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

Data Management Support for the EVOSTC Long-Term Monitoring Program

Exxon Valdez Oil Spill Trustee Council Project 16120114-D
Final Report

Rob Bochenek
Stacey Buckelew
Will Koeppen
Chris Turner

Axiom Data Science
1016 W 6th Avenue
Anchorage, Alaska 99501

May 2018

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

Data Management Support for the EVOSTC Long-Term Monitoring Program

Exxon Valdez Oil Spill Trustee Council Project 16120114-D
Final Report

Rob Bochenek
Stacey Buckelew
Will Koeppen
Chris Turner

Axiom Data Science
1016 W 6th Avenue
Anchorage, Alaska 99501

May 2018

Data Management Support for the EVOSTC Long-Term Monitoring Program

Exxon Valdez Oil Spill Trustee Council Project 16120114-D
Final Report

Study History: This project provided core data management services the *Exxon Valdez* Oil Spill Trustee Council's Gulf Watch Alaska program to help ensure data generated by this effort is available for long-term preservation, public discovery, and reuse. These activities were conducted over a five year period, and operated under projects from 2012-2016 (projects 12120114-D, 13120114-D, 14120114-D, 15120114-D, and 16120114-D). The work was coordinated with the Herring Research and Monitoring program and in partnership with the Alaska Ocean Observing System and the National Center for Ecological Analysis and Synthesis. Further, beginning in 2013 the scope of this effort was expanded under a supplemental project (project numbers 15150114-T and 16150114–T) to provide additional, needed data management support for the Gulf Watch Alaska and Herring Research Monitoring programs.

Abstract: This project supplied the Gulf Watch Alaska program with critical data management support to assist study teams in efficiently meeting their objectives and ensuring data produced or consolidated through the effort were organized, documented and available to be utilized by a wide array of technical and non-technical users. Specifically, a data management system was developed and implemented that supported the entire data lifecycle from sharing data among principal investigators, immediately after collection to eventual long-term preservation at a national data archive. The system was composed of tools including the Ocean Workspace, the Gulf of Alaska data portal, and the DataONE data repository. These combined services allow for the query, discovery, and use of data and metadata through web-based search, catalog, and visualization interfaces for data produced by the Gulf Watch Alaska and Herring Research and Monitoring program efforts to help ensure their long-term preservation, public discovery, and reuse. Beyond these tools, data management services were provided throughout the program to facilitate communication and coordination among program managers, principal investigators, and data management staff about data and metadata generated through the program. Through this process, a rigorous data management support service was provided that combined experienced data management personnel, regional data management expertise, and advanced cyberinfrastructure in an end-to-end system where facilitated, full-lifecycle data management led to accelerated data use and scientific discovery by the program researchers, program and resource managers, and broader scientific communities. Through these efforts, we built a data management system that internally shared 21,000 data files and 450GB data among nearly 100 users in the Gulf Watch Workspace group. Datasets from the 16 EVOSTC-funded monitoring programs resulted in 53 data collections that are available publicly through the Gulf of Alaska Data Portal. These datasets are discoverable among 300 additional GIS, environmental, numerical modeling and remote sensing data resources for the Gulf of Alaska. Ultimately, the datasets generated by all

projects are replicated in the DataONE archive for long-term preservation and discovery by over 60,000 annual users.

Key words: data archive, data management, DataONE, data portal, Gulf of Alaska data portal, metadata, Ocean Workspace

Project Data: This project did not include original data collection. Data collected for projects that contributed to this report are available through the Alaska Ocean Observing System (AOOS) Research Workspace and Gulf of Alaska data portal: https://l.axds.co/2I4bC48

The AOOS data custodian is Carol Janzen, 1007 W. 3rd Ave. #100, Anchorage, AK 99501, 907-644-6703, janzen@aoos.org.

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 dataset limitations or intended use.

Citation:
Bochenek, R., S. Buckelew, C. Turner, W. Koeppen. 2018. Data management support for the EVOSTC Long-Term Monitoring Program. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-D). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

In this project, the Alaska Ocean Observing System (AOOS), through its technical partner Axiom Data Science, provided core data management support and services to Gulf Watch Alaska (GWA), the long-term monitoring program funded by the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC). These services included the development and enhancement of a central data management system to allow for access, analyses and visualization of information and products produced from the GWA effort and ensure their long-term preservation, public discovery, and reuse. The overall goal of this program was to provide critical data management support to GWA investigators and program leads, in collaboration with similar data management efforts for the EVOSTC Herring Research and Monitoring (HRM) program, to assist them in efficiently meeting their objectives and ensuring data collected or consolidated through the effort are organized, documented, and available for their use and for future use by broader scientific communities.

This effort developed and implemented a central data management system for the EVOSTC's GWA and HRM programs that supported the entire data lifecycle from sharing data among principal investigators (PIs) immediately after collection to eventual long-term preservation at a national data archive. The system is composed of several tools, including: the Ocean Workspace, a scientific collaboration and data management tool used to secure, centralize, and publish data files on public portals and catalogs; the Gulf of Alaska data portal, which provides public access to data, allowing users to visualize and integrate data from different sources, including the EVOSTC GWA and HRM programs; and participation as a Member Node in the DataONE archive, which is a nationally recognized long-term archive to which project data and metadata have been deposited. All of these services allow for the query, discovery, and use of data and metadata through web-based search, catalog, and visualization interfaces for data produced by the GWA and HRM efforts to help ensure their long-term preservation, public discovery, and reuse.

Beyond these tools, data management services were provided to facilitate communication and coordination between program managers, PIs, and data management staff about data and metadata generated through the program. Through this process, we aimed to provide a rigorous data management support service that combined experienced data management personnel, regional data management expertise, and advanced cyberinfrastructure in an end-to-end system where facilitated, full-lifecycle data management leads to accelerated data use and scientific discovery by GWA researchers, program managers, and broader scientific audiences.

Through these efforts, we built a data management system that internally shared 21,000 data files and 450 GB data among nearly 100 users in the Gulf Watch Workspace group. Datasets from the 16 EVOSTC-funded monitoring programs resulted in 53 data collections that are available publicly through the Gulf of Alaska Data Portal. These datasets are discoverable among 300 additional GIS, environmental, numerical modeling and remote sensing data resources for the Gulf of Alaska. Ultimately, the GWA projects datasets are replicated in the DataONE archive for long-term preservation and discovery by over 60,000 annual users. The DataONE archive, at present, hosts nearly 950,000 environmental data

objects available through the DataONE search engine and a growing network of over 40 data repositories, including the Alaska Ocean Observation System and Axiom Data Science.

INTRODUCTION
Following the 1989 Exxon Valdez oil spill ('Spill'), several decades of scientific research has occurred to monitor the impacts and recovery to the Gulf of Alaska region and its resources. Over time, ecosystem impacts directly related to the Spill have become more challenging to detect due to regime shifts, natural variability, climate change, and other anthropogenic changes. Data collected through long-term observations and focused research are fundamental to inform management decision-making by determining whether changes are related to natural or Spill-related factors, and by identifying what potential recovery actions may be needed. To address these challenges and facilitate the recovery of injured resources, scientific and resource management communities need access to the most current scientific information to help make sound decisions.

An integrated monitoring program requires information on environmental drivers and pelagic and benthic components of the marine ecosystem. While extensive monitoring data has been collected thus far through EVOSTC-funded projects as well as from other sources and made publicly available, much of that information needs to be assessed holistically to understand the range of factors affecting individual species and the ecosystem as a whole. Interdisciplinary syntheses of historical and ongoing monitoring data are needed to answer remaining questions about the recovery of injured resources and impacts of ecosystem change.

Managing oceanographic data is particularly challenging due to the variety of data collection protocols and the vast range of oceanographic variables studied. Data may derive from automated real-time sensors, remote sensing satellite/observational platforms, field/cruise observations, model outputs, and various other sources. Variables can range from mesoscale ocean dynamics to microscale zooplankton counts. The resulting datasets are packaged and stored in advanced formats, and describe a wide spectrum of scientific observations and metrics. Due to the complexity of the data, developing data management strategies to securely organize and disseminate information is also technically challenging. Distilling the underlying information into usable products for various user groups requires a cohesive, end-to-end approach in addition to a fundamental understanding of the needs and requirements of the user groups and stakeholders.

Data management activities for oceanographic information can occur in isolated, physically distributed agencies, leading to low cross-agency utilization of data. Technical barriers, complex data formats, a lack of standardization and missing metadata have limited access to data and made the utilization of available scientific information cumbersome and daunting. As a consequence, existing data is underutilized and often has not undergone quality assurance.

In this project, we aimed to address these challenges by developing and implementing a central data management system for the EVOSTC's GWA and HRM programs that supported the entire data lifecycle from sharing data among PIs immediately after collection to eventual long-term preservation at a national data archive. The system is composed of several tools, including: the Ocean Workspace, a scientific collaboration and

data management tool used to secure, centralize, and publish data files on public portals and catalogs; the Gulf of Alaska data portal, which provides public access to data, allowing users to visualize and integrate data from different sources, including the EVOSTC's GWA and HRM programs; and participation as a Member Node in the DataONE archive, to which GWA project data and metadata can be deposited through the Workspace via an automated submission pathway. All of these services allowed for the query, discovery, and use of data and metadata through web-based search, catalog, and visualization interfaces hosted by Alaska Ocean Observation System (AOOS) and available for use by GWA researchers, program managers, and broader scientific audiences.

OBJECTIVES
The specific objectives of this project were to:
1) Provide data management oversight and services for the EVOSTC GWA project team data centric activities which include data structure optimization, metadata generation, and transfer of data between project teams.
2) Consolidate, standardize and provide access to study area datasets that are critical for retrospective analysis, synthesis and model development.
3) Develop tools for user groups to access, analyze and visualize information produced or processed by the GWA effort.
4) Integrate all data, metadata and information products produced from this effort into the AOOS data management system for long term storage and public use.

METHODS
The methods for this project focused on developing an end-to-end data management system that assisted in the organization, documentation and structuring of GWA-collected and study area data so that it could be transferred efficiently to long-term data archive and storage centers and made available for future use by researchers and other user groups. This was achieved by leveraging the AOOS cyberinfrastructure, long term funding and other active data management projects being undertaken by that organization. Further, Axiom Data Science worked to coordinate activities across the GWA program roles, including PIs, program managers, the National Center for Ecological Analysis and Synthesis (NCEAS), and EVOSTC, to ensure a cohesive and well-maintained effort throughout the data management lifecycle, from data inception, to quality review, data storage, documentation, and ultimate archive (Appendix 1). Datasets produced from the integrated research effort were served to users by extending existing data access, analysis and visualization interfaces supported and under continued development by the AOOS data management team. The specific components of the data management system were undertaken as follows.

Initial Data Assessment
In Year 1, data management staff worked with GWA program principal investigators (PIs) to assess the types of data that were to be collected during the program to inform that development of data management practices for PIs. The intent was to identify the data management needs and the types of tools needed by researchers to increase their abilities to manage and share their data in an automated, standard fashion. The details of the assessment were then used to assist and guide investigators in strategizing the overall data management approach to the program.

Ocean Workspace

Using the results of the assessment, a shared program platform was developed by the data management team to facilitate data transfer, metadata generation and archiving for the entire GWA project data management lifecycle. Beginning in 2011, the data management group developed a web-based platform (called the Ocean Workspace) for PIs to manage project level datasets and author metadata. The Ocean Workspace was released in 2012 for the GWA program as a web-based data management application built specifically for storing and sharing data among members of scientific communities. GWA PIs and their teams use the Workspace as an internal staging area prior to public release of data. The Workspace provides users with an intuitive, web-based interface that allows scientists to create projects, which represent individually funded projects within the larger GWA effort (Fig. 1). Within each project, users create topical groupings of data using folders and upload data and contextual resources (e.g., documents, images and any other type of digital resource) to their project by simply dragging and dropping files from their desktop into their web-browser (Fig. 2). Users of the Workspace are organized into campaigns, and everyone within a campaign can view the projects, folders and files accessible to that campaign. This allows preliminary results and interpretations to be shared by geographically or scientifically diverse individuals working together on the GWA program before the data is shared with the public. It also gives program managers, research coordinators and others a transparent and front-row view of how users have structured and described projects and how their program is progressing through time (Fig. 1).

Figure 1. The overview page for the Gulf Watch Alaska Workspace group. The group is organized by individual GWA projects, each of which contains ontological groupings of data files and products specific to those projects. The latest activity in the Workspace is shown in the right hand Activity Feed. This provides a real-time view of how the program is progressing through time.
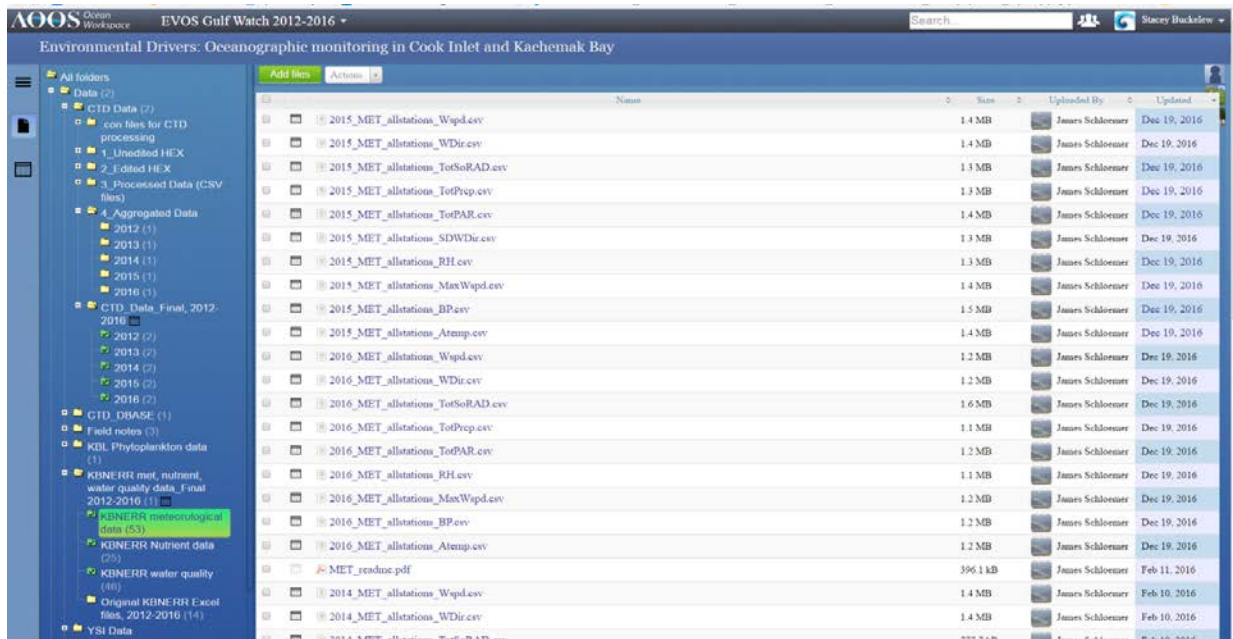
Figure 2. A screenshot of file management for individual projects within the Workspace. The display shows how a researcher would organize data independent files into folders, and how the upload activity (including person and date) are tracked by the Workspace.

The Workspace was developed with the following use capabilities:

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

Advanced and secure file management — Core functionality of the Workspace is the ability to securely manage and share any type of digital resource in real-time among researchers and study teams. Workspace users are provided with tools that allow them to bulk upload files or directory structures, organize uploaded content into hierarchically nested collections, create projects with predefined and user-created contextual tags, and control read and write permissions on files within projects. Version control for datasets is accomplished by tracking and providing access to past versions of datasets with the same file name. Integrated within the Workspace is an administrative file and metadata inventory tool that can be utilized to track progress on data submissions and metadata completeness.

Standards-Compliant Metadata
Properly describing and documenting the EVOSTC-collected datasets with metadata allows users to understand and track important details about the research. Additionally, metadata

5

facilitates the search, retrieval, and ultimate re-use of the data by a broader scientific community. Together with the Workspace, Axiom developed an integrated editor that allows for PIs to author standards-compliant metadata for both projects and individual files. Because the Workspace is a cloud-based service, researchers can move between computers during the metadata generation process in addition to allowing team members and administrators to simultaneously review and edit metadata in real time.

