in the lower Cook Inlet, Alaska
Rosellon-Druker	Participatory place-based integrated ecosystem assessment in Sitka, Alaska: Constructing and operationalizing a socio-ecological conceptual model for sablefish (<i>Anoplopoma fimbria</i>)
Siegert	Trophic structure of key taxa in rocky intertidal communities in two contrasting high-latitude environments
Shotwell	Synthesizing integrated ecosystem research to create informed stock-specific indicators for next generation stock assessments
Surma	Pacific herring (<i>Clupea pallasii</i>) as a key forage fish in the southeastern Gulf of Alaska

Mentoring

Long term monitoring programs provide important opportunities to mentor young scientists at undergraduate and graduate student levels, and postdoctoral scholars. GWA program projects mentored numerous young scientists, as summarized in Table 9. The University of Alaska Southeast (UAS) and NOAA Partnership in Education Program (PEP), UA Alaska Native Science and Engineering (ANSEP) program, and UAF Biomedical Learning & Student Training (BLaST) program specifically targeted undergraduates from rural Alaska and of Alaska Native heritage.

Table 9. Summary of Gulf Watch Alaska (GWA) principal investigators mentoring students associated with monitoring projects funded by the Exxon Valdez Oil Spill Trustee Council.

Degree	Student Affiliation	Topic
Undergraduate internship	University of Alaska Southeast (UAS) & National Oceanic and Atmospheric Administration (NOAA) Partnership in Education Program (PEP)	Humpback whale isotopes

Degree	Student Affiliation	Topic
	UAS	GWA-Herring Research & Monitoring (HRM) aerial survey
	University of Alaska Fairbanks (UAF) College of Fisheries and Ocean Sciences (CFOS)	Mussel size frequency
	Alaska Pacific University (APU)	Mussel core size and counts
	APU	Sea otters
	APU	Sea otters
	APU	Mussels
	North Gulf Oceanic Society (NGOS)	Hydrophone data sorting
	NGOS	Programing, data input
	NGOS	Geographic Information System (GIS), data archiving, field work
	NGOS	Data quality control, error checking field acoustics
	NOAA Hollings Scholarship program	Visualizing nearshore data
	NOAA Hollings Scholarship program	Nearshore fish
	American Academy of Underwater Sciences	Nearshore communities
	University of Alaska (UA) Alaska Native Science & Engineering Program (ANSEP)	Lab & fieldwork
	UAF Biomedical Learning & Student Training (BLaST)	Clam populations
	National Science Foundation (NSF) Research Experiences for Undergraduates (REU)	Circulation, fresh water distribution
Master of Science	UAS	Sea otters
	UAF CFOS	Mussel demographics
	UAF CFOS	Sea star wasting disease
	UAF CFOS	Mussel dynamics in nearshore communities
	UAF CFOS	Intertidal communities
	UAF CFOS	Freshwater pathways
	UAF CFOS	Stratification

Degree	Student Affiliation	Topic
	UAF CFOS	Jellyfish
	UAF CFOS	Neocalanus copepods
	UAF CFOS	Larvaceans & pteropods
	UAF CFOS	In situ plankton imaging
	NGOS/UAF CFOS	Killer whale acoustics
	Simon Fraser University (SFU)	Black oystercatchers
	SFU	Marine birds (Barrow's goldeneyes)
Post-doctoral scholar	UAF CFOS	Prince William Sound ecosystem model
	USGS	Nearshore Component synthesis
Artist intern	USGS	Fall integrated predator-prey survey

Communicating monitoring information to Trustee Agencies and other resource managers

The PMT communicated GWA monitoring activities and findings to Trustee Agencies and other resource managers through presentations, meeting participation, time series (see above, Table 6), a newsletter, and development of graphics for each of the components.

Presentations to agencies and resource managers are summarized in Table 10.

With the understanding that illustrations can often depict complex ideas that are difficult to convey in words, the PMT led a process of developing graphic illustrations for each of the components. The Nearshore component graphic was completed during the FY12-16 funding period and the Environmental Drivers (Figs. 6-8) and Pelagic component (Fig. 9) graphics were completed during the FY17-21 funding period.

Table 10. Examples of more than 20 (≥ 3 per year) Gulf Watch Alaska presentations given to Trustee Agencies and resource managers during the 2017-2021 funding cycle.

Date	Presenter	Presentation Title	Venue
Dec 2017	Mandy Lindeberg	We are watching – the long-term monitoring program of the <i>Exxon Valdez</i> Oil Spill Trustee Council (EVOSTC)	Prince William Sound (PWS) Regional Citizens' Advisory Council (RCAC) Science Night
Sep 2018	Donna Aderhold	An overview of GWA	Cook Inlet RCAC Board of Directors
Feb 2019	Mandy Lindeberg	2015 Lingering oil survey	Prince William Sound Regional Citizens' Advisory Council
Oct 2019	Mandy Lindeberg	GWA: A long-term monitoring program of the EVOSTC	North Pacific Fishery Management Council (NPFMC)
May 2019 - 2022	Rob Suryan	GWA contribution to Preview of Ecosystem and Economic Conditions	NOAA Alaska Fisheries Science Center
Sept 2020 - 2022	Rob Suryan	Ecosystem status and recruitment processes Annual update	NPFMC Groundfish Plan Team

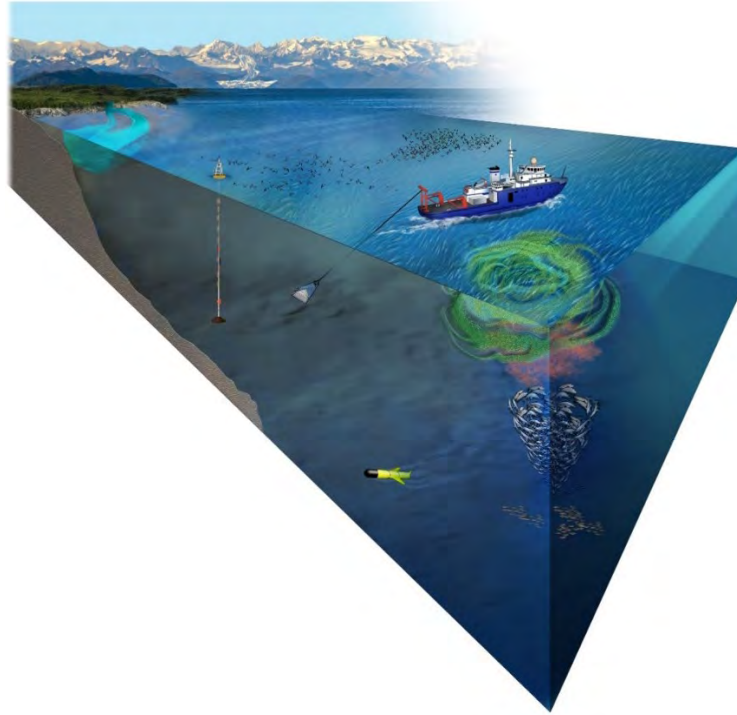


Figure 6. An Environmental Drivers ecosystem block to match previously developed blocks for the pelagic and nearshore components.

