EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
DATA MANAGEMENT PROGRAM PROPOSAL SUMMARY PAGE

Program Lead Name and Affiliation

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Program Abstract

The *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) requires a data management program composed of tools covering the entire data lifecycle, from immediately after data collection, to long-term preservation, to discovery and reuse. During the last EVOSTC five-year funding cycle, the Alaska Ocean Observing System (AOOS) provided data management services for both the "Long-Term Monitoring of Marine Conditions and Injured Resources and Services" Program, referred to as Gulf Watch Alaska (GWA), and the "Herring Research and Monitoring" (HRM) Program. These two programs leveraged the existing data management capacity of AOOS, but also helped inform and improve AOOS' overall data and metadata management, access, and visualization tools. Because of these past investments, the AOOS team and infrastructure are best situated to provide data services to the EVOSTC for the next five years and thus maintain continuity and build upon the ongoing efforts and data management system development. Beginning in 2017, AOOS proposes to continue providing access to these tools and services for which the principal investigators (PIs) of the GWA and HRM Programs depend. Among these, the Ocean Workspace, a web-based data management platform, will be maintained and supported to upload, organize, and document data, as well as to facilitate program administration. This platform is familiar to GWA and HRM PIs from the prior funded effort, and allows data to be made promptly and securely available to team members and program administrators. During the spring of 2016, the existing Ocean Workspace will be updated with an enhanced metadata editor designed to help researchers more easily generate flexible yet robust, standards-compliant metadata. As in previous years, GWA and HRM Program data will be shared publicly (or 'published') through the AOOS Gulf of Alaska Data Portal, where it can be accompanied by any supplemental files or project documentation. Publishing through AOOS makes the data available to a wide-ranging and established network of resource managers, scientists, and the general public to support decision-making. In addition, the GWA and HRM Program datasets will be ingested into DataONE for long-term preservation, where each dataset will be assigned a digital object identifier (DOI) and made discoverable through other DataONE nodes[1]. Through the AOOS data management system, the significant expertise of the data management staff at its technical partner organization, Axiom Data Science, is leveraged. The Axiom staff have extensive experience with the GWA and HRM Programs and their associated data through the prior five-year effort. Building upon these established relationships and infrastructure, AOOS is well-poised to deliver continued success in its data management services to facilitate the access and curation of data to support decision-making related to Spill affected ecosystems.

[1] The DataONE integration is underway and will be in place and operational before the start of the 2017-2021 funding cycle.

Appendix B

EVOSTC Funding Requested *(must include 9% GA)*

FY17	FY18	FY19	FY20	FY21	TOTAL
$218,000	$218,000	$218,000	$218,000	$217,900	**$1,089,900**

Non-EVOSTC Funding Available

FY17	FY18	FY19	FY20	FY21	TOTAL
$2,705	$2,786	$2,869	$2,955	$3,044	**$14,359**

1. Executive Summary

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 is 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 and environmental intelligence tools to help make sound decisions.

In 2012, EVOSTC awarded the Alaska Ocean Observing System (AOOS) a data management contract entitled "Collaborative Data Management and Holistic Synthesis of Impacts and Recovery Status Associated with the *Exxon Valdez* Oil Spill". In that project, AOOS and its partners successfully designed, developed, and maintained an interactive web-based data management system to support the data management needs of the GWA and HRM Programs and the EVOSTC.

This proposed FY17-21 work plan responds to the EVOSTC's continued need for a cost-effective data management program that also maintains continuity and builds upon the efforts of the prior contract. AOOS and its technical partner, Axiom Data Science, are best situated to provide that continuity by leveraging the data management system that was instituted for the GWA and HRM Programs in the previous five-year effort. In this proposed work, this system will be maintained and augmented to enhance the accessibility of GWA and HRM data and products to ensure they are readily available to the general science and natural resource management communities, both now and into the future.

The goal of this program is to provide critical data management support to GWA and HRM investigators and program managers in order to assist study teams in efficiently meeting their objectives and ensuring data collected or consolidated through the effort is organized, documented, and available for their use and for future use by the larger scientific community. We propose to be successful in meeting the goal of this project under a reduced budget by leveraging the extensive cyberinfrastructure and data management capacities of both Axiom and AOOS, and utilizing the existing, collaborative relationships with program PIs to ensure continuity in the data collected across efforts. These goals will be achieved with the following objectives:

Objective 1. Initiate data management services and oversight for EVOS GWA and HRM Program data-related activities.
Objective 2. Continue to standardize and provide access to data sets from the first five-year GWA and HRM efforts for continuity and integration.
Objective 3. Facilitate, monitor, and evaluate regular data submissions and metadata generation in the Ocean Workspace.
Objective 4. Provide, maintain, and modify technical infrastructure for user groups to access information produced or processed by the GWA and HRM Programs.
Objective 5. Publish and promote data collected by the GWA and HRM Programs, making it available for research, management, and general audiences.
Objective 6. Execute management, user feedback, and internal and external communications related to GWA and HRM data and data products.
Objective 7. Verify data and metadata completeness and final transfer at the term completion.

This program prioritizes data preservation and accessibility to scientific and resource management communities. This will be achieved through support for data submission and organization, metadata generation, and data transfer among study teams. Axiom data analysts and domain experts will continue to review metadata and data structure formats produced from GWA and HRM data collection activities and advise study team members in best practices for short-term and long-term data formats, as well as metadata authoring. Axiom software engineers will also enhance existing web-based tools to improve the discoverability of GWA and HRM project-level data, which will include the ability to search and filter EVOS-funded datasets by space, time, parameter and taxonomy, both privately within the project and externally after the data have been shared with the public. This data curation process has been designed to meet the requirements of the EVOSTC as specified in the Data Management Program Invitation, which also includes the transfer of GWA and HRM Program data to the EVOSTC storage resources at the completion of this funding term.

While these tools will build upon existing systems that were developed with previous funding from multiple sources (including the EVOSTC), they will be sufficiently scalable to address any new developments within the HRM and GWA Programs and the other focus areas (i.e. Lingering Oil Program), and to meet the environmental intelligence needs of researchers and resource managers required for an effective understanding of ecosystems affected by the Spill.

The partners in this program include 1) the Alaska Ocean Observing System (AOOS), which will serve as the project manager and contribute its extensive data resources and infrastructure; and 2) Axiom Data Science, which will serve as the technical lead for the project. The program will be managed by AOOS Director of Operations Dr. Carol Janzen, who will serve as the liaison for direct communications with the EVOSTC. She will work closely with the Axiom data management team to ensure reporting and meeting requirements occur on time and as per instructed in the Program Invitation. The two partner organizations will work to serve a diverse team of GWA and HRM researchers and program managers as they contribute scientific data and information to support decision-making related to Spill-affected ecosystems.

2. Relevance to the Invitation for Proposals

The work in this data management proposal is relevant to the EVOSTC 1994 Restoration Plan priorities for "strategies that involve multi-disciplinary, interagency, or collaborative partnerships" and for efforts that will "include a synthesis of findings and results, and will also provide an indication of important remaining issues or gaps in knowledge" (Restoration Plan p. 16).

This program will provide critical data management support to GWA and HRM investigators and program managers to assist study teams in efficiently meeting their objectives and ensuring data collected is organized, documented, and available for their use and for future use by general science and natural resource management communities. Using the significant data management experience of AOOS, we propose to address these challenges through a combination of supporting advanced cyberinfrastructure and leveraging the expertise and collaborations developed during the first five-year effort. Through this work we will continue to implement a full-lifecycle data management system that replicates and enhances a technical infrastructure system that has been successfully used by study teams in the current five-year effort. The ultimate goal is to build an archive of organized, documented, and EVOSTC-funded scientific datasets from the Gulf of Alaska ecosystem that can be used in perpetuity by future generations of scientists and resource managers. Through this, we expect: 1) a continued track record in archiving diverse datasets and implementing data discovery portals; 2) engagement with researchers and others stakeholders that will facilitate an expansion of the user context of datasets collected under the GWA and HRM Programs; and 3) a decade of experience managing and curating data collected by large, multidisciplinary research and monitoring programs that will inform the next decade of data collection by these programs.

In the Data Management Program Invitation, the EVOSTC states the need to ensure that critical data and products of the GWA and HRM Programs are available to the scientific and natural resource management communities, both now and into the future. Multiple reasons exist for sharing and archiving data, including reuse of old data for new research, reproducibility of results as well as improved scientific discovery through greater reliance on scientific information. This proposed data management system will provide GWA and HRM researchers access to intuitive tools and accessible staff to support the ingestion, organization, sharing, documentation, discovery, access, and reuse of a complex array of data types related to the Spill-affected ecosystem. As an example, the proposed FY17-21 HRM Program will be exploring the appropriate temporal and spatial scales of oceanographic drivers of herring recruitment or conditions (Objective 3 in the HRM Program). This HRM Program objective will require analysis of the relationships between oceanographic factors (such as temperature, salinity, and stratification-mixing) to understand how these environmental factors control various aspects of the herring lifecycle. Conducting the analysis will require easy access to existing and newly generated project-level data from both the HRM and GWA Program, and consistency of file formats among incoming project-level data as well as the historical data for the proposed FY 17-21 modeling efforts. The proposed Data Management Program has been established to perform the appropriate data sharing and accessibility between the EVOS funded Programs, thereby making project data integration and cross-collaborations efficient and tractable.

With a rapidly changing ecosystem in Alaska, new challenges exist for gaining an effective understanding of the effect of the Spill and the recovery status of affected ecosystems. Ready access to up-to-date scientific information is critical for detecting and understanding ecosystem changes to facilitate the recovery of injured resources and services. Researchers, resource managers, and restoration workers are among those needing this information to aid their decision-making, and will benefit from the ultimate success of this data management program. Through extending the capacity of the AOOS data management system, we aim to meet the needs of the GWA and HRM researchers as well as other stakeholders, including agency managers, policy makers, and local communities, thereby enhancing the value of the EVOSTC's investment in research and monitoring.

3. Program Personnel

The Program Lead will be Dr. Carol Janzen, Operations Director at AOOS. Dr. Janzen has her Ph.D. in Oceanography and three decades of experience in this field, including managing environmental

monitoring programs for private industry and state agencies, and serving as a lead principal investigator, research coordinator and project manager in the academic and private industry sectors. She has extensive internal and external communications and customer liaison experience, both nationally and internationally. In her current position, Dr. Janzen reports directly to the AOOS Executive Director, and is responsible for administrative oversight of all AOOS program objectives and activities, as well as serving as program manager and Lead Principal Investigator on multiple external grants. We are requesting salary for 6% of Dr. Janzen's time for this effort, which amounts to about 3 weeks annually. An additional week of Dr. Janzen's time is being made available in-kind through the AOOS program, bringing her total time dedicated to the program up to 1 month, or 8% FTE.

Axiom Data Science oversight will be managed by Rob Bochenek, who is the Lead Information Architect at Axiom. All work plans and activities will be coordinated with Dr. Janzen and the Program Leads from all EVOS programs at the inception of the program. The following additional personnel from AOOS and Axiom will be involved in this data management program. Their respective duties are listed in Table 1 followed by an organizational chart in Figure 1. The CVs for senior personnel are appended to this proposal (Appendix 1).

Table 1. The Data Management Program key personnel listed by name, organization, title, program duties, and percent of time dedicated to the program.

Name	Duties	% FTE
Carol Janzen, AOOS, Operations Director	Program Lead to provide primary project coordination, working closely with Axiom; serve as primary spokesperson to communicate, work with and respond to requirements of the EVOSTC; represent the Data Management project at EVOS Program meetings; review and submit annual reports and funding requests; ensure cross collaboration between HRM and GWA projects; facilitate cost-effective technically supportive funding required by project team.	8.0
Rob Bochenek, Axiom, Information Architect	Oversee all aspects of the Axiom portion of the project, and coordinate data management activities with AOOS, GWA and HRM Program Managers, and PIs	8.0
Chris Turner, Axiom, Data Librarian	Facilitate curation of datasets & provide guidance on data structures; track data submissions & metadata authoring; provide Ocean Workspace & metadata support	16.0
Stacey Buckelew, Axiom, Data Coordinator	Interface with GWA and HRM Program Managers, and PIs; track data submissions and metadata authoring; provide Ocean Workspace and metadata support	32.0
Shane StClair, Axiom, Software Architect	Maintain and enhance the Gulf of Alaska data portal to support continuity of data sets, including historical data and data collected during the previous five-year effort; enable automation of data audits and submission pathways	8.0
Ross Martin, Axiom, Senior Software Engineer	Maintain and enhance the Ocean Workspace to meet the needs of the GWA and HRM funded projects; enable automation of data audits and submission pathways	16.0
Brian Stone, Axiom, Senior Software Engineer	Maintain and enhance the Gulf of Alaska portal to meet the needs of the GWA and HRM funded projects; enable automation of data audits and submission pathways	16.0
Jordan Jenckes, Axiom, Data Analyst	Process physical oceanographic data to preservation-ready formats and support historical data aggregation	20.0
Luc Mehl, Axiom, Data Analyst	Conduct dataset manipulation and transformation to preservation-ready formats; conduct format readiness audits	16.0
Malcolm Herstand, Axiom, Data Analyst	Conduct dataset manipulation and transformation to preservation-ready formats; conduct format readiness audits	8.0

