

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

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<http://seamap.env.duke.edu/>

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 (OBIS) 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, sea bird and sea 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.

Web-based data query tools and explicit documentation of survey methods allow a wide array of users to view and manipulate data by survey cruise, species of interest, or geographic region. Animal location points may then be combined with environmental data like bathymetry, sea surface temperature, or wind speed. In addition, we will soon offer downloadable script tools for use with ESRI Geographic Information System (GIS) products to 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. All input data are identified to the species level (and to 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 have emphasized standardized long-term time series with broad seasonal coverage (e.g., NMFS marine mammal assessment cruises). Moreover, we have complemented 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 continued to evolve rapidly. Our latest approach is using a PostgreSQL database (www.postgresql.org), an enterprise level database that supports transactions and triggers, along with a PostGIS extension (www.postgis.refrations.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) and a PHP mapscript internet mapping framework called Chameleon (www.dmsolutions.ca/techserv/chameleon.html). 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 (www.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.

To date, the priority of the OBIS-SEAMAP team has been to include high quality data sets in the archive, together with supporting biological information (e.g., species range maps and descriptive information). Our partners, including NMFS (NEFSC, SEFSC, SWFSC, and NMML), Allied Whale, Cascadia Research, SMRU, and UNCW, have already provided very large data sets. We have also made great strides through prototype tool development, increasing utility of the mapping function, and allowing for online upload and management of data sets. Additionally, one of our staff members has spent the past year working at the NMFS-SEFSC laboratory in Miami to build and import a Microsoft Access database to organize their extensive data records. In the final months of this project, we will continue to solicit additional data providers to build upon the OBIS-SEAMAP database. We will also finish uploading additional databases currently in progress, including the International Whaling Committee's historical whaling records for the Atlantic Ocean, the entire Year of the North Atlantic

Humpback photo-id catalog, and the newly unified north and central Pacific humpback whale photo-id catalog.

OBIS-SEAMAP Staff	OBIS-SEAMAP Data Providers
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Ben Best, Duke University	Kelly MacLeod, SMRU
Michael Coyne, Duke University	Judy Allen, Allied Whale
Sloan Freeman, Duke University Marine Lab	Dan DenDanto, Allied Whale
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Ei Fujioka, Duke University	Tom Jefferson, Clymene Enterprises
	Lisa Ballance, NMFS-SWFSC
	Wallace J. Nichols, Blue Ocean Institute
	Paul Wade, National Marine Mammal Lab

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

WORK COMPLETED

The digital database is online and fully accessible at <http://seamap.env.duke.edu>. Named OBIS-SEAMAP, the Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Animal Populations, the database currently includes 101 datasets comprising 300,965 records from 1947 to 2005. During our second annual Data Providers' Meeting (Durham, NC, May 10-11, 2004), we brought together members of the OBIS-SEAMAP steering committee, existing data partners (NMFS NEFSC and SEFSC, College of the Atlantic), a CoML representative, and several other potential data providers (NMFS SWFSC and National Marine Mammal Laboratory, WiLDCoast/Blue Ocean Institute, University of Washington, Wake Forest University, and Seaturtle.org). The meeting was exceptionally productive, garnering extensive user feedback on the website and mapping functionality and eliciting many suggestions for future dataset targets.

A web mapping interface that allows the interactive display, query, and analysis of this database is currently available through the home page, and a newer prototype version is also being tested at <http://seamap.env.duke.edu/protomap/>. 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. This web-based GIS application makes these datasets widely accessible to students, researchers in less developed countries, and others without expensive desktop GIS programs. We are also expanding our focus to provide downloadable script tools for use in ESRI GIS products. This modular software "extension" model is a popular and successful method for end users to select the specialized add-on features they wish to use. For example, the widely used ArcGIS software suite has more than 550 user developed add-on analysis tools and extensions developed for specific user community needs (<http://arcscripts.esri.com>). These data query tools will greatly enhance the potential for research applications of the OBIS-SEAMAP database, and should attract many serious research users to the SEAMAP site.

