

A Digital Archive of Marine Mammal / Bird / Turtle Data for OBIS

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LONG-TERM GOALS

The goal of the digital archive project is to create and arrange for the sustainability of the marine mammal, seabird, and turtle components of the ocean biogeographic information system of the Census of Marine Life, in cooperation with the National Ocean Partnership Program. This database will have a global coverage, including the Pacific, Atlantic, and Antarctic Oceans, and will contain data from long-term observations. All these data will be freely and publicly available through a user-friendly, web-based system designed to make data easily accessible to a broad variety of users with wide abilities and backgrounds, ranging from research scientists to the public at large.

OBJECTIVES

OBIS-SEAMAP will augment our understanding of the distribution and ecology of marine mammal, bird and turtle populations by: (1) facilitating study of potential impacts on threatened species; (2) enhancing our ability to test hypothesis about biogeographic and biodiversity models, and (3) supporting modeling efforts to predict distributional changes in response to environmental change. Our intended audience includes educators, students and researchers, so we will provide a wide variety of products and data analysis tools on the website. Each mammal, bird and turtle species is profiled with illustrations, range maps, physical descriptions, behavioral information, and conservation status.

We are also working toward an interactive outreach component to assist educators with using the data sets and analysis tools in the classroom. Additionally, the web-based data query tools and explicit documentation of survey methods will enhance the potential for research applications of this database.

APPROACH AND WORK PLAN

We provide high-quality, geo-referenced, species-based observations (i.e., species recorded from a particular location at a particular time), including multiple taxa of the three vertebrate groups listed above. The input data will be identified at least to the species level (and to stock or population when possible). Appropriate data sets include any information that will contribute to the analysis of patterns of distribution and relative abundance at sea, including photo-identification, directed surveys, environmental conditions during surveys, and remote sensing environmental data. However, to facilitate the analysis of trends of distribution and relative abundance, we emphasize standardized long-term time series with broad seasonal coverage (e.g., NMFS marine mammal assessment cruises). Moreover, we complement these observations with additional material describing the biogeography (e.g., synthesized range maps, density estimates), and ecology (e.g., species profiles and natural history information) of all species in the database, as well as meta-data describing the survey, data processing, and analysis methods used to generate these observations.

We have implemented a relational database system to store and manage the geo-referenced and supporting data sets described above. The completed database is freely and openly available via the Internet. Geographic analysis tools have been created using open-source programming code whenever possible, and our system has been evolving rapidly over the past year. Our latest approach is using a PostgreSQL database (www.postgresql.org), which is an enterprise level database that supports transactions and triggers, along with a PostGIS extension (postgis.refractory.net) for handling storage and manipulation of geospatial features within PostgreSQL. The internet mapping functionality is achieved through the use of MapServer product (mapserver.gis.umn.edu). Additional database content is served to our website using Python scripting language (www.python.org) and the content management framework of Zope (www.zope.org). More specifically, we are using Plone (plone.org) as the wrapper of utilities and stylesheets within which to embed the community-oriented site. All of this powerful, free, open-source software runs on Redhat Linux (www.redhat.com) servers.

| OBIS-SEAMAP Staff | OBIS-SEAMAP Data Providers |
|---|--------------------------------------|
| Andrew Read, Duke University Marine Lab | Debi Palka, NMFS-NEFSC |
| Patrick Halpin, Duke University Landscape Ecology Lab | John Calambokidis, Cascadia Research |
| Larry Crowder, Duke University Marine Lab | Bill McLellan, UNCW |
| David Hyrenbach, Duke University Marine Lab | Steve Wong, NMFS-SEFSC |
| Ben Best, Duke University | Kelly MacLeod, SMRU |
| Christoph Spoerri, Duke University | Judy Allen, Allied Whale |
| Sloan Freeman, Duke University Marine Lab | Dan DenDanto, Allied Whale |
| | Peter Stevick, Allied Whale |
| | Tom Jefferson, Clymene Enterprises |

Table 1. Key people involved in the OBIS-SEAMAP project.

PIs Read and Crowder, with staff Hyrenbach, Freeman, and Gannon, have focused on obtaining permission to include high quality data sets and on supplying the supporting biologic information (e.g.,

species range maps, descriptive information). Partners like NMFS-NEFSC, NMFS-SEFSC, Allied Whale, Cascadia Research, SMRU, and UNCW have already provided substantial databases. These data sets have not only been useful in building the initial database structure, but also serve as an excellent example of the type of data we'll continue to attract. PI Halpin, project web developer Spoerri, and database expert Best have made great strides through prototype tool development, increasing utility of the mapping function, and allowing for online upload and management of data sets. In the final year of the project, we will solicit additional data providers to build upon the OBIS-SEAMAP database. We will also finalize linkages with other OBIS programs, like FishBase and CephBase through predator-prey interactions. As new data sets are added, new analysis tools will be developed and served to the users.