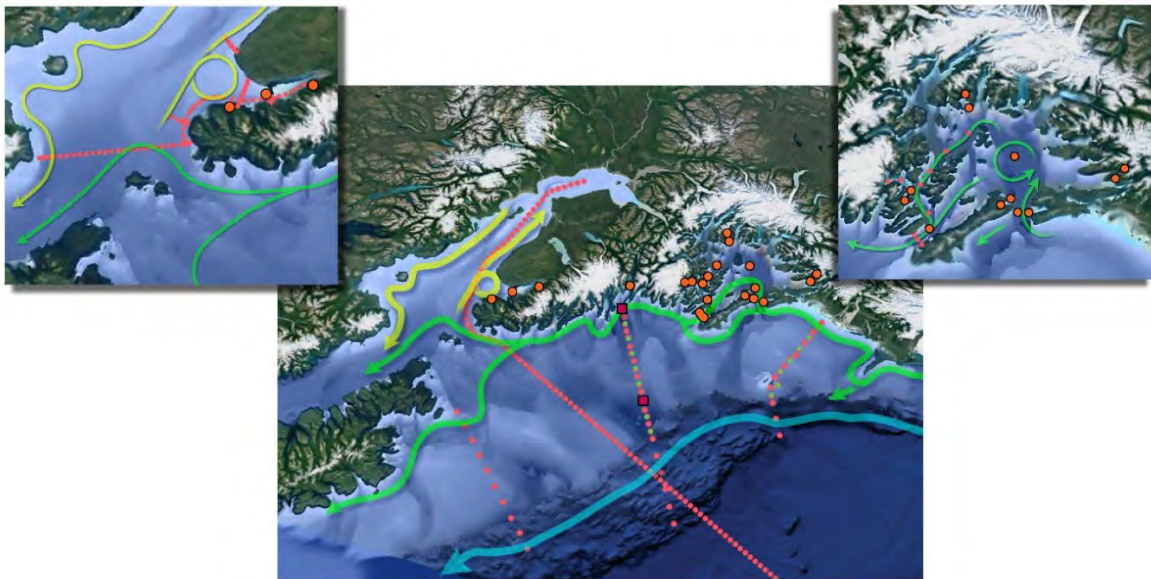


Figure 7. Bathymetric and oceanographic current graphic illustration showing Gulf Watch Alaska/Long-term Ecological Research Environmental Drivers monitoring transects, stations, and moorings throughout Prince William Sound, Gulf of Alaska continental shelf/break, and lower Cook Inlet/Kachemak Bay. These maps have separate modules and layers.

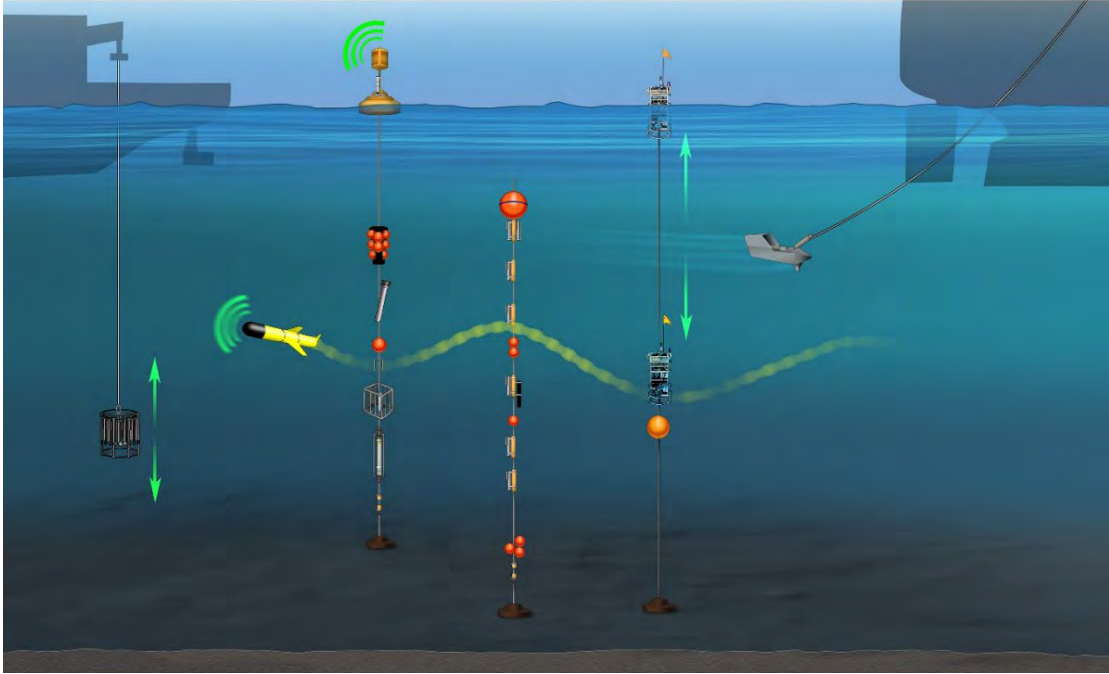


Figure 8. An Environmental Drivers composite of oceanographic instrumentation highlighting GAK1 and Seward Line moorings, the profiler in Prince William Sound, an autonomous glider, and continuous plankton recorder and conductivity and temperature at depth casts off vessels.

