

Using Geospatial and Information Science to Facilitate the Discovery and Access of Ocean Science Data

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Abstract— The ability to discover and access available ocean data and information is a major challenge for the ocean science community. This challenge has been recognized by the United States government policies that require science data be current, accessible and consistent with certain standards. This paper describes how the Bureau of Ocean Energy Management designed and developed a system that utilizes geospatial and information science to allow scientific data and information from its Environmental Studies program dating back to 1973 to be easily accessible and discoverable via the Internet.

Keywords—marine spatial planning; information management; outer continental shelf

I. INTRODUCTION

A. Background

Applying science to make informed decisions depends on the ability to readily discover relevant scientific information. In recent years, the U.S. government has made significant efforts to improve the discovery and access of ocean science information. These efforts are mandated by Executive Order 13547 “Stewardship of the Ocean, Our Coasts, and the Great Lakes” signed by President Obama on July 19, 2010 [1]. It requires government agencies “be held accountable for managing its own information assets by keeping them current, easily accessible, and consistent with Federal Standards”. In addition, in a 2013 memo titled “Increasing Access to the Results of Federally Funded Scientific Research” [2], the U.S. Office of Science Technology Policy has stressed the importance of federally funded research being made available to the public, industry and scientific community. This memo specifically stated that the agencies “must pursue a strategy for improving the public’s ability to locate and access digital data resulting from federally funded scientific research”. Pursuant to these mandates, the Bureau of Ocean Energy Management’s (BOEM) has developed a new strategy for improving access to the agency’s extensive ocean research information.

B. The Program and the Challenge

For more than 40 years the BOEM’s Environmental Studies Program (ESP) has conducted ocean research specifically to inform Outer Continental Shelf (OCS) energy and mineral resources decisions. Areas of research include marine biology, oceanography, and the social sciences. Historically, the results of this research have been communicated and preserved through study reports which are available through an online database, the Environmental Studies Program Information System (ESPIS). Other sources of scientific data and information were not included in ESPIS but rather archived with existing repositories such as the National Centers for Environmental Information (NCEI), and a variety of peer reviewed scientific publications. The distributed nature of this information made it challenging to locate and access it as well as to discern how it was related to BOEM research projects.

C. The Approach

Efforts were undertaken to streamline the search, discovery and retrieval of BOEM ocean science data and information. BOEM scientists partnered with the NOAA Office for Coastal Management to design a new ESPIS, utilizing the latest geospatial and database technology. This effort built on the success of another BOEM/NOAA partnership, MarineCadastr.gov. MarineCadastr.gov provides access to maps, tools, and over 150 authoritative and trusted datasets that can be used for ocean planning projects. ESPIS now extends MarineCadastr.gov to provide access to ocean science and related information. Access to BOEM ocean science has never been easier. Scientists and the general public can now search by geography, keywords, and filters to find over 1500 research projects.