Beginning in 2012, the metadata elements available to researchers in the Workspace were common to the Federal Geographic Data Committee (FGDC) endorsed successor to the Content Standard for Digital Geospatial Metadata (CSDGM) and the ISO 19115 standards for geospatial metadata, extended with the biological profiles of those standards. Axiom also developed an integrated FGDC biological profile extension editor that allows users to search the ~625,000 taxonomic entities of the Integrated Taxonomic Information System (ITIS) and rapidly generate taxonomic metadata.

In 2016, the metadata editor was updated to meet the standard, ISO 19115-2 compliant metadata. Features of the new editor included more metadata fields to allow for more robust descriptions of datasets and their connections to other resources, notably the historic EVOSTC datasets or time series dataset that were salvaged under the project 16120120. Further, the new editor helped to ease the metadata generation process through short, modular, and easily understood entry forms. This cascading metadata allows for different levels of granularity within the metadata record, with metadata fields that define the attributes of the data file in a standards-compliant format enabled at the file and folder levels (Figs. 3 and 4).
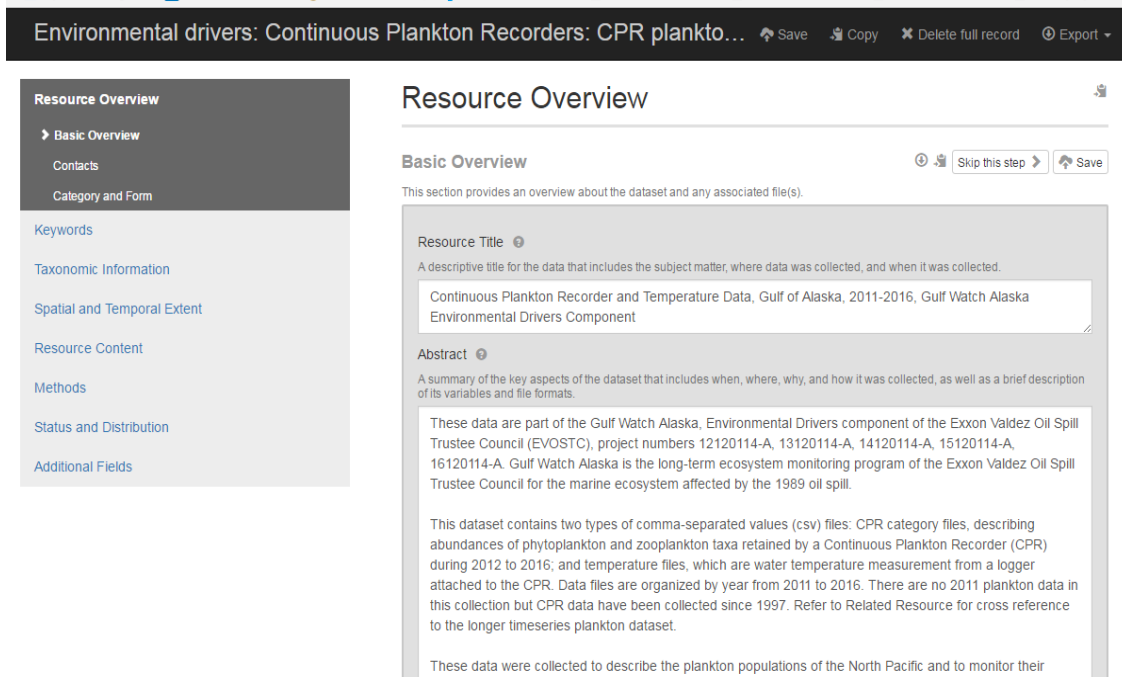
Figure 3. The metadata editor interface within the Workspace. The editor assists Workspace users in authoring robust, ISO standard-compliant metadata record alongside data objects. Individual fields are accompanied with help text and examples to guide users in creating metadata following best practice.
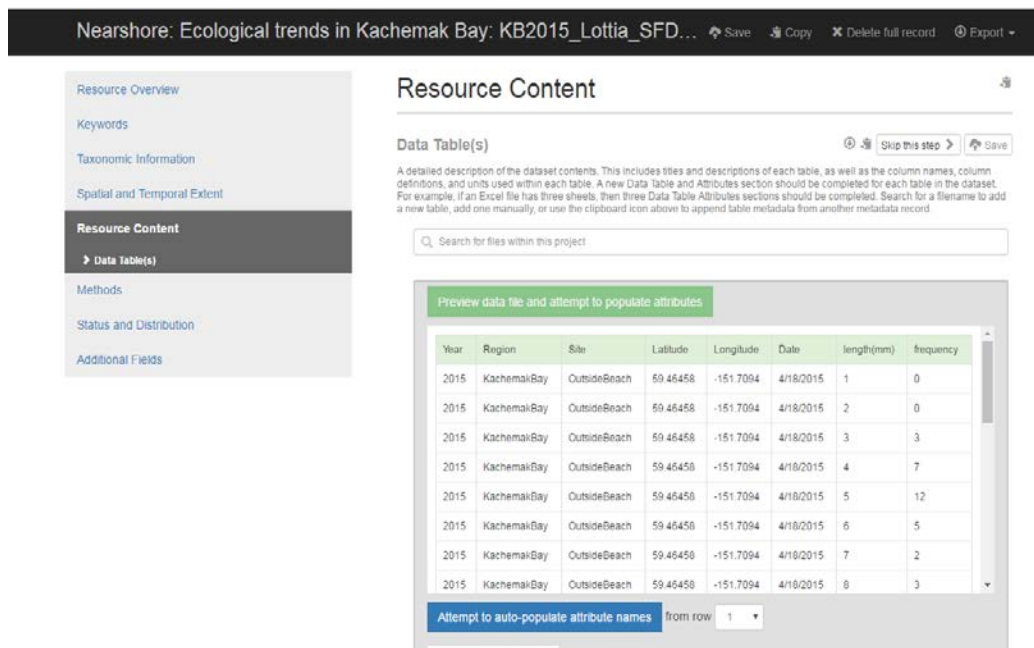
Figure 4. The metadata editor includes a feature that automating reads and populates the attributes of data file in a standards-compliant format enabled at the file and folder levels. This feature was introduced as a time-saving step to expedite the metadata authoring process while still maintaining best practice.

7

Technical Support for Metadata

Beginning in 2013, metadata authoring by GWA PIs occurred at multiple points throughout the project lifecycle. Initially, high-level overview information about the project was documented, which included the location, project timeline, contacts, keywords, taxonomic species, and expected data to be generated. As the projects progressed and more data was collected and moved through the quality control, processing, and analysis phases, more descriptive metadata was captured by the PI and their research teams. As the project data matured, the completeness, content, and quality of the metadata record also matured to robustly describe the data and be formatted in the new editor version following the ISO format standard.

To facilitate metadata completeness, the Axiom data management workflow included technical support and oversight on metadata format and content throughout the project lifecycle (Appendix 1). A data inventory for the program was developed and used as the foundation to track actual data and metadata submission to the Workspace by PIs. In-person meetings with project PIs were scheduled with the data management team at the annual GWA meeting to discuss data submissions and metadata authoring progress. Additionally, the data management team developed several tools to assist the PIs in authoring metadata, including written instructional materials, hands-on instruction in the Workspace, and a written metadata questionnaire (an alternative to the metadata editor). Last, a metadata process was also established to ease the authoring process by PIs and to help standardize the metadata formats across projects. The process included the PI completing the metadata questionnaire document before the meeting that included a set of questions about the project research in order to organize content for the metadata record. The questionnaire was adapted from the USGS best management practices to adhere to ISO metadata standards. For those projects for which a reasonably complete metadata record already existed, the data management team instead utilized the metadata questionnaire as a completeness check. Prior to the meeting, the data management team reviewed the questionnaires and then used the meeting to assist the PIs in walking through creation of the content need to complete or revise the metadata record. While the workflow for creating metadata varied project-by-project, annual metadata revisions were also done to keep pace with new data submissions and changes to the collection procedures.

In the last phase of the metadata process, the data management team focused on quality control of the data and metadata, including data file formatting and documentation to ensure authoring meets best practices and accurately reflects data captured within individual data files. The quality control used the following steps: 1) primary completeness check for required metadata fields and content, and subsequent correction by PI; 2) a secondary quality control check resulting in a list of any issues in the metadata that need corrected by the PI; and 3) a final check for ISO-format validation after metadata quality issues have been addressed and before submitting the dataset(s) to a national archive.

Data Sharing, Publication and Archive

To maximize data use for analysis, synthesis, review, and application, and to support the restoration and management of spill- injured resources, data from the GWA programs have been made available through multiple pathways. During the data collection and analysis phases, provisional datasets from GWA projects were securely available for internal use

through the Workspace (described above). As datasets were quality-reviewed and finalized, the data were also made available for exploration and discovery through a public-facing data portal, referred to as the AOOS Gulf of Alaska Data Portal ('portal'): http://portal.aoos.org/gulf-of-alaska.php (Fig. 5). Simultaneously, finalized datasets from the 2012-2016 GWA project efforts were archived through DataONE, where they will be preserved over the long-term. National repositories, such as DataONE, have the advantage of reaching wider audiences, thus expanding the access, discoverability, and active management of data collections generated through the GWA program.

Gulf of Alaska Data Portal
To consolidate and standardize relevant study area datasets and provide the GWA PIs with access to a large, diverse set of valuable information for retrospective analysis, synthesis, and model development, the Gulf of Alaska Data Portal was initiated in September 2013. The portal was designed to give access to hundreds of datasets from the Gulf of Alaska region that could be visualized, integrated with other data, and parsed both spatially and temporally and it includes both catalog and interactive mapping interfaces. These data included significant amounts of atmospheric, terrestrial, oceanographic, and coastal data (Fig. 6).

Additionally, to simplify the publishing of data and metadata for PIs, the Workspace was designed as a gateway to publish GWA project data and associated metadata into the public-facing portal. Through the portal, these data can be discovered through an integrated search catalog interface that allows users to search by category or keyword and to download associated data and metadata files (Fig. 7). The portal uses the metadata and other contextual information that has been entered or created in the EVOSTC GWA Workspace accounts to develop a series of search index utilizing a highly-scalable technology called Elastic search. Elastic search is a Java-based distributed indexing scheme that allows entire collections of documents, databases, and flat files to be indexed via several dimensions. With this feature, collections of information can be searched rapidly by spatial queries, time, text patterns, parameter and taxonomy. This technology facilitates data discovery and access to information, metadata, and data using a Google-like search interface.

To integrate data into the Gulf of Alaska Data Portal and enhance its use by GWA PIs and the public, data visualizations were completed for several EVOSTC long-term monitoring datasets. The goal of visualizations was to provide a clear and efficient visual communication of data by making complex or long-term information more accessible, understandable, and usable. Additionally, visualizations helped researchers to make comparisons to related environmental datasets.
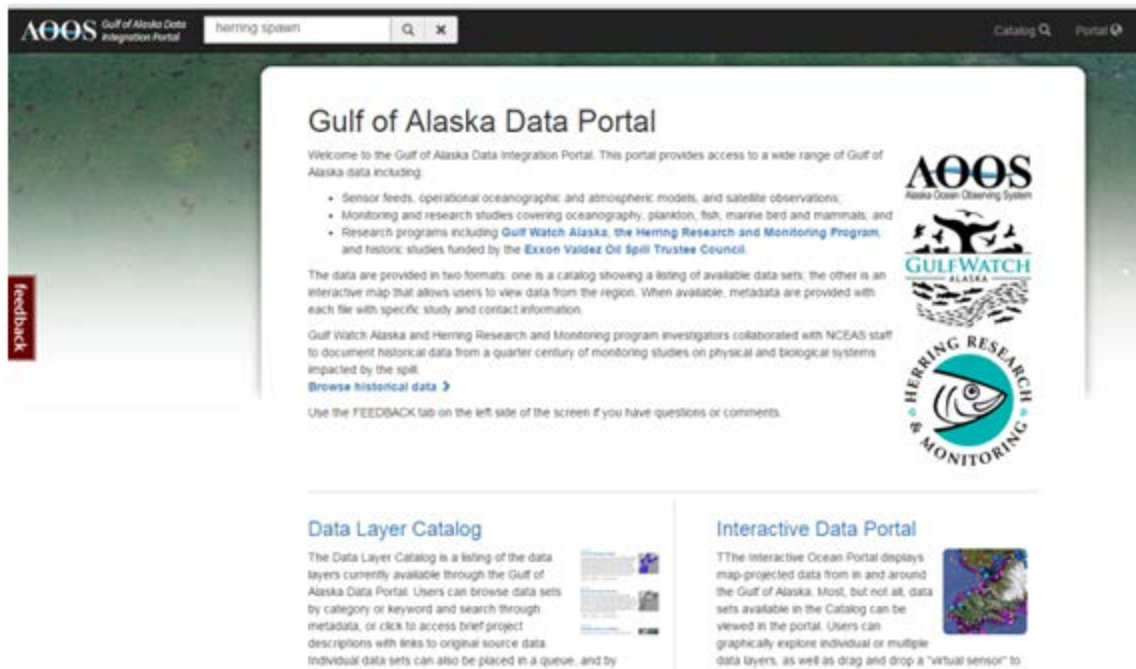
Figure 5. The overview page to the Gulf of Alaska Data Portal which highlights the availability of information from the EVOSTC-funded GWA and HRM programs as well as historical data available through the Gulf of Alaska Historical Data Portal. From here, users can access the catalog or the interactive mapping interface.
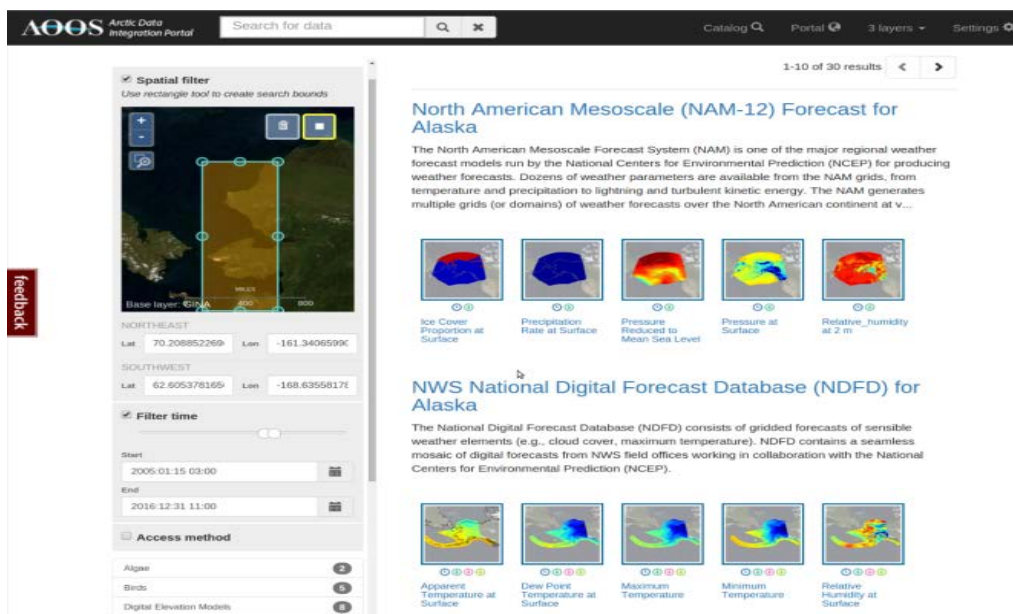
Figure 6. The catalog search interface where datasets within the portal can be searched. The catalog includes spatial and temporal filters, shown on the left side of the screen.
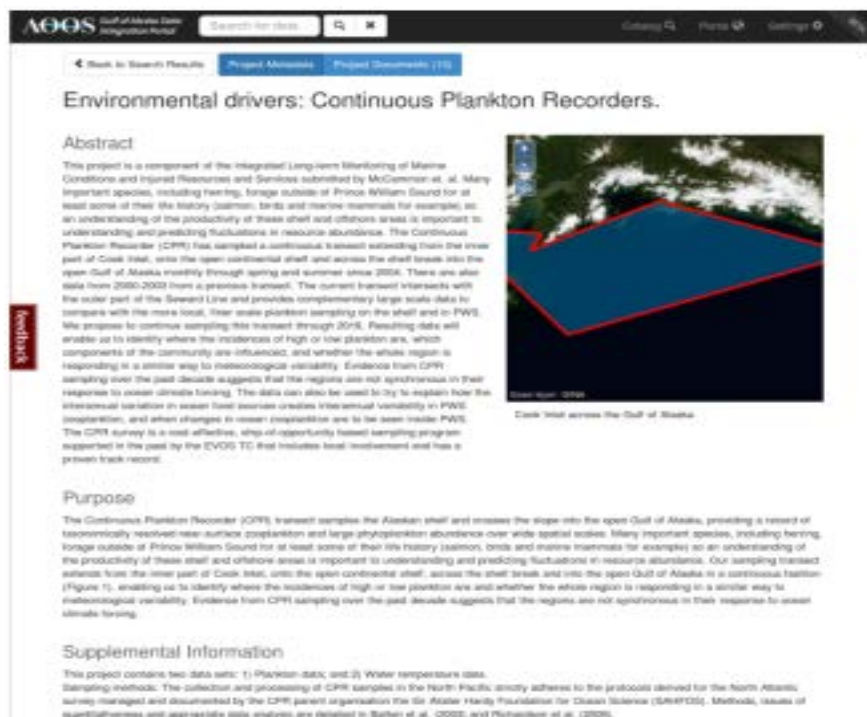
Figure 7. Screenshot of metadata imported from the Ocean Workspace into the public Gulf of Alaska Data Portal, which includes metadata for projects, folders (e.g. a collection of related data files), and single data files. This metadata facilitate the discovery of data within the portal through an integrated search catalog that searches by category or keyword, and allows users to download associated data and metadata files.