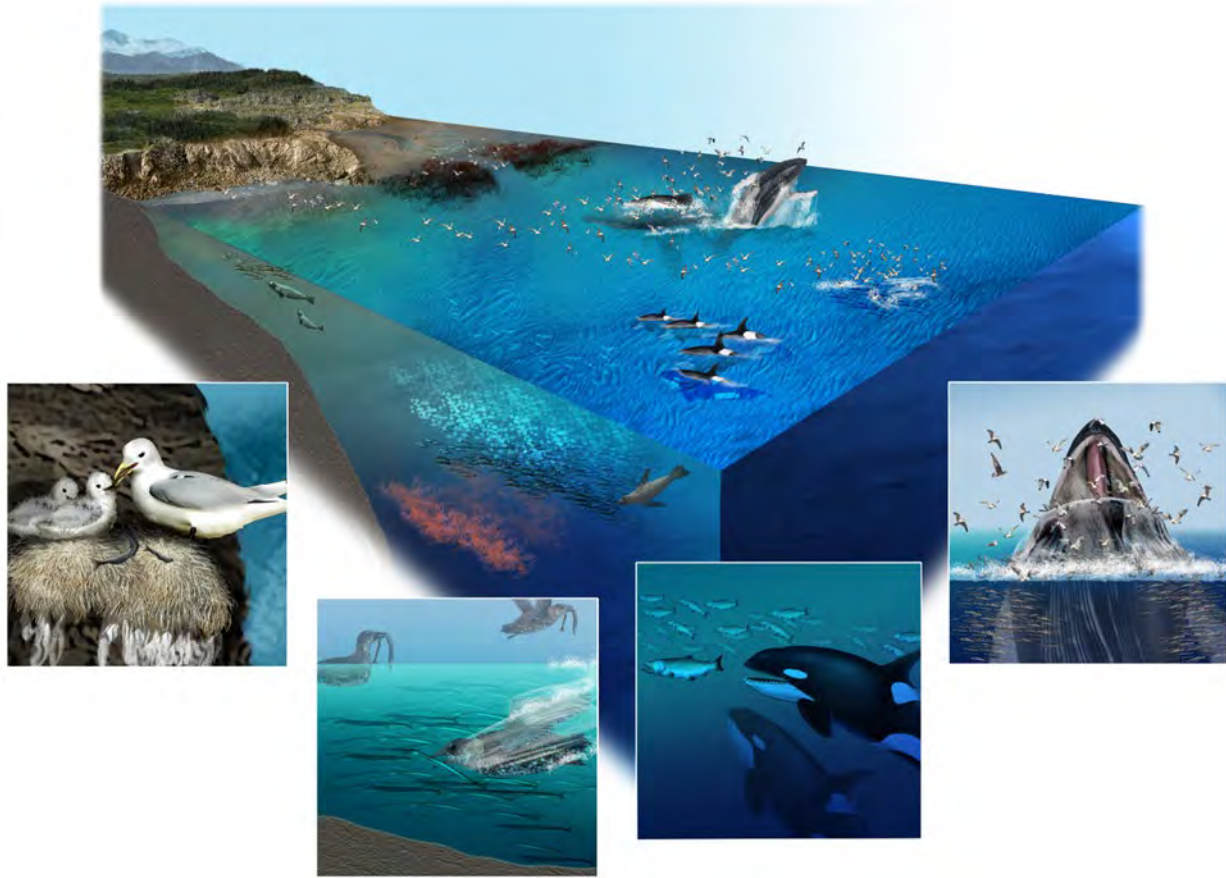


Figure 9. Gulf Watch Alaska Pelagic component graphic showing key predators and their prey being monitored in the pelagic ecosystem impacted by the Exxon Valdez oil spill.

The PMT developed and distributed a newsletter titled *Quarterly Currents* to EVOSTC staff, science panel members, public advisory committee members; GWA sponsoring agency public relations personnel; HRM PIs; and PWS and Cook Inlet Regional Citizens' Advisory Council staff and board members. The newsletter provided highlights of GWA program activities each quarter. All *Quarterly Currents* newsletters are available publicly on the GWA website (<https://gulfwatchalaska.org/resources/quarterly-currents-newsletter/>).

PMT members also attended and presented at scientific conferences. The primary conference was the AMSS held in Anchorage in January each year. The PMT also helped coordinate and participated in a GOA workshop at an Ocean Sciences conference (see above).

Through the course of the GWA program, the PMT and PIs have improved relationships with Trustee Agencies and demonstrated the value of the long-term monitoring program. Because of these relationships we have leveraged new partnerships (Table 11) and increased funding from sources outside of EVOSTC (Fig. 10).

Table 11. Summary of the leveraged partnerships within the Gulf Watch Alaska program, showing the diversity of agencies, organizations, and universities that have invested in and partnered with long-term monitoring projects.

Agencies	Organizations	Universities
National Oceanic and Atmospheric Administration (NOAA) Alaska Fisheries Science Center	Alaska Ocean Observing System	Georgia Institute of Technology
NOAA Alaska Fisheries Region	Alaska Sea Life Center	Hatfield Marine Science Center
NOAA Northwest Fisheries Science Center	Alaska Whale Foundation	Simon Frasier University
NOAA Northwest Region	Alutiiq Pride Shellfish Hatchery	University of Alaska Fairbanks
NOAA National Ocean Service (NOS) National Centers for Coastal Ocean Science (NCCOS) Beaufort Laboratory	Farallon Institute	University of Alaska Southeast
NOAA NOS NCCOS Kasitsna Bay Laboratory	Happywhale	University of Alaska Anchorage
US Geological Survey (USGS) Alaska Science Center	International Ocean Observing System	University of Washington
USGS Marrowstone Lab	International Whaling Commission	
USGS Bureau of Ocean Energy Management	Kachemak Bay National Estuarine Research Reserve	
US Fish and Wildlife Service Migratory Bird Management	Marine Biological Association	
Alaska Maritime National Wildlife Refuge	North Pacific Fisheries Management Council	
National Park Service	North Pacific Marine Science Organization (PICES)	
Alaska Department of Fish and Game	North Pacific Research Board	

Agencies	Organizations	Universities
Alaska Department of Environmental Conservation	National Science Foundation (NSF) Long Term Ecological Research	
Alaska Department of Health and Social Services	NSF Established Program to Stimulate Competitive Research	
Canadian Department of Fisheries and Oceans	Orcasound/Google	
	Prince William Sound (PWS) Science Center	
	PWS Regional Citizens' Advisory Council	

