FY12 INVITATION
PROPOSAL SUMMARY PAGE

Project Title: Data Management Support for the Integrated Herring Research Program

Project Period: FY12-FY16

Primary Investigator(s): Rob Bochenek, Alaska Ocean Observing System

Study Location: General Spill Affected Area

Abstract: This project supports the EVOS Integrated Herring Research Program with critical data management support to assist study teams in efficiently meeting their objectives and ensuring data produced or consolidated through the effort is organized, documented and available to be utilized by a wide array of technical and non technical users. This effort leverages, coordinates and cost shares with a series of existing data management projects, cyber-infrastructure and partnerships which contribute capacity and information to this effort. During year one and two, this project would focus on providing informatics support to streamline the transfer of information between various study teams and isolate and standardize historic data sets in the general spill affected area for use in retrospective analysis, synthesis and model development. This work would scale down in year three thru five to provide support for general project level data management and archival.

Estimated Budget:
EVOSTC Funding Requested:
FY12-120K, FY13-120K, FY14-20.5K, FY15-21.2K, FY16-22.0K
Non-EVOSTC Funds to be used:
FY12-683K, FY13-640K, FY14-620K, FY15-500K, FY16-500K

Date: 5-25-2011

PROJECT PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

Robust Pacific herring (*Clupea pallasii*) populations, suitable for exploitation by commercial fisheries, are typically sustained by periodic recruitment of strong year classes into the adult spawning population. However, the Prince William Sound (PWS) herring population has not had a strong recruitment class since 1989, when the *Exxon Valdez* Oil Spill (EVOS) occurred. In the EVOS settlement herring were identified as an injured resource and they remain listed as an unrecovered species by the EVOS Trustee Council (EVOSTC). Understanding why herring have not recovered in Prince William Sound requires understanding potential bottlenecks in the herring life cycle. The identification of the limiting conditions to herring recovery requires a series of focused process studies combined with monitoring of the natural conditions that affect herring survival.

Described here is the data management component of the PWS Herring Research and Monitoring Program that will enhance the current monitoring efforts of the Alaska Department of Fish and Game (ADF&G), and examine aspects of particular life stages to allow better modeling of herring populations. **The long-term goal of the program is to improve predictive models of herring stocks through observations and research.** While we do not anticipate that there will be a major change in our modeling ability in the next five years, we expect that the combination of monitoring and focused process studies will provide incremental changes over the next twenty years and result in a much better understanding of herring populations by the end of the program.

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

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

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

The proposed program addresses the goals and priorities outlined in the 1994 Restoration Plan (http://www.evostc.state.ak.us/Universal/Documents/Publications/IHRP%20DRAFT%20-%20July%202010.pdf) and in the FY 2012 invitation for proposals. In particular our program addresses the need to "Conduct research to find out why Pacific herring are not recovering" and "Monitor recovery", listed on page 48 of the 1994 Restoration Plan. It will lead to the development of new tools to improve herring management. The latter will be accomplished by providing the information needed to develop or test biological and physical models of herring growth.

In November 2006, a Herring Steering Committee was formed and tasked with developing a focused Restoration Program that identifies strategies to address recovery and restoration of herring, recognizing that activities in the program must span an ecologically relevant time frame that accounts for herring population dynamics and life history attributes. A draft Integrated Herring Restoration Program (IHRP) was completed in the fall of 2008 and was further refined in July of 2010. The main goal of the program is to determine what, if anything, can be done to successfully recover the Pacific herring in PWS. In order to determine what steps can be taken, the program examines the factors limiting recovery of herring in PWS, identifies and evaluates potential recovery options, and recommends a course of action for achieving restoration. Based on the recommendations of the IHRP the Trustee Council has stated in the FY12 request for proposals that they have chosen Restoration Option #2, Enhanced Monitoring, as the focus for their research interests. The program described below aims to meet the goals of this option by utilizing a combination of monitoring efforts to provide more information about the existing stock and process studies to elucidate aspects of the herring life cycle necessary to move us towards an analytical modeling approach.

II. PROJECT DESIGN

A. Objectives

1) Provide data management oversight and services for EVOS IHRP project team data centric activities which include data structure optimization, metadata generation, and transfer of data between project teams.

2) Consolidate, standardize and provide access to study area data sets that are critical for retrospective analysis, synthesis and model development.

3) Integrate all data, metadata and information products produced from this effort into the AOOS data management system for long term storage and public use.

The specific objectives of this proposed effort will directly support the overall objectives of the combined PWS Herring Research and Monitoring proposal which are listed below.

1) *Provide information to improve input to the age-structure-analysis (ASA) model, or test assumptions within the ASA model.* The ASA model is currently used by ADF&G for

estimating herring biomass (Hulson et al. 2008). The proposed monitoring efforts are designed to address this objective by either expanding the data available for the existing ASA model or by providing information about factors that determine the size of recruitment events.

2) *Inform the required synthesis effort.* Proper completion of a detailed synthesis means being able to access and manipulate different sources of data and information. We are proposing projects that make data available to all researchers.

3) *Address assumptions in the current measurements.* Many of the existing studies are based on historical or logistical constraints. We are proposing research necessary to put the existing measurements into context spatially and temporally. This effort will allow the design of the most accurate and efficient monitoring program.