Appendix B

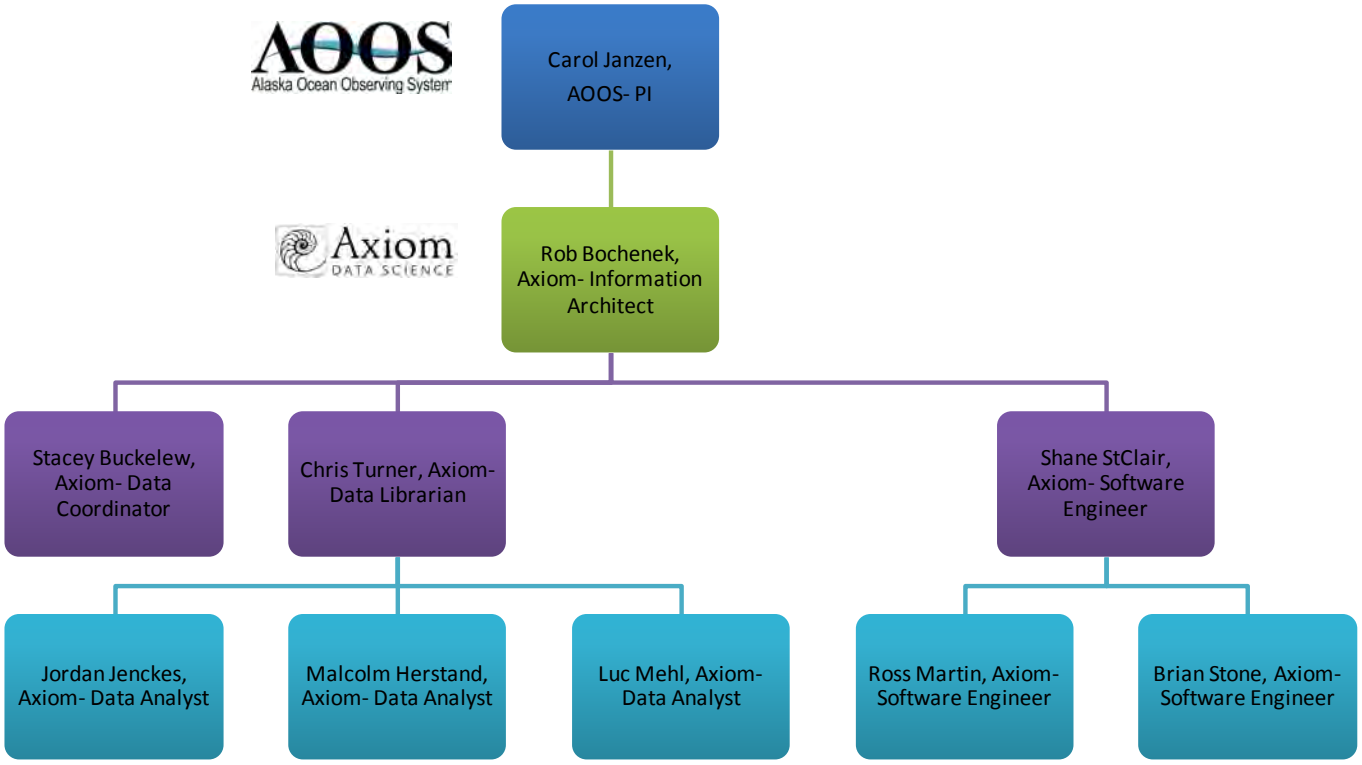

Figure 1. An organizational chart of key personnel for the data management program.

4. Program Administration

4.1 Administrative Plan

AOOS Director of Operations and Development, Carol Janzen, will lead the administration of this data management program in collaboration with Axiom Data Science. AOOS is a logical entity to lead this program since its mission is to address regional and national needs for ocean information, gather specific data on key coastal and ocean variables, and ensure timely and sustained dissemination and availability of these data to stakeholders that include scientists, natural resource managers, and the public. AOOS is the recognized Alaska regional component of the national Integrated Ocean Observing System (IOOS) and serves as the regional Data Assembly Center for oceanographic and coastal data and information products in Alaska waters. AOOS is governed by a board made up of federal and state agency and academic and research institution leads in Alaska, as well as representatives of NGOs and the private sector.

Axiom Data Science serves as the technical manager of the AOOS data management system. Axiom is mission-oriented and focused on developing scalable cyberinfrastructure that can be leveraged across a variety of users, clients, and institutions. Fifteen technical staff are employed at Axiom, primarily working in the software engineering or geoscience disciplines. Axiom's two focuses have been developing the cyberinfrastructure necessary to integrate and provide access to real-time, modeled, GIS and remote sensing data; and developing tools to address the needs of the scientific research community regarding project-level data types.

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This proposed data management program will be managed by AOOS, and all contract administration will go through the AOOS fiscal sponsor, the Alaska Sealife Center in Seward. AOOS will provide access to its existing cyberinfrastructure as well as a myriad of stakeholder networks for which information collected through the GWA and HRM Programs will be disseminated. As the Program Lead, Dr. Janzen will be responsible for ensuring coordination among the data management team, the EVOSTC, and with the EVOS funded GWA and HRM Programs. She will serve as the primary spokesperson to communicate, work with, and respond to requirements of the EVOSTC. Additionally, she will have oversight authority to ensure data accessibility and preservation needs of these EVOS programs are being met, and ensure annual reports are accurate, complete and submitted on schedule per stated in the RFP.

Axiom staff will focus on the day-to-day operations of this effort, including the responsibility for engaging with PIs, ingesting data, supporting metadata documentation, and curating data and data products from the GWA and HRM Programs to make them publically accessible. Rob Bochenek, Axiom's Lead Information Architect, will oversee all aspects of the Axiom work plan and tasks, including annual reporting requirements, and will be responsible for coordinating with Dr. Janzen on data management activities. The data management team at Axiom will actively coordinate and communicate data management activities directly with the GWA and HRM Program Leads and PIs. An organization chart summarizing the program management structure is shown in Figure 2.

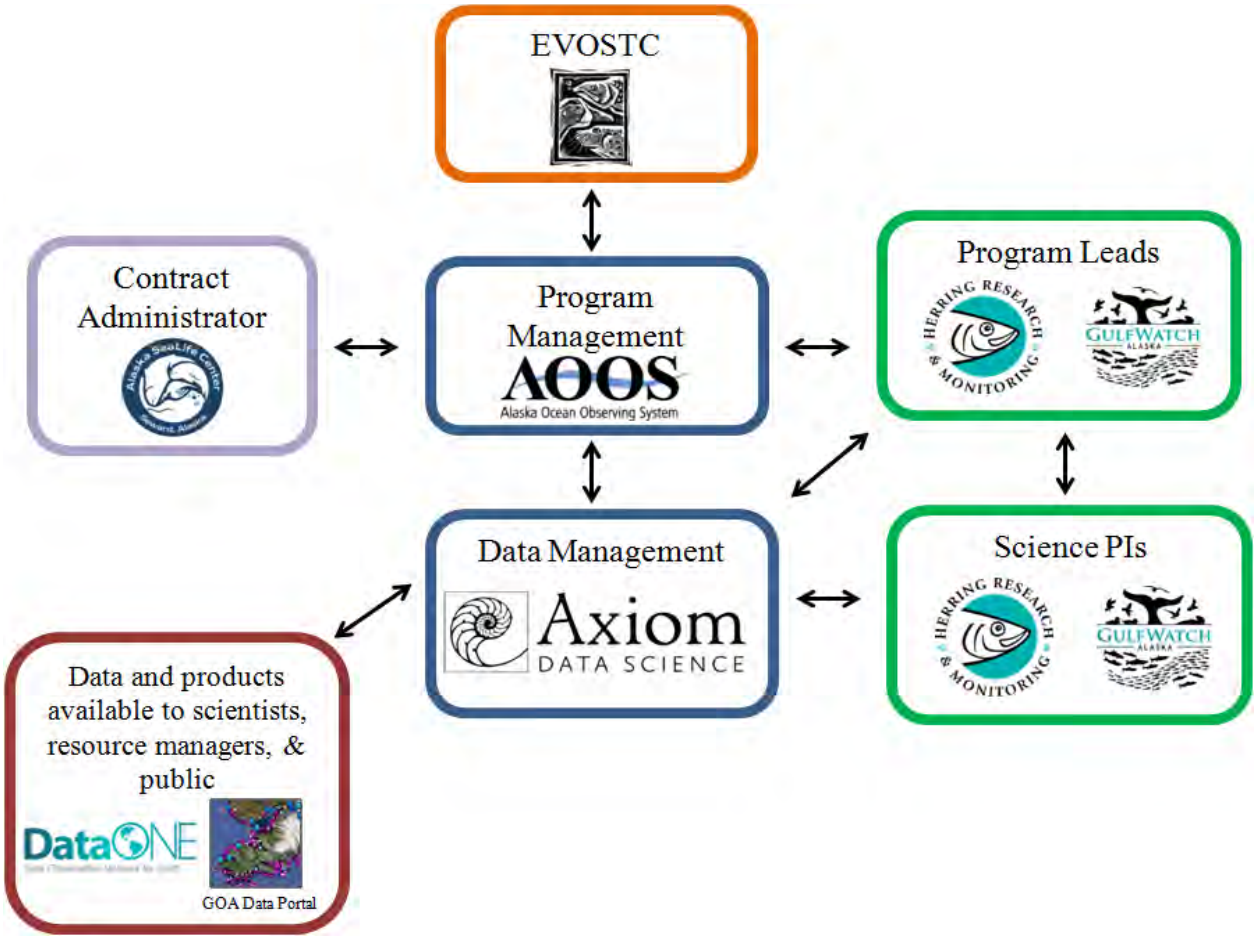

Figure 2. An organizational chart of the data management program management structure. This does not show the interactions between the EVOS-funded research and monitoring programs and their individual projects.

4.2 CONTRACT ADMINISTRATION AND RATES

The data management program contract administration will be covered through the AOOS fiscal sponsor, the Alaska SeaLife Center (ASLC). AOOS salary fringe benefits are charged as actual expenses (Direct Costs) estimated at 30% of salary. Fringe includes the cost of accrued leave, employer contributions to health insurance, required payroll taxes (social security, Medicare, and unemployment), and employer contributions to retirement plans (401K), long-term disability, workers compensation and other insurance programs.

Axiom salary fringe benefits are also charged as actual expenses (Direct Costs) and charged at 30% of salary. Axiom also charges a facility fee of 21% applied to personnel costs (Salary and Fringe) which covers the costs of operating its data center and other utilities.

AOOS does not charge indirect costs on grants it manages. All costs for the contract budget (including those provided by subaward to Axiom) are shown as direct costs. AOOS pays the Alaska SeaLife Center an overall fiscal sponsor fee at a 5% contract rate for administration fees for contracts, and those fees are paid to cover the following administrative duties:

- Accounting Services: Accounts payable, accounts receivable including invoicing of grant receivables.
- Audit services: Retain auditor and oversee annual audit per federal audit requirements. Provide auditor with information needed to conduct audit. Respond to any audit issues. Oversee compliance with federal award conditions, federal and state laws, and audit requirements. Maintain complete set of grant files.
- Grant Services: Assist with development of grant proposals and budgets, and submit on AOOS behalf. Review drafts and assist with preparation of subawards and contracts. Monitor administrative and compliance aspects of subawards and contracts. Provide overall grant financial tracking, monitoring and reporting. Assist with award changes and special requests (e.g., international travel, no cost extensions). Prepare and submit financial reports per grant requirements. Review financial transfers or budget amendments.
- Office Space: Maintain telephone system. Maintain official equipment inventory records. Review draft contracts (e.g., for rent, parking). Ensure physical equipment inventories are completed in accordance with grant requirements.
- Human Resources Support: Provide payroll administration, timesheets and process payment. Prepare W-2 forms, benefit package paperwork and assistance. Obtain and oversee worker's compensation, D&O and liability insurance policies, and process claims on insurance policies. Provide training and guidance on any personnel issues.

4.3 MEETING AND TRAVEL COSTS

A total of three weeks of Dr. Janzen's time has been budgeted per year for program management and administration activities. An additional week of her time is being contributed in-kind to the effort through AOOS. Dr. Janzen's budgeted time includes attendance at the annual EVOS GWA and HRM Program PI meetings and Alaska Marine Science Symposium. This budgeted time is five days total (including travel) per year. The majority of these meetings will be held in Anchorage, and up to three will be held in Spill-affected communities, such as Cordova, Homer, or Kodiak. Travel for the three annual PI meetings held outside Anchorage are budgeted to include round-trip airfare ($350) and per diem ($125 for two days). Two of the Axiom data management team members (Stacey Buckelew and Chris Turner) will also participate in the annual PI meetings and the Alaska Marine Science Symposium. This budgeted time is five days total (including travel) per person each year.

4.4 INFORMATION AND DATA SHARING PROTOCOLS

The EVOSTC requires data sharing among all principal investigators and program components. The GWA and HRM Workspace groups within the AOOS Ocean Workspace are password-protected to ensure data can be securely shared among GWA and HRM teams before it is ready for public release.

This data management program will require all PIs to adhere to the policies below, adopted by the GWA and HRM teams during the first five-year phase of the programs, unless prohibited by a partner agency.

- All data are to be posted on the GWA and HRM Workspace groups as soon after collection as is possible in order to promote internal integration and sharing within the project.
- Final QA/QC versions of data are to be added to the Workspace alongside the initial (raw) versions.
- Comprehensive standards-compliant metadata will be required for each final dataset.
- Metadata shall be authored by the PIs iteratively throughout the data workflow process using the Workspace metadata editor, unless individual agencies provide or require other means of creating metadata and provide a standards-compliant metadata record to be uploaded into the Workspace.
- Monitoring data will be made available to the public as soon as it has been QA/QC'd, or within 1 year following collection, whichever is sooner.
- Anyone making public use of another team member's data should contact the collector of the data and provide appropriate attribution and credit.
- The Programs' Science Coordinating Committee must agree to any deviations from these policies in advance.

Additionally, all PIs and project managers are expected to adhere to EVOSTC policies regarding retention of all documents, correspondence (electronic and paper), samples, and data per the terms of the EVOSTC court settlement.

4.5 REPORTING POLICIES AND SCHEDULE

Dr. Janzen will work with the Axiom data management team in advance of the report deadline to ensure adequate preparation of annual reports and budgets. AOOS will be responsible for the annual report submittal on March 1 each fiscal year, which will include a completed Program Summary Status Form, a Project Reporting form and correlated Budget Forms. To assist with the preparation of these reports, Dr. Janzen will review each quarter with Rob Bochenek (Axiom) the Data Management team's progress, and will help to facilitate the budget planning required by the project team prior to the annual funding requests (Updated Annual Proposals) on September 1 of each year.

The annual report will adhere to the following policies for the duration of this program following the below protocols:

- Ensure adequate resources are available for preparing and disseminating the report.
- Ensure that realistic timeframes are set for producing the report.
- Include information about data management services that is accurate, complete, easy to interpret, and addresses only issues that relate to the data and data product(s) being reported.
- Include special notification of non-compliant data submissions (following the procedures listed below).
- Include additional information as requested by the EVOSTC directly and/or within the report template.

Plan for addressing non-compliant PI's and programs

In the GWA and HRM Programs, PIs that fail to submit timely data and metadata in accordance with the above procedures are subject to corrective action, including recommendation to withhold a portion of the funds until compliance is met. An administrative file and metadata inventory tool within the Workspace (described in the Technical Infrastructure section below) will be used to identify potential PI non-compliance with data submission. At the annual one-on-one PI meetings (scheduled six months prior to annual report submission) the PI will be notified by the data management team of any shortfalls to their data submission and metadata authoring. Thereafter, the PI must correct any shortfalls within three months and steps must be taken to ensure future timeliness of submissions.

