

EXPANDING BIOLOGICAL DATA STANDARDS DEVELOPMENT PROCESSES FOR US IOOS: VISUAL LINE TRANSECT OBSERVING COMMUNITY FOR MAMMAL, BIRD, AND TURTLE DATA

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Abstract

The US Integrated Ocean Observing System (IOOS) has recently adopted standards for biological core variables in collaboration with the US Geological Survey/Ocean Biogeographic Information System (USGS/OBIS-USA) and other federal and non-federal partners. In this Community White Paper (CWP) we provide a process to bring into IOOS a rich new source of biological observing data, visual line transect surveys, and to establish quality data standards for visual line transect observations, an important source of at-sea bird, turtle and marine mammal observation data. The processes developed through this exercise will be useful for other similar biogeographic observing efforts, such as passive acoustic point and line transect observations, tagged animal data, and mark-recapture (photo-identification) methods. Furthermore, we suggest that the processes developed through this exercise will serve as a catalyst for broadening involvement by the larger marine biological data community within the goals and processes of IOOS.

Key words: biological observations, data standards, inter-agency coordination, line transect survey, data life-cycle.

1. INTRODUCTION, BACKGROUND, HISTORY OR ACCOMPLISHMENTS

1.1 Purpose

The Data Management and Communications (DMAC) subsystem must be capable of delivering real-time, delayed mode, and historical data for in situ and remotely-sensed physical, chemical, and biological observations. It must be responsive to users and make the products discoverable and accessible including metadata on information sources, methods and quality (IOOS, 2012). This paper shows how these needs are being addressed on biological observation data through an emerging federal marine biological data partnership.

1.2 Background

The Ocean Biogeographic Information System grew out of the Census of Marine Life (CoML), a 10-year effort to census the world's marine biota. OBIS was established because there was no system for storage and retrieval of ocean biological data (Grassle, 2000). Its development established regional nodes to serve geographic and geopolitical needs, and thematic nodes to address taxon-centric or other specific domain needs. The primary emphasis for this system was to provide access to marine biogeographic (biological observation) data. The result is a global database of species observations (OBIS) using a global biogeographic data standard (Darwin Core) with the potential to extend to other biological data types.

At the close of the Census of Marine Life, OBIS continued under the Intergovernmental Oceanographic Commission. The US Geological Survey was host to the US regional node of OBIS, OBIS-USA (Sedberry, et. al 2011) and Duke University was home to OBIS-SEAMAP, a thematic node specializing in data and analyses associated with marine mammal, seabird and sea turtles (Halpin et.al. 2006, 2009). Over these past few years an OBIS-USA, OBIS-SEAMAP and National Oceanographic Data Center (NODC) partnership has emerged to serve the needs of those seeking marine biogeographic data.

More recently, several federal agencies, including the Navy, the Bureau of Ocean Energy Management (BOEM) and National Oceanographic and Atmospheric Administration (NOAA) were discussing how to incorporate their growing biological data collections under a common set of data standards and shared software/hardware architecture to facilitate interagency sharing and reduce infrastructure cost. This need was outlined in a 2009 report by the Joint Subcommittee on Ocean Science and Technology (now also serving under EO 13547 as the Ocean Science and Technology Interagency Policy Committee) to the Executive Office of the President (Southall et al, 2009). Those

deliberations resulted in the concept of a Federal Marine Biological Data Architecture built on the OBIS/NODC partnership (Figure 1).

1.3 Accomplishments

OBIS-USA continues to use the Darwin Core standard for compatibility with OBIS world-wide. However, USGS through OBIS-USA has also established a requirements-based process for enhancing the use of the standard to meet growing application needs, especially those of US Federal Agency partners and other community members. OBIS-USA's Marine BioGeography data standard (MBG) is the enhanced implementation of Darwin Core that has already addressed data standards for richer data such as absence, abundance, tracking and sampling details. MBG and OBIS-USA's standards development process will be the foundation for further enhancements such as visual and other effort-based data, animal behavior, life stage, and more.

Beginning in 2010-2011, IOOS and Pacific Islands Ocean Observing System (PacIOOS) collaborated with USGS to extend Darwin Core to address presence absence and abundance data (Moustahfid et.al. 2011).