4) *Develop new approaches to monitoring.* With technological advances we have the potential to improve our monitoring programs so they require less effort or reduce the need to collect fish.

Providing a framework for efficiently managing data produced or consolidated by this effort will enable the information to be used to improve the ASA model, inform and facilitate the planned synthesis efforts, address assumptions in the current measurements and develop new approaches to monitoring. Data management activities are critical for the overall success of the IHRP program in addition to the integration of data sets and information transfer between study groups and research team leads.

B. Procedural and Scientific Methods

Objective 1. Provide data management oversight and services for EVOS IHRP project team data centric activities which include data structure optimization, metadata generation, and transfer of data between project teams.

AOOS data management staff will work with EVOS IHRP investigators to assess the types of data which will be collected during sampling efforts, assess Standard Operating Procedures (SOPs) for data collection to create metadata templates in addition to gauging general data management needs of PIs. This assessment is critical to identify the data management needs and the types of tools needed by researchers to increase their abilities to manage their data in an automated, standard fashion.

The AOOS data management group is currently developing a web base platform for PIs to manage project level data sets and author metadata. System development is currently supported through internal AOOS funds in additional to dedicated funding from the Prince William Sound Science Center. The AOOS Ocean Workspace will provide a web based platform for PIs to post and share data sets and rapidly author metadata. The system will be enabled with security authentication in order to limit access to IHRP investigators, project managers and

administrators. The system will also provide PIs with tools to generate metadata profiles which comply with national standards. Initially, this system will focus on authoring FGDC metadata formats including tools for authoring the biological extension for taxonomic classifications and measurements. The software development phase of this application was initiated in March 2011. An initial beta release/testing of this system will commence in August 2011 with a planned release date of October 1st, 2011. This platform will provide IHRP investigators and project managers with a transparent view of data collection and metadata authoring progress in addition to providing a framework for data integration. It is envisioned that this platform will function as the primary vehicle to facilitate data transfer, metadata generation and archiving for the entire IHRP project data management lifecycle. This proposed effort will provide a user base and focused environment for the expansion and refinement of this project level data management tool.

Objective 2. Consolidate, standardize and provide access to study area data sets that are critical for retrospective analysis, synthesis and model development.

This task will involve isolating and standardizing historic data sets deemed necessary for retrospective analysis by EVOS IHRP synthesis efforts. Early in the effort the EVOS IHRP researcher team will be engaged to prioritize sources of relevant data deemed of high value for the synthesis effort. Data will be prioritized by several metrics including length of time series, scientific importance, and quality and precision of the data storage format. All data acquired through efforts of this project will be merged into the AOOS data system for long term archival and access. Many herring related data sets not easily accessible to restoration researchers and managers have been standardized and made available through the actions of the PWS Herring Portal (EVOS Project 070822, 080822 and 090822). This proposed project would expand the geographic and programmatic scope of this work to include datasets in Lower Cook Inlet and potentially Kodiak regions.

Building upon results of the PWS Herring Portal Project, investigators will expand their efforts to additional project level data sets, long term time series produced from sensor platforms, remote sensing/satellite imagery data products, oceanographic/atmospheric/ecological model outputs and relevant GIS data layers. The AOOS data system currently has the capacity to manage all of these data types except for project level data. AOOS will be deploying a project level data management system in the fall of 2011 to address this need. This is the same system referenced in methods of objective 1. Data analysts preparing and salvaging historic project level datasets will leverage this system to consolidate, centralize and document data resources so that IHRP investigators can access these data as they are discovered, processed and made available for use.

Additionally, data management staff will leverage existing data management efforts and data sets currently under the stewardship of AOOS in this activity. These resources and efforts are detailed more fully in the “Coordination and Collaboration with Other Efforts” section of this proposal. These existing data resources include a wide array of physical and biological data sets in the general spill affected areas. These resources can be reviewer at http://data.aoos.org.

Potential Data Sources for this Effort

Lower Cook Inlet

The Alaska Department of Fish and Game in Homer (ADF&G-Homer) has flown aerial surveys to assess Pacific herring abundance trends in Lower Cook Inlet (LCI) since 1978 (Otis et al. 1998). An uninterrupted time series (1978-2008) of aerial survey data is available for the Kamishak and Southern (i.e., Kachemak Bay) districts and discontinuous data sets are available for the Outer and Eastern districts. The Outer/Eastern districts are oceanographically downstream of PWS. Embayments along the outer coast of the Kenai Peninsula may function as juvenile rearing areas for herring larvae advected from PWS via Montague Strait. Lower Cook Inlet's most comprehensive herring data set is for Kamishak Bay, where commercial sac-roe herring harvests occurred from 1974-1979, and from 1985-1998. The fishery is currently closed while the stock rebuilds, but ADF&G continues to fly aerial surveys and conduct vessel surveys to assess herring abundance and ASL composition of the spawning biomass. Through a previous NOAA grant funded project (Otis and Spahn 2003), the great majority of the Kamishak herring data set has already been digitized into a spatial database (ADF&G 2002), which can be readily ingested into the data management system for this project. However, herring survey and ASL data for the Southern, Outer, and Eastern districts of LCI remain spatially disabled and would require staff time to digitize and spatially reference them. Table 1 documents the type and current status of available herring data from LCI.