Following a failure to correct these submissions within three months, an *Out of Compliance* notification will be submitted by the data management team to the program managers and the associated PI(s). Clear documentation will be provided of what is required to correct any non-compliance. Together with the notification, internal controls will be discussed with the program managers to determine root causes of non-compliance and to adjust expected timetables or help ensure the PI maintains compliance in the future. Internal controls may include updates to the Workspace organization, ongoing training to the PIs, and/or additional data management support (e.g. metadata or database templates, one-on-one meetings, etc). Thereafter, with additional oversight by the program manager, the PI must correct any non-compliance within three months and steps must be demonstrated to ensure future compliance.

After these corrective actions, if the PI still fails to submit data then a *Non-Compliance* report will be submitted by the data management team to the EVOSTC during the annual report cycle. The *Non-Compliance* report will detail the nature of the non-compliance and corrective action steps taken by the PI(s) and data management team. The report may also include a recommendation for financial withholdings until compliance has been achieved.

5. Program Technical Design

5.1 TECHNICAL INFRASTRUCTURE: OVERVIEW

In this proposed work, the existing AOOS data system will be leveraged and enhanced to achieve the goals of the data management program. The data system and its expected developments are described below as follows:

(A) EXISTING INFRASTRUCTURE: AOOS Data System
(B) EXISTING INFRASTRUCTURE TO BE ENHANCED FOR IMPLEMENTATION: Ocean Workspace, metadata editor, and the Gulf of Alaska Data Portal
(C) DATA PUBLICATION AND PRESERVATION: Automated submissions to Gulf of Alaska Data Portal and national repositories.

A. Existing Infrastructure: AOOS Data System

The AOOS data system is the backbone of the cyberinfrastructure that will be leveraged to support end-to-end GWA and HRM data management. This infrastructure has been developed to meet the guidelines and specifications recommended by the NOAA-funded Integrated Ocean Observing System (IOOS) and endorsed by the federal Interagency Ocean Observation Committee and Global Earth Observation Program. The data system is built using several mature, open-source interoperability and data stewardship systems to provide full-lifecycle data management services, including: data ingestion,

metadata, data aggregation and assembly, data catalogue and discovery, QA/QC, data access and transport, data storage, and end user input and feedback.

The system is divided into four logical tiers, which separate the suite of technologies composing the system. Tier 1 is the source data produced by researchers, instruments, models, and remote sensing platforms, which are stored as files or loaded within geospatial databases (Fig 3). Interoperability systems in Tier 2, such as Web Map Services (WMS) and Web Coverage Services (WCS), are then implemented and connected to these underlying data sources. The asset catalogue, Tier 3, connects to internal interoperability systems in Tier 2, and to known external sources of interoperable data that populate a database describing the dimensional characteristics (space, time, measured parameter, and taxonomy) of each data resource. Web services in Tier 3 provide access to the descriptive metadata contained in the asset catalogue database for applications to more easily utilize data from multiple sources, formats, and types. The final technical level, Tier 4, is composed of the web-based applications and tools that allow users to discover and explore the data resources in the system. From the top of the pyramid, users have a powerful and intuitive experience of the underlying systems working together to facilitate rapid data discovery, improved data accessibility and understandability, and the potential to develop knowledge about the physical and biological environment.

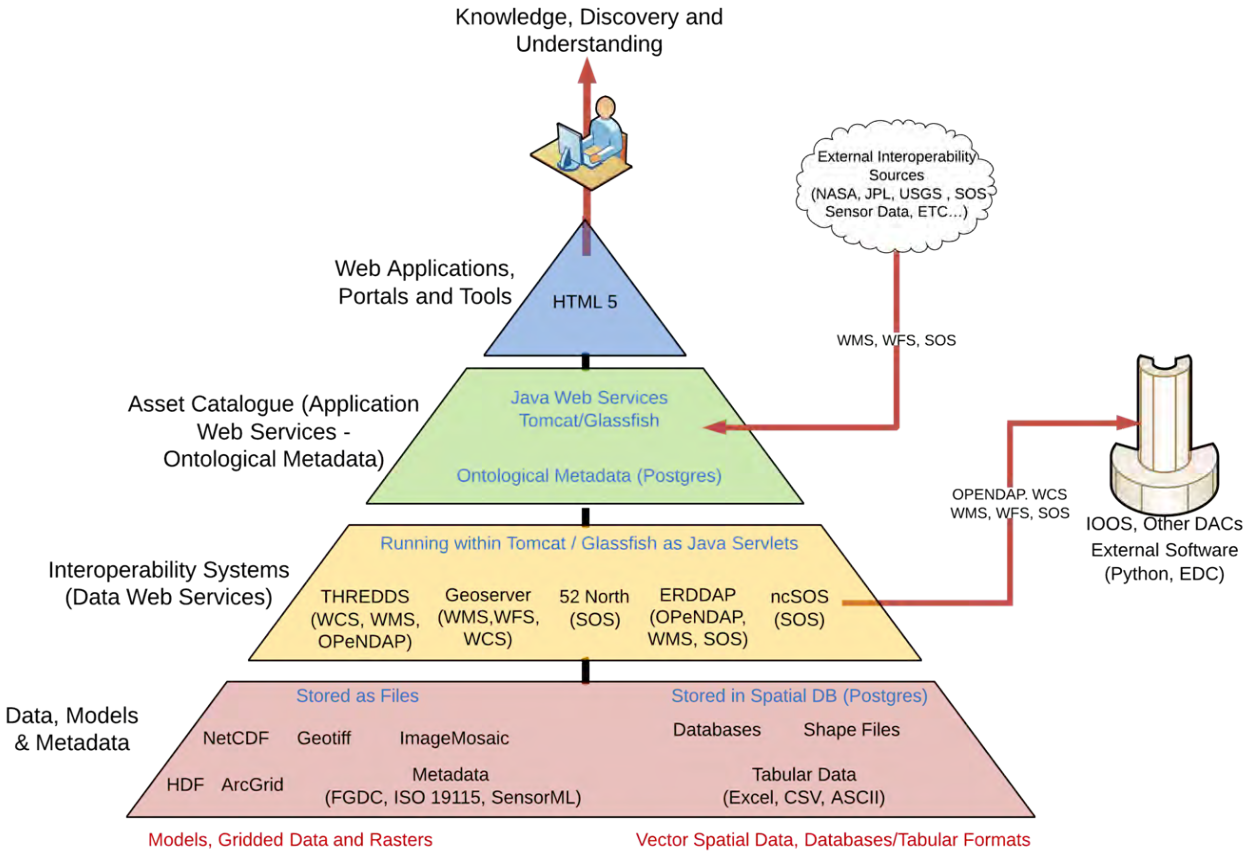

Figure 3. A schematic of the AOOS Data System that details the flow of data through logical technology tiers so that it can be consumed by users to enable discovery and understanding of GWA and HRM data and products.

AOOS Data System: Tier 1 (Data, Models and Metadata)

At the base of the data system framework are the datasets, metadata, and model outputs that provide the foundation for applications and user tools. These resources can be stored either in native formats or spatially enabled databases. The decision to choose one method over the other is dictated by the requirements of the interoperability system that will be serving the data. Data which has a tabular or vector form (Shapefiles, databases, Excel spreadsheets, comma separated values (CSV) text files, etc.) will be converted into netCDF files when appropriate, and will be loaded into a PostgreSQL database and spatially indexed. When possible, GeoServer, an open source geospatial data server, will then connect to the database and serve the data via WFS and WMS protocols. Imagery, raster, and model data will be stored in a file server in their native file formats. THREDDS and/or ncWMS will be used to serve NetCDF and HDF files which may contain two, three, four or higher dimensional gridded datasets. GeoServer or other OGC compliant mapping servers will be utilized to serve GeoTIFF, ArcGrid, or other two dimensional imagery/raster data.

AOOS Data System: Tier 2 (Interoperability Systems)

Various interoperability servers (GeoServer, THREDDS, ncWMS, 52 North SOS, etc.) are implemented on top of source data to expose a powerful set of interfaces for other computing systems and humans to extract, query, and visualize the underlying source data. These systems will facilitate all aspects of data delivery to users in addition to providing the muscle for the machine-to-machine data transfer to national data assembly systems as required. These systems have been developed using the Java programming language and run within Tomcat servlet containers.

AOOS Data System: Tier 3 (Asset Catalogue, Ontological Metadata and Services)

The asset catalogue provides a description of known internally and externally available data resources, access protocols for these resources (interoperability services, raw file download, etc.), and directives on how to ultimately utilize these data resources in applications. Because documentation and access methods vary widely between data sources, a system that catalogues data sources and reconciles these inconsistencies is essential if the data are to be used in an efficient manner. In addition to managing information about data availability and access methods, the asset catalogue also contains ancillary data such as geographic locations, spatial and temporal resolution, units, source location and CF parameter.

AOOS Data System: Tier 4 (User Applications)

Web services written in Java connect to the asset catalogue and provide applications with access to the underlying descriptions of AOOS data assets and sources. Because the asset catalogue contains relationally-structured maps between data types, sources, and a controlled set of definitions, user interface applications can connect users to vast arrays of data through simple but powerful interfaces. These interfaces include the following:

- A public-facing data catalog showing data assets that is updated automatically when new data is published into the system.
- A powerful, prioritized, Google-like search interface that allows users to search by geography, time, access method, or words contained in metadata descriptions.
- A secure method to share project-and file level metadata and data files with the public
- Interactive maps that allow users to explore other, related datasets relevant to the Gulf of Alaska.

User interfaces comprised of web-based applications and tools provide users access to all the data and products within the data management system. These applications provide easy ways to discover and explore data that has been published through the EVOS HRM and GWA programs.

AOOS Data System: Performance and Security

Axiom operates two High Performance Compute (HPC) clusters located in data centers in Portland, Oregon and Providence, Rhode Island. These HPC resources are composed of approximately 2500 processing cores staged in a series of interconnected blade arrays as well as 1.8 petabytes of storage. Compute nodes and storage nodes are connected over a low latency, converging network fabric (40 Gb/Sec Infiniband). GlusterFS is employed as a storage software abstraction layer that enables clients and storage servers to exploit data transfer over Remote Direct Memory Access (RDMA) protocols. This configuration enables data throughput from the storage cluster to the compute cluster to reach speeds greater than 160 Gb/Sec in high-concurrency situations. Axiom also has a dedicated multi-braided 1 Gb/Sec high speed internet connection for large file transfers between external data centers and for high-bandwidth demands of centralized web based applications. Axiom provides the following enterprise-level infrastructure capabilities:

- *Security and Redundancy* — Axiom operates two physically distributed, mirrored data centers (Portland, OR and Providence, RI). Each independent cluster also implements several levels of redundancy and backup. The two physical locations ensure that multiple redundant copies of data exist in addition to web application servers. Several layers of physical hardware (enterprise level firewalls) and system monitoring software (NAGIOS) are also in place to provide hardened cyber security.
- *Capacity and Performance* — High Performance Computing (HPC) has been a component of the Axiom technical strategy since early 2011. Axiom operates its own private "cloud" of compute and storage resources that data managers can provision to specific tasks and roles. The current number of processing cores and storage is scalable to allow additional resources to be added as necessary. Axiom engineers have demonstrated that large GIS, model, and remote sensing datasets require HPC environments to be visualized and queried over web-based interfaces. Because HPC is achieved through load balancing and parallelization, these types of systems also provide the added bonus of high availability and redundancy.

B. Existing Infrastructure to be Enhanced for Implementation

The Ocean Workspace and the AOOS Gulf of Alaska Data Portal will be immediately available for use at the start of the program to support data sharing, access, and use by the GWA and HRM programs. Over the life of the program, Axiom will implement planned enhancements to these components. These components, and the intended enhancements, are further described below.

Ocean Workspace

The AOOS data management team at Axiom Data Science have designed and developed a web-based data management application, named the Ocean Workspace ('Workspace'), that will be used by the GWA and HRM Programs to assemble, store, and share data between funded PIs and program affiliates. Since its release in April of 2012, the Ocean Workspace user base has grown to more than 500 individuals from a number of large-scale scientific research programs, including the EVOS GWA and HRM programs, the North Pacific Research Board's Gulf of Alaska Integrated Ecosystem Research Program and Annual Research Programs, the Distributed Biological Observatory, the

Marine Biological Observation Network (MBON, which includes the Arctic AMBON), the Arctic Animal Telemetry Network, the Marine Arctic Ecosystem Study, and several other integrated multidisciplinary programs. Users have uploaded over 18 terabytes of data spread across more than 800,000 files.

The Workspace provides users with an intuitive, web-based interface that allows scientists to create *projects* to represent particular scientific studies or focuses of research within a larger effort. Within each project, users may create topical groupings of data using folders and upload data and add 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 4). Standard, discovery-level ISO 19115-2 compliant metadata can be generated for both projects and individual datasets. Users of the Workspace are organized into groups, and everyone within a group can view the projects, folders, and files uploaded by other group members. This allows preliminary results and interpretations to be shared by geographically or scientifically diverse individuals working together on a project or program before the data is shared with the public. It also gives program managers and other stakeholders a transparent and front-row view of how users have structured and described projects, and how their programs are progressing through time. The Workspace has the following capabilities:

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

Advanced and secure file management — A 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.

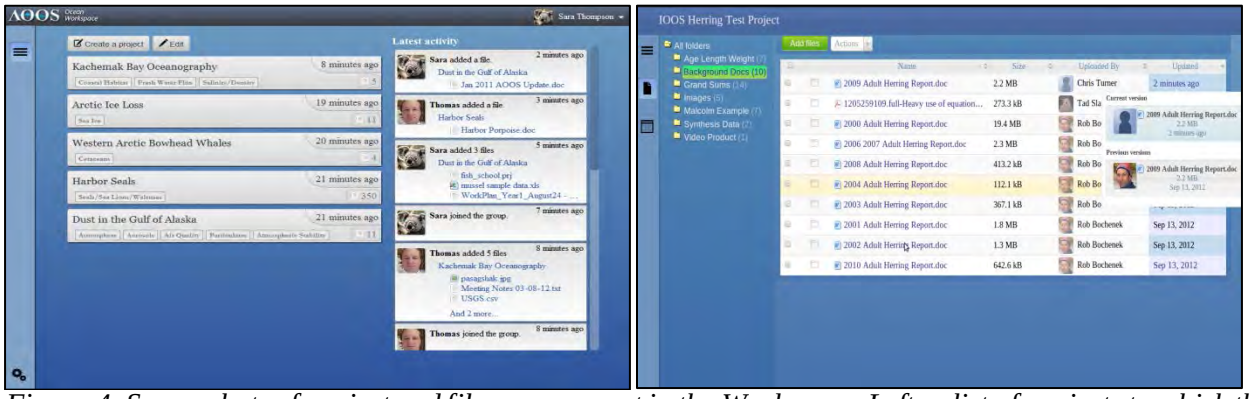

Figure 4. Screenshots of project and file management in the Workspace. Left: a list of projects to which the example user has access rights. Right: the interface a PI would use to organize independent files into folders, and the versioning system in the Workspace.