WORK COMPLETED

We have already made great progress in implementing the digital database, through design and population of the database, development of the website, and creation of online tools. The database has been named OBIS-SEAMAP, the Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Animal Populations. A prototype web-based system designed to allow the interactive display, query, and analysis of this database is currently available online at <http://www.obis.env.duke.edu>. Our intended audience includes educators, students, resource managers and researchers, so we have included a wide variety of products on the site to meet their diverse needs. More than forty datasets have already been posted with explicit metadata, including coverage of all three taxonomic groups. The OBIS-SEAMAP website also includes species profiles with species range maps and descriptions, a lesson plan for educators, and research pilot projects. The datasets are available through an interactive map query tool, and once accessed can be manipulated using a variety of online analysis and visualization tools. These data query tools will greatly enhance the potential for research applications of the OBIS-SEAMAP database. Furthermore, the web-based GIS application makes these datasets widely accessible to students, researchers in less developed countries, and others without expensive desktop GIS programs.

During our first annual Data Providers' Meeting (Durham, NC, May 1-2, 2003), we brought together members of the OBIS-SEAMAP steering committee (S. Batten, J. Croxall), six committed data partners (Allied Whale, NMFS NEFSC and SEFSC, Cascadia Research, and St. Andrews University), CoML and NOPP representatives, and several other potential data providers (National Marine Sanctuary system, WhaleNet, TOPP, University of New England, University of North Carolina at Wilmington, and Seaturtle.org) to finalize the "terms of use", and to establish the protocols for meta-data creation and rapid data integration into the OBIS-SEAMAP system. Additionally, we are actively recruiting future data providers, including the Minerals Management Service, state sea turtle stranding coordinators, and private research groups.

RESULTS

In the past year, the OBIS-SEAMAP project has developed an innovative method of incorporating survey effort with marine animal sightings data. This is the first OBIS project to collect, host, and synthesize this critical component of animal survey data; providing users with effort data allows for calculation of animal density and clarifies the distinction between 'no presence' and 'no observation' for users investigating animal habitat. Further, we have learned to incorporate several varying types of survey effort data in order to accommodate survey methods that differ by species.

In discussions with data providers, we learned that protecting their rights of data ownership would be a critical step in encouraging submission of data. A satisfactory Terms of Use agreement has been established in response, and data access is restricted until the user has accepted these terms. Balancing the open-access data distribution goals of the CoML and NOPP programs with the concerns of data providers has been an important accomplishment of the OBIS-SEAMAP project.