Long-Term Data Archive: DataONE
To facilitate the long-term storage and public-use of GWA data, final data and metadata were submitted to the Data Observation Network for Earth (DataONE), a nationally recognized long-term archive for scientific data. DataONE is a platform for innovative, collaborative environmental and ecological science, using sustainable cyberinfrastructure and a distributed framework to provide open, robust, persistent and secure access to Earth observational data. DataONE links together existing cyberinfrastructure to provide a distributed framework that enable long-term preservation of diverse multi-discipline observational data. The distributed framework is composed of geographically-distributed Member Nodes that provide resources for their own data and replicated data, and focus on serving their specific constituencies and diverse implementations. Axiom Data Science is a Member Node of the DataONE federation.

RESULTS
Ocean Workspace
During the initial phase of this project, the GWA Workspace group was established with 20 projects, with 16 of these representing individually-funded research efforts and 4 projects dedicated to aspects of program coordination and outreach. The Workspace was utilized consistently through the program duration as the internal location for file storage for data and program file sharing among the PIs. From 2012 to 2013, there was relatively limited

use of the Workspace as the program was becoming established and PIs were familiarizing themselves with the system (Figs. 8 and 9). Beginning in 2014, after two complete field seasons, the use of the Workspace and data stored there began to steadily rise from less than 1,000 to nearly 5,000 data files by year-end. Following the 2015 field season, however, PIs began to realize the full capacity of the data system. The files stored internally doubled to 10,000 and the volume of stored data rose exponentially to 350 GB. Data storage to the Workspace maintained a similar growth rate throughout 2016 and concluded with over 20,000 files and 450GB of available GWA data. As such, the Workspace was successfully relied upon as a key location used by GWA Program Managers, PIs, and project team members to facilitate the logistical, curatorial, and preservation-oriented aspects of data collection and management.
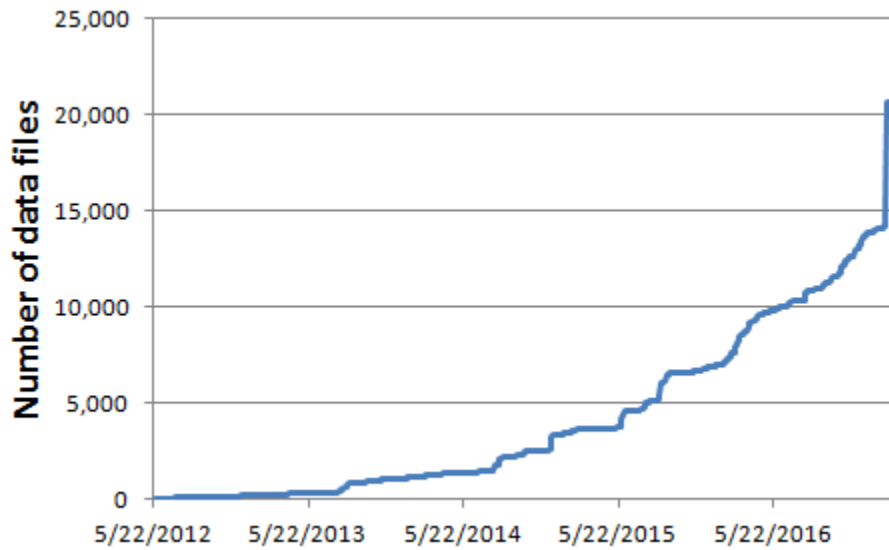
Figure 8. The total number of data files uploaded by PIs and Program Managers to the Gulf Watch Workspace group from 2012 to 2016.
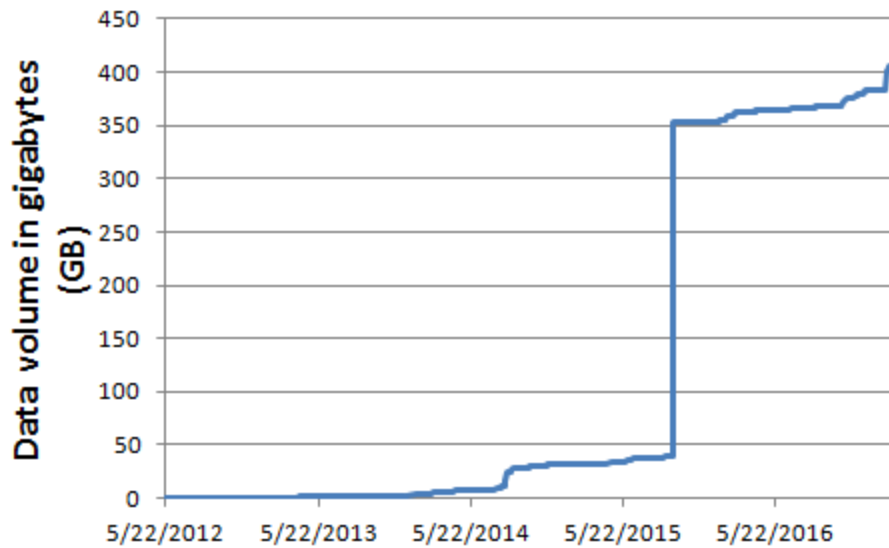
Figure 9. The total volume of data uploaded from 2012 to 2016 by PIs and Program Managers to the Gulf Watch Workspace group for long-term storage.

Over the course of the program the data management team provided both technical support to users and new features to improve the Workspace capabilities and use by GWA PIs. Axiom staff provided training throughout the program via webinars and support through email and in-person meetings to help PIs develop their proficiency. Software engineers at Axiom also routinely provided support for the Workspace, including resolving bugs and implementing new functionality in response to user feedback. This level of support facilitated the Workspace becoming a crucial internal staging area for all GWA data and work products. Within six months of data collection provisional data files were uploaded by PIs to the Workspace, which were then replaced with the final, quality reviewed files within 12 months post-collection. As of December 2016, all of the 2012-2016 data and products have been posted in the Workspace, per the Program Management data sharing protocols. Beyond the data from these years, some projects included data from a longer time series extending beyond the GWA effort.

Based on the success of the Workspace in the GWA program, this tool has become widely used in other ecosystem synthesis studies throughout Alaska. While these efforts were not funded by EVOSTC, the GWA program as a whole benefited from collective improvements and enhancements that were leveraged across programs. As of this writing, the system serves over 400 users, including a number of large-scale scientific research programs: the North Pacific Research Board, Chukchi Sea Environmental Studies Program, Russian-American Long Term Census of the Arctic (RUSALCA), Marine Biodiversity Observation Network (mBON), NOAA's Marine and Estuarine Goal Setting for South Florida (MARES), Central and Northern California Ocean Observing System (CeNCOOS), Southeast Coastal Ocean Observing Regional Association (SECOORA), and several other integrated multidisciplinary programs. In total, users of the Workspace across all programs have

13

uploaded over 1.1 million files totaling 34 TB spread across nearly 70 different Workspace groups.

Standards-Compliant Metadata
In December 2016, the new metadata editor was released into the GWA Workspace. The new editor was designed to be more flexible and to completely describe various dataset and project types. The editor also generates metadata in the ISO 19115-2 standards format that is necessary for preservation and publication in a DataONE member node. Historically, the metadata editor in the Ocean Workspace had allowed users to only write metadata for files and projects. This had created some confusion when the dataset to be shared, described, and archived was larger than a single or collection of data files, but smaller than the entire project dataset. The new editor addressed this problem by also enabling metadata creation at the folder level. This provided a simple way to describe a group of content as a single dataset (as opposed to having multiple redundant copies of metadata at the individual file level), and streamlined the archive of long-term monitoring datasets within DataONE.

Coupling the launch of the new editor, all existing GWA metadata records were migrated to the standards-compliant format and populated with more information, as applicable by the additional metadata fields in the ISO standard. The 2012-2016 GWA program generated 53 unique data collections, each of which are accompanied with robust metadata documentation to help ensure these datasets are understandable, discoverable, and reusable into the future. A list of these metadata records and the location where they can be found in the Workspace and DataONE archive are in Appendix 2.

Beyond the release of the new metadata editor format, Axiom software engineers redesigned the display for metadata created in the Ocean Workspace and imported into the Gulf of Alaska data portal. The design of the metadata pages in the portal underwent several design iterations based on user feedback before settling into their current form. Upon initial release of the portal in 2013, project metadata created in the Workspace was visible as an HTML webpage and file-level metadata from the Workspace was available in the portal as raw, unstyled JSON documents. Since that time, the metadata editor in the Ocean Workspace has been harmonized to provide the same interface and fields for project and file metadata, and also expanded to accommodate the new metadata fields. Further, the metadata in the editor can be converted to a standard metadata XML format and exported as a XML file for sharing (Fig. 10). The XML data file format is intended principally for processing by machines. Axiom also created a new stylesheet to display both the project and file level metadata from the Workspace into a human-readable form to facilitate its reuse by a broad audience of researchers, manager, and other members of the public.

    <gmd:CI_PresentationFormCode codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#CI_PresentationFormCode" codeListValue="tableDigital">tableDigital</gmd:CI_PresentationFormCode>
      </gmd:presentationForm>
    </gmd:CI_Citation>
  </gmd:citation>
  <gmd:abstract>
  ▼<gco:CharacterString>
      These data are part of the Gulf Watch Alaska (GWA), Nearshore component of the Exxon Valdez Oil Spill Trustee Council, project numbers 12120114-L, 13120114-L, 14120114-L, 15120114-L, and 16120114-L. Gulf Watch Alaska is the long-term ecosystem monitoring
      program of the Exxon Valdez Oil Spill Trustee Council for the marine resources affected by the 1989 oil spill. This dataset contains information about ecological communities in Kachemak Bay, Gulf of Alaska as collected by intertidal surveys conducted
      during spring 2012 to 2016. Following protocols established for Prince William Sound, surveys were conducted to document a range of communities and variables in Kachemak Bay, including the following: (1) infaunal clam populations at four gravel beach
      sites (2013 and 2015); (2) limpet (Lottia spp) size-frequency distribution at rocky intertidal sites (2012-2015 only); (3) mussel (Mytilus trossulus) size-frequency distribution at three rocky intertidal sites (Port Graham, Outside Beach, and Cohen
      Island), expanded to six sites in 2015; (4) the percent cover of taxa in the kelp overstory, the percent cover of understory, and counts of individual taxa > 2 cm; (5) the percent cover of substrate categories according to the Wentworth classification
      scheme; (6) the density of sea stars and large anemones found along transects in the low intertidal, along a 30X1 m swath (= 30 m2); (7) shoot density of seagrass (Zostera marina) at four sites; and (8) temperatures measured in the low intertidal zone of
      rocky shores. For comparison, density data for sea stars and large anemones found along transects in the low intertidal from 2005 to 2008 are included. The dataset exists as individual comma-separated values (csv) files exported from Microsoft Excel for
      each survey year and type. Additionally the sampling protocols followed to conduct the intertidal surveys are included as a .pdf file.
    </gco:CharacterString>
  </gmd:abstract>
  ▼<gmd:purpose>
  ▼<gco:CharacterString>
      The Gulf Watch Alaska program aims to provide information about the lingering oil and the recovery of species and resources injured by the spill, as well as other factors that may be affecting recovery, such as changing climate, oceanographic and
      ecosystem conditions. Many protocol similarities exist between the intertidal monitoring that is currently being done in Prince William Sound under the Gulf Watch Program (EVOSTC Project 16120114-R Intertidal Systems in Gulf of Alaska, Gulf Watch Alaska
      Nearshore Component) and that which is being done in Kachemak Bay. Information collected by this project will be used for regional comparisons with Prince William Sound and may be able to act as a control for Prince William Sound if another spill were to
      occur. The data are also comparable to monitoring programs in Kenai and Katmai National Parks (National Park Service SWAN Nearshore Monitoring Program). By continuing this monitoring in both areas, comparisons can be made between the two regions and
      Kachemak Bay. Historical data also exist in both areas, making future comparisons of trends even more valuable.
    </gco:CharacterString>
  </gmd:purpose>
  ▼<gmd:status>
      <gmd:MD_ProgressCode codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#MD_ProgressCode" codeListValue="completed">completed</gmd:MD_ProgressCode>
  </gmd:status>
  ▼<gmd:pointOfContact>
  ▼<gmd:CI_ResponsibleParty>
  ▼<gmd:individualName>
  ▼<gco:CharacterString>
          NOT_FOUND(.../first_name) Exxon Valdez Oil Spill Trustee Council
        </gco:CharacterString>
      </gmd:individualName>
  ▼<gmd:contactInfo>
  ▼<gmd:CI_Contact>
  ▼<gmd:phone>
  ▼<gmd:CI_Telephone>
  ▼<gmd:voice>
            <gco:CharacterString>907 278 8012</gco:CharacterString>
          </gmd:voice>
        </gmd:CI_Telephone>
      </gmd:phone>
  ▼<gmd:address>
  ▼<gmd:CI_Address>
  ▼<gmd:deliveryPoint>
            <gco:CharacterString>4210 University Drive</gco:CharacterString>
          </gmd:deliveryPoint>
  ▼<gmd:city>
            <gco:CharacterString>Anchorage</gco:CharacterString>
          </gmd:city>
  ▼<gmd:administrativeArea>
            <gco:CharacterString>AK</gco:CharacterString>
          </gmd:administrativeArea>
  ▼<gmd:postalCode>
            <gco:CharacterString>99508</gco:CharacterString>
          </gmd:postalCode>
  ▼<gmd:country>
            <gco:CharacterString>USA</gco:CharacterString>
          </gmd:country>
  ▼<gmd:electronicMailAddress>
            <gco:CharacterString>dfg.evos.restoration@alaska.gov</gco:CharacterString>
          </gmd:electronicMailAddress>

Figure 10. A screenshot of metadata converted to a standard metadata XML format and exported as a XML file for sharing. The XML data file format is intended principally for processing by machines.

Data Sharing, Publication and Archive

Gulf of Alaska Data Portal
The primary results for this task include the acquisition and documentation of historical and GWA PI-produced datasets and the aggregation of ancillary environmental datasets for integration into the public-facing AOOS Gulf of Alaska Data Portal. The individual EVOSTC GWA project descriptions, sampling activities, datasets, and other products are showcased within the portal while being coupled with historical data and other Gulf of Alaska models, sensor feeds, and GIS datasets for use by managers and scientists within Trustee Council agencies.

Historical Data
In a collaboration led by the National Center for Ecological Analysis and Synthesis (NCEAS), 126 historical datasets spanning the 25-year period since the *Exxon Valdez* oil spill were rescued and preserved. These activities are described in detail in Jones et al. 2017. Through interviews with original investigators, these historical datasets were recovered from projects funded over that time period by the EVOSTC, documented using detailed metadata describing their structure and contents, and preserved in the Gulf of Alaska Historical Data Portal (https://goa.nceas.ucsb.edu). The Gulf of Alaska Historical Data Portal is a data repository that was established by NCEAS in partnership with the data management team using the Metacat data repository system. This repository allowed the datasets to be replicated within the DataONE federation of repositories to ensure their long-term preservation, and it is also made available from within the main Gulf of Alaska Data Portal where it is discoverable along with more recent GWA project data and ancillary environmental datasets. Datasets that were recovered spanned a huge variety of

disciplines, including lingering oil, oceanography, habitat, invertebrates, fish, mammals, birds, plankton, and socio-ecological interactions between people and the environment.