Specifically, the Workspace employs the following technological components:

- Database systems — PostgreSQL 9 is used for storage of tabular and relational data representations, and is extended with PostGIS for spatial data. All data uploaded to the Workspace is replicated across multiple database servers to provide redundancy and ensure high availability.
- Object storage and schema-less data representations — MongoDB is used as a persistent NoSQL storage and query system for file objects, tabular data (flat structures) and hierarchically structured data (generally XML). MongoDB allows horizontal scaling through sharing across physical devices and provides redundancy and high availability through replication. The MongoDB instance consists of a three-node cluster, and each node maintains a complete replicate of the others. Data within each node is further redundant by virtue of RAIDed disk arrays.
- Web tier — The web services used by the Workspace are developed using Java and integrated into a web application framework called Play!, which provides a stateless architecture for Java and Scala development. The RESTful, stateless design allows services to be scaled across application nodes for load balancing, redundancy and horizontal scalability. The framework is also used to provide real time notifications browser clients to enable collaboration amongst users.
- Caching and pub/sub — Redis is used as an intermediary between the web and data tiers. It also serves as our pub/sub interface for managing communications between web tier nodes and serving real-time connections to browser clients in a scalable manner.
- User interface — The user interface of the Workspace is composed of several JavaScript and HTML5 libraries and integrates with server side modules wrapped into the Play! framework. The frontend uses a client-side MVC architecture in Backbone.js that synchronizes with its backend equivalent to provide users with a more responsive experience than is typically found in many web applications.

Metadata Editor

The Workspace includes an integrated metadata editor to support the documentation of data and facilitate its accuracy and reuse. Content collected in the Workspace metadata editor uses fields from the ISO 19115 suite of standards for geospatial metadata, which is the FGDC endorsed successor to the CSDGM extended to describe taxonomic classification for biological datasets. To facilitate taxonomic description, Axiom developed a tool that allows users to search the ~625,000 taxonomic entities of the Integrated Taxonomic Information System (ITIS) in order to rapidly add species information to metadata. Because the Workspace is a cloud-based service, researchers can move between computers during the metadata generation process in addition to allowing team members and administrators to simultaneously review and edit metadata in real time.

Axiom utilizes the metadata editor as a core component in it data management services. Metadata is generated at multiple points throughout the project lifecycle. At the onset of the project high-level overview information about the project is documented, which includes the location, project timeline, contacts, keywords, taxonomic species, and expected data. As the project progresses and data is collected and moved through the quality control, processing, and analysis phases, more-descriptive metadata can be captured by the PI and their research teams. While the workflow for creating metadata may vary project-by-project, annual metadata revisions help to keep pace with new data submissions and changes to the collection procedures. As the project data matures, the

completeness, content, and quality of the metadata record should also mature to robustly describe the data and meet national format standards.

After metadata has been written that complies with content and quality requirements, the Workspace can be used as a gateway to publish data and associated metadata to a publicly-accessible data discovery portal (Fig 5), described in more detail below. This feature simplifies the publishing of data and metadata for PIs, funders, and data managers.

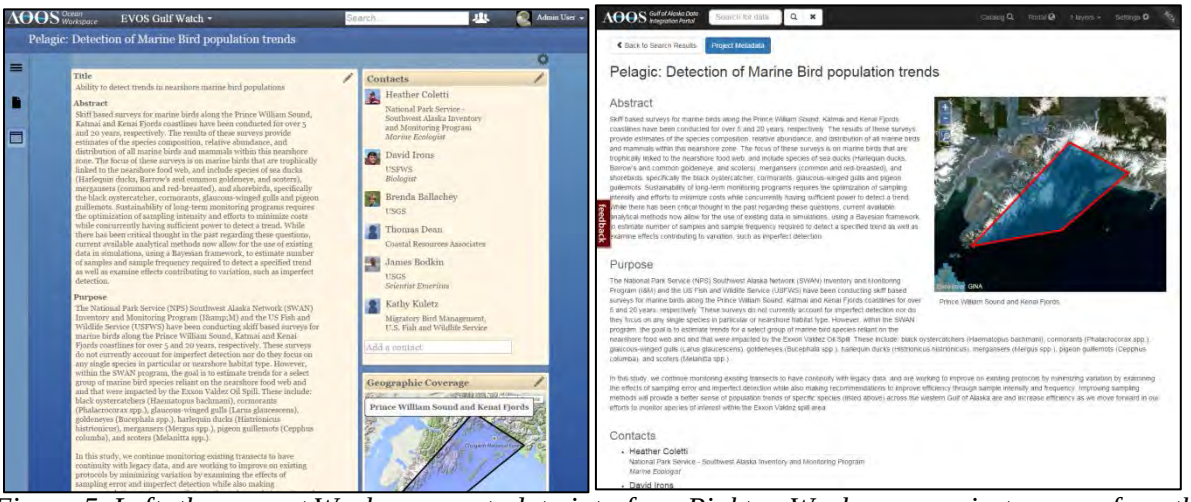

Figure 5. Left: the current Workspace metadata interface. Right: a Workspace project as seen from the Gulf of Alaska data portal.

At the time of proposal submission, an updated metadata editor is under development for the Workspace (Fig 6). The new editor will include more metadata fields, allowing more robust descriptions of datasets and their connections to other resources, and will ease the metadata generation process with short, modular, and easily understood entry forms. During the 2017-2021 funding cycle, the editor will be expanded to include data-type specific metadata input templates. The new editor will be released in Spring 2016, with templates being released periodically afterward.

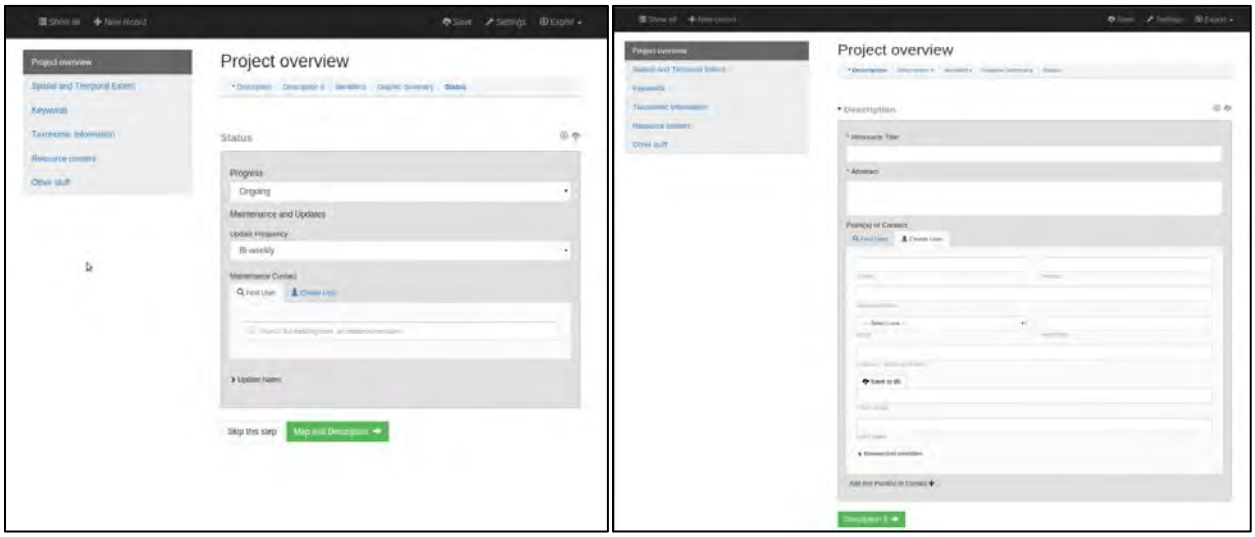

Figure 6. Screenshots of the in-development metadata editor. Left: the 'Status' tab on the 'Project Overview' metadata page, with fields to capture status, update frequency, and point of contact for project updates. Right: the basic 'Description' tab on the "Project Overview' page, showing title, abstract, and point of contact fields.

Gulf of Alaska Data Portal

AOOS will provide and maintain support for the Gulf of Alaska Data Portal, a customized public web interface that allows scientists, managers, and the general public to discover and explore datasets collected through the EVOS GWA and HRM Programs and related datasets that already exist in the AOOS data system. The portal uses the metadata and other contextual information that has been entered or created in the EVOS GWA and HRM Program's Workspace accounts to develop a series of search indexes 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. When implemented, 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.

The individual EVOS GWA and HRM project descriptions, sampling activities, data sets, and other products will be showcased via this interface while being coupled with Gulf of Alaska models, sensor feeds, and GIS datasets already under the stewardship of AOOS at: http://portal.aoos.org/gulf-of-alaska.php. The Gulf of Alaska portal, on top of the other infrastructure available to this effort, provides a framework to rapidly deploy or edit the public-facing data catalogues of the GWA and HRM Programs using the Workspace as a secure point of entry. The portal is powered by a combination of geoserver, postgres, java services, and several other systems running on a clustered data center with user interface tools written in javascript.

C. Specific Enhancements to Existing Technical Infrastructure

Under this proposed effort, enhancements will continue to be made to the technical infrastructure, including the Workspace, metadata editor, and public Gulf of Alaska Data Portal. These enhancements will build upon both the data manager and user experiences gained during the previous five-year effort. Continual adaptation of technology is required to keep pace with the volumes and diversity of data collected within the GWA and HRM Programs and the added functionality that is needed to provide connectivity among them. Using these enhancements, we aim to streamline and improve the performance of these systems to meet the Programs' needs, and to make data more easily discoverable and usable to a broader community of scientists, researchers, and decision-makers. These enhancements are described in more detail in the Objective and Milestones section below, and include:

- Complete automated submission pathways from the Workspace to national archives;
- Revision of the newly incorporated, ISO-compliant metadata editor based on usability feedback; and
- Connectivity in the Workspace and portal for continuous datasets across funded efforts, including records of published resource identifiers (e.g. DOIs or accession numbers).

6. Coordination and Collaboration

6.1 Herring and Long-Term Monitoring Program Coordination

Building upon previous experiences, we propose to continue our success by strengthening the existing collaborative relationships with the GWA and HRM Programs to most effectively meet their data management needs, including those of the other focus areas (i.e. Lingering Oil, Cross-Cutting, and Publication groups). By its very nature, AOOS's technical infrastructure (described in this proposal) is collaborative in the sense that the Workspace is designed to give open access across program teams for

file sharing and transparency of data progress. Backing this infrastructure is a data management team that is well-coordinated with GWA and HRM program managers and science teams for timely data submissions and accuracy of metadata authoring, and to ensure data and products are available to general science and resource management communities.

The coordination among these Programs will be achieved through the activities listed below:

- Across program coordination: Overall coordination of the data management effort will be provided by Dr. Janzen, the AOOS Program Lead, who will be responsible for ensuring coordination within this project and across the GWA and HRM Programs. AOOS's time dedicated to the EVOSTC programs will now be focused on data management project oversight to ensure integration across GWA and HRM Programs and the data management services. Coordination across the programs will occur through email, phone communications, and regularly schedule in-person meetings. Dr. Janzen and representatives from the Axiom data management team will attend annual PI meetings and regularly scheduled Program Management Team phone calls to ensure a seamless response to data management and decision-support needs.

- Within program and individual coordination: Regular communication will be maintained throughout this project between the Axiom data management team and the GWA and HRM PIs both within the program (e.g. all GWA or HRM PIs) and at the individual PI level. These communications are a continuation of effective working relationships developed with the science teams in the first five-year effort.

    - Within program: The data managers will maintain regular communications with PIs, program management, and EVOSTC staff through participation at annual PI meetings and through regular program-wide emails correspondence. At meetings AOOS and the data management team will communicate to all PIs about data submission progress and procedures through presentations and group discussions. Using emails, PIs will be notified of program data inventories and the submission timelines to help encourage compliance.

    - Individual: Regular communications will also be maintained to individual PIs through annual one-on-one meetings, and regular email and/or phone conversations. One-on-one meetings will be held at the start of the program to develop a project-level DMP, and then annually thereafter to track project progress and provide hands-on support for data organization, formatting, and metadata authoring. The data managers will also use email to inform individuals PIs of their data submission progress using the data inventory tool, and to respond to PIs inquiries and/or requests for additional assistance. Depending on the location of individual PIs, this assistance will be provided through the most practical communication method (e.g., email, phone correspondence, or scheduled meetings).

6.2 TRUSTEE OR MANAGEMENT AGENCIES COORDINATION

AOOS brings a significant level of leveraged resources, infrastructure, regional data management projects and partnerships to the proposed effort. The data management services for the GWA and HRM Programs could not be accomplished for the funds available within this proposed Data Management Program without these existing and leveraged resources. The project team provides data management visualization, and preservation services (including providing access to and facilitating the use of the Ocean Workspace) to a number of other programs that receive funding from or are administered or overseen by representatives from the Trustee Council agencies. None of the programs or projects listed

above conflict with this proposal. Some of these programs and their associated Trustee agencies are given below (Table 2).

Table 2. Other groups and agencies for which AOOS and Axiom coordinate data management services.