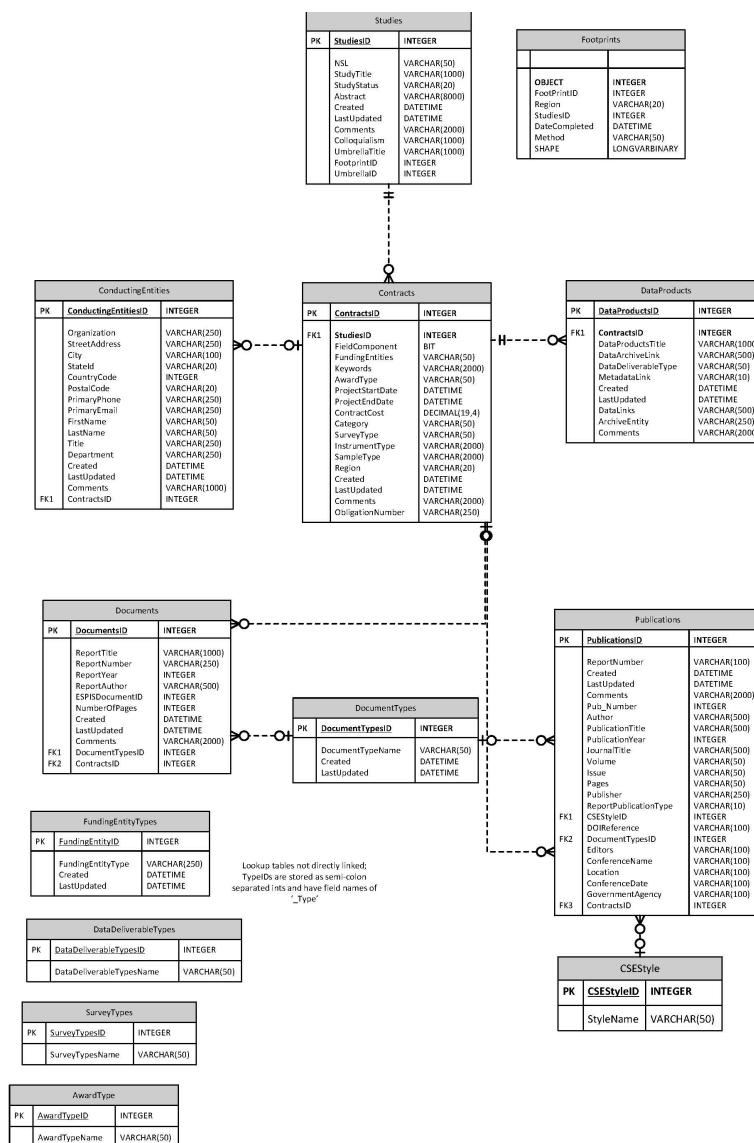


Figure 1. Relational database schematic for the ESPIS database. Example of study tables include information on publications that resulted from environmental studies (“publications” table), metadata for studies such as who conducted the studies (“conducting entities” table) and specific project related information such as the start and end date of the projects (“contract table”)

II. METHODS

A. Studies Research Metadata

Historically the ESPIS database only contained very limited attribute information about the study final report, such as the study title and year of completion. ESPIS now captures additional information that helps users understand the details of each research project. Some of these additional attributes include conducting entities, instrumentation, types of research, related peer review publications, and links to data products. Additionally, the new ESPIS database was built on an extensible platform that allows new attributes to be added as needed.

The new ESPIS has a robust data model that is designed to document more than 40 years of environmental studies

research (Figure 1). The list of attributes in this database was selected so as to be able to link a specific study conducted by the ESP with its related information and data. Extensive research was conducted to collect information supporting the data model. This included a review of historical agency records about specific projects as well as literature searches and telephone interviews. Two key components of the data model are the related publications and data products.

ESPIS was designed to store final reports available for each science project. However, scientists participating in this research often published peer-reviewed literature and other written products. This information was not typically included in ESPIS, although some of this information had been recorded over the years. The new data model supports the inclusion of these ancillary data and information. As part of this project extensive research was conducted to gather a list

of publications that directly resulted from research conducted by the ESP.

In addition to related publications there were often data associated with ESP studies. Much of this data was archived with the National Centers for Environmental Information (NCEI). A comprehensive search of the NCEI as well as other online resources was conducted to determine what data products were associated with each ESP study.

B. Study Footprints

From the start of this project an obvious user need was to be able to determine the geographic area that a study took place. In order to accommodate this user need, study “footprints” were developed. The study footprints are a geospatial data layer that contains a bounding polygon around the area of the study. It was not meant to depict precise location of where, for example specific point location of samples may have been collected, but rather the area of interest of the study. Study footprints were created in a

standardized way to ensure repeatability for future projects. This included utilizing existing maps, relying on study site descriptions within reports, and reformatting existing project data.

C. Database and User Interface (Search Tool)

The system front-end user interface utilizes Angular JS technology, Leaflet – an open source JavaScript library - to support a mapping interface (Search Tool) that allows users to search for information by geography, and Microsoft SQL Server to enable in-depth searches of thousands of documents and publications. This architecture allows discoverability of archived and current research using key word searches, full text searches, and map and geographic name index based spatial queries.

