

Developing the Next Generation Marine Mammal Information Center for Integrated Ocean Observing: OBIS-SEAMAP 2.0

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Award Number: NSF-OCE-07-39199

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LONG-TERM GOALS

The central work-plan for this reporting period continues to be a strategic expansion of the OBIS-SEAMAP information system in depth, breadth, functionality and the user community. In addition to maintaining the existing system on a growth trajectory, we are targeting four specific focal areas:

1. Data acquisition in the taxonomic, spatial and temporal gaps identified by our gap analysis;
2. Inclusion of and expanded functionality for new data types (acoustics, photo-ID, 4D telemetry, model outputs and turtle nesting);
3. Expanded functionality with oceanographic data; and
4. Solid foundation of OBIS-SEAMAP in the international OBIS network.

APPROACH AND WORK PLAN

1) OBIS-SEAMAP (<http://seamap.env.duke.edu>) compiles geo-referenced data on marine mammals, sea birds and sea turtles, with tools to query these observations in a dynamic, searchable environment. This information system is designed specifically to be publicly available. OBIS-SEAMAP has developed into a multi-function information system that provides data to scientists, managers, students and educators necessary for ocean stewardship under the NOPP program. With supplemental funding and associated expansion of scope and depth in late 2009, we are currently 3.25 years into our 4-year project. We report here on progress from November 2009 to October 2010.

2) Principal investigators Patrick Halpin and Andrew Read provide oversight of project development and guidance. PI Halpin also actively works as a member of the strategic planning committee for the newly formulated OBIS international portal under the IOC program of UNESCO-IODE. Ei Fujioka leads the technical development, ensuring that OBIS-SEAMAP is at the forefront of data sharing and visualization. Connie Kot has been conducting the comprehensive gap analysis work (described below), works on data acquisition and data uploading, and on incorporating oceanographic data. Andrew DiMatteo works in data acquisition, management and input with a focus on sea turtles and

also contributes to tool and interface design. Kim Urian leads the development of the photo-identification online matching system, including expansion to new species and partnerships. Melissa Soldevilla is leading the incorporation of acoustic data into OBIS-SEAMAP and works with data holders to maximize the utility of the data archive and attract more acoustic datasets. Ben Donnelly and Jesse Cleary provide support in system architecture, user interface and web programming. Jennifer Dunn is responsible for project management while Lucie Hazen assists with reporting requirements.

3) Through the collaborations with various organizations and communities and the development of the OBIS-SEAMAP systems, we continue to expand our role as a portal for marine protected species and facilitate the incorporation of alternative data types for our target species. Work plans for the upcoming year will focus on establishing new collaborations and developing novel mapping, visualization and search functionality for these data types (e.g. photo-identification, acoustic, Dtag, turtle nesting). We will continue to improve existing functionality and strengthening partnerships and efforts to collect more traditional data to fill in the gaps. We will also continue to develop the relationship between OBIS, OBIS-USA and OBIS-SEAMAP to establish a solid foundation for the future of OBIS-SEAMAP.

Collaborations and data sources: Dataset acquisition efforts (mainly led by Connie Kot and Andrew DiMatteo) are ongoing as we continue to extend geographic, temporal and taxonomic coverage. In the last year, we have requested data from under-represented regions, mainly in the Southern Hemisphere, and from researchers who study marine mammal or seabird species that were not already included on OBIS-SEAMAP. Our requests have been met with positive responses and resulted in seven datasets published on OBIS-SEAMAP this past year, such as Yangtze finless porpoise sightings in the Yangtze River, China, and cetaceans off the Society Islands (French Polynesia). We also have 10 datasets pending publication, including a large dataset (>20,000 records of marine mammals, seabirds, and sea turtles) from the Azores Fisheries Observer Program (POPA) and a dataset with Irrawaddy dolphin sightings near Indonesia. The primary constraints for acquiring data identified through published reports, journal articles, and website project pages continues to be a lack of time/resources and missing/irretrievable data.