Group, Agency	Level and Type of Coordination	Representative
Arctic Marine Biological Observation Network (AMBON), BOEM	Coordinate all data management activities for AMBON using the Workspace	Katrin Iken, Lead Principal Investigator
Annual Research Program, NPRB	Guidance given on data and metadata best practices; access to and facilitation of the Workspace; organization and archiving of historical projects	Matthew Baker, Science Director; Jo-Ann Mellish, Program Manager
Arctic Ecosystem Integrated Synthesis (Arctic EIS), BOEM	Provide guidance to program management on data and metadata best practices; access to and facilitation of the Workspace; organization and archiving of completed projects	Franz Mueter, Lead Principal Investigator
Marine Arctic Ecosystem Study (MARES), BOEM	Develop data management plans for each sampling effort; access to and facilitation of the Workspace; acquire and ingest into AOOS Arctic Data Portal environmental datasets identified by program PIs as important context for MARES program; facilitate conversion of data into long-term preservation-ready formats; submission of datasets to long-term archives	Francis Wiese, Lead Project Manager
IOOS Systems Integration, NOAA	Develop community standards for sensor observations; make regional data nationally accessible	Derrick Snowden, DMAC System Architect
Beluga Sightings Database Visualization, NMFS	Visualizations, guidance on building community standards for submitting marine mammal stranding observations	Mandy Migura, Marine Mammal Specialist
Alaska Ocean Observing System (AOOS) Data Management, NOAA	Data management; cyberinfrastructure; working directly with member and non-member organizations to ingest and document new datasets; visualizations	Molly McCammon, Director; Phil Mundy, Data Management Committee Chair
Central and Northern California Ocean Observing System (CeNCOOS) Data Management, NOAA	Data management; cyberinfrastructure; working directly with member and non-member organizations to ingest and document new datasets; visualizations	David Anderson, Director; Jennifer Patterson, Information Manager
Gulf of Alaska Integrated Ecological Research Program (GOAIERP), NPRB	Fully facilitated data and metadata management working directly with PIs, from initial sharing within the group to long-term archiving at NPRB	Danielle Dickson, Program Manager
Russian-American Long-term Census of the Arctic (RUSALCA), NOAA	Access to Workspace; guidance on data and metadata management; archiving; visualizations in support of mission	Kathy Crane, U.S. Mission Coordinator
Alaska Data Integration working group (ADIwg), USGS	Generate community standards for project data; advise on translation from ADIwg metadata content profile into suite of ISO geospatial metadata of standards	Josh Bradley, Data Manager

7. Schedule

7.1 OBJECTIVES & PROGRAM MILESTONES

This proposed data management program is focused around the following objectives:

OBJECTIVE 1. Initiate data management services and oversight for EVOS GWA and HRM Program data-related activities.

OBJECTIVE 2. Continue to standardize and provide access to data sets from the first five-year GWA and HRM efforts for continuity and integration.

OBJECTIVE 3. Facilitate, monitor, and evaluate regular data submissions and metadata generation in the Workspace.

OBJECTIVE 4. Provide, maintain, and modify technical infrastructure for user groups to access information produced or processed by the GWA and HRM Programs.

OBJECTIVE 5. Publish and promote data collected by the HRM and GWA Programs, making it available for research, management, and general audiences.

OBJECTIVE 6. Execute management, user feedback, and internal and external communications related to GWA and HRM data and data products.

OBJECTIVE 7. Verify data and metadata completeness and final transfer at the term completion.

The milestones related to achieving each of these objectives are described below.

OBJECTIVE 1. *Initiate data management services and oversight for EVOS GWA and HRM Program data-related activities.* A standardized data management approach is necessary to provide fundamental data management support for the GWA and HRM Programs in sharing data sets and authoring metadata records and for a data management system to handle many diverse data types and facilitate integration and long-term preservation. Such an approach requires data management staff and PIs to have a mutual understanding of when and what data is expected to be collected, how data can be best organized and formatted for sharing, and the expectations and goals for metadata.

Milestone 1. Convene data management meeting with GWA and HRM Program Managers - At the start of the program, Axiom will convene data management meetings with the GWA and HRM program managers to discuss the program-level data management strategy; make explicit the expectations for data management staff and program PIs; and verify the list of funded research projects, data collection periods, documentation of data quality control procedures, submission timelines, program outputs, and the production of any derived data products.

Milestone 2. Convene data scoping meetings with individual PIs to develop GWA and HRM data management plans (DMPs) - Axiom will meet with GWA and HRM PIs (in person or by phone) to share expectations regarding what data types will be collected and delivered, timelines for data submission and metadata generation, and expected and appropriate data and file formats and naming conventions. From these meetings, data management plans (DMPs) for the GWA and HRM Programs will be established, each of which details how data for individually-funded projects will be handled throughout that program's lifecycle, from data collection to preservation. Agreeing to a plan at the start of the program will ensure that, from the beginning, the data is organized, well-documented, and appropriately formatted for discovery, preservation, and ultimate data use for restoration and management purposes.

Milestone 3. Maintain up-to-date inventory of expected and submitted data - Using information generated during the DMP scoping, an inventory of data expected to be generated by EVOS GWA and HRM sampling efforts will be created. This inventory will describe the datasets, indicate the investigator responsible for the data, include some ancillary data, and note the status of metadata for each dataset. It will be used throughout the life of the project to track the status of datasets and their metadata.

Milestone 4. Institutionalize metadata authoring among program teams - Descriptively-robust and standards-compliant metadata records are critical for long-term data access and reuse. To ensure accurate and consistent metadata authoring within and across programs, Axiom will develop procedures to encourage frequent, incremental updates by PIs to their metadata as part of their normal workflows. Specifically, Axiom will develop program-specific metadata templates, which will inform PIs which metadata fields are mandatory, mandatory if applicable, or optional. To save PIs time and promote consistency, templates will include boilerplate information for fields that must contain program-wide metadata (e.g. access constraints, use constraints, and programmatic contact information). Templates will also indicate which fields can be filled out before data is even collected, to break up the process of metadata generation and make it seem less onerous. For example, at each project's onset (Year 1) high-level project information can be included in the metadata records (e.g. project identification information); following initial data collection (Year 2), the data quality components of the record will be created; and, to conclude the workflow, at the completion of data analysis the analysis step and data entity information will be made to the metadata record. This approach is intended to make metadata creation less cumbersome for PIs by using a real-time process that occurs in concert with data collection and analysis, as well as provide information for PIs to see what their peers are doing before the very end of the program. Throughout the project, program managers and PIs will receive training and regular communications (via email, in person, and at annual meetings) about the metadata procedures and authoring workflow.

OBJECTIVE 2. *Continue to standardize and provide access to data sets from the first five-year GWA and HRM efforts for continuity and integration.* This objective will maintain data continuity and build upon data management services from the first five-year effort. Early in the first quarter, Axiom will engage with individual PIs to identify whether data to be collected during the second five-year effort will be a continuation of a time series or a new project. Data sets that are a continuum will be updated to reference the data in the prior Workspace and historical data repository. These references are important to integrate related but independent datasets across funded efforts in a clear, organized manner. Further, this mapping encourages discovery of the entire time series (e.g. across multiple five-year funding periods) though project titles and lead PIs may have changed over time.

Milestone 1. Connect data and metadata to any previous data instances - For projects that are a continuation of those time-series collected under the previous five-year effort, metadata in both the Workspace and DataOne archives will be updated to document the chronology of data ownership, any DOI and/or national archive accession number, and the location of any historical dataset(s), including the previously funded NCEAS historical and GWA or HRM Workspace groups.

Milestone 2. Ingest prior GWA and HRM data, as needed, into the new Workspace group(s) - Some PIs in the current funding cycle may need access to previously collected datasets in the Workspace. While this is not encouraged, Axiom will ingest prior GWA and HRM datasets into the new Workspace group on an as-need basis. Copying *all* of the data collected during the first five-year effort from the former Workspace group has the potential for data duplication and inaccuracies; and therefore should be avoided to the extent possible.

OBJECTIVE 3. *Facilitate, monitor, and evaluate regular data submissions and metadata generation in the Workspace.* GWA and HRM investigators and administrators will use the Workspace as a web-based platform for PIs to upload, share and discover data sets and supporting documents, and to rapidly author metadata. The system is enabled with security authentication in order to limit access to GWA and HRM investigators, project managers, and administrators. Throughout the life of the project, Axiom staff will maintain oversight of timely and organized data, metadata documentation, and other program documents to the Workspace using a combination of data management personnel and technical infrastructure.

Milestone 1. Support and provide training for data transfer and metadata production using the Workspace - Experience with the use of the Ocean Workspace by 15 other research programs over the past four years has resulted in a system that is intuitive, easy to use, and designed to meet researcher needs. To enhance GWA and HRM PI use of this system, Axiom will host in-person and web-based training sessions in Year 1. These trainings will be scheduled as soon as possible after funding award. Throughout the life of the program, Axiom will continue to provide training and one-on-one assistance, as needed, to support PIs and Program Managers.

Milestone 2. Track regular data and metadata submissions - The data inventory (Obj. 1, M. 3) will be used to track data and metadata submissions to the Workspace against data that was expected to be generated through the GWA and HRM program terms. Using the DMPs (Obj. 1, M. 2), Axiom will audit the organization of data intended for publication by ensuring the types of data submitted are appropriate for long-term preservation and consistent conventions are used for naming files. This will be achieved by working directly with the PIs to implement any recommended changes identified during the audits. Depending on the extent of work, Axiom may develop the capability to automate these audits in the Workspace (Obj. 4, M 3); otherwise, audits will be performed manually by the data management team. In addition to the audits, file inventory reports generated by the Workspace will be used to track submission progress. Indication of data submission delays and formatting delinquencies will be identified and communicated following the procedures for addressing data non-compliance (see "Reporting Protocols" above). The corrective actions to address non-compliance will be implemented by the PIs with support from the Axiom data management team. On a semi-annual basis, the data management team will update the data inventory to reflect changes in dataset and metadata status.

Milestone 3. Hold annual data progress meetings with individual PIs - To facilitate timely data submission and metadata authoring, Axiom will meet annually with each individual PI to discuss progress. Based on previous experiences, one-on-one meetings are an effective way to address individual metadata authoring questions, create accountability for data submissions, and strengthen relationships between PIs and data management staff. During these meetings, data management staff will revisit and make any changes necessary to the DMPs to ensure the documents are responsive to any changes or unexpected issues that arise in data collection or processing.

Milestone 4. Provide supplemental data and metadata quality control- According to the data sharing policies (refer to section 4.4) the PIs are to conduct quality assurance on data collection procedures and quality control the data they generate. Quality control by the data managers will be focused on data file formatting and on metadata documentation to ensure authoring adheres to known best practices and accurately reflects data captured within individual data files. This process will include an automated completeness check for required metadata fields; a secondary quality control check by Axiom data management staff for accuracy and consistency of metadata resulting in a list of any issues in the metadata that will be delivered to the PI; and a final check for ISO-format validation after metadata quality issues have been addressed and before submitting the dataset to national archives.

OBJECTIVE 4. *Provide, maintain, and modify technical infrastructure to ensure access to information produced or processed by the GWA and HRM Programs*. The ultimate goal of this program is to provide technological and staff services to assist in the organization, documentation, and structuring of data collected by EVOS GWA and HRM activities so that it can be transferred efficiently to long-term data archive and storage centers for future use by researchers and other user groups. This program leverages cyberinfrastructure, long-term funding, and other active data management projects previously and currently undertaken by AOOS. Datasets produced from the GWA and HRM Programs will be shared with each other, documented, and shared with the public by extending and enhancing an existing technological infrastructure (see "Existing Infrastructure" above). These systems have capabilities to share, ingest, document, and archive project data and related documentation to ensure its long-term security and use.

Milestone 1. Create Workspaces to immediately serve the needs of GWA and HRM Programs - At the onset of this program, new Workspace groups will be created for the funded GWA and HRM programs. A new Workspace instance is necessary to clearly organize project-level data captured under this funded effort and to safeguard project and PI security settings across funding cycles.

Milestone 2. Develop semi-automated submission pathways to data archives - Axiom will develop tools that augment the Ocean Workspace to send data to a DataONE (a nationally recognized long-term archive for scientific data) member repository for long-term preservation. The intent of these tools is to ease the ingestion of data collections to data archives by simplifying the submission and upload of content and metadata. The pathway may include automated QA steps, bulk file ingestion, and completeness checks for metadata content. Automated pathways to national or disciplinary archives outside the DataONE network may be developed based on community interest and the relevance of the content of other archive to EVOSTC data.

Milestone 3. Provide scheduled and unscheduled maintenance to the system infrastructure - Provide scheduled and as-necessary maintenance to the data management system infrastructure, including the Workspace and Gulf of Alaska Data Portal, to ensure continuous operation and reliability for the GWA and HRM Program PIs. This may involve tasks such as applying security updates, monitoring for hardware failures, and upgrades to improve performance and capacity.

OBJECTIVE 5. *Publish and promote data collected by the HRM and GWA Programs, making it available for research, management, and general audiences*. To maximize data use for analysis, synthesis, review, and application, and to support the restoration and management of EVOS injured resource, data from the GWA and HRM programs will be made widely available through multiple pathways. During the research phase of this funding cycle, data will be securely available for internal use through the Workspace. When data is ready to be published, it will be made available through the existing, public-facing data portal (Gulf of Alaska Portal: portal.aoos.org/gulf-of-alaska.php) for exploration and discovery. Simultaneously, data will be archived through DataONE, where it will be preserved over the long-term. National repositories also reach wider audiences, thus expanding the access, discoverability, and active management of data collections generated through these programs.

Milestone 1. Prepare data and metadata into preservation-ready file formats - File formats play a key role in the ability for data access and reuse in the future. As opposed to proprietary or product-specific formats, open file formats are necessary for long-term preservation and storage, particularly in data repositories. Examples of preferred formats for different types of data include: ASCII formats (TXT, CSV, XML), NetCDF, and PDF. Ultimately, it is the responsibility of the data providers to generate and document preservation-ready data formats. However, Axiom data analysts will help convert data from agreed-upon formats (used by the PIs) into preservation-ready file formats when necessary. For datasets that may stray from format standardization, Axiom data analysts will work with PIs to

determine the best option for dataset preservation. Any custom scripts that are developed to convert between formats and visualize the data will be saved to streamline conversion of similar data types in the future. To ease file use and analysis by PIs that prefer proprietary or product-specific formats, the original files will be retained.

Milestone 2. Publish data and relevant program documents through the Gulf of Alaska Portal - After metadata that complies with content and quality requirements is completed, the Workspace will be used as a gateway to publish data and associated metadata to the GOA portal, which is publically-available for discovery by researchers, managers and general audiences. As data providers, PIs have ultimate control for managing which data is made publicly available. Within projects, PIs can individually elect to publish data folders to the portal using a simple, clearly marked checkbox. At the annual one-on-one meetings with PIs, Axiom will review the published data files with PIs to ensure no unintended publication occurs (e.g., if data has been published by another project collaborator before it is finalized).