GWA Project and Environmental Data

In September 2013 the Gulf of Alaska Data Portal was released to integrate data and project information produced by GWA PIs with more than 300 additional GIS, environmental, numerical modeling and remote sensing data resources. A final list of the datasets available through the portal are listed in Appendices 3 and 4. This list includes finalized datasets and metadata documentation generated by 16 EVOSTC long-term monitoring projects of the GWA program. Additionally, because the EVOSTC GWA and HRM programs are users of a central data management system, data from both programs are available in the portal. The availability of data in one shared location is intended to facilitate collaboration and to provide a comprehensive, cross-disciplinary portrait of the conditions monitored in the Gulf of Alaska by both programs.

Throughout the life of the programs, the portal was maintained and expanded upon to incorporate new data and capabilities to improve its utility to end-users. After the initial release of the catalog and mapping interface, additional features were developed using feedback primarily from Gulf Watch PIs including the following:

- Updated the EVOSTC project catalog entries to preview the area covered by the project.
- Rebuilt the search tool to improve the precision and relevancy of search results.
- Expanded the range of material indexed for search to include all file-level metadata imported into the Gulf of Alaska Data Portal from the Workspace.
- Provided quick links to directly access files from search results.
- Added advanced catalog search options, which provided the ability to filter datasets by time and/or geographic area by drawing a polygon on a map or setting latitude and longitude bounds.
- Redesigned the display of EVOSTC GWA and HRM metadata. Upon initial release of the portal, project metadata generated in the Ocean Workspace was visible as an HTML webpage, and file-level metadata from the Workspace was available in the portal as raw, unstyled JSON documents. In the time since the launch of the portal, the metadata editors in the Ocean Workspace have been harmonized to provide the same interface and fields for project and file metadata, and have expanded to provide new metadata fields. Axiom's interface designer created a new stylesheet to display the both the project- and file-level metadata in a much more human-readable form. The design of the metadata pages in the portal underwent several design iterations based on user feedback.
- Streamlined PI-driven publication of individual folders within Ocean Workspace Projects.
- Added support for NOAA Charts, USGS topographic maps, and the General Bathymetric Chart of the Oceans (GEBCO) basemaps in the interactive mapping portal.
- Added an updating scale bar, collapsible legend, and ability to zoom by dragging a polygon to the interactive map.

- Added functionality to allow search results to be added to the mapping portal from the portal search bar.

Data Visualizations

To integrate data into the Gulf of Alaska portal and enhance its use by GWA PIs and the public, data visualizations were completed for several EVOSTC long-term monitoring datasets. The goal of visualizations is to provide a clear and efficient visual communication of data by making complex or long-term information more accessible, understandable and usable. Additionally, visualizations help researchers to easily reason about data and make comparisons to other related or environmental datasets.

An example of these visualizations in the portal includes observations made of humpback whales during surveys conducted from 2006 to 2014 (EVOSTC projects 10100804, 090804, 080804, 070804, 12120114-N, 13120114-N, 14120114-N). The location, time, and notes about the observation (e.g. photos taken or individual whale identification) were mapped in the portal (Fig. 11). Using a time slider or seasonal filter, the change in humpback whale distributions over time can be explored. To aid the user in generating summary statistics about these observations, the polygon tool can be used to manually draw a polygon around a spatial area to generate a summary chart of the number of animals observed over time within that area (Fig. 12). To further summarize data over large spatial extents, a hexed heat map is generated when the user zooms out. The heat map displays the areas where humpback whales have been most frequently observed (Fig. 13). Using a time slider or seasonal filter to the heat map, the change in humpback whale distribution can also be explored.
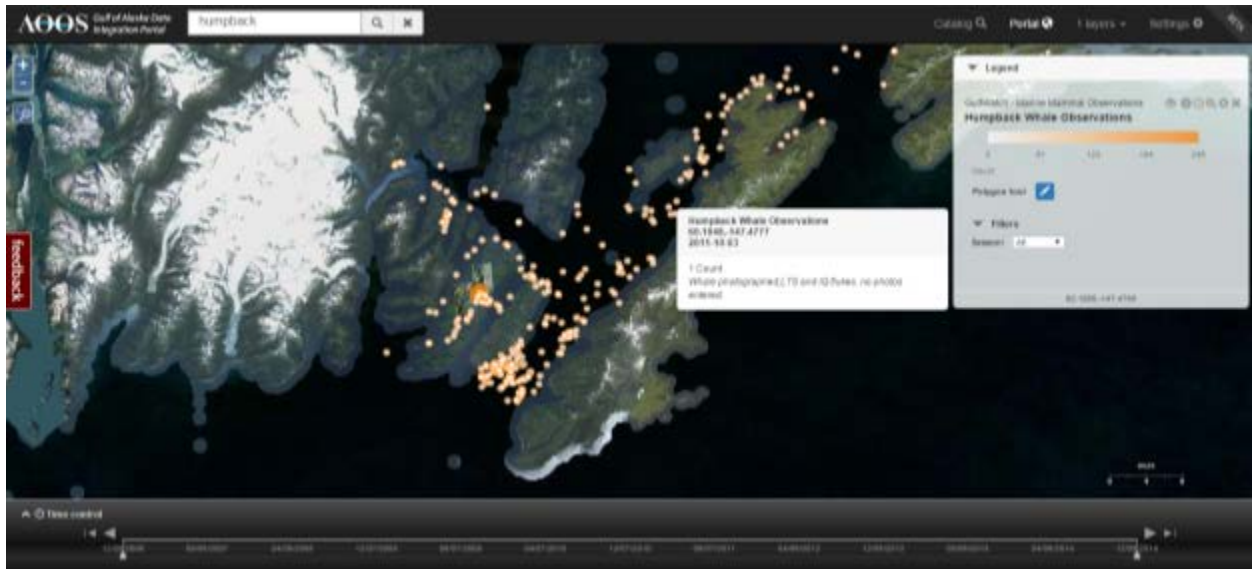
Figure 11. Screenshot of AOOS Gulf of Alaska Data Portal showing humpback whales survey observations made under the Gulf Watch Alaska program. Color represents counts of humpbacks in Prince William Sound. The date, time, location, and comments of interest (e.g. individual humpback ID) can be shown for each observation.
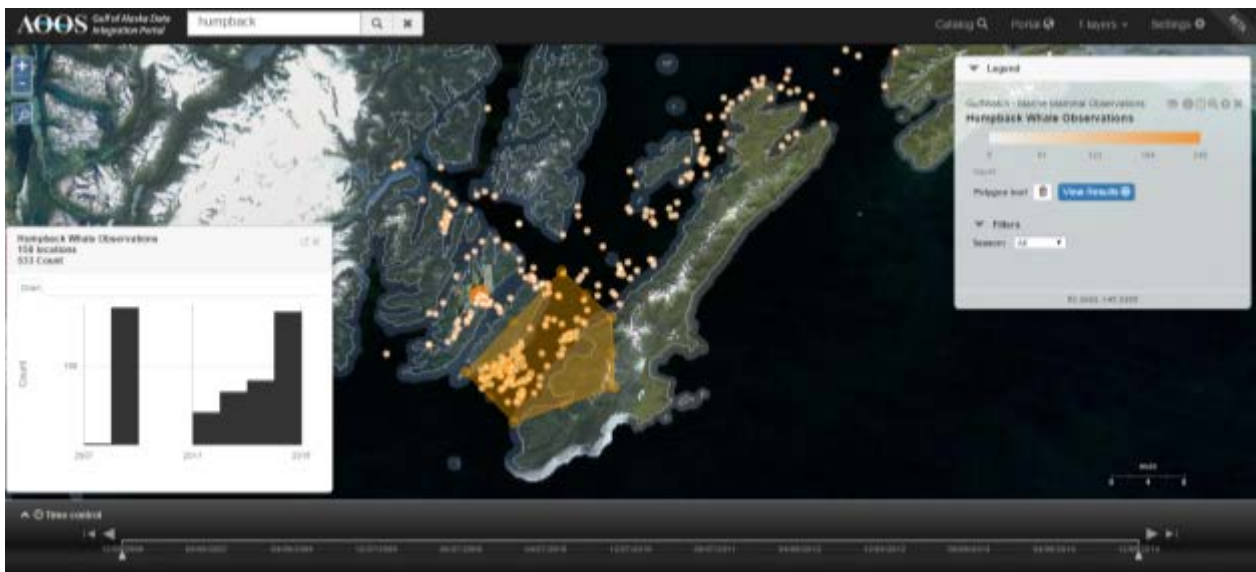
Figure 12. Screenshot of AOOS Gulf of Alaska Data Portal showing polygon tool that automates summary statistics within user-defined spatial areas. A histogram of the number of humpback whales observed surveys are shown over time.
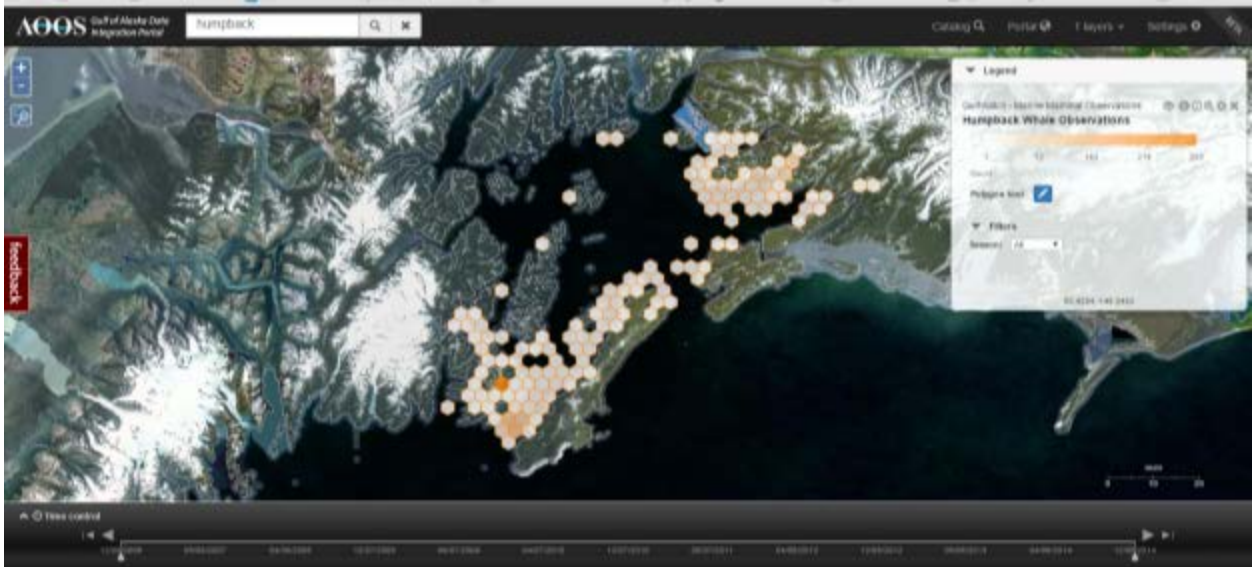
Figure 13. Screenshot of AOOS Gulf of Alaska Data Portal showing a hexed heat map of humpback whales observations in Prince William Sound. The darker the color, the greater the number of humpback whales were observed in that area. Using the time slider (at the bottom) or seasonal filter (in the right hand legend) the change in humpback whale distribution can be explored over time.

Additional data can be co-visualized with the humpback whale survey data to help infer changes in humpback whale distribution over time. As an example, the herring spawn survey data from the Alaska Department of Fish and Game (updated in the Workspace and portal through 2016 as part of this effort) (Fig. 14) have been visualized for the entire time series from 1973 to 2016. The herring spawn data can be displayed as either a plotted survey line or hexed heat map to represent the area where herring spawn activity has been observed. This dataset can be co-visualized (or 'stacked') together with humpback whale data to explore how distributions may coincide both spatially and temporarily with aggregations of spawning herring (Fig. 15). Additionally, the polygon tool can be applied to generate summary statistics of herring spawn and/or humpback whale observations within a user-defined area (Fig. 16).