Kodiak

The Alaska Department of Fish and Game in Kodiak (ADF&G-Kodiak) has been monitoring herring population and fishery parameters since the 1930's. Herring distribution and abundance trends have been assessed using a combination of aerial and acoustic surveys periodically since the mid-1980's. Spawn observations have been documented consistently since the 1970's and herring age, sex, length (ASL) data have been collected annually since 1967. Fishery performance and harvest data have been maintained since the 1970's and early fishery observations exist back to the 1930's. Marine mammal sightings and herring disease data are also available for recent years. Most of these valuable, historical data sets exist only in hard copy format and need to be digitized and spatially enabled to realize their full worth. Table 2 documents the type and current status of available herring related data from the Kodiak region.

PWS-ADF&G

The Alaska Department of Fish and Game in Cordova (ADF&G-Cordova) has flown aerial surveys in Prince William Sound since 1973. Population trends were initially monitored with aerial surveys to estimate biomass and the linear extent of beach used for spawning (Brady 1987), and have continued almost without interruption. Age, sex, and size data h as been collected from most fisheries and spawning aggregations since 1973 (e.g., Baker et al. 1991; Biggs et al. 1992). Dive surveys to estimate spawning biomass began with feasibility studies in 1983 and 1984 and continued in 1988-1992 and 1994-1997 (e.g., Willette et al. 1999). In 1993, ADF&G in cooperation with the Prince William Sound Science Center began fall acoustics surveys. Spring (March/April) acoustics surveys have been conducted during 1995-2009. Age structured models have been used since 1993 to estimate historical population parameters and project future biomass, recruitment, and abundance (Funk 1994). Disease assessments (1993-2002) indicate viral hemorrhagic septicemia virus (VHSV) and associated ulcers were related to population declines in 1993/1994 and 1998; and *Ichthyophonus hoferi* was related to a population decline in 2001 (Marty et al. 2004). Additional disease sampling to index the

prevalence of VHSV and *I. hoferi* (2003-2006) and measure the prevalence (2006-2009) have been funded by the Department of Fish and Game and the EVOS Trustee Council. Previous funding by the EVOS Trustee Council has allowed the digitizing and publishing of the majority of the aerial survey linear extent of spawn and biomass data; and age, sex, and size in addition to the commercial harvest data. (http://dev.axiomalaska.com/pwsherringportal/) and digitizing most of the commercial harvest and spawn deposition survey data. Table 3 documents the type and current status of available herring related data from the PWS region.

PWS-PWSSC

The Prince William Sound Science Center (PWSSC) has been collecting biological and physical measurements in Prince William Sound which are critical to understanding herring population dynamics back to the early 1990s. The data includes herring acoustic data (e.g., Thomas and Thorne 2003), herring nursery bay and larger PWS oceanographic conditions, zooplankton abundance, herring energetic, and seabird predation datasets for juvenile and adult herring. The data at PWSSC must be standardized, documented and up scaled into a geospatial database. Table 4 documents the type and current status of available herring related data from the PWS region stewarded by the Prince William Sound Science Center.

Objective 3. Integrate all data, metadata and information products produced from this effort into the AOOS data management system for long term storage and public use.

The ultimate goal of this project is to provide services to assist in the organization, documentation and structuring of data collected and made available via EVOS IHRP project activities so that it can be transferred efficiently to long term data archive and storage centers and made available for future use by researchers and other user groups. This task will leverage the AOOS cyber infrastructure, long term funding and other active data management projects being undertaken by that organization. Data sets produced from the integrated research effort will be served to users by extending existing data access, analysis and visualization interfaces currently supported and under development by the AOOS data management team.

Figure 1 below provides screen captures of existing AOOS data portals which provide access to data management systems that manage sensors, models/remote sensing and GIS data layers. These portals can be accessed off the AOOS website at http://data.aoos.org/.