Milestone 3. Submit all final data and metadata documents to a national archive - By the end of the proposed five-year term, all final data and metadata will be submitted to DataONE, a nationally recognized long-term archive for scientific data. Submissions will occur by initiating finalized datasets from the Workspace, having a final metadata review check by data management staff, and then a fully-automated submission process into the DataONE data federation[2]. Workspace integration with DataONE will provides services for automatically transferring data and metadata, controlling access to data products as they are populated in the system, and services for replication and preservation of data. Workspace project metadata will be updated to include any identifiers associated with the data once it has been ingested into DataONE (e.g., DOI, archival accession numbers). This pathway will simplify preservation and publication for PIs while providing transparency to the data managers, program managers, and funders.

OBJECTIVE 6. *Execute management, user feedback, and internal and external communications related to GWA and HRM data and data products.* During this proposed five-year term, the data management team will participate in program meetings, respond to user feedback, and maintain regular communication about project progress.

Milestone 1. Interface with program PIs on data management progress and procedures - Axiom will give an overview of the data management system and procedures to EVOS staff and HRM and GWA PIs at the initial kick-off meeting in Fall 2017. This presentation will specifically focus on a high-level description of the tools to be used and procedural changes from the initial five-year effort. These procedures will also be provided in writing and described more concretely at individual meetings with program managers PIs. Thereafter, Axiom will attend scheduled PI meetings to present on data management progress and receive feedback on any recommended modifications. Presentations may include topics such as the percent of data submissions and metadata generation completed on time, new features or process updates in the data management system, and progress towards publishing data and data products. Axiom staff will also be available at PI meetings to give one-on-one training, hands-on assistance, or to answer questions about data management practices. Throughout the project, the project team will maintain regular contact with PIs about data management throughout the year. These communications will entail notification of approaching deadlines for data or metadata submission, questions related to these submissions, and/or response to PIs about data management procedures and responsibilities questions.

[2] http://dataone.org

Milestone 2. Continually evaluate progress and new technologies to keep pace with program needs - Implementing a system to serve the GWA and HRM data management needs is a core component of this proposed work. To ensure progress of the data management team in meeting these needs, regular and structured feedback is required from data management system users, i.e., the program managers and PIs. User feedback through surveys, group discussions, and one-on-one meetings will be gathered throughout the course of this program. The feedback will be synthesized to identify what data management methods are working well and what procedural modifications or including new technologies could be made to improve the performance of the data management system. Improvements will be prioritized based on feasibility within program funding levels and implemented as is possible.

Milestone 3. Report progress annually to the EVOSTC - AOOS and Axiom will submit annual reports as detailed by the EVOSTC. These reports will document progress on objectives and milestones, as well as overall progress on data submission and metadata generation from GWA and HRM projects. Reporting will also include a final report at the conclusion of the five-year funding term.

OBJECTIVE 7. *Verify data and metadata completeness and final transfer at the term completion.*
In the final year of this five-year effort, AOOS and Axiom will ensure the completeness of all data and metadata records in the GWA and HRM collections. Upon request, AOOS and Axiom will work with EVOSTC to develop and implement a plan to transfer all data and metadata from the data management system to EVOSTC.

Milestone 1.Ensure the existence and completeness of all data in the data inventory - In the final year of this five-year effort, Axiom will revisit the DMP data inventory to ensure it is complete and representative of the entire legacy of data collected throughout the program. Using this inventory, Axiom will ensure that data and metadata generated across all years of the GWA and HRM activities are present, accurate, and complete. At the conclusion of this funded term, this process will provide verification of the submission of all data and serve as a guarantee of completeness for each dataset. Any discrepancies in data and metadata completeness will be resolved between the data management team and individual PIs.

Milestone 2. Identify appropriate method of transfer for metadata and data from Axiom infrastructure to other storage resources - Upon request, in the final year of this five-year effort Axiom and the EVOSTC will convene to discuss the total volume of data, metadata, and derived data products; the resources necessary to securely and usefully store the data and metadata; and a path forward for system transfer. Because the proposed data management system uses AOOS' and Axiom's significant, leveraged, and cloud-based cyberinfrastructure, it will not be feasible to transfer the entire functionality of the data management system to local EVOSTC storage and compute resources. Similarly, with the publication of all finalized GWA and HRM data to DataOne (a fully replicated archive), duplicating the data to EVOSTC servers may not be necessary. The outcome from the meeting will determine if a complete, local replicate is necessary or feasible for the EVOSTC to manage, and if so, where data should be relocated, and the timelines and procedures for transfer.

7.2 MEASURABLE PROGRAM TASKS

Below is a proposed schedule for all measurable program tasks by objective for each quarter over the next five-year period, FY17-21 (Table 3).

Appendix B

Table 3. The measurable data management program tasks by objective for each quarter in FY17-21.

Task	FY17				FY18				FY19				FY20				FY21			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Objective 1.																				
Complete initial data management meeting with Program Leads	X																			
Schedule & complete data management meetings with individual PIs	X	X																		
Complete & disseminate DMP for GWA & HRM Programs		X																		
Develop & disseminate metadata templates		X	X																	
Objective 2.																				
Set-up new GWA & HRM Workspace groups	X																			
Make prior data available to PIs in new Workspace groups		X	X																	
Modify Workspace metadata to connect time series data sets			X	X	X															
Objective3.																				
Provide Workspace and metadata training to PIs	X			X				X				X				X				
Hold one-on-one meetings with PIs on data progress		X				X				X				X				X		
Revise DMPs to respond to project-level changes						X				X				X				X		
Conduct semi-annual review of data submissions		X		X		X		X		X		X		X		X		X		X
Notification to PIs re: metadata & data submission deadline		X		X		X		X		X		X		X		X		X		X
Complete QC of data formats and completed metadata				X				X				X				X				X
Non-compliance notification to PM, following no PI action			X				X				X				X				X	
Non-compliance report to EVOSTC, following no PI action				X				X				X				X				X
Objective 4.																				
Serve existing infrastructure to newly funded GWA&HRM Programs	X																			
Deploy automated pathways from Workspace to archives			X																	
Provide maintenance on data management system	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Objective 5.																				
Verify the conversion of file formats as preservation-ready			X	X			X	X			X	X			X	X			X	X
Review data to be published with PIs for consent			X	X			X	X			X	X			X	X			X	X
Audit the readiness of datasets for archive			X	X			X	X			X	X			X	X			X	X
Publish data and data products through the GOA portal				X	X			X	X			X	X			X	X			X
Final data collections submitted to DataOne				X	X			X	X			X	X			X	X	X	X	X
Objective 6.																				
Present data management procedures & progress at annual meetings	X			X	X			X	X			X	X			X	X			X
Provide ongoing data and metadata support to PIs, as needed	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Conduct user surveys about data management progress				X	X			X	X			X	X			X	X			
Submit annual reports to EVOSTC					X				X				X				X			
Submit final reports to EVOSTC																				X
Objective 7.																				
Verify data and metadata completeness for GWA&HRM Programs																		X	X	X
Discuss final transfer and storage of data to EVOSTC																	X			
Implement transfer agreement																				X

8. Budget

8.1 BUDGET FORMS

The data management program budget is included in the Program Budget Proposal and Reporting Form (attached). The budget includes labor for the AOOS Program Lead, including fringe benefits. Funding is also requested for computer upgrades and minor supplies, and for Program Lead travel to attend annual PI meetings. Included in the budget is a contractual subaward to Axiom Data Science. This contract includes labor for data management team members and fringe benefits.

The budget does not include costs associated with international travel for meetings, symposia, or presentations, nor does it include costs for associated outreach or education efforts that are separate from or in addition to the Program.

8.2 SOURCES OF ADDITIONAL FUNDING

AOOS will also make available one additional week of in-kind salary for Dr. Janzen (Operations Director, AOOS) bringing her commitment to the Data Management Program to 4 weeks in order to fulfill Program Lead duties under this award and to oversee program data integration activities into the AOOS data system. The value of Dr. Janzen's in-kind support (includes salary, benefits, fiscal sponsor fees) will be $14,358.50, with annual values of $2704.49 in FY17, $2785.62 FY18, $2869.19 FY19, $2955.27 FY20, and $3043.93 in FY21.

Appendix 1:

Professional CVs for
Key Data Management Personnel

Carol D. Janzen, Ph.D.
1007 West 3rd Ave, Anchorage, AK 99501, USA
Cell: 425-736-4714, Email: janzen@aoos.org

Professional Preparation

University of Washington, Seattle	Oceanography	B.S.	1986
University of Delaware, Newark	Marine Studies	M.S.	1996
University of Delaware, Newark	Physical Oceanography	Ph.D.	2000
University of Wales, Bangor, UK	Physical Oceanography	Post Doc	2002

Appointments

06/2015- present	Operations Director, Alaska Ocean Observing System, AK, USA
07/2006-06/2015	Senior Oceanographer, Sea-Bird Electronics, Inc, WA, USA
11/2002–08/2006	Research Scientist-Physical Oceanographer, School of Marine Sciences, University of Maine, ME, USA
09/2000–10/2002	Physical Oceanographer (Post-Doctoral Researcher), School of Ocean Sciences, University of Wales (Bangor), UK
06/1993–08/2000	Research Assistant-Graduate Student (M.S. 1996, Ph.D. 2000), Graduate College of Marine Studies, Univ. of Delaware, DE, USA
01/1989-06/1993	Ecology Supervisor, Wash. State Dept. of Ecology, WA, USA
05/1985-12/1988	Assistant Scientist-Oceanographer, Envirosphere Company, WA, USA
03/1984-08/1984	Oceanographer-Intern, URS Engineers, WA, USA

Relevant Publications

Murphy, D.J., **C. D. Janzen, 2015.** Designing CTDs to meet the challenges of monitoring climate change in the ocean, Marine Technology Society Journal, May/June 2015Vol 49, No. 3, pp. 50-55.

Janzen, C., and E.Creed, **2011**.Physical oceanographic data from Seaglider trials in stratified coastal waters using a new pumped payload CTD. IEEE Conference Publication, OCEANS 2011 MTS/IEEE, Kona, Hawaii, USA, September 19-23, 2011. *Reprint with permission:* http://www.seabird.com/technical_references/PhysOcDataFromSeagliderTrials_JanzenCreed_MTS2011.pdf

Edwards, B., **C. Janzen,** D. Murphy, N. Larson, **2010**. Calibration response and hysteresis in deep sea dissolved oxygen measurements. Journal of Atmospheric and Oceanic Technology, 27(5). DOI:10.1175/2009JTECHO693.1

Janzen, C., 2009. Considerations for CTD spatial and temporal resolution on moving platforms. In: Ocean News and Technology, Vol. 15, Issue 6, pp. 54-55. Reprint with permission: http://www.seabird.com/sites/default/files/documents/ResolutionOnMovingPlatformsReprint.pdf

Janzen, C.D., J.H. Simpson, M.E.Inall, F. Cottier, **2005**. Across-sill circulation near a tidal mixing front in a broad fjord. Continental Shelf Research, 25, pp. 1805-1824.

Janzen, C.D., Jim Churchill, Neal Pettigrew, **2005**. Observations of bay/shelf exchange between eastern Casco Bay and the western Gulf of Maine. Deep-Sea Research Part II: Special Issue: The Ecology and Oceanography of Toxic Alexandrium fundyense Blooms in the Gulf of Maine, Vol. 52, Issue 19-21 September-October 2005, pp. 2411-2429. DOI 10.1016/j.dsr2.2005.06.032

J**anzen, C.D.**, K.-C.Wong, **2002**. Wind forced dynamics at the estuary-shelf interface of a large coastal plain estuary. Journal of Geophysical Research, Vol. 107, No.C10.

Janzen, C.D., and L.B. Eisner, **1993**. Marine Water Column Ambient Monitoring Program Annual Data Report for Wateryear 1991. Prepared for the Washington State Department of Ecology and the Puget Sound Water Quality Authority, Pub.No.93-13. https://fortress.wa.gov/ecy/publications/documents/9313.pdf

Janzen, C. D., K. S. Short, L. E. Hachmeister, **1991.** Long-term marine water quality and climatological trends in the Pacific Northwest. Oral presentation/Paper, Oceans' 91 Conference, Oceanic Engineering Society, Institute of Electrical and Electronics Engineers, Honolulu, HI. 1991 IEEE Oceans Proceedings, Vol. 2, No. 91CH3063-5, pp. 1044-1048.

Short, K.S., **C.D. Janzen**, C.J. Van Zee, and D.J. Hanzlick, **1991**.Oceanography. In: 1987 Final

Report for the Endicott Environmental Monitoring Program, Volume 3, Part II, Chapter 3. Prepared for by Envirosphere Company for the U.S. Army Corps of Engineers, Alaska District, Anchorage, AK.

Synergistic Activities

Contributions to the science of learning: Customer liaison for product users at Sea-Bird Electronics, and initiated, developed and managed Sea-Bird Scientific's Graduate Student Equipment Loan Program (2006-2015); plans, prepares and implements educational seminars and instrument training workshops; What you should know about data collection from moving platforms: Basic sampling theory, project considerations, and sources of error - Workshop, Coastal Estuarine Research Federation Conference, Daytona, FL, November 6, 2011; guest lecturer at local universities (continuous); assisted marine science teacher training for marine science curriculum for K1-12 (1989-1993).

Service to state and national organizations: Industry representative on the NANOOS Governing Council (2007-2015); Oceanographic Instrumentation Committee Chair for Marine Technology Society (2011-*); Guest editor of MTS Journal on polar research instrumentation and methods (MTSJ,2014, 48(5)); contributing author of the Environment 2010 Report prepared for the Washington State Governor's office; invited participant in EPA's Marine Water Quality Indicators workshop, 1989; represented Wash. State Dept. of Ecology on the Pacific Northwest Outer Continental Shelf Technical Subcommittee to recommend studies prior to oil and gas development in Washington and Oregon (1989-1993).

Development/Refinement of Research Tools: Instrument characterization assessment and performance testing in the lab and field; develops/evaluates data processing and sampling implementation protocols; develops calibration/validation methodologies for QA/QC of data; active industry/science expert in QARTOD (Quality Assurance of Real Time Ocean Data).