19
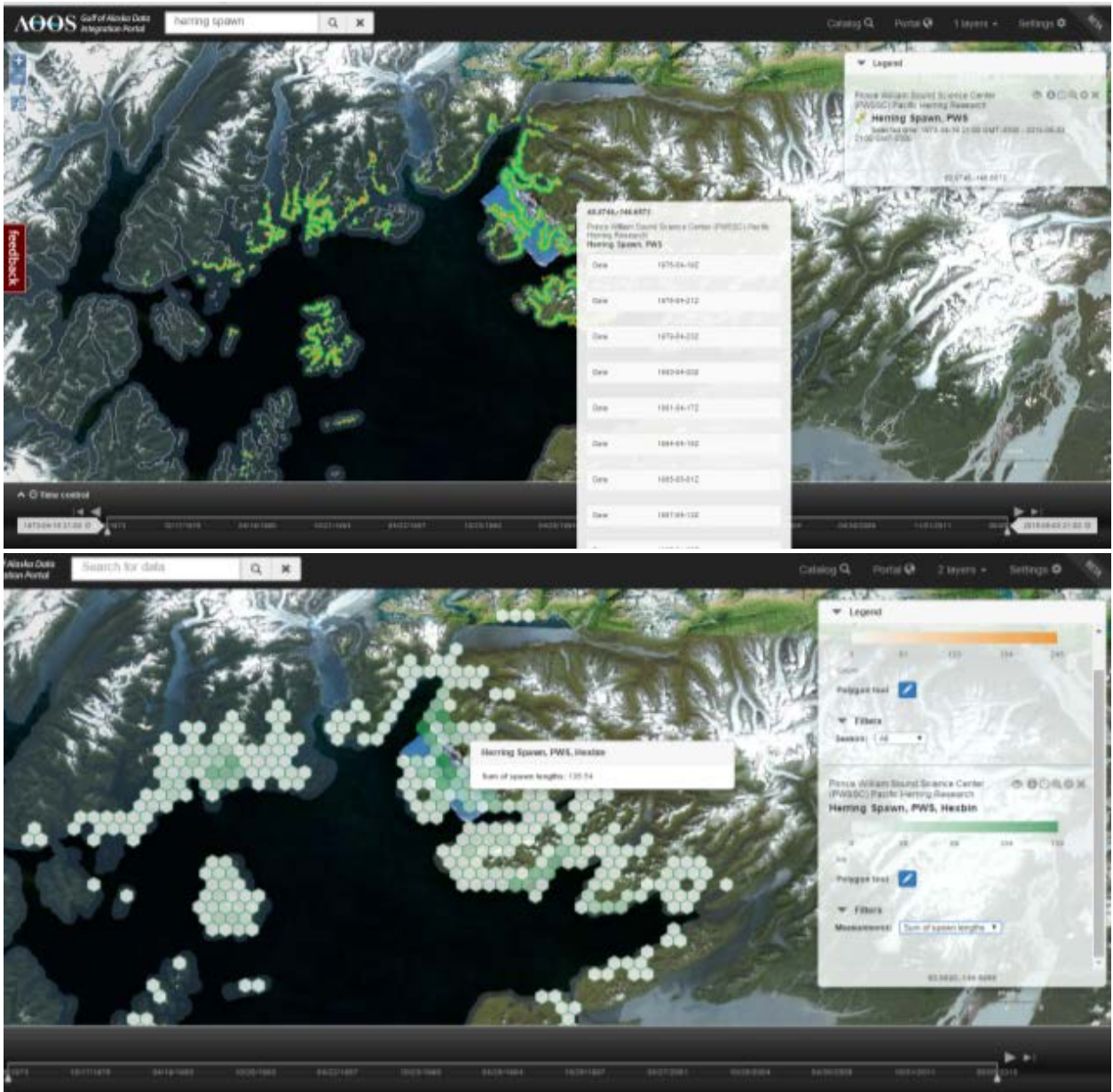
Figure 14. Screenshots of AOOS Gulf of Alaska Data Portal showing two different graphical displays of herring spawn observations in Prince William Sound from surveys conducted 1973 to 2015. The upper screenshot shows the length (km) of observed spawning area, whereas the heat map in the lower screenshot shows the sum of observed spawning lengths within a given area. The darker the color, the greater the length of total spawning activity that was observed in that area. Using the time slider (at the bottom), the change in herring spawn activity can also be explored over time.
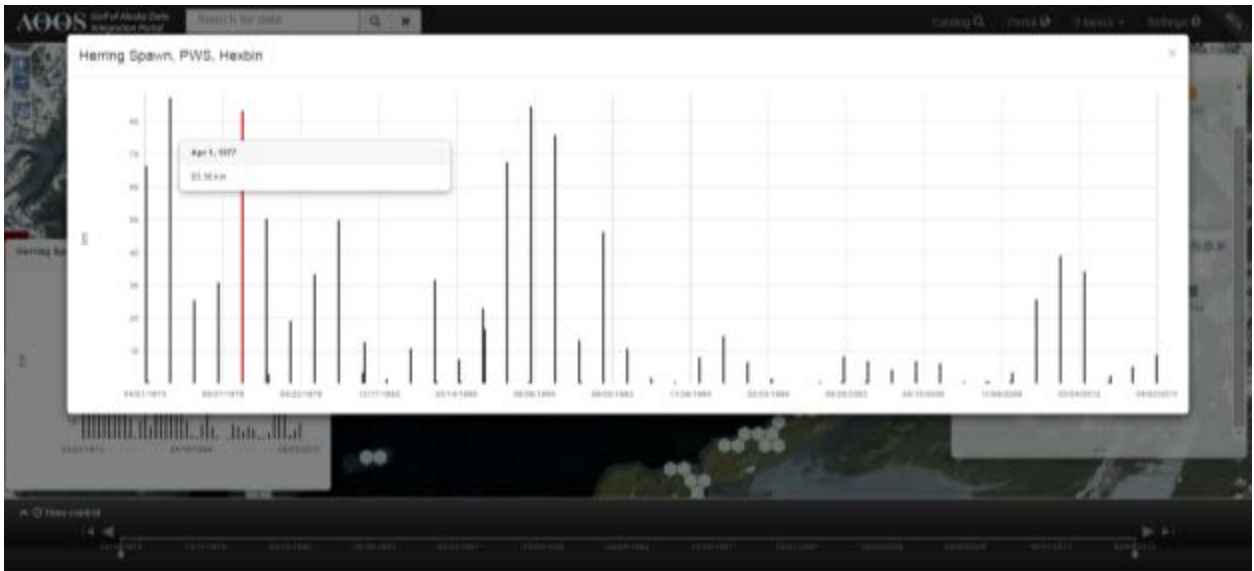
Figure 15. Screenshot of AOOS Gulf of Alaska Data Portal showing a polygon tool that automates summary statistics within user-defined spatial areas. A histogram of the length of herring spawn observed during aerial survey are shown over time from 1973 to 2015.
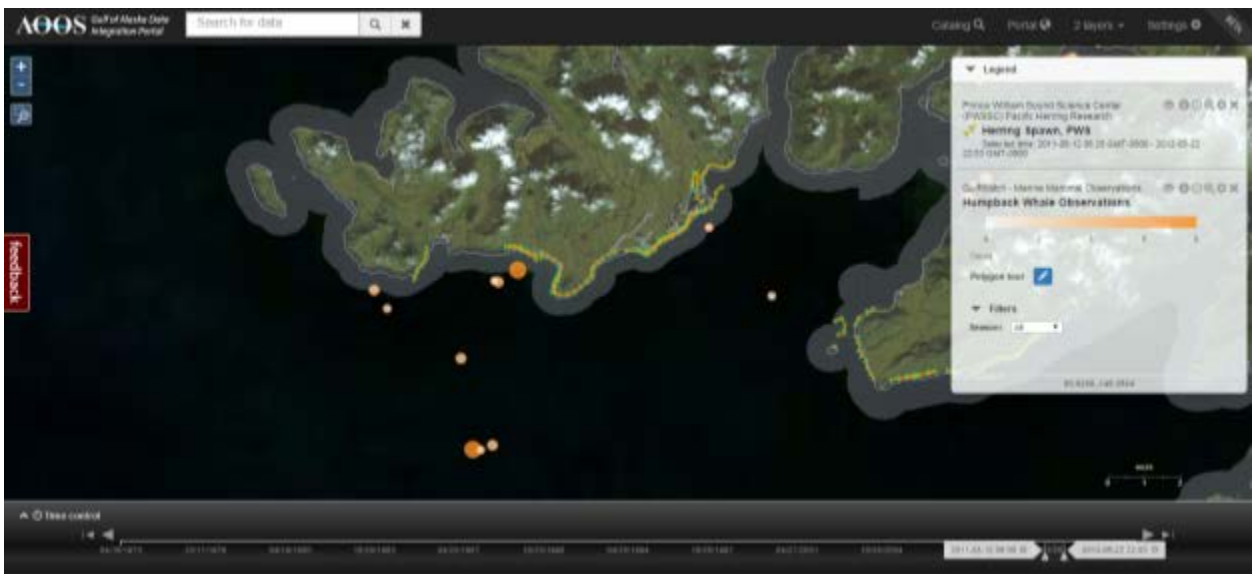
Figure 16. Screenshot of AOOS Gulf of Alaska Data Portal co-visualizing (or 'stacking') different data layers to allow for exploration of possible relationships. The length of observed herring spawn is shown along the coast in a green and orange dashed line, The number of humpback whales observed during surveys are shown in orange dots. The larger the dot and the darker the color, the greater the number of humpback whales observed in that area. Using the time slider (at the bottom), the change in humpback distribution relative to herring spawn activity can be explored over time and area.

Available in the Gulf of Alaska data portal are hundreds of additional datasets that allow for simplified, visual integration. As additional data is added from the GWA and HRM programs, the portal will continue to provide researchers with a streamlined visual environment for data selection, filtering, and exploration from multiple sources (including environmental, atmospheric, and numeric models). This tool allows rapid discovery of interesting findings to support (or deny) initial study hypotheses, inform further experimentation and experimental design, and generate additional hypotheses or "hot spots" related to drivers of environmental change in Prince William Sound.

Capabilities have also been developed to visualize 4-dimensional oceanographic data enabled by the netCDF data format. NetCDF is a well-documented, open, and self-describing format that was designed with the needs of long term preservation in mind. From the GWA project, Axiom analysts worked with GWA PIs to convert CTD data from1997 through 2013 for the Seward Line and GAK1 mooring projects into netCDF files that were used to create rich, 4D visualizations (Fig. 17). With these data format conversions complete, the datasets were more robustly visualized along standardized parameters while being ready for archiving in a long-term preservation environment. Specifically in this 4D visualization interface, the physical oceanographic datasets can be spatially and temporally parsed to view data from a particular location or time period on the transect (Fig. 18). For each location the vertical profile information has been mapped for each of the data parameters (e.g., water temperature, salinity. conductivity, and fluorescence). Further, various linear interpolation analyses (including inverse distance weighting, linear, Krig, and nearest neighbor) can be applied across depth increments to provide parameter measurements across the entire water column. The measurements are displayed in both a graph and 4D image that can be interacted with to observe changes in the water column both across spatial areas and time.

Figure 17. A list of the CTD dataset for the Seward Line and GAK1 mooring projects from from1997 through 2013 that are available as 4-D visualization in the Gulf of Alaska data portal.
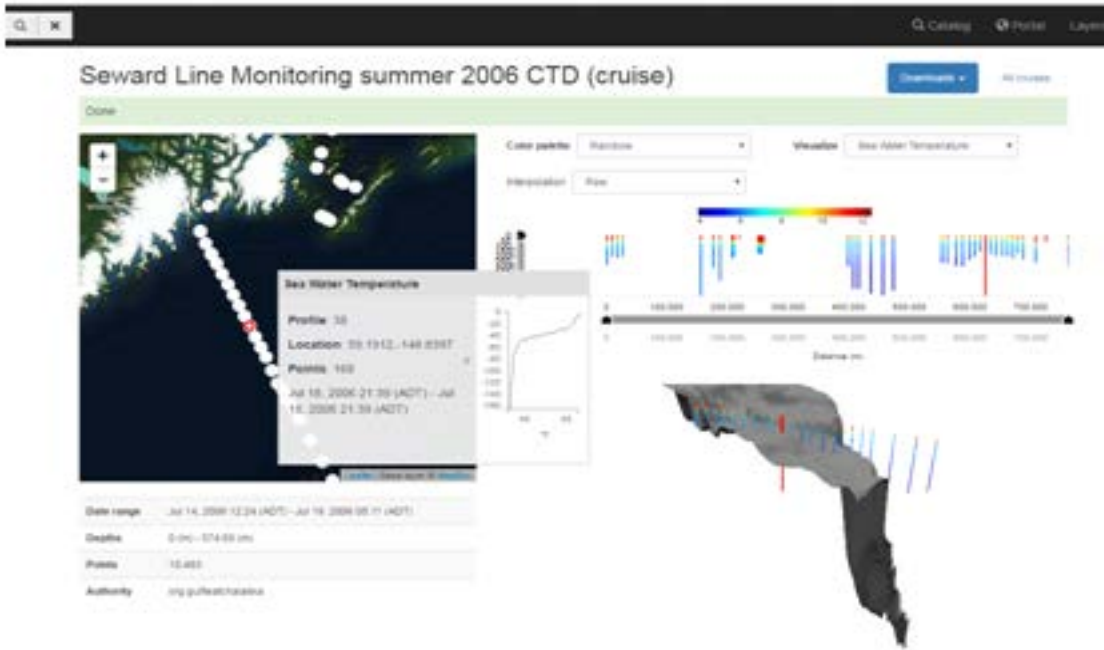
Figure 18. Visualizations of CTD data in the Gulf of Alaska data portal, including spatial and temporal data parsing, vertical profiles, and linear interpolation for various oceanographic parameters.

DataONE

In June 2017, Axiom Data Science became the 41st Member Node in the DataONE federation. The Member Node is named the Research Workspace, which is the next generation version of the Ocean Workspace that will be launched with expanded data sharing capabilities in summer 2017. The goals for becoming a DataONE Member Node were to ease the requirement of providing EVOSTC funded datasets to a data archive center by simplifying the upload of content, generation of metadata and archive submission processes for the PI while simultaneously providing transparency of program data management and archiving to the data managers, program leads, and funders. The technical pathway developed during the GWA program includes tools for metadata generation, archive package creation, and ingestion into the Member Node. Enhancements planned to be developed and implemented during the upcoming 5-year GWA funding cycle include automated data and metadata quality assurance steps and completeness checks for metadata content, customized metadata entry forms based on data types and programmatic requirements, and tools for reading in xml-formatted metadata from other standards, e.g., FGDC CSDGM or EML.

As the data creators, it was the responsibility of the PIs to make the final decisions about which data would be made publicly available and what level of quality control was required for the data. As the data management personnel and managers of the DataONE Member Node, it was the responsibility of Axiom staff to verify that PIs delivered all of the data that they had agreed was to be made publicly available, to provide any assistance necessary to the PIs to help them generate quality metadata for their data, and to augment the Workspace to send data to a DataONE member repository for long-term preservation. Submissions of GWA data to the DataONE Member Node was a collaborative effort dependent upon the responsibilities of both the data management team at Axiom and GWA PIs. After PIs uploaded final, quality-reviewed versions of their datasets into the Ocean Workspace, data management personnel first reviewed data file content to verify that all expect data had been delivered, and then reviewed metadata generated by the PI for quality and completeness. Data management personnel then sent metadata review notes back to PIs documenting any further needs of the metadata for each dataset uploaded. After PIs had addressed the needs of their metadata, data management personnel reviewed the final metadata and initiated the automated submission feature through the Workspace.

A list of the datasets archive in the DataONE repository and replicated in the Gulf of Alaska Member Node are listed in Appendix 2. Further these datasets are discoverable through DataONE Search (https://search.dataone.org), which is the default software for search and discovery of data and metadata within DataONE. At the time of writing, DataONE provides access to nearly 1 million Earth observation dataset and 300,0000 metadata files totaling nearly 30TB of data.

CONCLUSIONS

This project provided data management support to the EVOSTC GWA and HRM programs to ensure efficient organization, consolidation, and documentation of data collected for use by the study team as well for future use by a larger community. Concurrently, it provided tools for visualizing physical and biological datasets produced from the GWA research and monitoring efforts, which can then be integrated and displayed alongside historical spill-

related and other environmental dataset from the Gulf of Alaska region. This work coordinated and shares costs with several existing data management projects that are parallel in scope to the data management needs of the EVOSTC GWA and HRM programs, and it leverages cyberinfrastructure and existing data management capacities of both the AOOS and Axiom Data Science technologies. The project supported data submission and organization, metadata generation, and data transfer among study teams through the GWA Workspace instance. Axiom data managers, analysts, and domain experts quality reviewed metadata and data structure formats produced from GWA monitoring efforts and advise PIs in best practices for short-term and long-term data formats as well as metadata authoring. Through data and metadata submission tracking and engagement with PIs, Axiom helped to ensure that GWA projects meet their data sharing deliverables. Axiom software engineers also developed and provide web-based tools to facilitate data discovery and visual exploration of some GWA-produced datasets, which included the ability to search and filter datasets by space, time, parameter, taxonomy, and keyword. Last, to ensure the long-term preservation of GWA data final datasets and products were archived in the DataONE data repository where they can be discovered, accessed, and re-used for retrospective analyses of the recovery of the spill-affected ecosystem.

ACKNOWLEDGEMENTS

LITERATURE CITED

Jones M. B., R. Blake, J. Couture, and C. Ward. *In Review*. Collaborative data management and holistic synthesis of impacts and recovery status associated with the *Exxon Valdez* oil spill. Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120120). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Appendix 1. The responsibilities for each of the GWA program roles across the various steps in the data life cycle.

Lifecycle Step	PIs	Program Mgmt Team	Axiom Data Science	NCEAS	EVOSTC
Data	PI/agency responsibility; established sampling protocols for each component.	Review & maintain sampling Standard Operating Procedures (SOPs). Coordinate, with Science Coordinating Committee, consistency in sampling across the program.	Store current Standard Operating Procedures within Ocean Research Workspace.	Meet objectives focused on historic data salvage	Fund data collection projects and programs. Establish basic requirements: quality data, well documented, publicly accessible, archived.
QA/QC	PI responsibility based on agency or entity requirements. Documentation of instrument calibration & data QA/QC procedures to be included in sampling SOPs & project metadata.	Review QA/QC documentation before accepting data. Limited QA/QC performed on metadata to ensure it has required information (e.g., date, time, location, etc.) and data fields are appropriately documented (e.g., units in column headers).	Working with GWA program coordinator, specific datasets are aggregated together and reviewed for problems to prepare for synthesis efforts. Ensure QA/QC of metadata prior to archive.	For historical data, limited QA/QC (e.g., columns, domain, units) is performed and provided in metadata documentation to ensure it has required information. If original PIs are unavailable then any issues are simply noted in metadata.	Establish clear requirements for program and coordinate on agency data standards.
Metadata	PI responsibility to provide metadata according to agency and team standards.	Works w/PIs & data team to develop requirements. Assists PIs & reviews project level and file level metadata files.	Metadata can be created through the Workspace using the ISO suite of protocols with taxonomic extensions (ITIS). Provide technical assistance and training for PIs to author metadata	For historical data projects, NCEAS to research data and provide metadata as available to reconstruct the data set. Metadata are extracted from reports, papers, and other available	Coordinate on agency metadata requirements and standards.