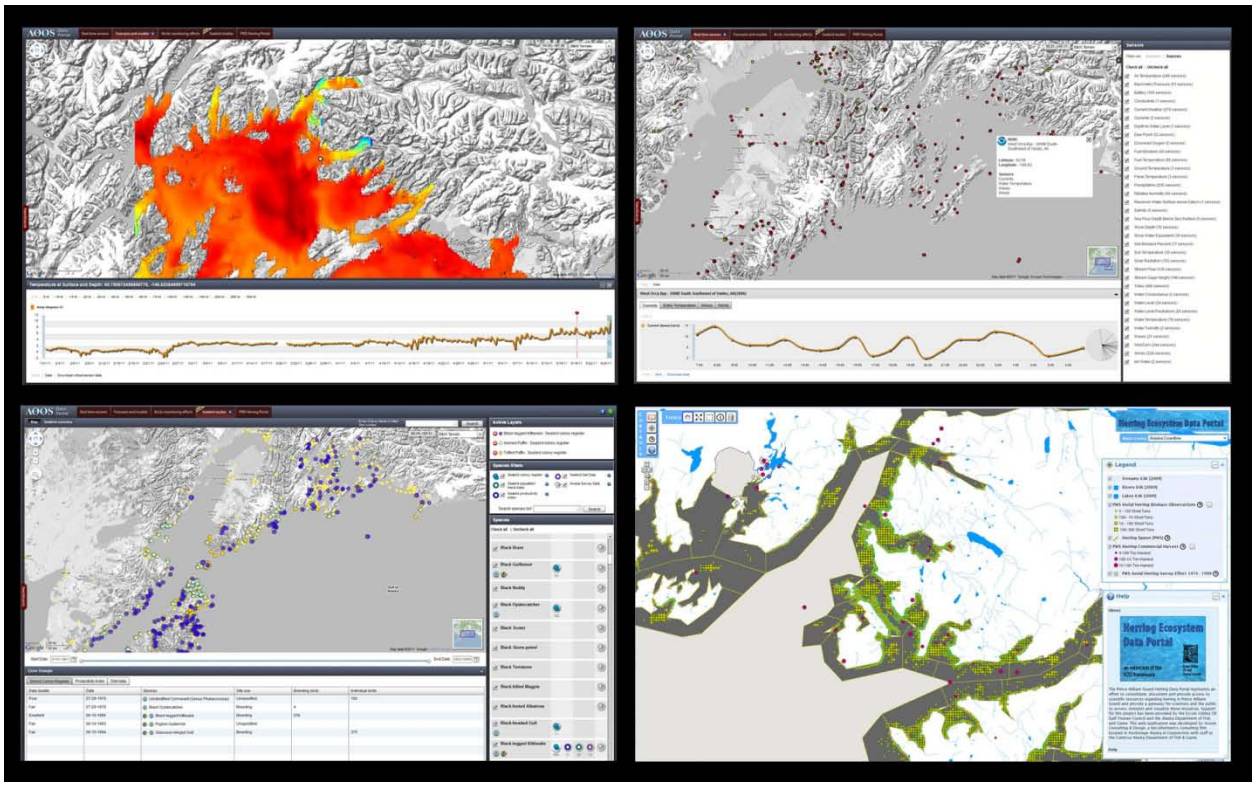

Figure 1. Screenshots of existing AOOS data management and visualization systems which are available at http://data.aoos.org. At the top left is a screenshot of the AOOS model explorer displaying a ROMS circulation model of Prince William Sound and an ocean temperature point source time series extraction near Port Fidalgo. On the top right of the figure is a screen capture of the AOOS real time sensor portal. On the bottom of the figure from the left to right are screenshots of the North Pacific Seabird Portal and the PWS Herring Portal.

C. Data Analysis and Statistical Methods

The overarching strategic plan for the AOOS data system involves implementing an end-to-end technological solution which allows data and information to be channeled and distilled into user-friendly products while simultaneously enabling the underlying data to be assimilated and used by the emerging external data assembly systems. The following diagram (Figure 2) details the four logical technical tiers of the approach. At the base (Tier 1) of the pyramid lie the source data produced by researchers, instruments, models, and remote sensing platforms which are stored as files or loaded within geospatial databases. Interoperability systems (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 addition to known external sources of interoperable data and populates a database describing the dimensional characteristics (space, time, measured parameter, and taxonomy) of each data resource. Also in this third tier are web services which provide access to the descriptive information contained in the asset catalogue database so that applications can 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 which provide users access to data and products. Users sit at the top of the pyramid with all underlying systems working together to create a powerful and intuitive user experience. The intended result is the facilitation of rapid data discovery, improved data access, understanding, and the development of knowledge about the physical and biological marine environment.