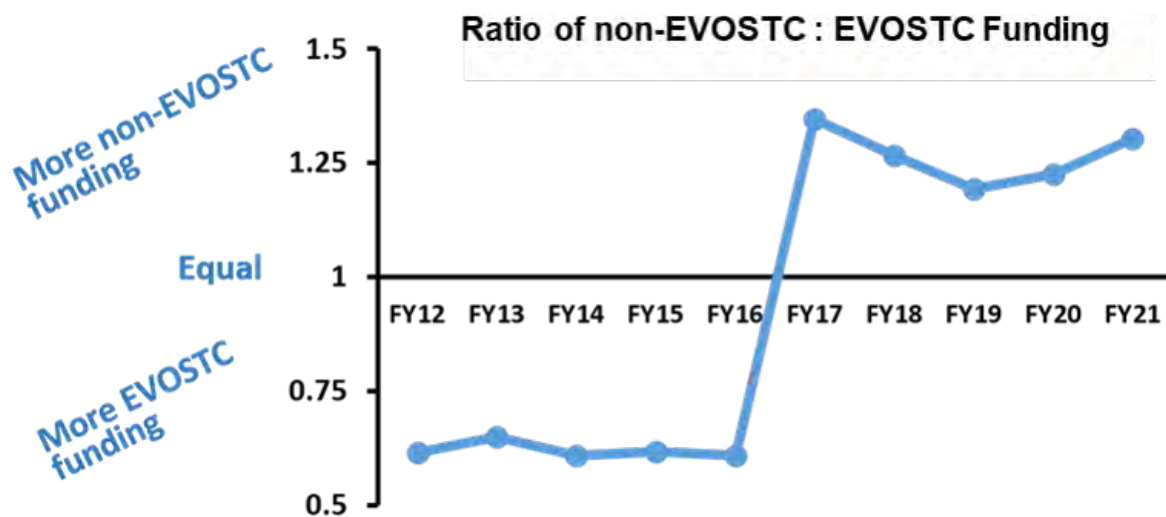


Figure 10. The ratio of funding from the Exxon Valdez Oil Spill Trustee Council (EVOSTC) and other sources for the Gulf Watch Alaska program showing that over the 10-year funding period the program leveraged more funding from non-EVOSTC sources than EVOSTC funding.

Coordination with other EVOSTC programs

The Research Workspace, managed by the Data Management program, was a critical feature for file sharing and archiving. Program Management files in the Research Workspace were available

to all GWA program team members. The Research Workspace was used to share GWA meeting agendas and notes, presentations, work plan and report templates, program photographs, outreach activities, publications, and other important files. The PMT also used the Research Workspace to submit draft and final deliverables (work plans, annual reports, synthesis reports, and final reports) with EVOSTC staff, providing a permanent record of deliverables.

The GWA PMT and Data Management program staff worked closely to ensure GWA projects met EVOSTC requirements for data publication on the AOOS's GOA data portal and DataONE (where finalized data are published with a data object identifier [DOI]). Data Management program team members were included in the GWA program email distribution list and were invited to attend and present at all GWA program team meetings. Data Management team members met one-on-one with GWA PIs during annual meetings to discuss data deliverables. The Data Management Program Lead provided the GWA PMT with updates on project data deliverable status, allowing PMT members to coordinate with PIs if data deliverables were falling behind.

The GWA PMT coordinated closely with HRM Lead Scott Pegau. Scott was included in the GWA program email distribution list and GWA PMT members were included in the HRM email distribution list. Scott was included in GWA PMT meetings which included discussion topics that affected the HRM program. Scott presented HRM program updates during GWA PI meetings and he invited the GWA Program Lead to present GWA program updates at HRM PI meetings. GWA and HRM annual PI meetings were scheduled to allow PIs and team members from both programs to interact and attend each other's sessions. Interactions between GWA and HRM PIs increased with science synthesis. During this period, GWA and HRM held joint synthesis meetings and PIs from both programs contributed to chapters of each other's synthesis reports to EVOSTC and subsequent peer reviewed publications. During the final year of the 5-year funding cycle the programs integrated further as the EVOSTC FY22-31 Invitation called for the merging of the two programs into one long-term research and monitoring program.

Pandemic Impacts

The World Health Organization declared an emerging coronavirus, SARS-CoV-2, a pandemic in spring 2020, followed by emergency declarations by the US government and Governor of Alaska. Because the virus was highly infectious and humans had no natural immunity, federal and state agencies issued work from home orders and restricted travel.

The emergency declarations occurred during March, a time when many GWA program projects were gearing up to conduct annual field work. Some projects were delayed in conducting field studies or analyses, some projects developed Covid protocols that allowed smaller field teams to collect data, and other project teams were unable to conduct field work.

Because of the collaborative nature of the GWA program, project PIs knew each other well and coordinated to collect data across projects where possible. This inter-project collaboration

extended between the GWA and HRM programs as well. The PMT worked with all program members to identify scientific priorities and adapt schedules and budgets to the best of their ability. Detailed contingency plans for conducting field and lab work safely were coordinated and shared among the PIs to meet the various requirements of federal and state agencies. The PMT helped PIs prioritize their scientific objectives and advised them on how to proceed with appropriate budgetary adjustments. Some creative solutions for resources and data collection were developed across projects, a clear benefit of a multi-agency program.

The PMT shifted its 2020 fall annual meeting to a virtual meeting by using videoconferencing software. Pandemic travel restrictions extended into 2021, AMSS was held virtually, and the GWA program held its winter PI meeting through videoconference. Based on the success of videoconferencing, the GWA program shifted from teleconferencing to videoconferencing for its spring and summer quarterly meetings. Because of the ongoing pandemic, the fall 2021 and winter 2022 PI meetings were held virtually by using videoconferencing software.

Fiscal Administration

Grant administration

Acting as the fiscal agent for the non-Trustee organizations that are part of the GWA program is among the most important roles of PWSSC as a member of the PMT. Without PWSSC as the fiscal agent, EVOSTC would need to administer separate contracts with each non-Trustee organization. Non-Trustee organizations involved in GWA during FY17-21 included AOOS, Axiom, Marine Biological Association, North Gulf Oceanic Society, PWSSC, and University of Alaska Fairbanks, Anchorage, and Southeast. PWSSC provides this service through a NOAA grant. After the EVOSTC authorized the GWA program to receive funding, PWSSC submitted a proposal, budget, and required federal forms to NOAA on behalf of the non-Trustee organizations separate from the EVOSTC proposal and NOAA awarded the grant.

In all five years of the FY17-21 funding cycle for the GWA program, PWSSC issued and managed subaward contracts for all non-Trustee Agency projects. They remunerated subawardees based on demonstrated expenses, tracked spending, and completed an annual audit each fall. Semi-annual grant reports to NOAA and annual reports and work plans to EVOSTC were submitted on time. Financial reports such as SF425s were submitted to NOAA by all required deadlines. Annual audits including federal single audits were completed in every program year. Project spending for all subawards was monitored and assistance was provided to the program overall with budget reconciliation, tracking of cumulative spending, and requests for line-item transfers or transfers between projects.

Logistics

PWSSC provided logistics and funding for SRP member travel to GWA PI meetings that were held in person, typically fall and winter meetings, and the Science Synthesis Workshop held with EVOSTC Science Panel members and staff in February 2020.

The GWA program held quarterly PI meetings. From 2017 through 2019 the spring and summer meetings were held via teleconference; the fall meetings were held in person in Cordova (2017), Anchorage (2018), and Homer (2019; Fig. 3); and the winter meetings were held in person in Anchorage in conjunction with AMSS. In person meetings included options for team members to participate remotely via GoToMeeting video conferencing software. When coronavirus restrictions began in March 2020 all meetings moved online. The fall 2020 meeting was held via GoToTraining video conferencing software (Fig. 3); the program allowed for breakout rooms with integrated online notetaking. All subsequent meetings were held via GoToMeeting video conferencing software.