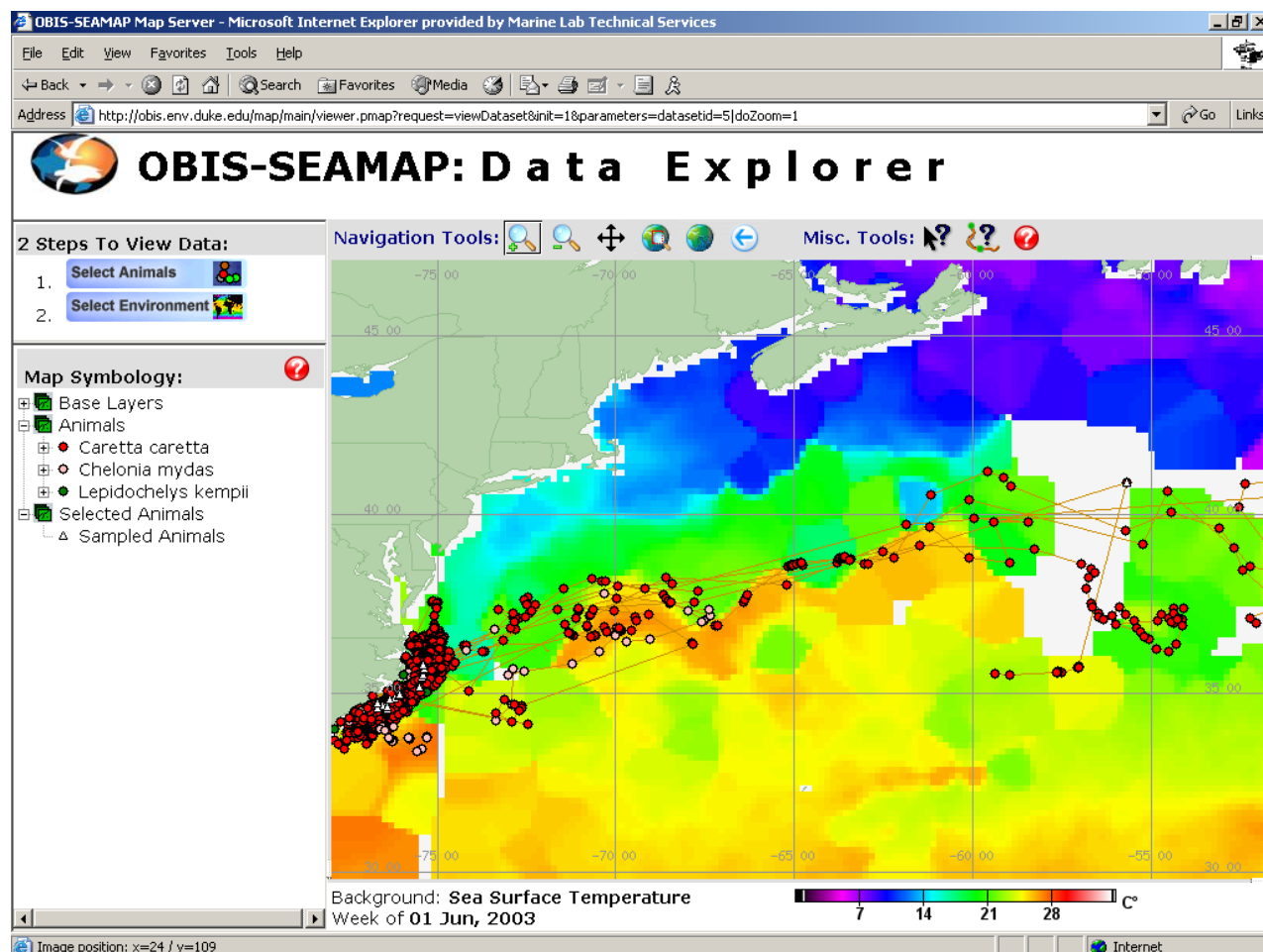


Figure 1. *The mapping interface of OBIS-SEAMAP allows users to overlay species observations or specific datasets on oceanographic variables like Sea Surface Temperature.*

IMPACT AND APPLICATIONS

Quality of Life

The OBIS-SEAMAP project will be of great utility to resource managers and conservation agencies. The website acts not only as a quick source of important biological and ecological background information for species of interest, but also informs managers about their typical habitat range and lists conservation concerns. Managers can access real survey and count data of interest, either by searching for a specific species or by selecting a region. Access to this type of high quality data will allow resource managers to consider the distribution of mammals, seabirds, and turtles when evaluating shipping lanes, fishery closures, or coastal development.

Science Education and Communication

One of the chief goals of the OBIS-SEAMAP project was to facilitate the use of real scientific data for educators in the classroom. Not only do the species profiles provide background information in easy-to-understand language, but students are exposed to the scientific practice of surveying or monitoring oceanic animals. They can investigate habitat usage by a particular species (e.g., comparing sea surface temperature to the distribution of green sea turtles), or follow the track of a satellite-tagged animal on a migration across ocean basins (e.g., circumnavigation by the wandering albatross). Educators are provided with full lesson plans that instruct them on different ways of using the site.

TRANSITIONS

Science Education and Communication

After demonstrating the OBIS-SEAMAP website at the National Marine Educators conference in June 2003, several museum consortiums have expressed interest in developing an OBIS-SEAMAP educational kiosk for use in museums and aquaria.

RELATED PROJECTS

Investigators Read, Halpin, Crowder and Hyrenbach were awarded funding from the Strategic Environmental Research and Development Programs (SERDP) for a new project "Predictive Spatial Analysis of Marine Mammal Habitats." The project award (\$ 969,000) will commence April 2004 and end March 2007. This research project will rely upon the OBIS-SEAMAP digital archive for marine mammal sightings data and build on innovations in oceanographic data integration. In addition, partnerships forged with NMFS-NEFSC during OBIS-SEAMAP will play a critical role in providing data to create and test the habitat prediction model.