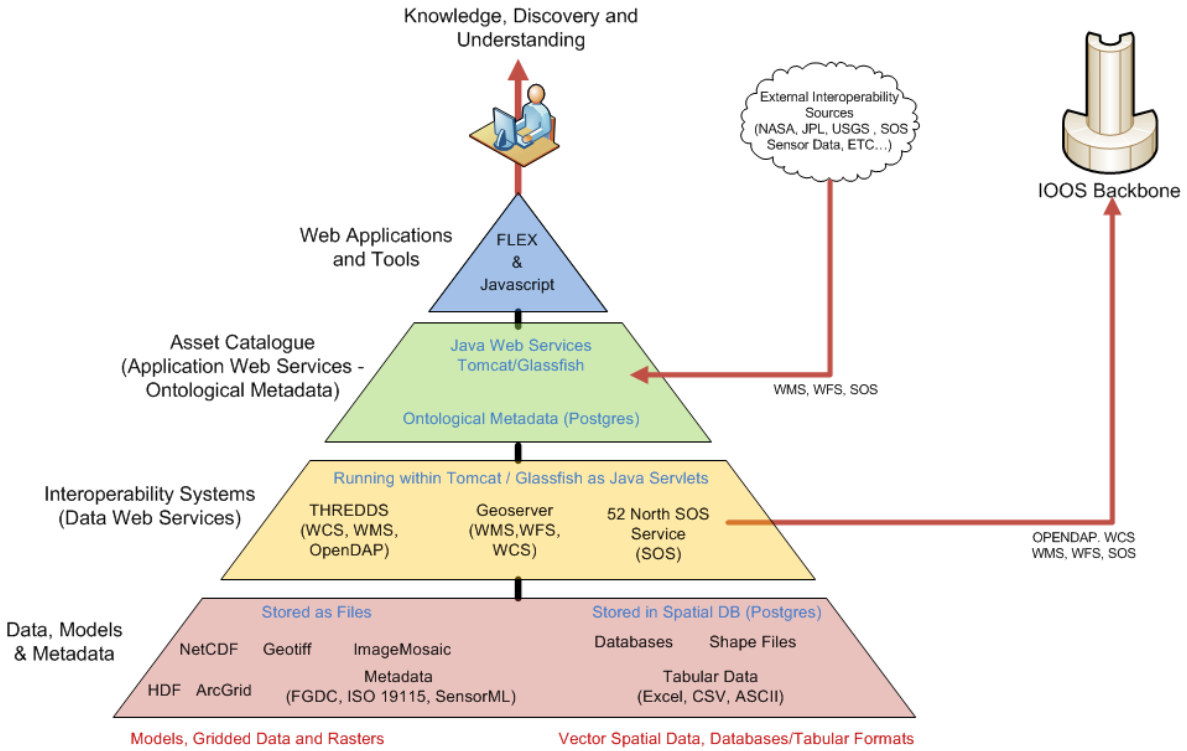

Figure 2. Data knowledge pyramid detailing the flow of data through logical technology tiers so that it can be consumed by users to enable discovery and understanding about the ocean environment.

Tiers are discussed in technical detail below.

- **Tier 1 (Data, Models and Metadata)** – At the base of the proposed data management 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 which 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 loaded into a PostgreSQL database and spatially indexed. GeoServer, an open source geospatial data server, will then connect to the PostgreSQL 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, ImageMosaic and other two dimensional imagery/raster data.

- **Tier 2 (Interoperability Systems)** – Various interoperability servers (GeoServer, THREDDS, ncWMS, 52 North SOS, etc.) will be implemented on top of source data. By design, these servers will 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. Because these systems have been developed using the Java programming language, they will run within a servlet container such as Tomcat or Glassfish.

- **Tier 3 (Asset Catalogue, Ontological Metadata and Services)** – The asset catalogue provides a description of known internal and external 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 which catalogs data sources and reconciles these inconsistencies must be implemented 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 will also contain an ontology that maps source data descriptions and metadata to a common set of internally stored terms with strict definitions. This mapping will allow users to easily locate related sets of information without having explicit knowledge of the internal naming conventions of each data-providing agency. The development of an internal ontology will also enable future endeavors to connect the asset catalogue to global ontologies in the semantic web. The following dimensions are to be stored in the database for mapping the heterogeneous characteristics of source data to common metrics:

  - **Source** – Service URLs and methods of interaction for these services.
  - **Data formats and return types** – Data format returned by the service and how data can be equated between various formats.
  - **Space (x, y, z)** – Spatial dimensions of dataset (1D, 2D, 3D). Upper and lower spatial bounds (bounding box or cube) stored in common projection (EPSG 4326).
  - **Time (t)** – For data resources with a time component: document time span, whether time corresponds to a single moment or if it is representative of a time period. If data is in discrete periods, document individual available periods.
  - **Taxonomy** – Taxonomic data mapped to International Taxonomic Information System (ITIS) codes.
  - **Parameter** – Parameter(s) and units in the data resource and how they map to internally defined universal terms. For example: Datasets SST, AVHRR, and Sea_Surface all contain parameters that map to internal universal term Sea Surface Temperature.

  Web services written in the Java programming language will be developed to connect to the asset catalogue and provide applications with access to the underlying descriptions of

all known data sources. Because the asset catalogue contains a structured ontological definition of data sources and maps all known data sources to a common definition, applications can be developed which connect users to vast arrays of data through simple but powerful interfaces. The following is a list of example functionality that is possible utilizing this methodology:

- Users can load multiple data layers (potentially existing in different physical locations and being served by different systems) onto a single web based map. Users can also filter all layers simultaneously by time or request spatial and temporal subsamples of data that can be pulled from multiple sources and automatically packaged into a single download.
- All real time sensor feeds can be accessed and visualized on a single uniform user interface by parameter even though the sources of the sensor feeds may exist in a wide array of formats and service protocols.
- Users can query the asset catalogue to discover which data is available for an area, time period, parameter, and species.

- **Tier 4 (User Applications)** – Users interface with web based applications that bring together combinations of underlying data and allow users to make discoveries, improve understanding, and develop knowledge through visualization and data access. These types of applications would most likely be interactive map based data portals. Applications will also be developed which provide specific targeted functionality. These focused applications could include marine spatial planning tools, emergency response applications, and educational/outreach portals. Developed tools are designed to meet user needs and thus require user input into their initial design and periodic feedback to direct functional improvements for future design iterations.

D. Description of Study Area

The majority of this project will involve consolidating existing data, metadata, and other electronic resources related to herring in Spill Affected Area. Specific areas of focus include those areas in PWS, Lower Cook Inlet, and Kodiak where herring fisheries currently do, or historically did occur. The north, east, south, and west bounding coordinates of this area are 59.767, -145.837, 61.834, and -154.334

E. Coordination and Collaboration with Other Efforts

This proposal is part of the integrated "PWS Herring Research and Monitoring" proposal submitted by the Prince William Sound Science Center to the Exxon Valdez Oil Spill Trustee Council. It includes the collaboration and coordination described there for work within the herring research group and with the Long-Term Monitoring proposal submitted by the Alaska Ocean Observing System. This project is also highly coupled with the proposed data management component of the EVOS Long Term Monitoring program.

AOOS brings a significant level of leveraged resources, infrastructure, regional data management projects and partnerships to this proposed effort. The data management effort for the LTM and herring projects could not be accomplished for the budgeted amount by a team without these leveraged resources.