PWSSC planned for, secured, and paid for in-person venues and group meals and refreshments; secured blocks of rooms and group discount rates at hotels for fall meetings; and provided teleconferencing and videoconferencing software for all meetings.

Outreach and Community Involvement

PWSSC oversaw outreach and community involvement during the funding cycle. The activities reflected the reduced outreach budget and streamlined outreach activities as defined in the Invitation guidance. Primary outreach activities included:

- dissemination of program information via the website <https://gulfwatchalaska.org/>
- community presentations by program scientists
- published articles in PWSSC's annual natural history periodical *Delta Sound Connections*
- engagement with Alaska Native communities within the spill-affected area via listening sessions

Maintain website

The GWA website was the primary outreach tool during the FY17-21 funding cycle based on the requirements of the Invitation (EVOSTC 2015). Project pages were updated annually with recent findings and brief interpretations of the findings. The two Nearshore component projects from the first 5-year funding cycle were combined at the beginning of the current funding cycle so the Nearshore Ecosystem component pages were revamped (Fig. 9) to better illustrate the wide variety of physical and biological data collected in intertidal areas across the spill-affected area (intertidal temperature, intertidal biological communities, bivalves, marine birds, black oystercatchers, and sea otters).



Figure 11. Gulf Watch Alaska website nearshore ecosystem component page showing the list of updated the component’s areas of study.

A section titled “Latest News” was added to the website. This section was updated as GWA program scientists and projects were highlighted in local or national news or on agency news releases or website profiles. The latest three news items appeared on the right side of the GWA home page and subsequent pages and on its own page under the Resources and News tabs (Fig. 10). During the funding cycle, 48 articles were added. The Guardian highlighted results from the Continuous Plankton Recorder in the article “[Tiny plankton tell the ocean’s story – this vast marine mission has been listening](#)”. The team’s work in understanding the effects of the Pacific heat wave on the spill affected area was noted in the Anchorage Daily News piece titled “[Massive die-off of Pacific seabirds linked to a warm-water ‘blob’](#)”. *Eos* called out GWA synthesis work on the marine heatwave with “[Years after the Pacific marine heatwave, ecosystem shifts persist](#).” Trustee Agency press highlighting GWA project results are highlighted on the website, and quarterly program updates can be found there, as well.

The website was also updated regularly with GWA publications and reports. Reports included approved annual reports to EVOSTC, FY12-16 final reports, and science synthesis reports finalized in 2015 and 2021. By the end of the FY17-21 funding cycle, scientists associated with the GWA program had published more than 150 articles in peer reviewed journals, books, and university theses and dissertations that included GWA data.



Figure 12. The “Latest News” page of under the Resources and News tabs of the Gulf Watch Alaska website.

Community presentations

PMT members and project PIs gave presentations throughout the funding cycle, taking advantage of opportunities to present information about the GWA program and its findings to a wide array of audiences. Through these activities, we engaged Trustee Agencies, managers, and community members with interests in the spill affected area. Table 13 summarizes presentations by PMT members and public outreach opportunities coordinated by the PMT. Project PIs also provided public presentations as part of their outreach activities; see individual project final reports for those listings.

Table 12. Gulf Watch Alaska presentations given to general audiences during the 2017-2021 funding cycle.

Date	Presenter	Presentation Title	Venue
Nov 2018	Robb Kaler	2015-2016 murre die-off in the Gulf of Alaska	Prince William Sound Science Center Tuesday night lecture series
Mar 2018	Mandy Lindeberg	Gulf Watch Alaska (GWA) program overview	Recruitment Processes Alliance annual meeting
May 2018	Rob Suryan	Gulf of Alaska ecosystem variability	Juneau Marine Naturalists Symposium

Date	Presenter	Presentation Title	Venue
July 2018	Rob Suryan	GWA: Why we study ecosystems	Juneau Yacht Club
Feb 2019	Mandy Lindeberg	Long-term programs of the EVOSTC	Alaska Forum on the Environment
Oct 2019	Mandy Lindeberg	GWA: A long-term monitoring program of the EVOSTC	University of Alaska Anchorage, Kachemak Bay Campus community lecture series
Oct 2019	Rob Suryan	Biological response to a marine heatwave in the Gulf of Alaska	University of Alaska Anchorage, Kachemak Bay Campus community lecture series
Oct 2019	Brian Robinson	Movement, migration, monitoring: The black oystercatcher	University of Alaska Anchorage, Kachemak Bay Campus community lecture series
Oct 2019	Kris Holderied	Oceanography of Kachemak Bay	University of Alaska Anchorage, Kachemak Bay Campus community lecture series
Nov 2019	Rob Suryan	Changing climate, changing ecosystems	Sitka Whalefest
Dec 2019	Rob Suryan	Forage fish in hot water	Conservation Connection podcast
Oct 2020	Mandy Lindeberg	GWA: A long-term monitoring program of the EVOSTC	EVOSTC public meeting (virtual)

The Program Coordinator participated in several activities associated with the Coastal Observation and Seabird Survey Team (COASST) based out of the University of Washington. COASST recently developed a more condensed die-off alert training as a systematic way for communities or people in remote areas to document a bird die-off. The Program Coordinator attended a die-off alert “train the trainer” training and participated with the Kachemak Bay

National Estuarine Research Reserve in die-off alert trainings in Port Graham and Seldovia. The Program Coordinator also provided die-off alert training to GWA team members at the November PI meeting in Anchorage for times when GWA project teams are working in the field and need to document a bird die-off that is not part of regularly scheduled work. Finally, the PMT held a teleconference with Julia Parrish and other COASST leaders to discuss the availability of GWA data for analysis of marine bird monitoring and die-offs in the Gulf of Alaska.

Delta Sound Connections

Delta Sound Connections is a newspaper style periodical produced annually by the PWSSC and distributed widely throughout PWS, the Copper River Delta, and adjacent areas (e.g., state ferries, Ted Stevens Anchorage International Airport, Mudhole Smith Airport in Cordova, Begich Boggs Visitor Center at Portage Glacier, and a variety of sites in Girdwood, Glenallen, Copper Center, and Valdez). The newspaper includes articles on natural history and science news from the Prince William Sound and Copper River Delta bioregion, including the northern GOA. The GWA program contributed several articles per year and financially contributed to production of the newspaper (Table 13, Fig. 11). Articles written about the GWA program by PMT members are listed at the end of this report under the Other References section.

Table 13. Articles written by Gulf Watch Alaska (GWA) scientists for the Prince William Sound Science Center annual periodical Delta Sound Connections during the FY17-21 funding cycle, including the FY22 no cost extension year.