We have maintained our collaboration with the European Seabirds at Sea (ESAS) initiative. The Joint Nature Conservation Committee, the leading organization for ESAS, is now soliciting other groups to submit their data to OBIS-SEAMAP. As data are compiled from these requests, we expect that OBIS-SEAMAP will experience significant growth in its data holdings. We are also collaborating with the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS). We will develop a customized front page and search interface for this extensive collection to better represent their datasets. Another potential collaborator is the Australian Antarctic Data Centre; we are currently in discussions with them about their data contributions.

Photo-ID researchers working on several cetacean species have expressed interest in replicating the web-based matching system developed for bottlenose dolphins. We have received photo-id images and associated data from the Pacific Islands Photo-Identification Network (PIPIN), a consortium of researchers studying spinner dolphins in Hawaii. Kim Urian and Ei Fujioka are working with Marie Hill, of NOAA's Pacific Islands Fisheries Science Center, and the curator of the PIPIN catalog, to use the template developed for bottlenose dolphins and adapt it for use with their data. We are in the process of integrating the spinner dolphin dataset into a similar structure as the existing bottlenose dolphin database and web interface. In addition, as it has been more than two years since the Photo-ID

system was developed for bottlenose dolphin, new technologies and techniques are available now, which we will apply to the system for spinner dolphins to improve the functionality and user interface.

Website improvements: We are planning three major improvements of the website: 1) Upgrade of the existing OBIS-SEAMAP web interface by incorporating the new techniques and skills that the OBIS-SEAMAP team acquired from the development of the OBIS Portal; 2) additional oceanographic data with improved visualization options and semi-automated upgrades of the oceanographic data into the future; and 3) enhanced spatial search capability with data filtering in relation to commonly used areas, such as Exclusive Economic Zones and global marine protected areas.

After the launch of the online interface for the State of the World's Sea Turtle (SWOT) data, Andrew DiMatteo has begun data collection for the latest year. The new data will be added to the existing SWOT database and featured in SWOT's annual publication, allowing users to explore changes in sea turtle nesting data over years. Also planned for the coming year are a protocol for users to submit updates to Regional Management Unit layers, and the implementation of a set of recommendations for minimum data standards to allow long term population assessments at the regional and global scales. We will work on streamlining the data collection, using the SWOT website maintained by Conservation International to drive both users and data providers to the SWOT application hosted by OBIS-SEAMAP.

Improving the linkages between OBIS-SEAMAP, OBIS-USA and the international OBIS portal:

The international OBIS portal has recently been adopted as an official project of the UNESCO / IODE / IOC program. This move now provides a highly visible and permanent home for the portal under the auspices of a UN agency. After the conclusion of the Census of Marine Life, the international OBIS network is now in action for the future plan and the project. PI Halpin has been in close communication with PIs of OBIS and OBIS-USA to come up with an ideal organizational structure among OBIS, OBIS-USA and OBIS-SEAMAP as well as other regional/thematic OBIS nodes. In this effort, Halpin attended a strategic planning meeting for the new IOC/OBIS system in Oostende, Belgium in November 2010 and represented the interests of the OBIS-SEAMAP project in this new international organization context. A very promising result of this meeting is that OBIS-SEAMAP has become an official thematic node in the OBIS network. From now on, OBIS will consolidate the notion of 'Regional OBIS Node (RON)' and 'Thematic OBIS Node' and simply call it an 'OBIS Node.' We will continue to tighten our relationship with OBIS and work with the OBIS team to improve the OBIS Portal. We are also planning to implement a seamless, non-redundant, consistent data exchange between OBIS, OBIS-USA and OBIS-SEAMAP. Since the OBIS-SEAMAP team is the core developer of the OBIS Portal website, we will continue to provide technical support to the OBIS team to improve the Portal.

