CENSUS OF MARINE LIFE

UNITED STATES

Biological Ocean Observing:

Exploring Components of the Integrated Ocean Observing System (IOOS®) from the Perspective of the Census of Marine Life

Workshop sponsored by the U.S. National Committee of the Census of Marine Life
January 14-15, 2008 • Washington, D.C.

Executive Summary

About the Census of Marine Life

The United States Census of Marine Life (U.S. CoML) was established in 2002 in consultation with the National Academy of Sciences, the National Research Council, the National Oceanic and Atmospheric Administration (NOAA) and the International Scientific Steering Committee (SSC) of the Census of Marine Life (CoML). The U.S. component, led by a National Committee (USNC), seeks to build broad U.S. community support to establish CoML as a sustained national research and monitoring program for marine and coastal biodiversity in support of its mission.

The U.S. CoML's mission is to serve as an unbiased source of sound scientific information to support the needs of the nation by assessing and explaining the changing diversity, distribution, and abundance of marine species in the past, present, and future, as well as the functional role of marine biodiversity in the U.S. and its territories and commonwealths.

About the Consortium for Ocean Leadership

The Consortium for Ocean Leadership is a Washington, D.C.-based nonprofit organization that represents 95 of the leading public and private ocean research education institutions, aquaria, and industry with the mission to advance research, education and sound ocean policy. The organization also manages ocean research and education programs in areas of scientific ocean drilling, ocean observing, ocean exploration, and ocean partnerships.

Executive Summary

An increased understanding of the ocean, and the marine life within it, is essential for protecting and sustaining all human life. Central to this understanding is the exploration of the delicate interaction between all ocean processes, whether they are physical, chemical, or biological. Scientists have long studied chemical and physical elements of the ocean to learn more about their roles in our food supply, the production of oxygen, and the regulation of the global climate. Monitoring physical elements of the ocean also provides insight to sea level rise, coastal flooding, coastal erosion, and storm and hurricane prediction. However, without incorporating and assessing biological elements, these observations create a strong, yet incomplete, view of the ocean. Consequently, biological information and biodiversity data must be integrated with physical and chemical parameters such as temperature, salinity, and currents data to help effectively assess and predict the overall health and sustainability of our nation's ocean ecosystem, as well as the entire global marine ecosystem.

The Joint Subcommittee on Ocean Science and Technology (JSOST) released *Charting the Course for Ocean Science in the United States for the Next Decade: An Ocean Research Priorities Plan and Implementation Strategy*, an interagency effort that identified biological ocean observing as one of the United States' most compelling national research priorities. The document emphasizes the overwhelming and growing support for an ocean observing system. Immediate implementation of a system that integrates biological data with physical and chemical data will assist in the describing the current state of the ocean and ensure the detection of future changes, and if necessary, solutions to those changes.

It is imperative that decision-makers are supplied with the data and tools needed to help conserve living marine resources for future generations. Biodiversity data, linked with physical and chemical data, are needed to describe the marine environment and evaluate the effects, response and resilience of marine species and their environments to activities, such as fishing and bycatch, and short-term events such as harmful algal blooms. With changes to the Magnuson-Stevens Fishery Conservation and Management Act and greater emphasis from federal agencies to comply with the National Environmental Policy Act, there is a need for marine ecosystem data to meet such legal mandates.

The Integrated Ocean Observing System (IOOS®), a multidisciplinary system created to enhance the ability to collect, deliver and utilize information about the ocean, is a significant driver of this strategy. IOOS strives to

provide ocean data to support research in formats and at scales that are needed and often required by managers, decision-makers and governments. IOOS has defined seven societal needs and goals:

- Improve predictions of climate change and weather and their effects on coastal communities and the nation;
- Improve the safety and efficiency of marine operations;
- Mitigate the effects of natural hazards;
- Improve national and homeland security;
- Reduce public health risks;
- Protect and restore healthy coastal marine ecosystems; and
- Enable the sustained use of marine resources.

In an effort to demonstrate the importance of incorporating biological data – particularly Census of Marine Life data – into IOOS, the United States National Committee of the Census of Marine Life organized a workshop entitled *Biological Ocean Observing: Exploring Components of the Integrated Ocean Observing System (IOOS) from the Perspective of the Census of Marine Life* in Washington, D.C. from January 14 to 15, 2008. The workshop brought together experts from academia, management agencies, industry, and the IOOS Regional Associations to address four central objectives:

- Explore the general types of biological observing data that currently exist, and identify specific data sets that should be integrated into IOOS;
- Consider critical data gaps in biological data measurement/collection, analysis, and management that should be addressed by IOOS;
- Identify specific strategies to advance the interoperability between CoML/Ocean Biogeographic Information System (OBIS) and IOOS; and
- Explore the development of predictive models based on current and future IOOS data efforts to support the move towards ecosystem-based management.