Lifecycle Step	PIs	Program Mgmt Team	Axiom Data Science	NCEAS	EVOSTC
			following best practice. Quality review metadata prior to archive.	materials. Metadata are provided in EML format using tools developed at NCEAS (web entry, and Morpho entry).	
Internal data access and staging	Post data on Ocean Research Workspace as soon as possible, but no later than 1 year after collection.	Keeps records of data availability. Assists PIs in posting data on Ocean Research Workspace. Coordinates with Axiom/AOOS and NCEAS on user requirements for Workspace.	Provide Workspace as internal staging area for use by team. Work w/team to develop additional functionality for team use. Workspace is highly leveraged tool that is password protected.	Use Redmine ticket system to track the lengthy process of finding, acquiring, and processing historical data. As data are processed, they are inserted as private objects into the GoA Member Node, and then made public as the documentation is completed.	
Data security	n/a	n/a	Data are archived on AOOS server in Anchorage & at mirror site in Portland OR. Data also archived on the Axiom Member Node, replicated to DataONE, and a copy is made on the AOOS data servers. DataONE checks validity of content through rolling audit.	Historical data are archived on the NCEAS GoA Member Node, replicated to DataONE, and a copy is made on the AOOS data servers. DataONE checks validity of content through rolling audit.	Provide requirements, if any, for agency data archive.
Data analysis, synthesis & visualizatio	Produce data analyses, synthesis documents and	Coordinates with PIs, AOOS, Axiom and NCEAS to produce synthesis	Provides team with full access to all data for potential	Historical data are made publicly available via	

Lifecycle Step	PIs	Program Mgmt Team	Axiom Data Science	NCEAS	EVOSTC
n	data visualizations from project data.	and visualization products and reports.	applications. Provide team access to all ancillary AOOS data & tools. Provide time series animations & syntheses on request from science team & outreach team.	the GoA Member Node, and can be accessed from the web, analytical environments like R, and workflow systems like Kepler and VisTrails.	
Data discovery (search function)	Ensures that data are complete, QA/QCd & have complete metadata records.	Determines when data & metadata are ready to be published to public AOOS portal.	Incorporates data & metadata into AOOS GoA data search catalog w/additional GWA & historical EVOSTC tags. Data are also searchable in the DataONE archive.	Historical data are listed on the AOOS GoA data portal, and are searchable on the DataONE portal as well as the KNB.	
Public data delivery	Reviews published data on data portal for accuracy.	Reviews published data on data portal for accuracy. Keeps track of program data delivery status.	When data meet all above requirements, publish data & metadata into the AOOS Gulf of Alaska portal, the Axiom DataONE member node, and DataONE replica servers.	Historical data and metadata can be downloaded from AOOS GoA Data Portal, the GoA DataONE member node, and DataONE replica servers.	Public data access is required.
Long-term archive			AOOS data system is being used for long-term storage. Further, an automated delivery to the DataONE Member Node. Provide linkages to DataONE to replicate data	Provide linkages to DataONE to replicate data across diverse institutions to protect against funding and policy failures. Historical data have 3 replicas nationally.	Long-term archiving required by trustee agencies.

Lifecycle Step	PIs	Program Mgmt Team	Axiom Data Science	NCEAS	EVOSTC
			across diverse institutions to protect against funding and policy failures. Data have 3 replicas nationally, GoA porta, Axiom Member Node, DataONE.		

Appendix 2. Datasets generated by EVOSTC Gulf Watch Alaska programs from 2012 to 2016 that are stored in the AOOS Workspace, and made publicly available in the Gulf of Alaska data portal and replicated in the DataONE archive for long-term preservation.

Project	PI	EVOSTC Project #	Resource Information	
EVOSTC Gulf Watch Alaska, 2012-2016	Kris Holderied, Molly McCammon	12140114, 13140114, 14140114, 15140114, & 16140114	Metadata title:	Gulf Watch Alaska: Long-term Monitoring of Marine Conditions and Injured Resources in the Gulf of Alaska Exxon Valdez Oil Spill Affected Area
			Dataset content:	n/a
			Years:	2012-2016
			AOOS metadata ID:	58bdbb152ab79c00077c0577
			Workspace storage:	n/a
			DataONE archive:	https://doi.org/10.24431/axds/83479591-af7c-4f64-974f-febb843035b8
Environmental drivers: Continuous Plankton Recorders	Sonia Batten	12120114-A, 13120114-A, 14120114-A, 15120114-A, 16120114-A	Metadata title:	Continuous Plankton Recorder and Temperature Data, Gulf of Alaska, 2011-2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	CPR Plankton category; temperature data
			Years:	2012-2016 (plankton); 2011-2016 (temperature)
			AOOS metadata ID:	5893cbfd30c49e00075392a9
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4655/files
			DataONE archive:	https://doi.org/10.24431/rw1k112
Environmental drivers: Gulf of Alaska Mooring (GAK1)	Seth Danielson, Thomas Weingartner	12120114-P, 13120114-P 14120114-P, 15120114-P, & 16120114-P	Metadata title:	GAK1 Mooring Timeseries data, Seward, AK, from the GAK1 project, 2012-2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	Mooring data
			Years:	1970-2016
			AOOS metadata ID:	58b6126a2ab79c0008dd33f7
			Workspace storage:	https://workspace.aoos.org/group/4601/project/23194/folder/23936/mooring-data
			DataONE archive:	https://doi.org/10.24431/rw1k18
Environmental drivers: Gulf of Alaska Mooring (GAK1)	Seth Danielson, Thomas Weingartner	12120114-P, 13120114-P 14120114-P, 15120114-P, & 16120114-P	Metadata title:	CTD profile time series data from the GAK1 project, 2012-2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	CTD data
			Years:	2012-2016
			AOOS metadata ID:	58d968f82ab79c00077c05b2
			Workspace storage:	https://workspace.aoos.org/group/4601/project/23194/folder/24090/ctd-data
			DataONE archive:	https://doi.org/10.24431/rw1k1b
Environmental drivers: Gulf of Alaska Mooring (GAK1)	Seth Danielson, Thomas Weingartner	12120114-P, 13120114-P 14120114-P, 15120114-P, & 16120114-P	Metadata title:	Toward Long-Term Monitoring of the Gulf of Alaska Ecosystem, Calculation of Freshwater Discharge, 1970-2014
			Dataset content:	Modeled freshwater discharge data
			Years:	1931-2013
			AOOS metadata ID:	590781cf2ab79c00077c05ea
			Workspace storage:	https://workspace.aoos.org/group/4601/project/23194/folder/24091/discharge-data

Project	PI	EVOSTC Project #	Resource Information	
			DataONE archive:	n/a
Environmental Drivers: Oceanographic Conditions in Prince William Sound	Rob Campbell	12120114-E, 13120114-E, 14120114-E, & 16120114-E	Metadata title:	Oceanographic Conditions in Prince William Sound, CTD, Chlorophyll-a, and Zooplankton Data: 2013-2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	Chl-a, CTD, zooplankton data
			Years:	2013-2016
			AOOS metadata ID:	58ae28ea2ab79c0008f5c87b
			Workspace storage:	https://workspace.aoos.org/group/4601/project/23640/folder/31816/chl-a
			DataONE archive:	https://doi.org/10.24431/rw1k19
Environmental Drivers: Oceanographic monitoring in Cook Inlet and Kachemak Bay	Kris Holderied, Angela Doroff	12120114-G, 13120114-G, 14120114-G, 15120114-G, & 16120114-G	Metadata title:	Oceanographic Monitoring in Cook Inlet and Kachemak Bay, Water Quality, Meteorological, and Nutrient Data collected by the National Estuarine Research Reserve System's System-wide Monitoring Program (NERRS SWMP), 2012-2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	KBNERR meteorological, nutrient, and water quality data
			Years:	2012-2016
			AOOS metadata ID:	589baeadb3cb1f0008806b4e
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4673/folder/263792/kbnerr-meteorological-data
			DataONE archive:	https://doi.org/10.24431/rw1k1c
Environmental Drivers: Oceanographic monitoring in Cook Inlet and Kachemak Bay	Kris Holderied, Angela Doroff	12120114-G, 13120114-G, 14120114-G, 15120114-G, & 16120114-G	Metadata title:	Oceanographic Monitoring in Cook Inlet and Kachemak Bay, CTD Data, 2012-2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	CTD data
			Years:	2012-2016
			AOOS metadata ID:	5893c78730c49e00075392a7
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4673/folder/30407/published-ctd-data
			DataONE archive:	https://doi.org/10.24431/rw1k1d
Environmental Drivers: Oceanographic monitoring in Cook Inlet and Kachemak Bay	Kris Holderied, Angela Doroff	12120114-G, 13120114-G, 14120114-G, 15120114-G, & 16120114-G	Metadata title:	Oceanographic Monitoring in Cook Inlet and Kachemak Bay, Zooplankton Data, 2012-2015, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	Zooplankton category data
			Years:	2012-2016
			AOOS metadata ID:	589b86efb3cb1f000824db4a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4673/folder/223680/zooplankton_final
			DataONE archive:	https://doi.org/10.24431/rw1k12
Environmental Drivers: Seward Line	Russell Hopcroft	12120114-J, 13120114-J, 14120114-J, 15120114-J, & 16120114-J	Metadata title:	Seward Line Conductivity, Temperature, and Depth (CTD) Data, 2012 to 2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	CTD data
			Years:	2012-2016
			AOOS metadata ID:	58c712ce2ab79c00077c0587

Project	PI	EVOSTC Project #	Resource Information	
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4663/folder/24099/ctd-data
			DataONE archive:	https://doi.org/10.24431/rw1k1l
Environmental Drivers: Seward Line	Kathy Kuletz	12120114-J, 13120114-J, 14120114-J, 15120114-J, & 16120114-J	Metadata title:	Seward Line and Lower Cook Inlet Marine Bird Survey Data, 2006-2016, Gulf Watch Alaska Nearshore Component
			Dataset content:	Seabird observation and processed density data
			Years:	2012-2016
			AOOS metadata ID:	58b87da42ab79c0008dd33fc
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4663/folder/223356/seabird-data
			DataONE archive:	https://doi.org/10.24431/rw1k1m
Environmental Drivers: Seward Line	Russell Hopcroft	12120114-J, 13120114-J, 14120114-J, 15120114-J, & 16120114-J	Metadata title:	Prince William Sound Zooplankton Data, 1997 to 2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	Zooplankton data: multinet and calvet
			Years:	1997-2016
			AOOS metadata ID:	58c711f52ab79c00077c0586
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4663/folder/30595/zooplankton-data
			DataONE archive:	https://doi.org/10.24431/rw1k1k
Environmental Drivers: Seward Line	Russell Hopcroft, Thomas Weingartner, Seth Danielson	12120114-J, 13120114-J, 14120114-J, 15120114-J, & 16120114-J	Metadata title:	Prince William Sound Chlorophyll-A and Nutrient Data, 2012 to 2016, Gulf Watch Alaska Environmental Drivers Component
			Dataset content:	Chlorophyll and nutrient final data merged with CTD
			Years:	2012-2016
			AOOS metadata ID:	58f6679c2ab79c00077c05da
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4663/folder/1912372/chlorophyll-nutrient-final-data-merged-with-ctd
			DataONE archive:	https://doi.org/10.24431/rw1k1j
Lingering Oil: Harlequin Ducks and Sea Otters	Dan Esler, Brenda Ballachy	12120114-Q, 13120114-Q, 14120114-Q, 15120114-Q, & 16120114-Q	Metadata title:	Harlequin duck capture and EROD activity data from Prince William Sound, Alaska, 2011, 2013, and 2014, Gulf Watch Alaska Lingering Oil Component
			Dataset content:	Oil spill response data
			Years:	2011, 2013-2014
			AOOS metadata ID:	590242f82ab79c00077c05e9
			Workspace storage:	https://workspace.aoos.org/group/4601/project/28460/folder/2419672/lingering-oil-data-with-doi-numbers
			USGS archive:	http://dx.doi.org/10.5066/F7KD1W1M
Lingering Oil: Harlequin Ducks and Sea Otters	Dan Esler, Brenda Ballachy	12120114-Q, 13120114-Q, 14120114-Q, 15120114-Q, & 16120114-Q	Metadata title:	Sea otter gene expression data from Kodiak, the Alaska Peninsula and Prince William Sound, Alaska, 2005-2012
			Dataset content:	Sea otter gene expression data
			Years:	2005-2012
			AOOS metadata ID:	592f1cdb30c49e0008b17c36
			Workspace storage:	https://workspace.aoos.org/group/4601/project/28460/folder/2425906/for-review-before-publishing
			DataONE archive:	http://dx.doi.org/10.5066/F789141P

Project	PI	EVOSTC Project #	Resource Information	
Lingering Oil: Tracking of Oil Levels and Weathering	Mandy Lindeberg, Mark Carls	12120114-S, 13120114-S, 14120114-S, 15120114-S, & 16120114-S	Metadata title:	Lingering Oil Measurements, Site, Sample, and Photographic Data from Prince William Sound, 2015, Gulf Watch Alaska Lingering Oil Component
			Dataset content:	Hydrocarbon database; Site, survey, gravimetric, oil composition, and sample chain of custody data; lingering oil survey photos
			Years:	2015
			AOOS metadata ID:	591dd09d30c49e0008b17c30
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4667/folder/1761690/lingering-oil-survey-data_final-2015
			DataONE archive:	https://doi.org/10.24431/rw1k1h
Nearshore: Ecological Trends in Kachemak Bay	Katrin Iken, Brenda Konar	12120114-L, 13120114-L, 14120114-L, 15120114-L, & 16120114-L	Metadata title:	Long-term Monitoring of Ecological Communities in Kachemak Bay, 2012-2016, Gulf Watch Alaska Nearshore Component
			Dataset content:	Lottia, mussel, clam, community composition, substrate, swath, seagrass, and temperature logger data
			Years:	2012-2016
			AOOS metadata ID:	58992600b3cb1f000824db43
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4653/files
			DataONE archive:	https://doi.org/10.24431/rw1k1o
Nearshore: Ecological Trends in Kachemak Bay	Angela Doroff	12120114-L, 13120114-L, 14120114-L, 15120114-L, & 16120114-L	Metadata title:	Sea Otter Diet Data, Long-term Monitoring of Ecological Communities in Kachemak Bay, 2008-2015: Gulf Watch Alaska, Nearshore Component
			Dataset content:	Sea otter diet data
			Years:	2008-2015
			AOOS metadata ID:	589b6fdcb3cb1f000824db49
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4653/folder/230530/sea-otters
			DataONE archive:	https://doi.org/10.24431/rw1k1e
Nearshore: Intertidal Systems in Gulf of Alaska	Heather Coletti, Jim Bodkin, Brenda Ballachy, Dan Monson, Dan Esler, Mandy Lindeberg, Tom Dean, Ben Weitzman, Kim Kloeker, George Esslinger	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Nearshore Component: Black oystercatcher nest density and chick diets from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park, 2006-2016 Data
			Dataset content:	black oystercatcher nest density and chick diets
			Years:	2006-2016
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26495/black-oystercatchers
			USGS archive:	http://dx.doi.org/10.5066/F7WH2N5Q http://alaska.usgs.gov/portal/project.php?project_id=99 http://science.nature.nps.gov/im/units/swan/monitor/nearshore.cfm
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Nearshore Component: Monitoring Site Locations from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park
			Dataset content:	rocky intertidal, mussel sampling, and soft sediment site location information, and eelgrass bed locations
			Years:	2003-2015
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26427/slope
			USGS	https://doi.org/10.5066/F78S4N3R

Project	PI	EVOSTC Project #	Resource Information	
			archive::	
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Benthic Component: Intertidal Soft-Sediment Invertebrates from Prince William Sound, Katmai National Park & Preserve, and Kenai Fjords National Park, 2007-2015
			Dataset content:	species identification, counts, and size measurements from intertidal soft-sediment sampling sites
			Years:	2007-2016
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26411/invertebrates-on-sand-and-gravel-beaches
			USGS archive:	These data are still being error-checked and will be published soon through the USGS data portal. Data are available publicly through the GOA data portal.
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Nearshore Component: Intertidal Mussel Site Data from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park, 2008-2015
			Dataset content:	1. mussel sampling site layout information, 2. mussel count and 3. size measurements for mussels greater than 20 millimeters, 4. mussel count and 5. size measurements for all mussels collected from core samples
			Years:	2008-2015
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/1836122/mussel--data-with-doi-numbers:-publish
			USGS archive:	https://doi.org/10.5066/F7FN1498
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Nearshore Component: Intertidal Mussel Site Data from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park, 2016
			Dataset content:	1. Mussel sampling site layout information, 2. Mussel count and 3. Size measurements for mussels greater than 20 millimeters, 4. Mussel count and 5. Size measurements for all mussels collected from core samples
			Years:	2016
			AOOS metadata ID:	n/a
			Workspace storage:	n/a
			USGS archive:	https://workspace.aoos.org/group/4601/project/4650/folder/1836122/mussel--data-with-doi-numbers:-publish
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Benthic Component: Intertidal Rocky Shore Limpet Size Data from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park, 2006-2014
			Dataset content:	sizes of the limpet, Lottia persona, from intertidal rocky substrate sampling sites
			Years:	2006-2014
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26433/size
			USGS archive:	http://dx.doi.org/10.5066/F7513WCB
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Benthic Component: Intertidal Rocky Shore Nucella and Katharina counts from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park, 2006-2014
			Dataset content:	counts of Nucella sp., Lirabuccinum dirum, and Katharina tunicata from intertidal rocky substrate sampling sites
			Years:	2006-2014
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26431/nucella-and-katharina