WORK COMPLETED

As the Mapping & Visualization team for the Census of Marine Life, the OBIS-SEAMAP team made significant progress in improving the OBIS Portal, applying the latest technologies and new ideas to efficiently search over 30 million records within the OBIS database (Figure 1). The techniques and skills we acquired through the work on the OBIS-SEAMAP project were effectively transferred to the OBIS Portal. In return, we have acquired new techniques, knowledge, skills and ideas from the OBIS Portal development, which we will bring back to the OBIS-SEAMAP website. The OBIS Portal we developed was highly acclaimed by the Census community and other researchers around the world, resulting in a stronger tie between the OBIS-SEAMAP project and the international OBIS network.

Data acquisition in this reporting period remains as strong as in the previous year. We obtained 60 new datasets, 33 of which are now published on OBIS-SEAMAP. These new datasets add more than 85,000 observations (320,000 observations including the unpublished datasets). One of the notable additions is a collection of marine mammal survey datasets from the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS). ACCOBAMS, in collaboration with Whale and Dolphin Conservation Society (WDCS) has agreed to provide more datasets from its research partners. Thanks to this extensive collection, we are developing a customized front page for ACCOBAMS/WDCS datasets to facilitate this collaboration and encourage more partners to submit their data. Another promising addition is a set of satellite telemetry datasets from the Census of Marine Life Tagging of Pacific Predators (TOPP). We have registered the TOPP datasets in the database and they are now in review by the provider. The summarized data of the TOPP datasets were already calculated and uploaded into iOBIS in advance of the Census of Marine Life London events.

The online search & mapping interface for the State of the World Sea Turtles (SWOT) has been well received by the sea turtle community. In this reporting period, we also added the ability to display and download the Regional Management Units and mtDNA/nDNA sample locations compiled by the IUCN Marine Turtle Specialist Group and SWOT Scientific Advisory Board (Figure 2). This new functionality is now under expert review and expected to go online by the end of 2010. We will expand this functionality to include community-participating area management allowing the participants to suggest revisions and improvements, do analyses, or to inform management strategies through the interface.

We continue to expand the capability of OBIS-SEAMAP to better represent and visualize acoustic data. We have developed a prototype acoustics data structure that is capable of representing the wide variety of data collection, analysis, and summarization methods that are utilized by passive acoustic monitoring researchers. This structure allows the representation of data collected from a variety of instrumentation types, including fixed seafloor arrays, ship-based arrays, telemetry tags, drifting instruments, and autonomous vehicles (e.g. gliders). To achieve accurate geospatial representations, the new structure allows a variety of location types to be presented depending on data analysis capabilities, including instrument location, instantaneous animal location, and animal tracks. Finally, the structure allows the incorporation of summarized occurrence data at a variety of quantified levels including the number of animals, number of calls, calling rates, presence or absence, and duration of calling bouts.

To date, fifteen acoustic data sets including over 160,000 observations have been incorporated into OBIS-SEAMAP to test this structure and its ability to accommodate and accurately represent the broad suite of acoustic data types that we anticipate receiving. These pilot data sets represent four major platforms of data collection including spatially rich ship-based surveys, temporally rich autonomous fixed instruments at point locations, temporally and spatially rich fixed instrument arrays, and instruments attached to animals (DTags) that include a depth component. Eleven new datasets that have gone through the data registration processes this year and will be soon published include:

1. Delphinid click detections from autonomous fixed instruments off California provided by Scripps Institution of Oceanography;

2. Minke whale vocalizations including detections and localizations from instrument arrays at the U.S. Navy's Hawaiian Pacific Undersea Missile Range provided by the Density Estimation of Cetaceans Using Acoustic Fixed Sensors (DECAF) project;
3. Beaked whale click detections from a fixed instrument array in the U.S. Navy AUTEK range provided by DECAF;
4. Beaked whale click detections from animals with DTags in the Navy AUTEK range provided by DECAF;
5. Sperm whale click detections from a fixed instrument array in the Navy AUTEK range provided by DECAF;
6. Odontocete call detections from a ship-based survey by Encana Corporation; and
7. Bottlenose dolphin whistle detections from autonomous fixed instruments in Pamlico Sound, NC provided by Duke University.