The final Search Tool was developed through an iterative process utilizing stakeholder input. The first stages of this process included gathering extensive information as to how the ESPIS system would be used to access information. This

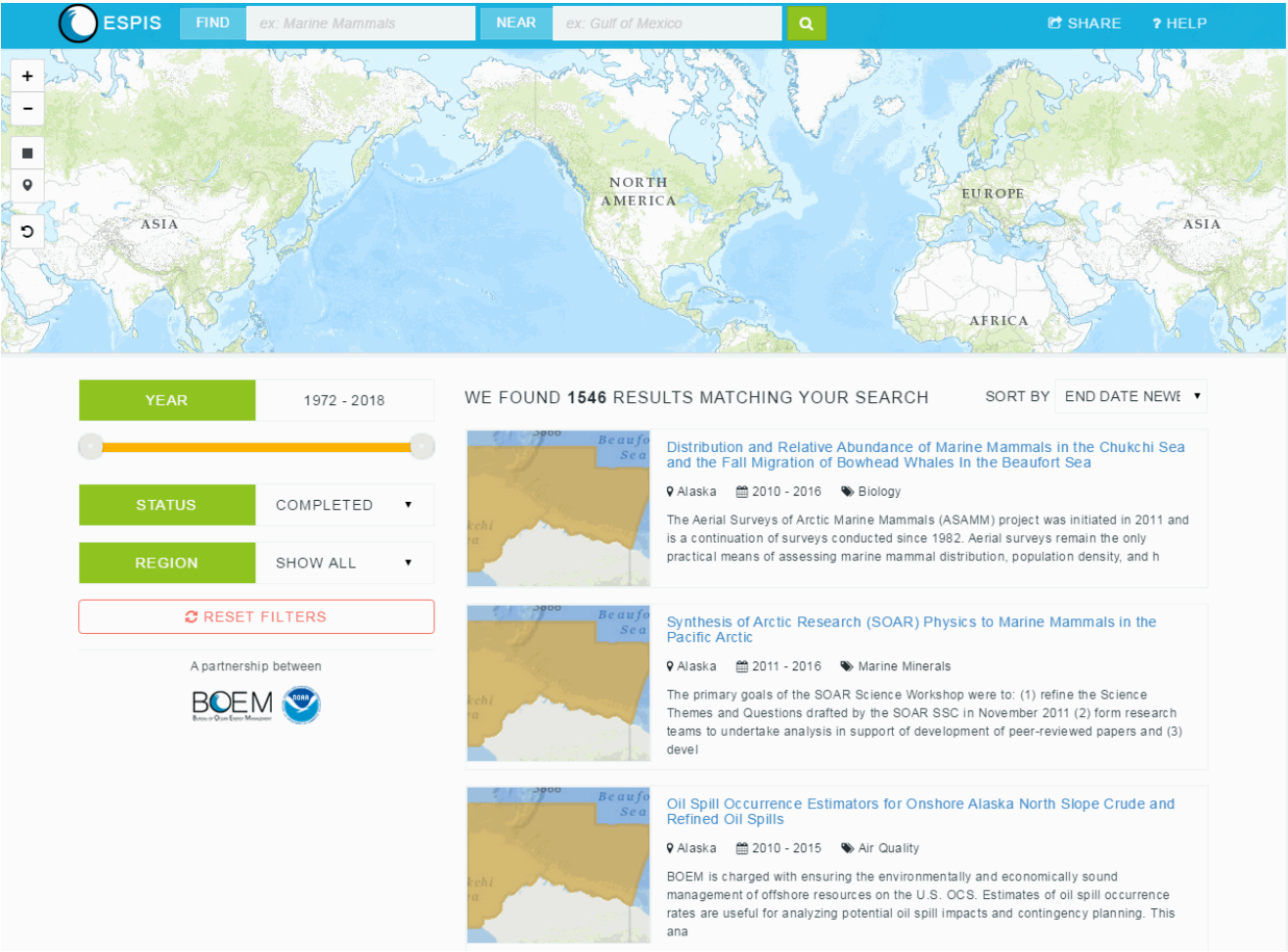


Figure 2. Example of the ESPIS study results return page. The user has the option to search for studies using the map to conduct spatial searches using a map or text based searches. The location of studies can be ascertained by viewing thumbnail images of the study footprints. Results can be further filtered by date, region, and state of completion (left side).

included larger group discussions as well as individual use case studies.