1. AOOS – (500k to AOOS DM) Alaska oceanographic data management effort. Supports open source, standards based data system that serves up and archives real-time sensor feeds, models & remote sensing applications, GIS data layers, and historical datasets. Data system developed on interoperability concepts and meets NOAA Integrated Ocean Observing System standards and protocols for streaming data feeds to national data assimilation sensors. Data Management Committee chaired by Dr. Phil Mundy provides ongoing advice, prioritization and direction to the team at Axiom Consulting & Design. AOOS board is made up of federal and state agencies, and major marine research institutions in the state that have committed to data sharing. The AOOS board has committed to supporting a statewide data system for as long as AOOS exists. Federal funding is stable, although we would like to see it increase. In the event AOOS was to end, all data and data products would be transferred to the University of Alaska.
2. PWSSC – PWSSC Data Management Project ($50K to AOOS DM).– Project involves the creation of a prototype data management system for use by PWSSC staff to manage, track, document via metadata and visualize oceanographic and biological data being collected at the center. Project will utilize a stack of open source technologies and protocols with the overall goal of creating a packaged solution for research organizations to better manage and document their data resources. This project is to function as the pilot application for the AOOS project level data management system.
3. Northern Forum/USFWS Seabird Data System – ($50K)Project involves the creation and population of a series of new seabird metric databases (diet and productivity) and integrating these new databases with legacy seabird databases (species distribution and abundance at seabird colonies, pelagic species distribution and abundance, USGS seabird monitoring databases and NPRB's North Pacific Seabird Diet Database). Modern spatially explicit, web based data entry interfaces have and continue to be developed to assist researchers existing in distributed agencies to contribute their historic and current seabird metric data into standard data structures. Project will result in vastly increasing the amount and quality of seabird species distribution, diet and other seabird data available for use in retrospective analysis and management. Though data includes areas around all of Alaska, most available data is located in GOA and PWS.
4. AOOS – 3-year funded partnership (~$200K to ADF&G) with ADF&G Division of Commercial Fisheries to develop data sharing and transfer to make commercial fisheries data more accessible, and to allow ADF&G researchers greater access to oceanographic data. Project builds upon an effort funded by the Moore foundation to develop improved data management capacity and salmon fishery management tools for the PWS fisheries.
5. AOOS – collaborator with Alaska Data Integration Working Group – an initiative with the Alaska Climate Change Executive Roundtable – to develop protocols for serving up project data to increase data sharing among federal and state agencies.
6. AOOS and NOAA – initiatives to develop data sharing agreements with private sector, including oil & gas companies.

7. Cook Inlet Regional Citizens Advisory Council (27K) – contract with Axiom to develop a data management system for their oceanographic and contaminants data in Cook Inlet.

III. SCHEDULE

A. Project Milestones

Objective 1. Provide data management oversight and services for EVOS IHRP project team data centric activities which include data structure optimization, metadata generation, and transfer of data between project teams.

This objective will be addressed throughout the entire span of the project and will follow the annual cycle of field data collection and analysis by principal investigators. Investigators will be engaged before each field season to ensure that preparations have been made to stage data collected by the project so that other members of the IHRP project can access the data produced by project participants.

Objective 2. Consolidate, standardize and provide access to study area data sets that are critical for retrospective analysis, synthesis and model development.

This objective will be met by the fourth quarter of year two of the effort (September 2013).

Objective 3. Integrate all data, metadata and information products produced from this effort into the AOOS data management system for long term storage and public use.

This objective will be addressed throughout the entire span of the project. The AOOS data system is to serve as the vessel to capture all project level data produced through this effort in addition to those datasets salvaged to inform the historic synthesis effort. This task will be ongoing as long as the program is producing or acquiring additional data.

B. Measurable Project Tasks

FY12 1st Quarter (October 1, 11 to December 31, 11)

October	Project authorized by trustee council
October	Release AOOS Ocean Workbench (Project DM System)
November	Set up user profiles for PIs in Ocean Workbench
November	Initialize historic data salvage effort
December	Draft historic data set manifest

FY12 2nd Quarter

January	Annual Marine Science Symposium
January	Prioritize historic datasets for inclusion into synthesis effort
February	Adjust historic data aggregation effort and AOOS integration

FY12 3rd Quarter

April	Prepare for FY12 field season
May	Participate in annual PI meeting
June	Submit FY13 work plan for review

FY12 4th Quarter

August	Submit annual report

FY13 1st Quarter (October 1, 12 to December 31, 12)

October	Assess year 1 datasets and metadata submitted through Ocean Workbench

FY13 2nd Quarter

January	Annual Marine Science Symposium
January	Release updated Ocean Workbench tool

FY13 3rd Quarter

May	Participate annual PI meeting
June	Submit FY14 work plan for review
June	Complete integration of data salvaged into AOOS DM System

FY13 4th Quarter

August	Submit annual report
January	Annual Marine Science Symposium

FY14 1st Quarter (October 1, 13 to December 31, 13)

October	Assess year 2 datasets and metadata submitted through Ocean Workbench

FY14 2nd Quarter

January	Annual Marine Science Symposium
Winter	EVOS workshop with Herring and Long-term monitoring programs

FY14 3rd Quarter

May	Participate in annual PI meeting
June	Submit FY15 work plan for review

FY14 4th Quarter

August	Submit annual report

FY15 1st Quarter (October 1, 14 to December 31, 14)

October	Assess year 3 datasets and metadata submitted through Ocean Workbench

FY15 2nd Quarter

January	Annual Marine Science Symposium

FY15 3rd Quarter

May	Participate in annual PI meeting
May	Submit five-year plan for FY17-22 and work plan for FY16

FY15 4th Quarter

FY16 1st Quarter (October 1, 15 to December 31, 15)

October	Assess year 4 datasets and metadata submitted through Ocean Workbench

FY16 2nd Quarter

January	Annual Marine Science Symposium

FY16 3rd Quarter

June	Submit work plan for FY17

FY16 4th Quarter

August	Submit annual report

Table 1. Data type and current status of herring related survey data collected from Lower Cook Inlet, 1971-present.