Collaborators and Other Affiliations

Molly McCammon, Alaska Ocean Observing System, USA; Rob Bochenek, Axiom Data Science, LLC;
David J. Murphy, Sea-Bird Electronics, Inc., USA; Neal Pettigrew, University of Maine;
Matt Walkington, NIWA (National Inst of Water and Atmospheric Research), NZ; Phil Sutton, NIWA;
R.Venkatasen, NIOT (National Institute of Ocean Technology), Chennai, India;
Warren Horowitz, BOEM; Peter Winsor, University of Alaska, Fairbanks (UAF);
Seth Danielson, UAF; Wiley Evans, Hakai Institute, British Columbia, Canada

Graduate Advisors (5)

Kuo-C. Wong, M.S. and Ph.D. Advisor, University of Delaware, College of Earth, Ocean and Environment
Richard Garvine, M.S. and Ph.D. Co-Advisor, University of Delaware, College of Marine Studies, Deceased
Marlene Noble, Ph.D. Co-Advisor, USGS (United States Geological Survey), emeritus
Steve Lentz, Ph.D. Co-advisor, WHOI (Woods Hole Oceanographic Institution)
Richard Geider, M.S. Co-advisor, University of Essex, School of Biological Sciences, UK

Postdoctoral Advisors (1)

John Simpson, Post-Doctoral Advisor, Bangor University (Wales), School of Ocean Sciences

Thesis Advisor (2) and Postgraduate-Scholar Sponsor (1)

Laura Brothers, M.S. Co-Advisor, USGS, Woods Hole, USA
Gregg Sinnett, M.S. Co-Advisor, SCRIPPS Institute of Oceanography, USA
Neil Fisher, Postgraduate-Scholar Sponsor, University of Maine, USA

Robert Bochenek
Information Architect
Axiom Data Science, LLC
Phone: 907.230.0304;
Email: rob@axiomdatascience.com

Professional Preparation

University of Michigan, Ann Arbor, MI; Aerospace Engineering; B.S.E., 2001

Appointments

2013 – Present	Technical Lead, Central and Northern California Ocean Observing System, Moss Landing, CA
2010 – Present	Technical Lead, Alaska Ocean Observing System, Anchorage, AK
2006 – Present	Information Architect, Axiom Consulting and Design, Anchorage, AK
2003 – 2006	Data Systems Manager, Exxon Valdez Oil Spill Trustee Council (EVOSTC), Anchorage, AK
2001 – 2002	Analyst Programmer, Alaska Department of Fish & Game, Anchorage, AK

Products

Bochenek, R.B., S. StClaire, B.Stone (2012), AOOS Arctic Portal. Accessible from http://portal.aoos.org/?v=rand&portal_id=3.

Bochenek, R.B., S. StClaire, D. Snowden, L. Finfrock (2013), IOOS Sensor Observation Service. Accessible from http://ioossos.axiomalaska.com/.

Bochenek, R.B., S. StClaire, L. Finfrock (2013), Central and Northern California Data System. Accessible from http://data.cencoos.org/.

Bochenek, R.B., S. StClaire , B.Stone, L. Finfrock (2013), Gulf Watch Data Portal . Accessible from http://www.gulfwatch.org/.

Bochenek, R.B., S. StClaire, B.Stone (2012), Alaska Ocean Observing System Data Management System. Accessible from http://data.aoos.org.

Synergistic Activities

2012 – Present	Funded under the NOAA High Performance Computing program for exploratory research in applying HPC concepts to serving and visualizing gridded multidimensional models and observational data sets
2011 – Present	Member of the IOOS Sensor Observation Service standardization Committee
2010 – Present	Member of the Alaska Data integration Working Group (ADIWG) focused on developing frameworks for interchange of scientific information across Alaskan Agencies.
2008 – 2010	Development of the Prince William Sound Data Portal, A tool for scientists, educators and the public to visualize four dimensional fisheries data

Collaborators

Broderson, Dayne	Geographic Information Network of Alaska (GINA), Fairbanks, AK

Dugan, Darcy	Alaska Ocean Observing System, Anchorage, AK
Howard, Katherine	Alaska Department of Fish and Game, Anchorage, AK
Jones, Matt	National Center for Ecological Analysis and Synthesis, Santa Barbara, CA
Krueger, Charles	Great lakes Fishery Council, Ann Arbor, MI
McCammon, Molly	Alaska Ocean Observing System, Anchorage, AK
Moffit, Steve	Alaska Department of Fish and Game, Anchorage, AK
Moss, Jamal	Alaska Fisheries Science Center, Juneau, AK
Mueter, Franz	University of Alaska, Juneau, AK
Mundy, Phillip	Alaska Fisheries Science Center, Juneau, AK
Pegau, Scott	Oil Spill Recovery Institute, Cordova, AK
Saupe, Susan	Cook Inlet Citizen's Advisory Council, Anchorage, AK
Smith, Stan	United states geological Survey, Anchorage, AK
Snowden, Derrick	Integrated Ocean Observing System, Silver Springs, MD
Svoboda, Michael	Environment Canada, Whitehorse, Canada
Wiese, Francis	North Pacific Research Board, Anchorage, AK

Chris Turner
Data Librarian
Axiom Data Science, LLC
Phone: 907.306.8663;
Email: chris@axiomdatascience.com

Professional Preparation

University of Alaska Anchorage, Anchorage, AK; Mathematics; B.S., 2007
Syracuse University, Syracuse, NY; Library & Information Science; M.S., 2012

Appointments

2012 – Present	Data Librarian, Axiom Data Science, Anchorage, AK
2011	Polar Profile Intern, National Snow and Ice Data Center, Boulder, CO
2010 – 2012	eScience Graduate Fellow, Syracuse University, Syracuse, NY
2008 – 2010	Serials Cataloger, Consortium Library, University of Alaska, Anchorage, AK

Synergistic Activities

2013 – 2015	Advisory role on the Alaska Data Integration Work Group (ADIwg) to inform about the structure and content of ISO 19115 metadata and to guide translation from ADIwg content standard to ISO metadata
2012 – Present	Provide data management services as best practice guidance to several integrated ecological research programs, including NPRB's GOAIERP, EVOSTC's Gulf Watch Alaska, BOEM's ArcticEIS and MARES programs
2014 – Present	Present, participate, and facilitate hands-on workshops and trainings at Gulf of Alaska and Arctic focused data management meetings and workshops including the following: Marine Arctic Ecosystem Study kick off meeting (August, 2015); Distributed Biological Observatory and Pacific Arctic Group meeting and data management breakout (October, 2014); Arctic Ecosystem Integrated Survey PI meeting (June 2014); Exxon Valdez Oil Spill Trustees Council Long-Term Monitoring Program Data Meeting (January 2014) and Annual PI meetings (November 2013, 2014, 2015), and Public Outreach and Science Panel Meeting (February 2015)
2011 – 2012	As data management consultant for the Thermochronology and Tectonics Research Group at Syracuse University, research experimental procedures and data generation pathways for thermochronology research to develop plans for data and sample management
2011	As data management consultant for Human Migration Research Group at Syracuse University, designed metadata profile, data management plans, and database for management of migrant and refugee data

Collaborators

Bradley, Joshua	U.S. Fish and Wildlife Service, Fairbanks, AK
Neher, Tammy	U.S. Forest Service, Tonto National Forest Office, Mesa, AZ
Ignizio, Drew	U.S Geological Survey, Fort Collins Science Center, Fort Collins, CO
Kent, Holly	Alaska Ocean Observing System, Anchorage, AK
McCammon, Molly	Alaska Ocean Observing System, Anchorage, AK
Pegau, Scott	Oil Spill Recovery Institute, Cordova, AK
Smith, Stan	U.S Geological Survey, Alaska Science Center, Anchorage, AK
Walworth, Dennis	U.S Geological Survey, Alaska Science Center, Anchorage, AK
Weems, Jared	Univ of Alaska Fairbanks, School of Fisheries & Ocean Sciences, Fairbanks, AK
Wiese, Francis	Stantec, Anchorage, AK

Stacey Buckelew
Data Coordinator
Axiom Data Science, LLC.
95 Sterling Highway Homer, AK 99603
Phone: 907.717.4583
Email: stacey@axiomdatascience.com

Professional Preparation

University of California, Santa Cruz; Marine Biology; B.S., 2000
University of California, Santa Cruz; Ecology and Evolutionary Biology; M.S., 2007

Appointments

2015 – Present	Data Coordinator, Axiom Data Science, Anchorage, AK
2012 – 2015	Coastal Training Program Coordinator, Kachemak Bay Research Reserve, Homer, AK
2011 – 2012	Program Manager, Saltwater Inc, Anchorage, AK
2010 – 2011	Alaska Dept of Fish & Game, Div of Commercial Fisheries, Anchorage, AK
2005 – 2010	Project Manager, Island Conservation, Santa Cruz, CA
2002 - 2005	Field Biologist, US Antarctic Marine Living Resources Program
2000 – 2002	Research Technician, University of California Santa Cruz

Synergistic Activities

2015 – Present	As Axiom Data Coordinator for the EVOS LTM and HRM programs, help scientists organize, document, and upload their datasets and descriptions to be available to the general public. Monitor and update data and metadata delivery schedules, and provide assistance with the adherence to data and documentation formats suitable for long-term preservation. Support users of the AOOS data portals and data management tools.
2012 – 2015	As Coastal Training Program Coordinator, deliver science-based information to coastal decision-makers to promote informed decisions about coastal resources through meetings, workshops, and training events. Outreach science and research about coastal ecosystems and management issues through training programs and products. Establish and maintain effective working relationships with government agencies, partners, and the public.
2010 – 2011	Maintain cooperative relationships with management agencies, including National Marine Fisheries Service (NMFS) and AK Dept of Fish and Game, to coordinate research program and collect scientific information about marine mammal interactions needed for fisheries management purposes. Communicate research findings to local stakeholders, including federal and state agencies, researchers, private organizations, and fishing industry, using oral and written communications.
2010 – 2011	Coordinate research programs among federal agencies, universities, private groups, and tribal organizations working towards salmon enhancement and restoration on U.S. and Canada portions of Yukon River and tributaries. Prepare annual management reports, including compiling and synthesizing commercial and subsistence harvest information.

2005 – 2010 Develop and implement conservation management plans to protect native wildlife on islands by removing invasive species. Work with multiple partnered agencies to develop conservation and invasive species management strategies on federal refuge in Alaska, Hawaii, Canada, and Mexico.

Peer-Reviewed Publications

Croll, D.A., M. MacKown, K. Newton, N. Holmes, J. Williams, H. Young, S. Buckelew, C. Wolf, M. Bock, B. Tershy. 2016. Passive recovery of an island bird community after rodent eradication. *Biological Invasions 18:703-715.*

Doroff, A, Baird, S., Freymueller, J., Buckelew, S., Murphy, M. Assessing coastal habitat changes in a glacially influenced estuary system: Kachemak Bay, Alaska. *In review*.

Buckelew, S**.** 2014**.** Bivalves in Kachemak Bay: Applying Lessons Learned from Restoration along the Pacific Coast. Kachemak Bay Research Reserve, *Workshop Proceedings.*

Buckelew, S**.** 2013**.** Oyster Population Resiliency: Situation Assessment Report. Kachemak Bay Research Reserve, Homer, Alaska.

Buckelew, S., V. Byrd, G. Howald, S. MacLean, and J. Sheppard. 2011. Preliminary ecosystem response following invasive Norway rat eradication on Rat Island, Aleutian Islands, Alaska. *Island invasives: eradication and management. IUCN, Gland, Switzerland.*

Buckelew, S., G. Howald, S. Maclean, G. Siekaniec. 2009. Conservation in action: restoring habitat and protecting seabirds in the Aleutian Islands. *Oryx. 43(2).*

Trivelpiece, W.Z., S. Buckelew, C. Reiss, and S.G. Trivelpiece. 2007. The winter distribution of chinstrap penguins from two breeding sites in the South Shetland Islands of Antarctica. *Polar Biology. 30(10).*

Maron, J. L., J. A. Estes, D. A. Croll, E. M. Danner, S. C. Elmendorf, & S. L. Buckelew**.** 2006. An introduced predator transforms Aleutian Island plant communities by disrupting spatial subsidies. *Ecological Monographs. 76.*

Collaborators

Bailey, Kathleen	Integrated Ocean Observing System, Silver Spring, MD
Baker, Matthew	North Pacific Research Board, Anchorage, AK
Dickson, Danielle	North Pacific Research Board, Anchorage, AK
Doroff, Angela	Kachemak Bay Research Reserve, Homer, AK
Dugan, Darcy	Alaska Ocean Observing System, Anchorage, AK
Hoem-Neher, Tammy	NOAA Kasitsna Bay Laboratory, Homer, AK
Hoffman, Katrina	Prince William Sound Science Center, Cordova, AK
Holderied, Kris	NOAA Kasitsna Bay Laboratory, Homer, AK
Holman, Amy	NOAA National Ocean Service, Anchorage, AK
Iken, Karin	University of Alaska Fairbanks
Kent, Holly	Alaska Ocean Observing System, Anchorage, AK
Mellish, Joann	North Pacific Research Board, Anchorage, AK
McCammon, Molly	Alaska Ocean Observing System, Anchorage, AK
Pegau, Scott	Oil Spill Recovery Institute, Cordova, AK
Ryan, Jessica	Kachemak Bay Research Reserve, Homer, AK
Saupe, Susan	Cook Inlet Citizen's Advisory Council, Anchorage, AK
Seiden, Erika	NOAA National Estuarine Research Reserve, Silver Spring, MD
Snowden, Derrick	Integrated Ocean Observing System, Silver Spring, MD

1. **Information on Organization**

a**. Years in existence.** The Alaska Ocean Observing System (AOOS) has been in existence since 2005 (12 years).

b. Current and future sources of funding. AOOS receives its core funding through a 5-year cooperative agreement with NOAA's Integrated Ocean Observing System Program. The latest agreement for FY 16-20 was just approved by NOAA for $2.4 million. AOOS is subject to annual appropriation by Congress, but has been approximately level funded for the past six years and anticipates similar funding or higher in the future. AOOS also successfully competes for additional funds from multiple sources: other NOAA programs including National Marine Fisheries Service and National Weather Service, BOEM, USFWS, USGS, National Science Foundation and National Fish and Wildlife Foundation.

c. Current staff size by area of expertise (e.g. science management, administration, IT, etc.).

Executive Management/CEO: 1
Operations and Science Program Management: 1
Administrative Assistance and Outreach: 1
Program Management: 0.5

Data team: 10 under contract with Axiom Data Science

d. Audited financial statement covering past three years.

Attached for FY 12, 13 and 14.

e. Information about facility, including location, ownership, authority to use, size, and resources available.