Project	PI	EVOSTC Project #	Resource Information	
			USGS archive:	http://dx.doi.org/10.5066/F7513WCB
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Benthic Component: Intertidal Rocky Shore Invertebrate and Algae from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park, 2006-2014
			Dataset content:	species identification, counts, and size measurements from intertidal rocky substrate sampling sites
			Years:	2006-2016
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26429/percent-cover-algae-and-inverts
			USGS archive:	http://dx.doi.org/10.5066/F7513WCB
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Benthic Component: Intertidal Rocky Shore Seastar counts from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park, 2006-2014
			Dataset content:	counts of seastars from intertidal rocky substrate sampling sites
			Years:	2006-2014
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26430/sea-stars
			USGS archive:	http://dx.doi.org/10.5066/F7513WCB
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	NearshoreBenthicSystemsInGOA_SOP4_Rocky_2014QuadratSubstrateData_FINAL
			Dataset content:	substrate classifications from intertidal rocky sampling sites
			Years:	2014
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26428/substrate-composition
			USGS archive:	These data are still being error-checked and will be published soon through the USGS data portal. Data are available publicly through the GOA data portal
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Benthic Component: Marine Bird and Mammal Survey Data from Katmai National Park and Preserve and Kenai Fjords National Park, 2006-2015
			Dataset content:	date, time, latitude, longitude, species abbreviation, count, and behavior
			Years:	2006-2015
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/2421027/survey-data
			DataONE archive:	https://dx.doi.org/10.5066/F7416V6H
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska Benthic Component: Marine Water Quality, Water Temperature from Prince William Sound, Katmai National Park & Preserve, and Kenai Fjords National Park, 2006-2014
			Dataset content:	date, time, site name, and temperature measurements from intertidal rocky sampling sites
			Years:	2006-2014
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/1761229/archive-data-without-doi-numbers:-rocky-site-temperature

Project	PI	EVOSTC Project #	Resource Information	
			USGS archive:	http://dx.doi.org/10.5066/F7WH2N3T
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska, Benthic Monitoring Component: Sea otter Carcass Collection from Prince William Sound, Katmai National Park & Preserve, and Kenai Fjords National Park
			Dataset content:	information related to collection of sea otter carcasses
			Years:	2006-2012
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26455/carcass
			USGS archive:	http://dx.doi.org/10.5066/F7WH2N3T
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Gulf Watch Alaska, Benthic Monitoring Component: Sea otter foraging observations from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park, 2013
			Dataset content:	observations made of foraging sea otters
			Years:	2013
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26452/forage
			USGS archive:	http://dx.doi.org/10.5066/F7H993CZ
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Sea Otter Aerial Surveys in Katmai National Park and Preserve 2008 and Kenai Fjords National Park 2007
			Dataset content:	sea otter counts along survey transects and additional information to allow calculation of a correction factor for animals missed due to incomplete detection
			Years:	2007-2008
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26459/population-estimates
			USGS archive:	http://dx.doi.org/10.5066/F7CJ8BN7
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Sea Otter Aerial Surveys in Katmai National Park and Preserve 2008 and Kenai Fjords National Park 2007
			Dataset content:	sea otter counts along survey transects and additional information to allow calculation of a correction factor for animals missed due to incomplete detection
			Years:	2007-2008
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26459/population-estimates
			USGS archive:	http://dx.doi.org/10.5066/F7CJ8BN7
Nearshore: Intertidal Systems in Gulf of Alaska	See above	16120114-F (birds)/ 16120114-R (nearshore)	Metadata title:	Sea Otter Aerial Surveys in Katmai National Park and Preserve 2008 and Kenai Fjords National Park 2007
			Dataset content:	sea otter counts along survey transects and additional information to allow calculation of a correction factor for animals missed due to incomplete detection
			Years:	2007-2008
			AOOS metadata ID:	n/a
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4650/folder/26459/population-estimates
			USGS archive:	http://dx.doi.org/10.5066/F7CJ8BN7
Pelagic: Fall	Mary Anne	090814,	Metadata	Fall and Winter Seabird Abundance Data, Prince William Sound, 2007-2016, Gulf Watch

Project	PI	EVOSTC Project #	Resource Information	
and Winter Seabird Abundance	Bishop	12100132-H, 12120114-C, 13120114-C, 14120114-C, 15120114-C & 16120114-C	title:	Alaska Pelagic Component
			Dataset content:	Seabird survey data from fall and winter
			Years:	2007-2016
			AOOS metadata ID:	588fd17530c49e0007539296
			Workspace storage:	https://workspace.aoos.org/group/4601/project/23643/folder/1766253/completed-survey-data
			DataONE archive:	https://doi.org/10.24431/rw1k1w
Pelagic: Forage Fish Distribution, Abundance, and Body Condition	John Piatt, Mayumi Arimitsu	12120114-O, 14120114-O, & 16120114-O	Metadata title:	Gulf Watch Alaska Forage Fish Component: Fish morph data in Prince William Sound, Alaska 2012-2015
			Dataset content:	Forage fish morphometric data
			Years:	2012-2015
			AOOS metadata ID:	58c776062ab79c00077c058e
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4688/folder/24048/forage-fish
			USGS archive:	http://dx.doi.org/10.5066/F74J0C9Z
Pelagic: Forage Fish Distribution, Abundance, and Body Condition	John Piatt, Mayumi Arimitsu	12120114-O, 14120114-O, & 16120114-O	Metadata title:	Gulf Watch Alaska Forage Fish Component: Marine bird and mammal surveys in Prince William Sound, Alaska 2012-2013 and 2015
			Dataset content:	Marine predator (bird and mammal) survey data
			Years:	2012-13; 2015
			AOOS metadata ID:	58c777112ab79c00077c0590
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4688/folder/24049/marine-predator-survey
			DataONE archive:	http://dx.doi.org/10.5066/F74J0C9Z
Pelagic: Forage Fish Distribution, Abundance, and Body Condition	John Piatt, Mayumi Arimitsu	12120114-O, 14120114-O, & 16120114-O	Metadata title:	Gulf Watch Alaska Forage Fish Component: Oceanographic profile data from various regions in Prince William Sound, 2012-2015
			Dataset content:	CTD data
			Years:	2012-2015
			AOOS metadata ID:	58c7754a2ab79c00077c058d
			Workspace storage:	https://workspace.aoos.org/project/4688/folder/2532150/ctd-data,-2012-2015
			DataONE archive:	http://dx.doi.org/10.5066/F74J0C9Z
Pelagic: Forage Fish Distribution, Abundance, and Body Condition	John Piatt, Mayumi Arimitsu	12120114-O, 14120114-O, & 16120114-O	Metadata title:	Gulf Watch Alaska Forage Fish Component: Zooplankton biomass data from 2012-2015 in Prince William Sound, Alaska
			Dataset content:	Zooplankton category data
			Years:	2012-2015
			AOOS metadata ID:	58c777522ab79c00077c0591
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4688/folder/233522/zooplankton
			DataONE archive:	http://dx.doi.org/10.5066/F74J0C9Z
Pelagic: Forage Fish Distribution, Abundance,	John Piatt, Mayumi Arimitsu	12120114-O, 14120114-O, &	Metadata title:	Gulf Watch Alaska Forage Fish Component: Nutrients data from CTD sampling stations in Prince William Sound, Alaska 2012-2015
			Dataset content:	Water chemistry data

Project	PI	EVOSTC Project #	Resource Information	
and Body Condition		16120114-O	Years:	2012-2015
			AOOS metadata ID:	58c7777f2ab79c00077c0592
			Workspace storage:	https://workspace.aoos.org/project/4688/folder/24108/water-chemistry-data,-2012-2015
			DataONE archive:	http://dx.doi.org/10.5066/F74J0C9Z
Pelagic: Forage Fish Distribution, Abundance, and Body Condition	John Piatt, Mayumi Arimitsu	12120114-O, 14120114-O, & 16120114-O	Metadata title:	Gulf Watch Alaska Forage Fish Component: Fish catch data in Prince William Sound, Alaska 2012-2015
			Dataset content:	Fish abundance data
			Years:	2012-2015
			AOOS metadata ID:	58c7766c2ab79c00077c058f
			Workspace storage:	https://workspace.aoos.org/project/4688/folder/24048/forage-fish-count-data,-2012-2015
			DataONE archive:	http://dx.doi.org/10.5066/F74J0C9Z
Pelagic: Forage Fish Distribution, Abundance, and Body Condition	John Piatt, Mayumi Arimitsu	12120114-O, 14120114-O, & 16120114-O	Metadata title:	Gulf Watch Alaska Forage Fish Component: Hydroacoustic surveys in Prince William Sound, Alaska 2014-2015
			Dataset content:	Processed hydroacoustic data
			Years:	2013-2015
			AOOS metadata ID:	58c1b2cb2ab79c00077c057e
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4688/folder/1914140/hydroacoustic
			DataONE archive:	http://dx.doi.org/10.5066/F74J0C9Z
Pelagic: Humpback Whale Predation on Herring	John Moran, Jan Straley	12120114-N, 13120114-N, 14120114-N, 15120114-N, & 16120114-N	Metadata title:	Lipid Analyses for Pacific Herring, Invertebrates and Humpback Whales in the Gulf of Alaska, 2012-2015, Gulf Watch Alaska Pelagic Component
			Dataset content:	Marine mammal and prey lipid database
			Years:	2012-2015
			AOOS metadata ID:	58af2e592ab79c0008dd33eb
			Workspace storage:	https://workspace.aoos.org/project/4684/folder/2510153/whale-lipid-data,-2012-2015
			DataONE archive:	https://doi.org/10.24431/rw1k1q
Pelagic: Humpback Whale Predation on Herring	John Moran, Jan Straley	12120114-N, 13120114-N, 14120114-N, 15120114-N, & 16120114-N	Metadata title:	Significance of Whale Predation On Natural Mortality Rate of Pacific Herring in Prince William Sound, Alaska: 2006 - 2009, 2011-2015, Gulf Watch Alaska Pelagic Component
			Dataset content:	Whale survey database
			Years:	2006 - 2009, 2011-2015
			AOOS metadata ID:	5893aa5a30c49e00075392a6
			Workspace storage:	https://workspace.aoos.org/project/4684/folder/30756/whale-survey-and-prey-data,-2006-2009,-2011-2015
			DataONE archive:	https://doi.org/10.24431/rw1k1n
Pelagic: Humpback Whale Predation on Herring	John Moran, Jan Straley	12120114-N, 13120114-N, 14120114-N, 15120114-	Metadata title:	Dall's and Harbor Porpoise Survey Data, Prince William Sound, Alaska: 2007 - 2008, 2011-2015, Gulf Watch Alaska Pelagic Component
			Dataset content:	Porpoise observation data
			Years:	2007-2008, 2011-2015
			AOOS metadata	58991bc1b3cb1f000824db40

Project	PI	EVOSTC Project #	Resource Information	
		N, & 16120114-N	ID:	
			Workspace storage:	https://workspace.aoos.org/project/4684/folder/2514142/porpoise-survey-data,-2007-2008,-2011-2015
			DataONE archive:	https://doi.org/10.24431/rw1k1p
Pelagic: Long-term Killer Whale Monitoring	Craig Matkin	12120114-M, 13120114-M 14120114-M, 15120114-M, & 16120114-M	Metadata title:	Acoustic Recordings of Killer Whales in Prince William Sound and Kenai Fjords, 2012 to 2016, Gulf Watch Alaska Pelagic Component
			Dataset content:	Acoustic data and catalog
			Years:	2012-2016
			AOOS metadata ID:	58b0dffa2ab79c0008dd33ed
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4682/folder/1933794/acoustic-recordings
			DataONE archive:	https://doi.org/10.24431/rw1k1f
Pelagic: Long-term Killer Whale Monitoring	Craig Matkin	12120114-M, 13120114-M 14120114-M, 15120114-M, & 16120114-M	Metadata title:	Kenai Fjords and Prince William Sound Long-Term Photographic Monitoring of Killer Whales, 2012-2016, Gulf Watch Alaska Pelagic Component
			Dataset content:	Photo summary and catalog
			Years:	2012-2016
			AOOS metadata ID:	58b477ce2ab79c0008dd33ef
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4682/folder/1933798/photographic-encounters
			DataONE archive:	https://doi.org/10.24431/rw1k1s
Pelagic: Long-term Killer Whale Monitoring	Craig Matkin	12120114-M, 13120114-M 14120114-M, 15120114-M, & 16120114-M	Metadata title:	Prince William Sound Killer Whale Satellite Telemetry Data, 2004 to 2016, Gulf Watch Alaska Pelagic Component
			Dataset content:	Satellite tagging data
			Years:	2004-2014
			AOOS metadata ID:	58bf2f022ab79c00077c0579
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4682/folder/1847084/satellite-tagging-data
			DataONE archive:	https://doi.org/10.24431/rw1k1g
Pelagic: Long-term Killer Whale Monitoring	Craig Matkin	12120114-M, 13120114-M 14120114-M, 15120114-M, & 16120114-M	Metadata title:	Biopsy Summaries and Biochemical Data from Killer Whales in Alaska, 2012-2016
			Dataset content:	Biopsy summary data
			Years:	2012-2016
			AOOS metadata ID:	58b4798f2ab79c0008dd33f3
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4682/folder/24158/biopsy-data
			DataONE archive:	n/a
Pelagic: Long-term Killer Whale Monitoring	Craig Matkin	12120114-M, 13120114-M 14120114-M, 15120114-M, & 16120114-M	Metadata title:	Database of Southern Alaska Killer Whale Surveys and Encounters, 2001 to 2016, Gulf Watch Alaska Pelagic Component
			Dataset content:	Killer whale survey database
			Years:	2001-2016
			AOOS metadata ID:	58b478042ab79c0008dd33f0
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4682/folder/24159/database-of-surveys-and-encounters

Project	PI	EVOSTC Project #	Resource Information	
			DataONE archive:	https://doi.org/10.24431/rw1k1r
Pelagic: Prince William Sound Marine Birds	Robert Kaler, Kathy Kuletz	12120114-K, 14120114-K, & 16120114-K	Metadata title:	Prince William Sound Marine Bird Surveys, July 2012 to 2016, Gulf Watch Alaska Pelagic Component
			Dataset content:	Seabird survey data for summer and environmental data
			Years:	2012-2016
			AOOS metadata ID:	588f967c30c49e0007539290
			Workspace storage:	https://workspace.aoos.org/group/4601/project/4680/folder/1645604/2012-2016-summer-surveys
			DataONE archive:	https://doi.org/10.24431/rw1k1w

Appendix 3. The primary entries of data available through the Gulf of Alaska data portal. Each entry may contain one or more associated mapped data layers and/or files available for download. For a complete list of data layers associated with each catalog entry refer to Appendix 4.