Several plenary sessions helped establish the context for the central objectives. These presentations covered an array of issues, including: the role and purpose of IOOS; biological data sets critical to the success of IOOS; applications of information products for the public and policy-makers; interoperability among data streams; and the possibility of using IOOS observations to model complex ocean ecosystems. Workshop participants used the plenary presentations to initiate and support discussions of the central objectives.

The discussions at the workshop revolved around five major interwoven themes:

- Sampling protocols;
- Data standards;
- Data accessibility;
- Data interoperability; and
- Data applications.

In order for data to become more useful and interoperable, the group noted that there must be a shift in the culture of sampling. Specifically, several breakout sessions discussed the need for establishing standardized sampling protocols. Additionally, participants stressed that it is crucial for physical, chemical, and biological data to be collected simultaneously to allow for more comprehensive analyses of the health of marine ecosystems. Over the long term, this change in sampling and protocols should lead to greater efficiency, better data interaction, and lower sampling costs.

In addition to addressing the need for sampling protocols, many breakout discussions focused on data standards. Attendees emphatically agreed that there is an urgent need to advance an agreed-upon core set of national data standards for biological data and pushed for the standardization of best data practices. The group also suggested that the development of consistent and transparent quality assurance/quality control approaches in data would facilitate interoperability and the group further believed that defining a schema (vocabulary, etc.) and data model would be useful.

Discussions of data standards also led to dialogue on the third major theme – data accessibility. During the workshop, participants explained that data standard agreements would provide important guidance on how to make data available, the specified formats, and limitation on its use. According to the group, making pre-existing data sets, that have been particularly elusive, open and accessible to the ocean community is one of the goals of an integrated ocean observing system.

The group also emphasized that physical, chemical, and biological data systems must become interoperable with other systems to capitalize on these improved sampling protocols, core data standards, and newly available key datasets.

Data application, the fifth and final theme, tied the entire discourse together. Once sampling protocols, data standards, data accessibility, and data interoperability are established, the scientific community needs to determine how this collective data will be utilized. This will require the development of clear and readily available synthesized products to meet the needs of managers and other users on an ongoing basis. The group noted that these data must be applied in a manner that will best support policy and decision-makers, the Group on Earth Observations (GEO), the Global Earth Observation System of Systems (GEOSS), and other necessary stakeholders and organizations.

Recommendations for OBIS and the Future of Biological Ocean Observing Programs

The workshop concluded with a moderated discussion designed to evaluate the previous days' breakout sessions. During the final discussion, attendees arrived at several conclusions and made the following recommendations for future biological observing programs. It is vitally important that these recommendations be acted upon quickly to establish the biological components of ocean observing in a manner that makes the best use of the OBIS data and structure.

- Improve interaction between researchers, data collectors, data managers, and user groups. A culture shift must occur, encouraging a unified effort towards developing a successful national observing system.
- Create a core national set of data standards (this is an issue that must be resolved within months, not years). These data standards should build as much as possible on existing standards that are widely used by the scientific community.
- Expand OBIS schema to incorporate data standards that allow OBIS to capture different types of biological and physical information (e.g. stock assessment, density and line transect data). Collaborate on this with existing initiatives such as Ecological Metadata Language (EML), the Marine Metadata Initiative (MMI), and the European SeaDataNet Consortium.
- Attempt to either integrate or make interoperable five to ten historical datasets, surveys, and records that span both coasts and several agencies within the next six to twelve months. Suggestions included: Marine Resources Monitoring Assessment Prediction Program (MARMAP), Southeast Area Monitoring and Assessment Program (SEAMAP), and California Cooperative Oceanic Fisheries Investigations (CalCOFI) datasets; U.S. Environmental Protection Agency (EPA) water quality, National Estuarine Research Reserves (NERR), U.S. Geologic Survey (USGS), and fisheries/trawl surveys; habitat characterization data; and protected species stock assessments.
- Incorporate environmental data into the OBIS schema and develop products (i.e., maps and summary statistics) to illustrate data applications and the utilization of OBIS for managers and policy makers.
- Publicly share the status of initiatives, integration, and product development to help reduce the chance of multiple groups "reinventing the wheel" when collecting and processing data.
- Have data producers and OBIS provide ongoing web service and tools training to address the use of existing tools and services to help determine capacity building needs. This should also include training in metadata preparation.
- Implement Regional Pilot Studies to illustrate the benefits of IOOS and OBIS to the marine community; demonstrate that data can be interoperable; market why IOOS is economically important; and capitalize on regional opportunities in communication.

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