Year	Author(s)	Article Title
2017	Aderhold	(Introduction) GWA monitors ecosystem health
	Weitzman	Clam declines in the northern Gulf of Alaska
	Matkin	Tracking whales with remote hydrophones
	Kaler	Unusual observations of seabirds in the Gulf of Alaska following the 2015-2016 mass die-off
	Arimitsu	Forage fish in hot water contribute to seabird die-off
2018	Suryan	(Introduction) GWA looks beyond “The Blob”
	Schaefer	A winter refuges for seabirds
	Campbell	Productive plankton in the world’s richest waters
	Konar and Iken	Wasting sea stars in the Gulf of Alaska
	Moran	Dall’s porpoise: Life in the fast lane

Year	Author(s)	Article Title
2019	Lindeberg and Heintz	(Introduction) 30 years since the <i>Exxon Valdez</i> oil spill: An era of scientific research and monitoring that has changed our understanding of oil spill impacts
	Suryan	What does the future hold for the Gulf of Alaska?
	Danielson and Hopcroft	Tracking water layers in the ocean
2020	Aderhold	(Introduction) Scientists integrate studies of predators and prey in Prince William Sound
	Schaefer	Are warmer waters driving shearwaters into Prince William Sound
	Arimitsu	Forage fish in the northern Gulf of Alaska: On the road to recovery at last?
	Moran	What happened to the humpback whales of Prince William Sound?
2021	Aderhold	(Introduction) Gulf Watch Alaska program leads to understanding of species adaptation
	Campbell	Smile, you're on plankton cam
	Traiger	Mussels are thriving: Thank your (un)lucky stars
	Olsen	The seasonal harvest for Alaska's resident killer whales
2022	Aderhold	(Introduction)GWA celebrates a decade of data!
	McKinstry	Warm waters have impact on tiniest Cook Inlet residents
	Irons	Prince William Sound Kittiwakes experienced dramatic decadal differences in population trend
	Coletti	A case study of brown bears and sea otters along the Katmai coast
	Danielson	Underwater glider makes first ever mid-winter voyage in the Gulf of Alaska
	Ostle	Plankton feeling the heat

GULF WATCH ALASKA
Page 6 DELTA SOUND CONNECTIONS 2021-22

GULF WATCH ALASKA

SMILE, YOU'RE ON PLANKTON CAM!

ROB CAMPBELL
Co-Manager, Prince William Sound Science Center

Plankton from the base of the marine food web... The single-celled plant plankton (phytoplankton) grow and are consumed by animal plankton (zooplankton)...

SMILE, YOU'RE ON PLANKTON CAM!

DOHNA ROBERTSON & ADEHOLD
Co-Manager, Prince William Sound Science Center

All organisms must adapt to their environments or they will cease to exist... The Gulf Watch Alaska program is studying organisms from plankton and seaweeds to forage fish and whales in the northern Gulf of Alaska through long-term monitoring...

THE SEASONAL HARVEST FOR ALASKA'S RESIDENT KILLER WHALES

DAN OLSEN
Co-Manager, North Gulf Oceanic Society

For thousands of years, Native Alaskans have adapted to fluctuations in marine mammal abundance... The bowhead (Cetorhinus maximus) and killer whale (Orcinus orca) are not so different. Both are fed through the ocean's food web...

GULF WATCH ALASKA
PRINCE WILLIAM SOUND SCIENCE CENTER PWSSC.ORG Page 7

MUSSELS ARE THRIVING; THANK YOUR (UN)LUCKY STARS

SARAH TRAEGER
Assistant Manager, U.S. Geological Survey

Sea stars are considered keystone species because even in relatively small numbers they have large effects on marine ecosystems... The Gulf Watch Alaska program is studying organisms from plankton and seaweeds to forage fish and whales in the northern Gulf of Alaska through long-term monitoring...

ABOVE: Aerial photo of a rocky intertidal beach showing zones for rockweed (above the red line), mussels (above the blue line), and upper portion of sea star predation on mussels (below the blue line).

RIGHT: Pacific blue mussel (Mytilus) after feeding during a high tide. Their shells show traps, and black, and black Ophiurostoma.

TOP: Healthy mottled sea stars, their color: Mottled Looking Glass.

BOTTOM: Mottled star with sea star wasting disease. Sea stars break down star.



Figure 13. Example of Gulf Watch Alaska articles and page layout in Delta Sound Connections, Prince William Sound Science Center's annual newspaper.

Engagement with spill-affected communities

Specific engagement with Alaska native communities affected by the spill was a priority during the funding cycle (EVOSTC 2015). The GWA program outreach team planned to visit communities in Kachemak Bay during 2018 and PWS in 2020. Project teams visited Seldovia and Port Graham in Kachemak Bay as scheduled but were unable to visit Chenega or Tatitlek in PWS because of the coronavirus pandemic. These outreach activities are described below.

Through exploratory conversations, it was determined that a good venue for engagement with Tribal members in Kachemak Bay would be to convene a listening session in association with the 2018 Kachemak Bay Science Conference, which occurs once every three years. The purpose of the conference is to share scientific work occurring in the Kachemak Bay region among scientists and community members. The Program Coordinator and several GWA PIs participated on the steering committee for the triennial conference that was held in Homer March 7-10, 2018.

Chugachmiut Heritage Preservation local education coordinators held meetings with PWS and Kachemak Bay village elders and other community members in conjunction with the conference, and Chugachmiut local education coordinators and elders attended the conference (Fig. 12). Members of the PMT and select GWA scientists attended these gatherings to learn about ecosystem change from Tribal members, hear what questions Tribal members had about recovery from the spill and ecosystem change since the spill, and answer questions asked of them by Tribal members.



Figure 14. Chugachmiut local education coordinators, elders from Prince William Sound and Kachemak Bay villages, and Gulf Watch Alaska scientists participated in a dialog about ecosystem changes during a meeting in Homer, November 2018.

The Program Coordinator participated in planning and conducting outreach events to spill-affected Alaska Native communities in the Kachemak Bay area, including conversations with Chugachmiut Heritage Preservation local education coordinators and Chugachmiut region elders from Tatitlek, Chenega Bay, Valdez, Port Graham, and Nanwalek; an information exchange session in Port Graham; and a bird die-off alert training session in Seldovia (in association with Seldovia Village Tribe). A planned information exchange session in Nanwalek was cancelled due to unforeseen circumstances.

The information exchange session in Port Graham included GWA and HRM project team members from the Kachemak Bay oceanography project, Nearshore program, and herring disease program with expertise in oceanography and climate change, clams and intertidal communities, sea otters, marine birds, and fish disease. After a brief introduction about the GWA program, program scientists engaged in one on one and small group discussions based on the interests of community members present.