IV. RESULTS

A comprehensive database of studies metadata was created for more than 1500 studies each with a study footprint. To date more than 4,600 related publications and 1,500 data products related to these studies have been identified and included in the database. This list continues to grow as new information is discovered.

Using the initial search results page from the Search Tool, the user is able to review high level information about each study including a thumbnail of the study location, study title,

and abstract (Figure 2). The user has many options to further filter these results such as by time or status of completion. By selecting an individual study (Figure 3), the user is able to view information such as the BOEM final report, related publications, and data products. For each of these, either a reference or a hyperlink to its location is provided, as appropriate.

Overall, the new system provides unprecedented access and discovery of ESP data and information for use by the ocean science community.

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Aerial Surveys Of Endangered Whales In The Beaufort Sea, Fall 2006-2008

Alaska
 Apr 25, 2007 - Oct 20, 2011
 Endangered Species

ABSTRACT

This report describes field activities and data analyses for aerial surveys of bowhead whales (*Balaena mysticetus*) conducted during fall 2006 (2 September – 16 October) fall 2007 (3 September – 10 October) and fall 2008 (5 September – 18 October) in the Beaufort Sea between 140°W and 158°W south of 72°N and north of the Alaskan coastline.

STUDY FOOTPRINT

STUDY INFORMATION

PROJECT DATES	April 25, 2007 - October 20, 2011
REGION	Alaska
CONDUCTING ENTITIES	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center
DISCIPLINE	Endangered Species
KEYWORD(S)	Aerial Surveys, Bowhead Whales, Beaufort Sea, Migration, Distribution, Sightings

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BOEM STUDY REPORTS AND DOCUMENTS

Final Report
Aerial surveys of endangered whales in the Beaufort Sea, Fall 2006-2008
 Janet T. Clarke, Cynthia L. Christman, Megan C. Ferguson, Stephanie L. Grassia | 2011

RELATED PUBLICATIONS

	Clarke JT, Christman CL, Ferguson MC, Morse LJ, "Bowhead Whale Aerial Survey Project (BVAASP) status update in 2009." Presentation at Alaska Marine Science Symposium, Anchorage, AK, January 15-22, 2010.
	Clarke JT, Ferguson MC, Morse LJ, Friedrison G, Rone B, Christman CL, "Aerial surveys for marine mammals in the northeastern Chukchi Sea: 2009." Presentation at Alaska Marine Science Symposium, Anchorage, AK, January 15-22, 2010.
	International Whaling Commission. Aerial surveys for bowhead whales in the Alaskan Beaufort Sea: BVAASP update 2000-2009 with comparisons to historical data. International Whaling Commission, 2010.

DATA PRODUCTS

Historical BVAASP and COMIDA database (1979 to 2010)
 US Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center

Figure 3. Example of the ESPIS search results for an individual study. The user is able view a map of the study area as well as links to the BOEM final report, related publications and data products. For this study there are three related publications, and one data product (project data is available via an online database).

Acknowledgments

The implementation of this program has involved many people over the last 5 years. Rodney Cluck has been involved from the very beginning providing leadership and vision. Trent Richardson, Charlie Broadwater, Sam Cable and others helped develop an early prototype. BOEM staff from all of the regional offices provided essential input into this project. The NOAA Office for Coastal Management provided database, application development, project management, and contract management support. Steve Raber, Ian Watson, Jeff Skahill, and others at Quantum Spatial provided significant research and technical support. This project would not have been possible without support from BOEM and BSEE.

References

1. E.O. 13547 "Stewardship of the Ocean, Our Coasts, and the Great Lakes". Federal Register Citation: 75 FR 43021. July 19, 2010.
2. Whitehouse Office of Science and Technology Memorandum "Expanding Public Access to the Results of Federally Funded Research". February 22, 2013.