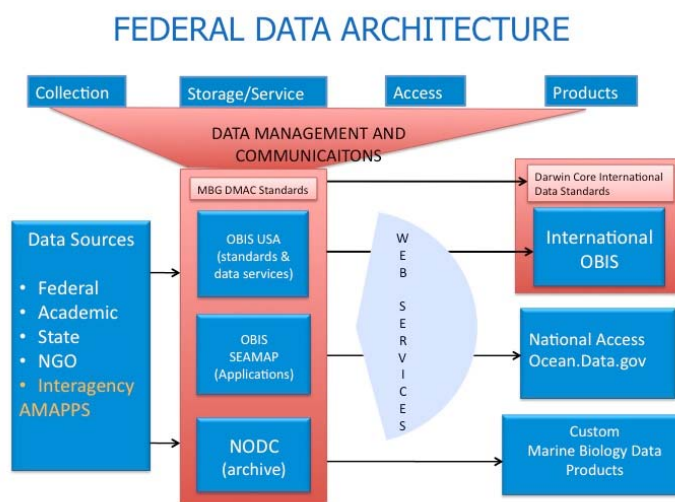


Figure 1: This diagram highlights the key role of the federal data lifecycle partnership (OBIS-USA develop and implement data standards and services; OBIS SEAMAP develop applications and solutions; and NODC archive services) and the active engagement of IOOS DMAC in the extension and adoption of a marine biological data standard and its relevance to all three IOOS subsystems.

This effort is now (in FY12) being extended to include Gulf of Mexico Coastal Ocean Observing System (GCOOS) and Southeast Coastal Ocean Observing

Region Association (SECOORA). At the same time both Navy and BOEM provided funds in 2011 and 2012 for the purpose of developing a common Federal Marine

biological data infrastructure and a community based standards process for shipboard marine mammal observation data. The National Science Foundation (NSF) also provided Post-Doctoral support to the effort. Both of these studies resulted in significant progress in extending the global Darwin Core and MBG by adding innovations consistent with the global standard and by driving innovations directly from user requirements.

2. TECHNICAL USER REQUIREMENTS

Producers and users of marine biological data have two requirements that substantially relate to the DMAC subsystem: 1) the development of standards of practice that will facilitate confidence in the data and ease of merging and comparing data sets from multiple sources, and 2) the development and operation of a “data life cycle” concept, built upon information technology and process infrastructure to provide an effective and consistent path for data from diverse sources, from origin through discovery, application and archive.

The conceptualization of a Federal data architecture and early engagement by IOOS in a customer-specified extension of Darwin Core and MBG is an important step in addressing the biological data needs of the US ocean observing community. The process engages activities of the three IOOS subsystems: 1) collaborating with data originators to ensure effective capture of data and methodology details and quality; 2) providing standardized and well-understood data access services, repository and archive and 3) the ability for users to explore, evaluate, query and obtain data for applications and services.

3. STATE OF PROTECTED SPECIES OBSERVING AND TECHNOLOGY

The data requirements of Federal agencies that operate in and/or regulate the use of the marine environment - BOEM, Navy, Department of Energy (DOE), Coast Guard, Maritime Administration (MARAD), and others - are helping to encourage biological data standardization and development of tools for synthesis of those data with other ocean data products. These agencies require effort-based geospatial distribution, abundance and density information about protected marine species like marine mammals, seabirds, and sea turtles in order to meet the legal obligations of National Environmental Policy Act (NEPA), Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA) and similar legislation. Basic biological data (species presence, time, location) are insufficient to support these needs, obligating these agencies and regulated industries to search out richer data sets and

collect additional data in a form that can be compared and merged with existing collections.

NOAA National Marine Fisheries Service (NMFS) regularly conducts surveys of marine mammals, sea turtles and other marine protected species using Distance line transect sampling methods (Buckland et al, 2001; Buckland et al 2004). Distance sampling has become the standard and consequently is also applied to all current surveys by Navy and BOEM. This pre-existing commonality will greatly aid the creation of standards for visual survey observations.

The Navy requires all contracted biological data collections to be submitted to the OBIS-SEAMAP system at the completion of the contract. BOEM places similar requirements on its contractors to deposit data in NODC and is additionally contributing some data sets to OBIS-USA and OBIS-SEAMAP. The multi-agency Atlantic Marine Assessment Program for Protected Species (AMAPPS) project similarly deposits its data, metadata, and derived data products in OBIS-SEAMAP. The NMFS places metadata for all its collections in NODC and is developing processes for depositing raw or minimally processed data as well. Thus, the main data streams within the Federal government become interconnected through the OBIS-SEAMAP, OBIS-USA and NODC framework as illustrated in Figure 1, making integration into IOOS structures and processes systematic and repeatable. Bilateral data sharing agreements exist for OBIS-USA and OBIS-SEAMAP (USGS, University of Colorado Boulder and Duke University) and for OBIS-USA and NODC (USGS and NOAA).

4. INTEGRATION WITHIN IOOS MODELING AND DMAC

The OBIS-USA / OBIS-SEAMAP / NODC partnership provides infrastructure that can be leveraged by IOOS DMAC to facilitate access to marine biological data throughout its life cycle. The expanding relationship between OBIS-USA and IOOS provides the Federal ocean observing community a structured, Federally supported process for polling marine biology communities-of-practice about their data needs and standards of practice, and incorporating those standards into MBG. This provides access to historical data as well as a pathway for delayed and near-real time data and the inclusion of richer data types.