Data Type	District	Years	Current Status	Comments
Herring School Observations	Kamishak	1978-present	ESRI .shp files with accompanying attribute tables (.dbf)	
(timing, location, est. biomass)	Southern	1978-present	Hard copy survey maps; Excel files w daily biomass est.	Handwritten biomass observations by bay
(from aerial/vessel surveys)	Outer/Eastern	1978-1992	Hard copy survey maps	Handwritten biomass observations by bay
Herring Spawn Observations	Kamishak	1978-present	ESRI .shp files with accompanying attribute tables (.dbf)	
(timing, location, magnitude)	Southern	1978-present	Hard copy survey maps	Very few spawning events documented
(from aerial/vessel surveys)	Outer/Eastern	1978-1992	Hard copy survey maps	Very few spawning events documented
Herring ASL Data	Kamishak	~1974-present	Hard copy data (74-87), ascii .txt (88-02), Excel (03-Present)	Continuous
(age, sex, length, weight)	Southern	~1973-present	Hard copy data (73-87), ascii .txt (88-02), Excel (03-Present)	Intermittent
	Outer/Eastern	~1971-1991	Hard copy data (71-87), ascii .txt (88-91)	Intermittent
Commercial Fishery Data	Kamishak	~1974-1998[1]	ADF&G Herring Fish Ticket Database (SQL)	Confidentiality rules apply when fewer than 4 permits fished
(commercial openings and	Southern	~1974-1989[1]	ADF&G Herring Fish Ticket Database (SQL)	Confidentiality rules apply when fewer than 4 permits fished
harvest by date and stat area)	Outer/Eastern	~1974-1987[1]	ADF&G Herring Fish Ticket Database (SQL)	Confidentiality rules apply when fewer than 4 permits fished
Marine Mammal Observations	Kamishak	1978-present	ESRI .shp files with accompanying attribute tables (.dbf)	
(timing, location, est. number)	Southern	1978-present	Hard copy survey maps	Very few marine mammal sightings documented
(from aerial/vessel surveys)	Outer/Eastern	1978-1992	Hard copy survey maps	Very few marine mammal sightings documented
Seabird Observations	Kamishak	1978-present	ESRI .shp files with accompanying attribute tables (.dbf)	
(timing, location, est. number)	Southern	1978-present	Hard copy survey maps	Very few seabird sightings documented
(from aerial/vessel surveys)	Outer/Eastern	1978-1992	Hard copy survey maps	Very few seabird sightings documented
Disease Data	Kamishak	2002-2007	.pdf files	Pathology reports
Management Boundaries	Kamishak	current	ESRI .shp files with accompanying attribute tables (.dbf)	Herring mgt areas, stat areas, aerial survey index areas, etc.
Photo Links	Kamishak	misc.	.tiff and .jpg images	Historical photos of fishery, vessels, landmarks, etc.
Water Temperature	Kamishak	1999-present	electronic files (Excel)	Thermographs deployed 2 m below surface at Nordyke I. and Iniskin Bay
Aerial Survey Trackline	Kamishak	1978-present	ESRI .shp files with accompanying attribute tables (.dbf)	generalized track line for standard survey flight
Vessel Survey Tracklines	Kamishak	1999-2007	ESRI .shp files with accompanying attribute tables (.dbf)	daily tracklines for chartered survey vessels collecting ASL samples
Misc. Fisheries Information	Lower Cook Inle	1973-present	Hard copy and electronic reports	AMR's, RIR's, Conference Proceedings, etc.

[1] *The Kamishak, Southern and Outer/Eastern district sac roe herring fisheries have been closed since 1998, 1989, and 1987, respectively.*

Table 2. Data type and current status of herring related survey data collected from the Kodiak district.

Data Type	Years	Current Status	Comments
Herring Spawn Maps	1977-1989	Hard copy	
Spawn Observations	1970's-present	Hard copy, various notes	
Herring ASL Data	~1967- present	1967-1984, hard copy	
		1985-present, database	
Shelikof Biomass Estimates	1986, 1989-1990	Digital hydroacoustic tapes, notes	
Aerial Surveys	~1970-present	Hard copy	Variable data through range of dates
Commercial Fishery Data	~1970-present	~1970-1984, hard copy	Daily harvest
		1985-present, digital	Daily harvest
Acoustic Survey (Research)	2002-present	Electronic (quantitative)	Excel
Acoustic Survey (Management)	~1985-present	Hard copy (qualitative)	Intermittent through range of dates
Disease Data	2007-present	Hard copy	
Marine Mammal Sightings	2002-present	Hard copy	
Misc. Field Notes	1960's-present	Hard copy	Various notes and years
Misc. Fisheries Data	1930's-present	Hard copy AMR's	

Table 3. Data type and current status of herring related survey data collected from the PWS district (ADF&G).