ID	Catalog Entries	Data Category
1	ADF&G Anadromous Waters Catalog (2006)	GIS; fish
2	ADF&G Anadromous Waters Catalog (2016)	GIS; fish
3	Alaska Region Digital Elevation Model v2.0	numeric model
4	Alaska ShoreZone	GIS; habitat
5	Alaska ShoreZone Imagery	coastal imagery
6	AOOS Historical Sensor Catalog	sensor observation
7	AOOS Real-time Sensor Catalog	sensor observation
8	Aquarius Sea Surface Salinity Daily Aggregate V3.0	numeric model
9	Aquarius Sea Surface Salinity Monthly Aggregate Image V3.0	numeric model
10	Aquarius Sea Surface Salinity Seven-Day Aggregate V3.0	numeric model
11	Aquarius Sea Surface Salinity V4.0	numeric model
12	Aquarius Wind Speed Daily Aggregate V3.0	numeric model
13	Aquarius Wind Speed Monthly Aggregate V3.0	numeric model
14	Aquarius Wind Speed Seven-Day Aggregate V3.0	numeric model
15	Aquarius Wind Speed V4.0	numeric model
16	ARSC High Resolution Rapid Refresh (HRRR)	numeric model
17	Audubon Alaska Important Bird Areas (IBAs)	GIS; bird
18	Central Gulf of Alaska Bathymetry	physical oceanographic
19	Cook Inlet Bathymetry	physical oceanographic
20	Cook Inlet ESI	GIS; habitat
21	Cook Inlet Geographic Response Strategies	GIS; oil spill response
22	Essential Fish Habitat - Alaska	GIS; fish

ID	Catalog Entries	Data Category
23	EVOSTC Historical Data Catalog	repository: biological , physical, environmental observations
24	Extratropical Storm Surge Water Level Guidance for Alaska V2.0	numeric model
25	Extratropical Storm Surge Water Level Guidance for Alaska V2.1	numeric model
26	General Bathymetric Chart of the Oceans (GEBCO)	physical oceanographic
27	GHRSST Global G1SST Sea Surface Temperature (1km)	numeric model
28	GHRSST Level 4 MUR Global Foundation Sea Surface Temperature Analysis (.01deg/1km)	numeric model
29	Gulf of Alaska Hydrology Model	numeric model
30	GulfWatch - Marine Mammal Observations	biological observations; project
31	Habitat Studies (Salt Marsh and Species)	GIS; habitat
32	Hydrocarbon Contaminants in Alaska's Southern Coast	GIS; contaminants
33	Kachemak Bay Ecological Characterization	ecological
34	Kachemak Bay Intertidal Habitats	GIS; habitat
35	Kamishak Herring	ecological
36	Multisensor Analyzed Sea Ice Extent (MASIE)	numeric model
37	NCEP 0.25-degree Global Forecast System (GFS) Forecast	numeric model
38	NCEP Global Forecast System (GFS) Model (2015 ONLY)	numeric model
39	NCEP Reanalysis Daily Averages Surface Flux	numeric model
40	NOAA Coastal Survey Development Lab (CSDL) Regional Ocean Modeling System (ROMS)	numeric model
41	North American Mesoscale (NAM-12) Forecast for Alaska	numeric model
42	NSIDC Sea Ice Concentration	numeric model

ID	Catalog Entries	Data Category
43	NWS National Digital Forecast Database (NDFD) for Alaska 2011-2016	weather forecast
44	Pacific Marine Arctic Regional Synthesis (PacMARS)	biological , physical, environmental observations; project
45	Polar Data Catalogue Metadata Repository	repository: biological , physical, environmental observations
46	Prince William Sound, ADF&G Pacific Herring Fishery Monitoring	ecological
47	Prince William Sound, ADF&G Pacific Herring Fishery Monitoring- Bird Observations	ecological
48	Prince William Sound, ADF&G Pacific Herring Fishery Monitoring- Marine Mammal Observations	ecological
49	Prince William Sound (PWS) Regional Ocean Modeling System (ROMS) Forecast - 1-km Resolution	numeric model
50	Prince William Sound (PWS) Regional Ocean Modeling System (ROMS) Forecast - 3-km Resolution	numeric model
51	Prince William Sound (PWS) Regional Ocean Modeling System (ROMS) Forecast - 9-km Resolution	numeric model
52	Salmon Telemetry from the Copper River, Alaska	ecological
53	SNAP Historical Monthly Temperature and Precipitation	historical weather
54	SNAP Scenario Climate Projections	climate forecast
55	Studies and Monitoring Efforts	GIS; project
56	Texas A&M Prince William Sound (PWS) Wave Simulation	numeric model
57	UAF/CMI-BOEM Historical Distribution and Ecology of Demersal Fishes in the Chukchi Sea	ecological
58	Water	numeric model
59	Wave Watch III (NMWW3)	numeric model
60	Wave Watch III (NMWW3)	numeric model

ID	Catalog Entries	Data Category
61	Wave Watch III (WW3)	numeric model
62	Weather Research and Forecasting (WRF) for Prince William Sound and Cook Inlet from AEFF	weather forecast
63	Weather Research and Forecasting (WRF) for South Central Alaska (12 km) from AEFF	weather forecast

Appendix 4. A complete list of data layers associated with individual catalog entries in the Gulf of Alaska data portal. The catalog entries are referred to by ID number as referenced in Appendix 3.

ID	Data Layer	ID	Data Layer
1	Chum Salmon	36	Sea Ice Extent
1	Sockeye Salmon	37	Total cloud cover (Mixed_intervals Average) @ Entire atmosphere
1	Fish Survey Sites	37	Wind speed (gust) @ Ground or water surface
1	Coho Salmon	37	Zonal Wind
1	Pink Salmon	37	Relative humidity @ Specified height level above ground
1	Chinook Salmon	37	Total cloud cover @ Convective cloud layer
1	ADF&G Anadromous Waters Catalog (2006)	37	Pressure @ Ground or water surface
2	ADF&G Anadromous Waters Catalog, Species Data (2016)	37	Pressure reduced to MSL @ Mean sea level
2	ADF&G Anadromous Waters Catalog (2016)	37	Pressure @ Specified height level above ground
3	Digital Elevation Model	37	Precipitation rate (Mixed_intervals Average) @ Ground or water surface
4	Biological Wave Exposure	37	Potential Evaporation Rate @ Ground or water surface
4	Nautical Shore Infrastructure	37	Icing severity @ Isobaric surface
4	Shore Sediment	37	Total precipitation (Mixed_intervals Accumulation) @ Ground or water surface
4	Oil Persistence	37	Meridional Wind
4	Salt Marsh Vegetation Biobands	37	Dewpoint temperature @ Specified height level above ground
4	Shore Stability	37	Ice cover @ Ground or water surface
4	Environmental Sensitivity Index	37	Temperature @ Specified height level above ground
4	Splash Zone Bioband	37	Temperature @ Ground or water surface
4	Kelp Biobands	37	Snow depth @ Ground or water surface
4	Dominant Structuring Process	37	wind
4	Urchin, Mussel, and Barnacle Biobands	37	Water runoff (Mixed_intervals Accumulation) @ Ground or water surface
4	Shore Type	38	Temperature at Ground or Water Surface
4	Sea Grass Biobands	38	Pressure at Ground or Water Surface
4	Shore Modification	38	Pressure Reduced to Mean Sea Level (MSL)
4	Algae Biobands	38	Ice Cover at Ground or Water Surface
5	Alaska ShoreZone Imagery	38	Snow Depth at Ground or Water Surface
6	AOOS Historical Sensors	38	Pressure at Specified Height Level Above Ground
7	AOOS Real-time Sensors	38	Relative Humidity at Specified Height Level Above Ground

8	Sea Surface Salinity	38	Wind Speed (Gust) at Ground or Water Surface
9	Sea Surface Salinity	38	Temperature at Specified Height Level Above Ground
10	Sea Surface Salinity	38	Wind
11	Sea Surface Salinity Daily Aggregate	39	Daily Mean Skin Temperature
11	Sea Surface Salinity Seven-Day Aggretate	40	Sea Surface Height
11	Sea Surface Salinity Monthly Aggregate	40	Sea Water Velocity
12	Ocean Surface Wind Speed	41	Temperature at Surface
13	Ocean Surface Wind Speed	41	Water Equivalent Of Accumulated Snow Depth
14	Ocean Surface Wind Speed	41	Visibility at Surface
15	Ocean Surface Wind Speed Monthly Aggregate	41	Pressure Reduced to Mean Sea Level
15	Ocean Surface Wind Speed Seven-Day Aggregate	41	Vegetation
15	Ocean Surface Wind Speed Daily Aggregate	41	Wind Speed Gust at Surface
16	Skin Temperature at Surface	41	Snow Cover at Surface
16	Total Precipitation Accumulation at Surface	41	Water Temperature at Surface
16	Wind	41	Pressure at Surface
17	Audubon IBA Core Areas in Alaska	41	Temperature 2 m
17	Colony Points	41	Precipitation Rate at Surface
17	Audubon IBAs in Alaska	41	Relative_humidity at 2 m
18	Bathymetry	41	Snow Depth
19	Bathymetry	41	Total Cloud Cover
20	Marine Mammals	41	Ice Cover Proportion at Surface
20	Volcanoes	41	Surface Albedo
20	Socioeconomics	41	Wind at 10 m
20	Fish	42	Sea Ice Concentration
20	Sea Ice Extent	43	Relative Humidity at Surface
20	Nests	43	Significant Height Of Wind Waves at Surface
20	Invertebrates	43	Wind Speed Gust at Surface
20	Birds	43	Wind at Surface
20	Map Index	43	Maximum Temperature
20	Rip Current	43	Temperature at Surface
20	Cook Inlet ESI	43	Dew Point Temperature at Surface
20	Management	43	Minimum Temperature
21	Geographic Response Strategies	43	Apparent Temperature at Surface
22	EFH - Pink Salmon	43	Total Cloud Cover at Surface
22	EFH - Sablefish	43	Total Snowfall Accumulation at Surface
22	EFH - Alaska Plaice	43	Total Precipitation Accumulation at Surface
22	EFH - Coho Salmon	44	Sediment Chlorophyll-a
22	EFH - Dover Sole	44	Integrated Chlorophyll-a

22	EFH - Dusky Rockfish	44	Benthic Macroinfaunal Parameters
22	EFH - Greenland Turbot	44	Bottom Water Nutrients
22	EFH - Grooved Tanner Crab	44	Sediment Community Oxygen Uptake
22	EFH - Northern Rockfish	44	Surface Sediment Parameters
22	EFH - Pacific Ocean Perch	45	Polar Data Catalogue Metadata Repository
22	EFH - Red King Crab	46	Aerial Herring Biomass Observations, PWS
22	EFH - Golden King Crab	46	Herring Spawn, PWS, Hexbin
22	EFH - Rex Sole	46	Aerial Herring Survey Effort, PWS [1974 - 1999]
22	EFH - Arctic Cod	46	Herring Commercial Harvest, PWS
22	EFH - Blue King Crab	46	Herring Age Sex Length, PWS
22	EFH - Flathead Sole	46	Herring Spawn, PWS
22	EFH - Pacific Cod	46	Aerial Herring Survey Route, PWS [1997-2016]
22	EFH - Rock Sole	47	Bird Observations
22	EFH - Yellowfin Sole	48	Marine Mammal Observations
22	EFH - Yelloweye Rockfish	48	Stellar Sea Lion Observations
22	EFH - Weathervane Scallop	49	Sea Surface Height
22	EFH - Walleye Pollock	49	Salinity at Surface and Depth
22	EFH - Triangle Tanner Crab	49	Sea Water Velocity
22	EFH - Thornyhead Rockfish	49	Temperature at Surface and Depth
22	EFH - Tanner Crab	50	Sea Water Velocity
22	EFH - Sockeye Salmon	50	Salinity at Surface and Depth
22	EFH - Opilio Snow Crab	50	Temperature at Surface and Depth
22	EFH - Sculpin	50	Sea Surface Height
22	EFH - Snow Crab	51	Salinity at Surface and Depth
22	EFH - Skate	51	Sea Water Velocity
22	EFH - Shortraker and Rougheye Rockfish	51	Sea Surface Height
22	EFH - Saffron Cod	51	Temperature at Surface and Depth
22	EFH - Squid	52	Sockeye Radio Telemetry, Copper River, Alaska
22	EFH - Arrowtooth Flounder	52	Chinook Radio Telemetry, Copper River, Alaska
22	EFH - Atka Mackerel	53	Monthly Average Air Temperature
22	EFH - Chinook Salmon	53	Monthly Total Precipitation
22	EFH - Chum Salmon	54	Scenario B1 Monthly Average Air Temperature
23	EVOSTC Historical Data Catalog	54	Scenario A2 Monthly Average Air Temperature
25	Extratropical Storm Surge Water Level	54	Scenario A1B Monthly Total Precipitation
25	Extratropical Storm Surge Plus Tide Water Levels	54	Scenario A2 Monthly Total Precipitation
25	Extratropical Storm Surge Water Levels	54	Scenario A1B Monthly Average Air Temperature
26	Elevation relative to sea level	54	Scenario B1 Monthly Total Precipitation
27	Analysed SST	55	Research Assets
28	Sea Surface Temperature	56	Stokes Drift Directions
28	Sea Ice Area Fraction	56	Peak Wave Periods
29	Mean Daily Discharge	56	Significant Wave Heights

29	Modeled Snow Water Equivalent Depth	57	Demersal Fish Distribution
30	Humpback Whale Observations	58	Alaska Precipitation
31	Trading Bay CIRCAC Salt Marsh Mapping	58	AWSHED CRKS Watershed Boundaries, 6th level
31	Chickaloon Bay CIRCAC Salt Marsh Mapping	58	Streamflow Regions
31	Redoubt Bay CIRCAC Salt Marsh Mapping	58	Anadromous Waters Interior
32	Hydrocarbon Contaminant Sampling Locations from CIRCAC	58	Anadromous Waters Arctic
32	EVOSTC Shoreline Surface Oiling	58	Anadromous Waters Southwest
32	Extent of the Exxon Valdez Oil Spill	58	Anadromous Waters West
32	Exxon Valdez Oil Spill Shoreline SubSurface Oiling	58	Hydrography, HUC4-1902, 1:63K [2009]
33	Anadromous Char, Trout and Whitefish	58	AWSHED CRKS Watershed Boundaries, 5th level
33	Finfish Distributions	58	Hydrography, HUC2-19, 1:1M [2007]
33	Marine Mammal Concentration Areas	58	Anadromous Waters Southeast
33	Bird Concentration Areas	58	Hydrography, HUC2-19, 1:63K [2007]
33	Marine Invertebrate Distributions	59	Direction Of Swell Waves
33	Bald Eagle Nest Locations	59	Significant Wave Height Combined Wind Waves and Swell
33	Anadromous Salmon	59	Wind Wave Period
33	Sea Mammal Critical Habitat Areas	59	Wind Wave Direction
33	Terrestrial Mammal Critical Habitat Areas	59	Primary Wave Period
34	Low Zone Use	59	Significant Swell Wave Height
34	Lowmedium Zone Rock Size	59	Wind Wave Direction
34	Low Zone Slope	59	Significant Wind Wave Height
34	Lowmedium Zone Slope	59	Significant Wave Height Combined Wind Waves and Swell
34	Highmedium Zone Slope	59	Significant Swell Wave Height
34	High Zone Slope	59	Significant Wind Wave Height
34	Intertidal Low Roundness	59	Primary Wave Direction
34	Intertidal Debris	59	Swell Wave Period
34	Intertidal Energy	59	Wind
34	Highmedium Zone Use	59	Primary Wave Direction
34	High Zone Bioband	59	Wind
34	High Zone Energy	59	Direction Of Swell Waves
34	Low Medium Zone Bioband	59	Swell Wave Period
34	Low Zone Bioband	59	Wind Wave Period
34	Intertidal High Roundness	59	Primary Wave Period
34	Low Zone Dynamism	61	Primary Wave Direction
34	Lowmedium Zone Dynamism	61	Significant Wave Height

34	Highmedium Zone Dynamism	61	Wind Wave Period
34	Lowmedium Zone Use	61	Primary Wave Period
34	Intertidal Media	61	Secondary Wave Period
34	High Zone Dynamism	61	wind
34	Low Zone Energy	61	Wind Direction
34	Lowmedium Zone Energy	61	Secondary Wave Direction
34	Highmedium Zone Energy	61	Wind Wave Direction
34	Low Zone Rock Size	62	Air Temperature at 2 Meters
34	Highmedium Zone Rock Size	62	Snow Water Equivalent
34	High Zone Rock Size	62	Hourly Accumulated Precipitation
34	Low Zone Relief	62	Surface Skin Temperature
34	Lowmedium Zone Relief	62	Hourly Accumulated Snow and Ice
34	Highmedium Zone Relief	62	Wind
34	High Zone Relief	62	Sea Surface Temperature
34	Intertidal Subclass	62	Physical Snow Depth
34	High Zone Use	63	Snow Water Equivalent
34	High Medium Zone Bioband	63	Wind
34	Intertidal Lowmedium Roundness	63	Sea Surface Temperature
34	Intertidal Highmedium Roundness	63	Hourly Accumulated Precipitation
35	Aerial Survey Path, Kamishak Bay, Alaska [1978-2001]	63	Hourly Accumulated Snow and Ice
35	Herring Spawn, Kamishak Bay, Alaska [1978-2001]	63	Air Temperature at 2 Meters
35	Relative Spawn Prediction Index (1-1000), Kamishak Bay, Alaska	63	Surface Skin Temperature