The focus of this CWP is on the opportunity to integrate data streams of marine mammal, sea turtle and sea bird data collected as part of regular ongoing environmental stewardship obligations of several

Federal agencies into IOOS. Further, it proposes that a successful implementation with this community will provide a pathway to engage a broad range of communities that regularly collect marine biological data.

5. THE WAY FORWARD FOR THE NEXT TEN YEARS

5.1. Rationale

The nature of the marine mammal, sea bird, and sea turtle visual line transect data make it an ideal next step for IOOS integration. First, it continues the standardization of presence, absence, and abundance data begun in collaboration with Regional Associations (RAs). Second, it engages Federal agencies from a national perspective complementing the region-based approach currently underway. Third, there is a very real need identified by key Federal agencies (e.g. Navy, NOAA, BOEM, DOE, NSF, USGS, National Aeronautics and Space Administration etc.). Fourth, these data are relevant to both National interests and regional interests demonstrating an ability to integrate data from both communities. Discussion of such partnerships between the IOOS RAs and Federal partners in OBIS-USA have already begun for BOEM and Navy in Alaska, the Mid-Atlantic region, Gulf of Mexico, Southern California and other regions. In addition, DOE is developing a coordination process for the mid-Atlantic region that pulls in many small state and local data collection efforts in support of growing DOE offshore alternative energy programs.

5.2. A Process for Marine Biological Data Standards

Major obstacles are the inconsistent quality and lack of data standards for most marine biological data, including visual line transect data. OBIS-USA in collaboration with IOOS offers a means of engaging the community in a standards development process for visual line transect surveys. USGS compliments the application of the global standard by providing staff and infrastructure to reach out to data generators to “enroll” their biological data into MBG and DMAC. At present, the focus would extend the standard to visual line transect methods used to collect data on large marine vertebrates, and then on to other related methods that provide similar data such as passive acoustic surveys, mark-recapture (photo-ID) and tagged animal data. But the basic process itself can be readily applied over the next decade to plankton sampling communities, coral reef and other hard bottom ecosystem research communities, benthic organism research communities and others identified, for example, in the Zettler et al (2011) report.

Potential Partners include:

- U. S. Geological Survey
- U. S. Navy
- Bureau of Ocean Energy Management
- NOAA (National Ocean Service, NMFS, other)
- Dept. of Energy
- NASA
- U. S. Fish and Wildlife Service
- National Science Foundation
- The Smithsonian Institution
- Army Corps of Engineers
- US IOOS

5.3 New Sources of Ocean Observations Data

In the past decade several agencies, most notably Navy and BOEM, have undertaken NEPA analyses and MMPA permitting of their activities. This has led to a steady, high-volume marine biological data generating investment, primarily in marine mammal, sea bird, and sea turtle visual surveys and monitoring programs. These data are not only valuable for the immediate environmental risk assessment processes for a single agency and single action, but the data will continue to deliver value if collected and managed in a consistent way. Data captured and enrolled through the OBIS-USA process will be available to support applications serving the supporting agency or other agencies, as well as supporting a greater range of research and resource management applications by agencies like NOAA NMFS and the U. S. Fish and Wildlife Service.

As such, these regularly repeated surveys also constitute ocean observatories as defined by IOOC. In many cases the monitoring programs also offer opportunities for partnership with IOOS Regional Associations, in the Alaskan Arctic, the Southern California Bight, Gulf of Mexico and Mid-Atlantic. These surveys, fully funded by the regulated agencies, and often conducted in partnership with NOAA, offer quality ocean biological data to IOOS, now and for many years to come.

As previously noted, the data meet critical immediate application needs of Federal agencies and many ocean-related industries, including offshore oil and gas, renewable energy, shipping, and commercial fishing. From these data, powerful, rich sequences (time histories) can also be constructed for research on climate change, ocean productivity, and ecosystem physical/biological dynamic processes.

6. CONCLUSIONS

The process under development by USGS in partnership with several Federal agencies engages all three IOOS subsystems, facilitating understanding and use of data from observation through application. In summary:

- Active engagement by IOOS in extension of Darwin Core to include measures of abundance in response to customer needs.
- Continued engagement by IOOS in advancing Darwin Core and implementing the enrollment process expands access utility of data to IOOS and partners.
- Adoption of OBIS-USA-led line transect survey standards as IOOS biological data standards establishes a process for community-generated biological data standards to enter IOOS while producing an infrastructure consistent with IOOS standards and practices.
- Integration with the joint OBIS-USA, OBIS-SEAMAP, NODC data infrastructure captures several fully-funded ongoing ocean biological data streams from Navy, BOEM and other agencies.
- Integration of the OBIS-USA framework and partner agency data collection efforts offers opportunities for IOOS RAs to establish new, rewarding partnerships with federal agency partners conducting line transect surveys in their region.

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