The GWA outreach team was developing plans for outreach in PWS during winter and spring 2020 when the coronavirus pandemic arrived in Alaska and many remote villages closed to outside visitors. The outreach team discussed other options to engage with these communities, such as videoconferencing, and realized remote engagement was not desirable because of limited internet bandwidth in remote villages, difficulties with technology, and the realization that

nothing could replace in-person social engagement for the information sharing and relationship building intended for the engagement. The pandemic continued for the remainder of the funding cycle and the outreach team felt uneasy with the possibility of bringing the virus to a remote village even as restrictions lifted.

The Chugach Regional Resources Commission held its 20th annual Subsistence Memorial Gathering virtually on March 24, 2022. The purpose of the gathering was to share traditional knowledge related to subsistence resources and their conservation and sustainability. The GWA Science Coordinator presented at the gathering on the impacts of the Pacific marine heatwave on fish, marine mammal, and bird species in the northern GOA, many of them important for subsistence harvest. Members of the HRM program also presented. GWA program team members participated in the event to learn the perspectives of tribal members.

CONCLUSIONS

Program Management successfully led GWA through a second and highly productive 5-year period. We demonstrated how a small and integrated leadership team can help scientists collaborate, synthesize their findings, and share their knowledge with a diverse array of stakeholders. GWA produced more than 60 publications and over 250 scientific and public presentations, while also providing numerous development opportunities for students and early career professionals. Program Management met all reporting fiscal management requirements, produced high impact science synthesis materials, and expanded outreach to communities, resource managers, and the scientific community. We leveraged GWA resources to develop collaborations and new partnerships.

GWA and its many legacy time series are becoming increasingly valued in understanding how environmental change in the spill affected area is impacting fisheries, mariculture, subsistence, tourism, and recovery of injured resources. GWA Program Management is instrumental in increasing efficiency, impact, and value of this diverse yet highly integrated ecosystem monitoring program.

ACKNOWLEDGEMENTS

The GWA Program Management Team thanks the SRP members who provided invaluable peer oversight of the long-term monitoring program: Hal Batchelder, Rich Brenner, Ron Heintz, Leslie Holland-Bartels, Terrie Klinger, and Stanley “Jeep” Rice. We thank the SCC members who helped coordinate the projects within each component: Heather Coletti (Nearshore), Mayumi Arimitsu (Pelagic), and Russ Hopcroft (Environmental Drivers). We thank our partners in the Data Management program, Carol Janzen at AOOS and Stacey Buckelew, Chris Turner, and many team members at Axiom Data Science, for providing platforms and support for our program website and data publication. Scott Pegau, program lead for the HRM program, provided regular insights into long-term monitoring and was instrumental in the GWA program’s

integration with PWS herring projects. The incredible amount of scientific knowledge and synthesis developed by the GWA program would not be possible without the many PIs, co-PIs, scientists, postdoctoral scholars, graduate students, interns, technicians, and others who contribute to the individual projects that comprise the program. The program would not be successful without those working behind the scenes in accounting, logistics, outreach, and other day to day activities that allow scientists to focus on their work. Finally, with thank the Council for the vision of long-term monitoring to understand the complex issues associated with oil spill recovery and for selecting this team to conduct the work. This project is part of the Gulf Watch Alaska long-term monitoring program. These findings and conclusions presented by the author(s) are their own and do not necessarily reflect the views or position of the *Exxon Valdez* Oil Spill Trustee Council.

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Publicly available datasets

As the program management project, this project was not scientific in nature and did not collect original data. Data associated with the scientific projects that comprised the program may be found at the Gulf of Alaska Data Portal and DataONE:

AOOS Gulf of Alaska Data Portal – <http://portal.aos.org/gulf-of-alaska.php>

DataONE published datasets. Gulf Watch Alaska Research Workspace. Doi: 10.24431/rw1k113.

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

Scientific presentations

Aderhold, D. 2018. An overview of Gulf Watch Alaska. Presentation. Oral presentation. Cook Inlet Regional Citizens' Advisory Council Board of Directors meeting, Homer, Alaska, September.

Arimitsu, M., J. Piatt, R. M. **Suryan**, S. Batten, M. Bishop, R. W. Campbell, H. Coletti, D. Cushing, K. Gorman, S. Hatch, S. Haught, R. Hopcroft, K. J. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, S. Pegau, A. Schaefer, S. Schoen, J. Straley, and V. R. von Biela. 2020. Synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave. Oral presentation. *Exxon Valdez* Oil Spill Trustee Council Science Review Panel. Science Synthesis Workshop. Anchorage, Alaska, February 27.

Arimitsu, M., J. Piatt, R. **Suryan**, S. Batten, M. A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, S. Hatch, S. Haught, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, S. Pegau, A. Schaefer, S. Schoen, J. Straley, and V. von Biela. 2020. Synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave. Oral presentation. Pacific Seabird Group annual meeting, Portland, Oregon, February 11-16.

- Arimitsu, M., J. Piatt, R. **Suryan**, D. Cushing, S. Hatch, K. Kuletz, C. Marsteller, J. Moran, S. Pegau, M. Rogers, S. Schoen, J. Straley, and V. von Biela. 2019. Reduced energy transfer through forage fish disrupted marine food webs during the North Pacific marine heatwave. Oral presentation. North Pacific Marine Science Organization (PICES) annual meeting. Victoria, British Columbia, Canada, October 16-27.
- Danielson, S., T. D. Hennon, D. H. Monson, R. M. **Suryan**, R. W. Campbell, S. J. Baird, K. Holderied, and T. J. Weingartner. 2020. A study of marine temperature variations in the northern Gulf of Alaska across years of marine heatwaves and cold spells. Oral presentation. *Exxon Valdez* Oil Spill Trustee Council Science Review Panel. Science Synthesis Workshop. Anchorage, Alaska, February 27.
- Lindeberg**, M. 2017. The long-term monitoring program of the *Exxon Valdez* Trustee Council. Oral presentation. Briefing to the *Exxon Valdez* Oil Spill Trustee Council, November 14.
- Lindeberg**, M. 2017. We are watching – the long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council. Oral presentation. Prince William Sound Regional Citizens' Advisory Council Science Night, December.
- Lindeberg**, M. 2018. Gulf Watch Alaska program overview. Speed talk. Recruitment Process Alliance Annual Meeting. Juneau, Alaska, March.
- Lindeberg**, M. 2018. Gulf Watch Alaska program overview. Speed talk. Ocean Sciences Conference. Portland, Oregon, February 11-16.
- Lindeberg**, M. 2018. Gulf Watch Alaska nearshore ecosystems. Speed talk. Ocean Sciences Conference. Portland, Oregon, February 11-16.
- Lindeberg**, M. 2018. Gulf Watch Alaska program overview. Oral presentation. *Exxon Valdez* Oil Spill Trustee Council. Anchorage, Alaska, November.
- Lindeberg**, M. 2018. Science without borders – is it possible? Plenary presentation. Kachemak Bay Science Conference. Homer, Alaska, March 7-10.
- Lindeberg**, M. R. 2019. Long-term programs of the *Exxon Valdez* Oil Spill Trustee Council. Oral presentation. 2019 Alaska Forum on the Environment, Anchorage, Alaska, February 11-15.
- Lindeberg**, M. 2020. Gulf Watch Alaska program: Website overview. Oral presentation. EVOSTC Public Advisory Committee. *Exxon Valdez* Oil Spill Trustee Council Science Synthesis Workshop. Anchorage, Alaska, February 26.
- Lindeberg**, M., and J. Bodkin. 2020. Gulf Watch Alaska: Program overview and highlights and monitoring upper trophic consumers in the nearshore. Oral presentation. Virtual Multi-Agency Rocky Intertidal Network (MARINe) Annual Workshop, March 13.