LOCATION:
Alaska Ocean Observing System
1007 West 3rd Ave
Anchorage, AK 99501

OWNERSHIP: Renting office space through North Pacific Research Board

AUTHORITY TO USE: Full authority to use site for work related activities and meetings

RESOURCES AVAILABLE: conference rooms (1 large - 40 person capacity, 1 small – 10-15 person capacity), 4 offices for personnel; conference room at Axiom Data Science

f. Statement confirming proposal and related activities are consistent with the founding, authorizing documentation of the Proposer's organization.

AOOS is a logical entity to lead the EVOSTC Data Management program since the AOOS mission is to address regional and national needs for ocean information, gather specific data on key coastal and ocean variables, and ensure timely and sustained dissemination and availability of these data to stakeholders that include scientists, natural resource managers, and the public. AOOS is the recognized Alaska regional component of the national Integrated Ocean Observing System (IOOS) and serves as the regional Data Assembly Center for oceanographic and coastal data and information products in Alaska waters. AOOS is governed by a board made up of federal and state agency and academic and research institution leads in Alaska, as well as representatives of NGOs and the private sector.

g. Number of members of the organization's existing science or technical review panel. If no panel currently exists, please note as such.
The AOOS Board is composed of 18 heads of federal and state agencies, academic and research institutions, and private entities (or their designees) that are party to the AOOS Memorandum of Agreement. The Board provides policy and implementing guidance, and reviews and approves all budgets and proposals. Additional scientific review is provided by a variety of technical and science advisors on an as-needed basis.

h. Number of members of the organization's existing public advisory committee or mechanism for public involvement. If no group currently exists, please note as such.
AOOS relies on a variety of avenues to engage stakeholders and solicit recommendations. This feedback allows AOOS to both identify gaps in ocean observing and enhance AOOS tools and products. Due to the enormous geographic size of Alaska and the diversity of coastal and marine issues, the AOOS board determined it would be more effective to use existing communication pathways and forums, specific stakeholder engagement events, and informal working groups to provide input to AOOS rather than maintain a standing "stakeholder committee". This method has allowed AOOS to effectively interact in a focused way with multiple interest groups.

i. Name and resume of the Program Lead(s) and any key staff. This should include a summary of the experience of the Program Lead(s) in managing large and complex scientific programs.
The Program Lead will be Dr. Carol Janzen, Operations Director at AOOS. Dr. Janzen has her Ph.D. in Oceanography and three decades of experience in this field, including managing environmental monitoring programs for private industry and State agencies, and serving as a lead principal investigator, research coordinator and project manager in the academic and private industry sectors. She has extensive internal and external communications and customer liaison experience, both nationally and internationally. In her current position, Dr. Janzen reports directly to the AOOS Executive Director, and is responsible for administrative oversight of all AOOS program objectives and activities, as well as serving as program manager and Lead Principal Investigator on multiple external grants. CV is attached to Proposal.

j. Capabilities of existing IT infrastructure to make data and reports publically available.

The AOOS data system is the backbone of the cyberinfrastructure that will be leveraged to support the end-to-end GWA and HRM data management. This infrastructure has been developed to meet the guidelines and specifications recommended by the NOAA-funded Integrated Ocean Observing System (IOOS) and endorsed by the federal Interagency Ocean Observation Committee and Global Earth Observation Program. The data system is built using several mature, open-source interoperability and data stewardship systems to provide full cycle data management services, including: data ingestion, metadata, data aggregation and assembly, data catalogue and discovery, QA/QC, data access and transport, data storage, and end user input and feedback. As in previous years, GWA and HRM Program data will be shared publicly (or 'published') through the AOOS Gulf of Alaska Data Portal, where it can be accompanied by any supplemental files or project documentation. Publishing through AOOS makes the data available to a wide-ranging and established network of resource managers, scientists, and the general public to support decision-making. In addition, the GWA and HRM Program datasets will be ingested into DataONE for long-term preservation, where each dataset will be assigned a digital object identifier (DOI) and made discoverable through other DataONE nodes.

2. **Experience with EVOSTC**

a. Amount of funding received by the organization or individual PIs from EVOSTC currently or in the past and listing of projects funded: Data Management Services (McCammon PI) through the PWSSC's Long-term Monitoring Program FY 12-16 for a total of $33,000 for outreach and other support. Axiom Data Science for FY 12-16: $200k for Herring Research Program; $750k for Long Term Monitoring; and $200k for Additional Data Management.

b. We have read and understand the Council's founding documents and the policies and procedures that are relevant to the proposal.

3. **Collaboration/Coordination**

a. Experience working with state, federal, and private entities to complete projects.
AOOS has extensive experience working with state, federal, and private entities to complete projects including all of the projects listed in 1.b. AOOS is governed by a board made up of federal and state agency directors and academic and research institution leads in Alaska, as well as representatives of NGOs and the private sector.

b. Experience working with local and tribal communities in the Spill Area. This ensures cross-collaboration amongst all entities working in the region.
As the Program Lead PI for the prior Long-term Monitoring Program administered by the Prince William Sound Science Center, AOOS Executive Director Molly McCammon has extensive experience working with local spill-area communities and tribes.

c. Outreach plan that details the types of outreach envisioned and the audience for each type. N/A

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
PROGRAM BUDGET PROPOSAL AND REPORTING FORM

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$8.1	$8.4	$8.6	$8.9	$9.2	$43.1	
Travel	$0.0	$0.6	$0.6	$0.0	$0.6	$1.8	
Contractual	$191.9	$191.0	$190.8	$191.2	$190.2	$955.0	
Commodities	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*will vary by proposer*)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
SUBTOTAL	$200.0	$200.0	$200.0	$200.0	$200.0	$1,000.0	N/A
General Administration (9% of subtotal)	$18.0	$18.0	$18.0	$18.0	$18.0	$90.0	
PROJECT TOTAL	$218.0	$218.0	$218.0	$218.0	$217.9	$1,090.0	
Other Resources (Cost Share Funds)	$2,705.0	$2,786.0	$2,869.0	$2,955.0	$3,044.0	$14,359.0	N/A

COMMENTS:
This summary page provides an five-year overview of proposed funding and actual cumulative spending. The column titled 'Actual Cumulative' must be updated each fiscal year as part of the annual reporting requirements. Provide information on the total amount actually spent for all completed years of the project. On the Project Annual Report Form, if any line item exceeds a 10% deviation from the originally-proposed amount; provide detail regarding the reason for the deviation.

FY17-21

Program Title: EVOS Data Management Program
Program Lead(s): Carol Janzen, AOOS

PROGRAM SUMMARY PAGE

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$8.1	$8.4	$8.6	$8.9	$9.2	$43.1	
Travel	$0.0	$0.6	$0.6	$0.0	$0.6	$1.8	
Contractual	$9.1	$9.1	$9.1	$9.1	$9.1	$45.5	
Commodities	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*will vary by proposer*)							
SUBTOTAL	$17.2	$18.1	$18.3	$18.0	$18.9	$90.4	
General Administration (9% of	$1.6	$1.6	$1.6	$1.6	$1.7	$8.1	N/A
PROJECT TOTAL	$18.8	$19.7	$20.0	$19.6	$20.5	$98.6	
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	

COMMENTS:
This summary page provides an five-year overview of proposed project funding and actual cumulative spending. The column titled 'Actual Cumulative' must be updated each fiscal year as part of the annual reporting requirements. Provide information on the total amount actually spent for all completed years of the project. On the Project Annual Report Form, if any line item exceeds a 10% deviation from the originally-proposed amount; provide detail regarding the reason for the deviation.

FY17-21

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

NON-TRUSTEE AGENCY SUMMARY PAGE

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Carol Janzen		0.8	10.8		8.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	10.8	0.0	
				Personnel Total	$8.1

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY17

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
ASLC Fiscal Service Fee	9.1
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$9.1

Commodities Costs: Description	Commodities Sum
Commodities Total	$0.0

FY17

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY17

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Carol Janzen		0.8	11.2		8.4
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	11.2	0.0	
				Personnel Total	$8.4

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Travel to PI Meeting	0.4	1	2	0.1	0.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.6

FY18

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
ASLC Fiscal Service Fee	9.1
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$9.1

Commodities Costs: Description	Commodities Sum
Commodities Total	$0.0

FY18

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY18

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Carol Janzen		0.8	11.5		8.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	11.5	0.0	
				Personnel Total	$8.6

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Travel to PI Meeting	0.4	1	2	0.1	0.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.6

FY19

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
ASLC Fiscal Service Fee	9.1
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$9.1

Commodities Costs: Description	Commodities Sum
Commodities Total	$0.0

FY19

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY19

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Carol Janzen		0.8	11.8		8.9
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	11.8	0.0	
				Personnel Total	$8.9

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY20

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
ASLC Fiscal Service Fee	9.1
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$9.1

Commodities Costs: Description	Commodities Sum
Commodities Total	$0.0

FY20

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY20

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Carol Janzen		0.8	12.2		9.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	12.2	0.0	
				Personnel Total	$9.2

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Travel to PI Meeting	0.4	1	2	0.1	0.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.6

FY21

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
ASLC Fiscal Service Fee	9.1
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$9.1

Commodities Costs: Description	Commodities Sum
Commodities Total	$0.0

FY21

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY21

Project Title: EVOS Data Management Program
Primary Investigator: Carol Jazen, AOOS

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$149.6	$149.3	$149.2	$149.1	$149.3	$746.4	
Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Contractual	$31.4	$31.4	$31.3	$31.3	$31.3	$156.7	
Commodities	$1.8	$1.3	$1.1	$1.7	$0.5	$6.4	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*will vary by proposer*)							
SUBTOTAL	$182.8	$181.9	$181.7	$182.1	$181.1	$909.5	
General Administration (9% of	$16.4	$16.4	$16.4	$16.4	$16.3	$81.9	N/A
PROJECT TOTAL	$199.2	$198.3	$198.1	$198.4	$197.4	$991.4	
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	

COMMENTS:
This summary page provides an five-year overview of proposed project funding and actual cumulative spending. The column titled 'Actual Cumulative' must be updated each fiscal year as part of the annual reporting requirements. Provide information on the total amount actually spent for all completed years of the project. On the Project Annual Report Form, if any line item exceeds a 10% deviation from the originally-proposed amount; provide detail regarding the reason for the deviation.

FY17-21

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

NON-TRUSTEE AGENCY SUMMARY PAGE

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Rob Bochenek		1.0	11.5		11.0
Brian Stone		1.9	10.5		20.1
Chris Turner		2.4	8.6		20.6
Malcolm Herstand		1.0	7.5		7.2
Jordan Jenckes		2.4	5.3		12.8
Luc Mehl		1.9	8.3		16.0
Ross Martin		1.9	10.7		20.5
Stacey Buckelew		3.8	7.9		30.5
Shane Stclair		1.0	11.2		10.8
					0.0
					0.0
					0.0
		Subtotal	81.6	0.0	
				Personnel Total	$149.6

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY17

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
Axiom Facilities Charge	31.4
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$31.4

Commodities Costs: Description	Commodities Sum
Server Replacement	1.8
Commodities Total	$1.8

FY17

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY17

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Rob Bochenek		1.0	11.9		11.4
Brian Stone		1.9	10.8		20.7
Chris Turner		2.4	8.8		21.2
Malcolm Herstand		1.0	7.8		7.5
Jordan Jenckes		2.5	5.5		13.8
Luc Mehl		1.9	8.6		16.5
Ross Martin		1.7	11.0		18.5
Stacey Buckelew		3.8	8.2		31.4
Shane Stclair		0.7	11.5		8.3
					0.0
					0.0
					0.0
		Subtotal	84.0	0.0	
				Personnel Total	$149.3

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY18

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
Axiom Facilities Charge	31.4
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$31.4

Commodities Costs: Description	Commodities Sum
Server Parts	1.3
Commodities Total	$1.3

FY18

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY18

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Rob Bochenek		1.0	12.2		11.7
Brian Stone		1.9	11.1		21.4
Chris Turner		2.4	9.1		21.9
Malcolm Herstand		1.0	8.0		7.7
Jordan Jenckes		2.4	5.7		13.6
Luc Mehl		1.9	8.8		17.0
Ross Martin		1.7	11.3		19.0
Stacey Buckelew		3.7	8.4		31.3
Shane Stclair		0.5	11.9		5.7
					0.0
					0.0
					0.0
		Subtotal	86.6	0.0	
				Personnel Total	$149.2

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY19

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
Axiom Facilities Charge	31.3
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$31.3

Commodities Costs: Description	Commodities Sum
Server Parts	1.1
Commodities Total	$1.1

FY19

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY19

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Rob Bochenek		0.8	12.6		10.6
Brian Stone		1.9	11.5		22.0
Chris Turner		2.4	9.4		22.5
Malcolm Herstand		1.0	8.2		7.9
Jordan Jenckes		2.0	5.8		11.9
Luc Mehl		1.9	9.1		17.5
Ross Martin		1.7	11.7		19.6
Stacey Buckelew		3.6	8.7		31.2
Shane Stclair		0.5	12.3		5.9
					0.0
					0.0
					0.0
		Subtotal	89.2	0.0	
				Personnel Total	$149.1

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY20

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
Axiom facilities Charge	31.3
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$31.3

Commodities Costs: Description	Commodities Sum
Server Parts	1.7
Commodities Total	$1.7

FY20

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY20

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Rob Bochenek		0.7	13.0		9.3
Brian Stone		1.9	11.8		22.7
Chris Turner		2.2	9.7		20.9
Malcolm Herstand		1.0	8.5		8.1
Jordan Jenckes		1.9	6.0		11.5
Luc Mehl		1.9	9.4		18.0
Ross Martin		1.4	12.0		17.3
Stacey Buckelew		4.0	8.9		35.4
Shane Stclair		0.5	12.6		6.1
					0.0
					0.0
					0.0
		Subtotal	91.8	0.0	
				Personnel Total	$149.3

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY21

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
PERSONNEL & TRAVEL DETAIL

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

Contractual Costs: Description	Contract Sum
Facilities Charge	31.3
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$31.3

Commodities Costs: Description	Commodities Sum
Server Parts	0.5
Commodities Total	$0.5

FY21	**Project Title: EVOS Data Management Program** **Primary Investigator: Rob Bochenek, Axiom Data Science**	**FORM 3B** **CONTRACTUAL & COMMODITIES DETAIL**

Date Prepared: 03/31/2016

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY21

Project Title: EVOS Data Management Program
Primary Investigator: Rob Bochenek, Axiom Data Science

FORM 3B
EQUIPMENT DETAIL

Date Prepared: 03/31/2016