Data Type	Years	Current Status	Comments
Spawn Deposition Transects	1977-1989	Excel, GIS (5/15/2009)	
Egg Loss Transects	1970's-present	Excel	
Herring ASL Data	1969-2009	Visualizations Online/Data Ready	
Aerial Surveys Linear Spawn	1973-2006	Online now	
Aerial Surveys Linear Spawn	2007-2009	Ready	
Aerial Surveys Track Lines	1973-2007	Online now	
Aerial Surveys Track Lines	2008-2009	Ready	
Aerial Survey Biomass Estimates	1973-2007	Online now	
Aerial Survey Biomass Estimates	2007-2009	Ready	
Commercial Fisheries Data	~1973-present	Ready	Harvest, EO's, Effort
Acoustic Survey Tracks/Data	1997-2007	Electronic (quantitative)	Excel
Disease Data	2007-present	Hard copy	
Marine Mammal Sightings	2002-present	Hard copy	
Forecast Data	1993-2009	Ready	

Table 4. Data type and current status of herring related survey data collected from the PWS district (Science Center).

Data Type	Years	Source	Comments
Herring Acoustic Data	1993-2009	Dick Thorne	
Herring Nursery Bay Oceanographic	1995-1998	Shelton Gay	SEA Project
PWS Oceanography	1995-2009	Scott Pegau, Mark Halverson	
Zooplankton Abundance	2004-2009	Rob Campbell	
Herring Energetics	1995-1999, 2006-2009	Tom Kline	
Seabird Predation on Spawning Herring	1994-1996	Mary Anne Bishop	EVOS Project 95320Q
Seabird Predation in Herring Juvenile Bays	2006-2009	Mary Anne Bishop	
Herring Diet	1996-1997	Mary Anne Bishop	NVP Data EVOS Project 97025

BUDGET JUSTIFICATION: Fiscal Year: 2012

Personnel:
Funds are requested ($94.4K) to support a Senior Software Engineer (2 months), Software Engineer (1.5 months), Information Architect (1 month), and two data analysts (2 staff for a total of 7.5 months) in the AOOS data management unit. The software Engineers and Information Architect will supervise and direct data processing activities of the data analysts. These lead staff members will also assists in developing data management plans for projects and support the AOOS Ocean Workbench project level data management system. The data analysts will focus their activities on acquiring, accessing, documenting and loading data sets deemed important to the IHRP effort into the AOOS data system for use in synthesis efforts.

Equipment:
A disk array will be procured (3.9K) in FY12 to increase storage capacity of the AOOS data system.

Indirect:
AOOS's indirect Rate is 23% (21.7 K) and has been figured into the AOOS budget. This covers expenses for software, telecommunications and other operating expenses.

BUDGET JUSTIFICATION: Fiscal Year: 2013

Personnel:
Funds are requested ($93.7K) to support a Senior Software Engineer (1.5 months), Information Architect (1 month), software engineer (3 months) and data analyst (6 months) in the AOOS data management unit. The Senior Software Engineer and Information Architect will supervise and direct data processing activities of the data analysts and data system development of the software engineer. These lead staff members will also assists in developing data management plans for projects. The data analyst will focus activities on acquiring, accessing, documenting and loading data sets deemed important to the IHRP effort into the AOOS data system for use in synthesis. The software engineer will work developing web based pathways (extend the AOOS Ocean Workspace) for data sharing, discovery and visualization by researchers and others.

Equipment:
A disk array will be procured (3.9K) in FY12 to increase storage capacity of the AOOS data system.

Indirect:
AOOS's indirect Rate is 23% (21.7 K) and has been figured into the AOOS budget. This covers expenses for software, telecommunications and other operating expenses.

BUDGET JUSTIFICATION: Fiscal Year: 2014

Personnel:
Funds are requested ($16.7) to support a Senior Software Engineer (0.5 month) and a Data Analyst (1.5 months) in the AOOS data management unit. The Software Engineer and data analyst will work with PIs to develop and implement data management plans and load data sets into the AOOS data system.

Indirect:

AOOS's indirect Rate is 23% (3.8 K) and has been figured into the AOOS budget. This covers expenses for software, telecommunications and other operating expenses.

BUDGET JUSTIFICATION: Fiscal Year: 2015

Personnel:
Funds are requested ($17.3) to support a Senior Software Engineer (0.5 month) and a Data Analyst (1.5 months) in the AOOS data management unit. The Software Engineer and data analyst will work with PIs to develop and implement data management plans and load data sets into the AOOS data system.

Indirect:
AOOS's indirect Rate is 23% (4.0 K) and has been figured into the AOOS budget. This covers expenses for software, telecommunications and other operating expenses.

BUDGET JUSTIFICATION: Fiscal Year: 2016

Personnel:
Funds are requested ($17.9) to support a Senior Software Engineer (0.5 month) and a Data Analyst (1.5 months) in the AOOS data management unit. The Software Engineer and data analyst will work with PIs to develop and implement data management plans and load data sets into the AOOS data system.

Indirect:
AOOS's indirect Rate is 23% (4.1 K) and has been figured into the AOOS budget. This covers expenses for software, telecommunications and other operating expenses.