Continued efforts are being made to integrate uncertainty in detection, classification and localization of cetacean vocalizations that is inherent in passive acoustic surveys, as well as providing accurate data while protecting classified information from sensitive sources. We have been in close communication with partners such as the Office of Naval Research and the Cornell Laboratory of Ornithology to further facilitate the development of an archive center for acoustic data.

The web-based online Photo-ID system developed for the Mid-Atlantic Bottlenose Dolphin Catalog was presented by Kim Urian at the “Workshop on population connectivity and conservation of *Sousa chinensis* off the Chinese coast” in Nanjing China in June. Researchers conducting photo-id studies on the Chinese white dolphin in Hong Kong, Taiwan and the Chinese mainland are very interested in developing a similar system to promote collaboration to ensure the conservation of this iconic Chinese species. As researchers continue to learn of the power of this system, we will continue to expand and offer this template to other studied species using photo-id methods. We received photo-id images and associated data from the collaborative spinner dolphin photo-id project in the Hawaiian Islands and we will start the development of a similar online Photo-ID system for this species. This will be a great opportunity to demonstrate and expand the existing Photo-ID systems on the OBIS-SEAMAP website to other species.

Connie Kot completed a formal gap analysis to better understand areas, time periods, and species in which observations are missing from OBIS-SEAMAP. This detailed analysis identified existing datasets not currently included in OBIS-SEAMAP from 1983-2003 and provided a clear picture of where we should focus our data gathering efforts. The findings of the gap analysis have been published in PLoS ONE. Based on these findings, we will continue to follow-up on over 140 dataset requests initiated within the last year and to search for new contacts/datasets that would expand the OBIS-SEAMAP collection.

RESULTS

Our ongoing efforts to communicate with data providers are critical to the successful expansion of the OBIS-SEAMAP project in both its functionality and data holdings. As one of the few thematic nodes that is still active in the international OBIS network and a pivotal team of the development of the OBIS Portal, OBIS-SEAMAP has a strong reputation as a significant data center, an important source of expertise in mapping and visualization, and a crucial collaborator in the research and management of marine protected species.

IMPACT AND APPLICATIONS

Science Education and Communication

The PIs continue to work with the broader scientific community to plan for the future of the data archive and to ensure that our current efforts meet critical management and conservation needs. The most notable activity in this reporting period is that Pat Halpin participated in the tenth meeting of the Conference of the Parties (COP 10; October 2010, Nagoya, Japan) hosted by the International Convention of Biological Diversity's (CBD) where he presented OBIS-SEAMAP in the context of the international OBIS network.

TRANSITIONS

Economic Development

OBIS-SEAMAP is the largest open access data center of its kind. The architecture of the data portal allows users to streamline their search efforts and thus improve their efficiency. The online Photo-ID system is one example of how we are improving the efficiency of a scientific workflow to maximize the information exchange among collaborating researchers. This is also an excellent example that demonstrates how an existing application created for a certain species/community can be reframed to benefit another species/community, thereby significantly reducing the cost and effort that otherwise would have been required if the development took place from scratch.