- Lindeberg, M., R. A. Heintz, and J. Maselko.** 2018. Decadal persistence of *Exxon Valdez* Oil in Prince William Sound – that was not anticipated. Poster. Ocean Sciences Conference, February, Portland, Oregon, February 11-16.
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- Lindeberg, M., R. Suryan, D. Aderhold, and K. Hoffman.** 2020. Gulf Watch Alaska program overview and highlights (FY2012-2019). Oral presentation. *Exxon Valdez* Oil Spill Trustee Council Science Review Panel. Science Synthesis Workshop. Anchorage, Alaska, February 27.
- Lindeberg, M., R. Suryan, D. Aderhold, and K. Hoffman.** 2020. Gulf Watch Alaska program recommendations. Oral presentation. *Exxon Valdez* Oil Spill Trustee Council Science Review Panel. Science Synthesis Workshop. Anchorage, Alaska, February 27.
- Lindeberg, M., R. Suryan, D. Aderhold, K. Hoffman, R. Hopcroft, H. Coletti, M. Arimitsu.** 2021. Gulf Watch Alaska: Building partnerships to understand ecosystem change. Poster. Alaska Marine Science Symposium, virtual, January 26-28.
- Lindeberg, M., and S. Traiger.** 2021. Changes in nearshore ecosystems and relevance to coastal communities – Gulf of Alaska. Panelists. Alaska Marine Science Symposium, virtual, January 26-28.
- Suryan, R. M.** 2018. Gulf of Alaska ecosystem variability. Oral presentation. Juneau Marine Naturalists Symposium. Juneau, Alaska.
- Suryan, R. M.** 2019. Mixed signals of “recovery” from the Gulf of Alaska marine heatwave: Perspectives from Gulf Watch Alaska. Oral presentation. University of Alaska Southeast, Juneau, Alaska.
- Suryan, R. M.** 2019. Gulf of Alaska ecosystem status for 2018 and early indicators for 2019. Oral presentation. Alaska Groundfish and Halibut Working Group, National Oceanic and Atmospheric Administration, Alaska regional office, Juneau, Mar 27-28.
- Suryan, R. M.** 2019. Gulf Watch Alaska. Oral presentation to ecosystem-based fisheries management meetings and workshops within the National Oceanic and Atmospheric

Administration, Integrated Ecosystem Assessment, Alaska Fisheries Science Center, including (1) Preview of Ecosystem and Economic Conditions workshop and (2) Ecosystem and Socioeconomic Profile workshop. Seattle, Washington.

Suryan, R. M., M. Arimitsu, H. Coletti, M. A. Bishop, D. Cushing, D. Esler, S. Hatch, D. Irons, R. Kaler, K. Kuletz, J. Piatt, and A. Schaefer. 2020 response of seabirds on colony and at sea to a prolonged marine heatwave in the Gulf of Alaska. Written presentation (tweets). 6th World Seabird Twitter Conference, May 4-6.

Suryan, R., M. Arimitsu, H. Coletti, R. Hopcroft, M. Lindeberg, S. Barbeaux, S. Batten, W. Burt, M. Bishop, J. Bodkin, R. Brenner, R. Campbell, D. Cushing, S. Danielson, M. Dorn, B. Drummond, D. Esler, T. Gelatt, D. Hanselman, S. Hatch, S. Haught, K. Holderied, K. Iken, D. Irons, A. Kettle, D. Kimmel, B. Konar, K. J. Kuletz, B. Laurel, J. M. Maniscalco, C. Matkin, C. McKinstry, D. Monson, J. Moran, D. Olsen, W. Palsson, S. Pegau, J. Piatt, L. Rogers, A. Schaefer, I. Spies, J. Straley, S. Strom, K. Sweeney, M. Szymkowiak, B. Weitzman, E. Yasumiishi, S. Zador. 2020. Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska. Oral presentation. *Exxon Valdez* Oil Spill Trustee Council Science Review Panel. Science Synthesis Workshop. Anchorage, Alaska, February 27.

Suryan, R. M., and M. L. Lindeberg. 2020. Gulf Watch Alaska. Oral presentation to ecosystem-based fisheries management meetings and workshops within the National Oceanic and Atmospheric Administration, Integrated Ecosystem Assessment, Alaska Fisheries Science Center, including: (1) Preview of Ecosystem and Economic Conditions workshop, (2) Ecosystem and Socioeconomic Profile workshop, (3) Recruitment Processes Alliance annual meeting and strategic planning. Seattle, Washington.

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

Suryan, R., M. Lindeberg, D. Aderhold, K. Hoffman, M. Arimitsu, H. Coletti, and R. Hopcroft. 2018. Gulf Watch Alaska: Taking the pulse of the northern Gulf of Alaska. Poster. Alaska Marine Science Symposium, Anchorage, Alaska, January 23-26.

Suryan, R., M. Lindeberg, D. Aderhold, K. Hoffman, M. Arimitsu, H. Colletti, and R. Hopcroft. 2018. Gulf Watch Alaska: Taking the pulse of the northern Gulf of Alaska. Poster. Kachemak Bay Science Conference, Homer, Alaska, March 7-10.

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Online resources

Alaska Ocean Observing System Gulf of Alaska Data Portal (Gulf Watch Alaska data):
https://gulf-of-alaska.portal.aos.org/#search?type_group=all&tag|tag=evos-gulf-watch-projects&page=1

Gulf Watch Alaska: <https://gulfwatchalaska.org/>

Herring Research and Monitoring: <https://pwssc.org/herring/>