Science Education and Communication

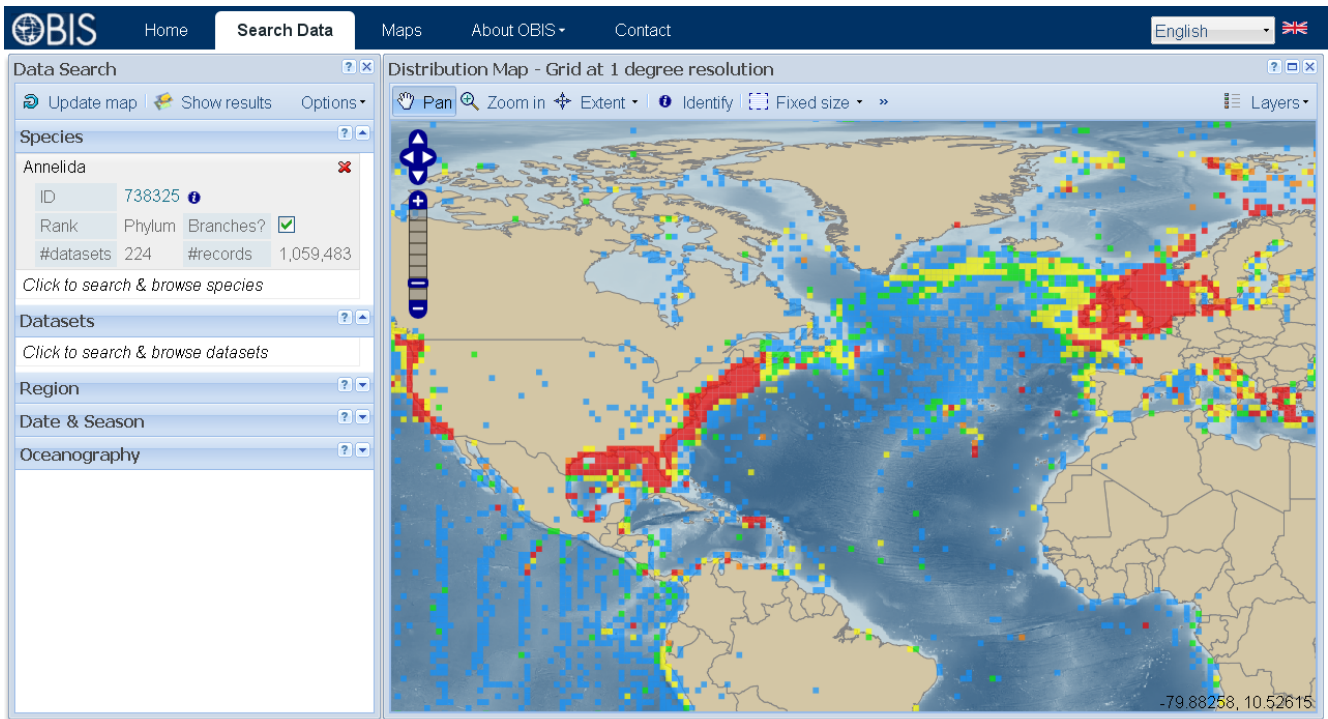
Feedback we have received through the OBIS-SEAMAP website from users and other related marine education sources have shown that there have been an increasing number of teachers and students using the data and information provided by OBIS-SEAMAP for their lessons and studies (GIS/biology classes). For example, PBS included OBIS-SEAMAP as a link for more information in their "Ocean Adventures: Gray Whales on the Move Lesson" materials, available online for teachers of grades 6-8 at: <http://www.pbs.org/kqed/oceanadventures/educators/pdf/OceanAdv-OnTheMove.pdf>. OBIS-SEAMAP also continues to be a persistent link on the NOAA Sea Grant and National Marine Educators Associations' Bridge Ocean Education Teacher Resource Center website at: <http://web.vims.edu/bridge/?svr=www>. There is also an increased interest among NGOs, especially those operating whale watching tours, expressing their intention to provide sighting data.

RELATED PROJECTS

Our complementary Census of Marine Life Mapping & Visualization (M&V) project is concluding this December. The first, global Census of Marine Life culminated in October 2010 with international acclaim and significant contributions from OBIS-SEAMAP. This major achievement brought greater public awareness to OBIS-SEAMAP and the increasing number of the Census projects such as Pacific Ocean Shelf Tracking (POST) is interested in continued collaboration with the OBIS-SEAMAP team.

PUBLICATIONS

Kot, C., E. Fujioka, L.J. Hazen, B.D. Best, A.J. Read and P.N. Halpin. 2010. Spatio-temporal gap analysis of OBIS-SEAMAP project data: Assessment and way forward. PLoS ONE 5(9): e12990.



OBIS strives to document the ocean's diversity, distribution and abundance of life. Created by the Census of Marine Life, OBIS is now part of the Intergovernmental Oceanographic Commission of UNESCO, under its International Oceanographic Data and Information Exchange programme



Figure 1: The revised OBIS Portal search interface developed by the OBIS-SEAMAP team.

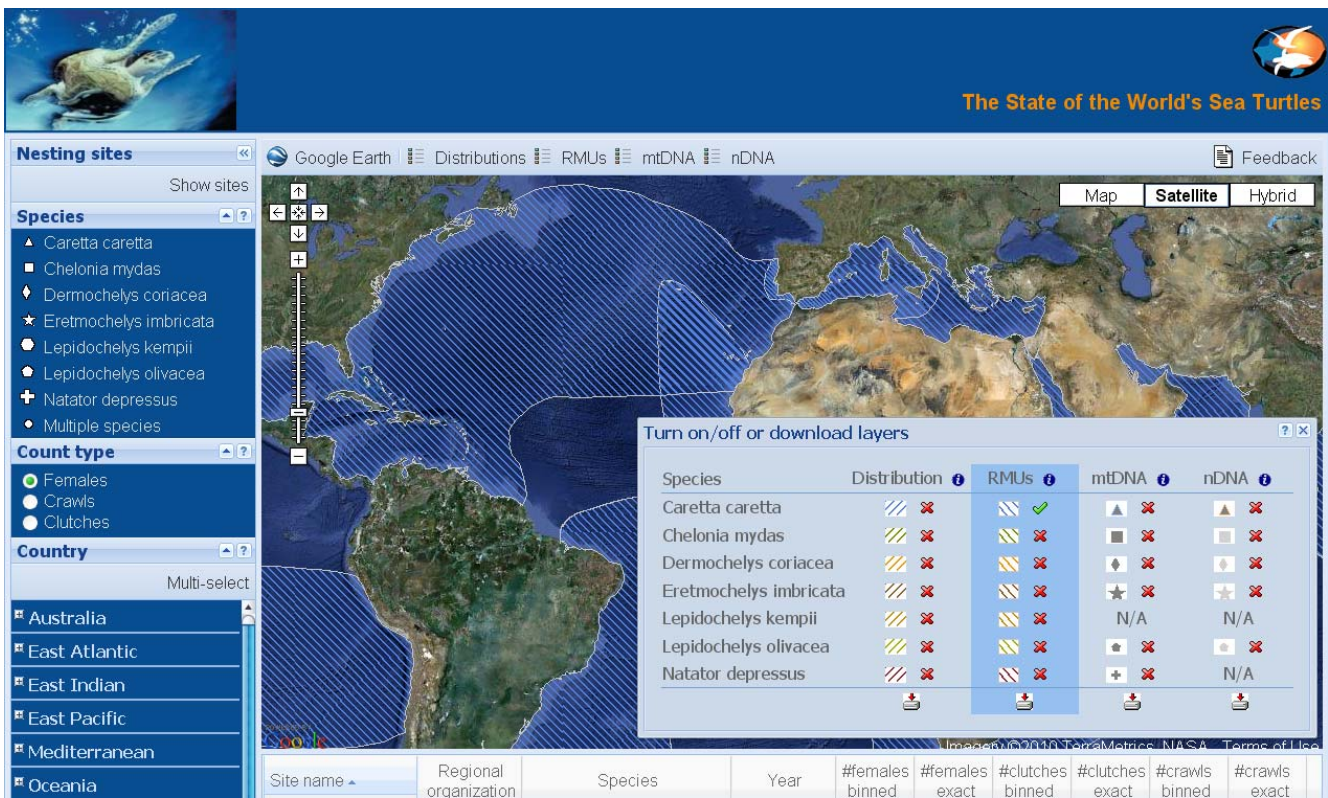


Figure 2: Enhanced mapping interface for SWOT turtle nesting data with visualization of Regional Management Units and mtDNA/nDNA sample locations.