The OBIS-SEAMAP website also includes 369 species profiles of marine mammals, sea birds, and sea turtles. Each profile includes a species range map and physical description, a discussion of the current threats and conservation status, a dynamically linked map displaying all data records for that species contained in the OBIS-SEAMAP database, and a list of OBIS-SEAMAP datasets that includes the profiled animal (Figure 2, or <http://seamap.env.duke.edu/species/tsn/180438> for an example).

We have worked hard at outreach this past year to increase visibility of the project at both the national and international levels. Highlights include presentations at the Annual Meeting of the American Association for the Advancement of Science in Seattle and the major international meetings of marine mammals (in the United States) and sea turtles (in Costa Rica).

Each posted dataset includes explicit metadata with full contact information for the original data provider. Users must agree to specific Terms of Use before gaining access to the data; these Terms require that users gain written consent and appropriately cite the original data provider if the data are used in any publication or product.

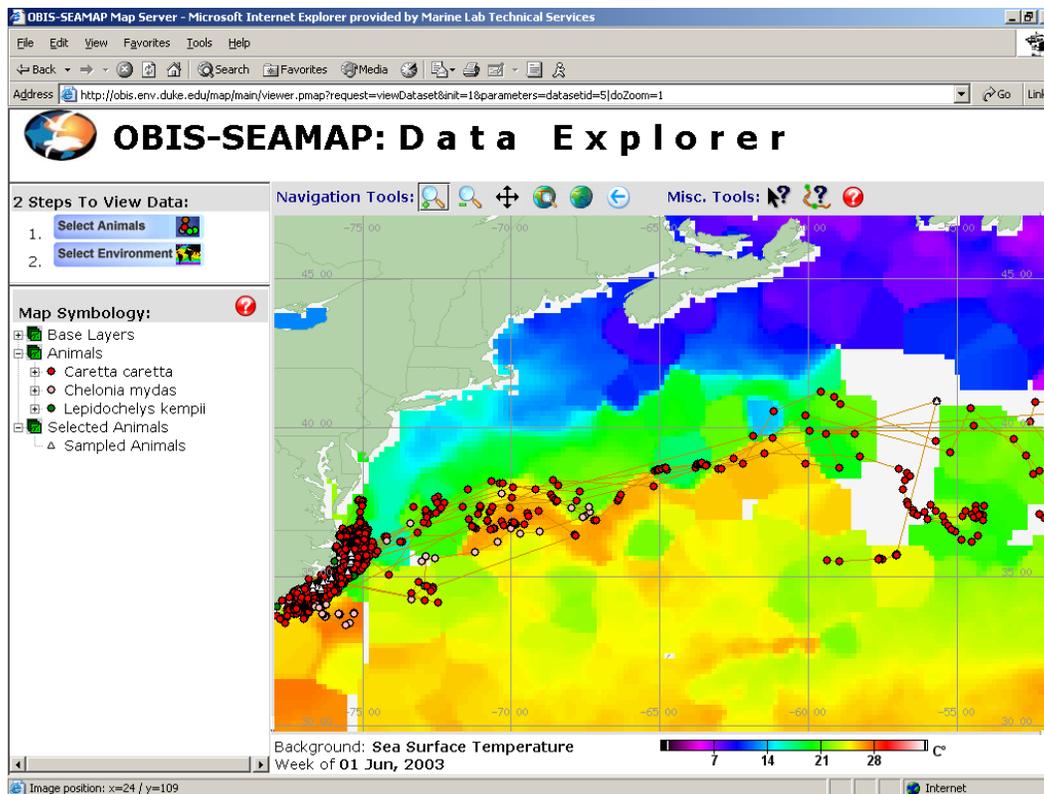


Figure 1. *The mapping interface of OBIS-SEAMAP allows users to overlay species observations or specific datasets on oceanographic variables like Sea Surface Temperature.*

RESULTS

In the past year, the OBIS-SEAMAP project has continued to innovate the incorporation of survey effort with marine animal sightings data. As the first OBIS project to collect, host, and synthesize this critical component of animal survey data, we are now working with other OBIS nodes to provide similarly enhanced data. As new datasets are introduced, for example biopsy reports and acoustic

monitoring programs, we continue to develop new ways to include the varying types of survey effort data.

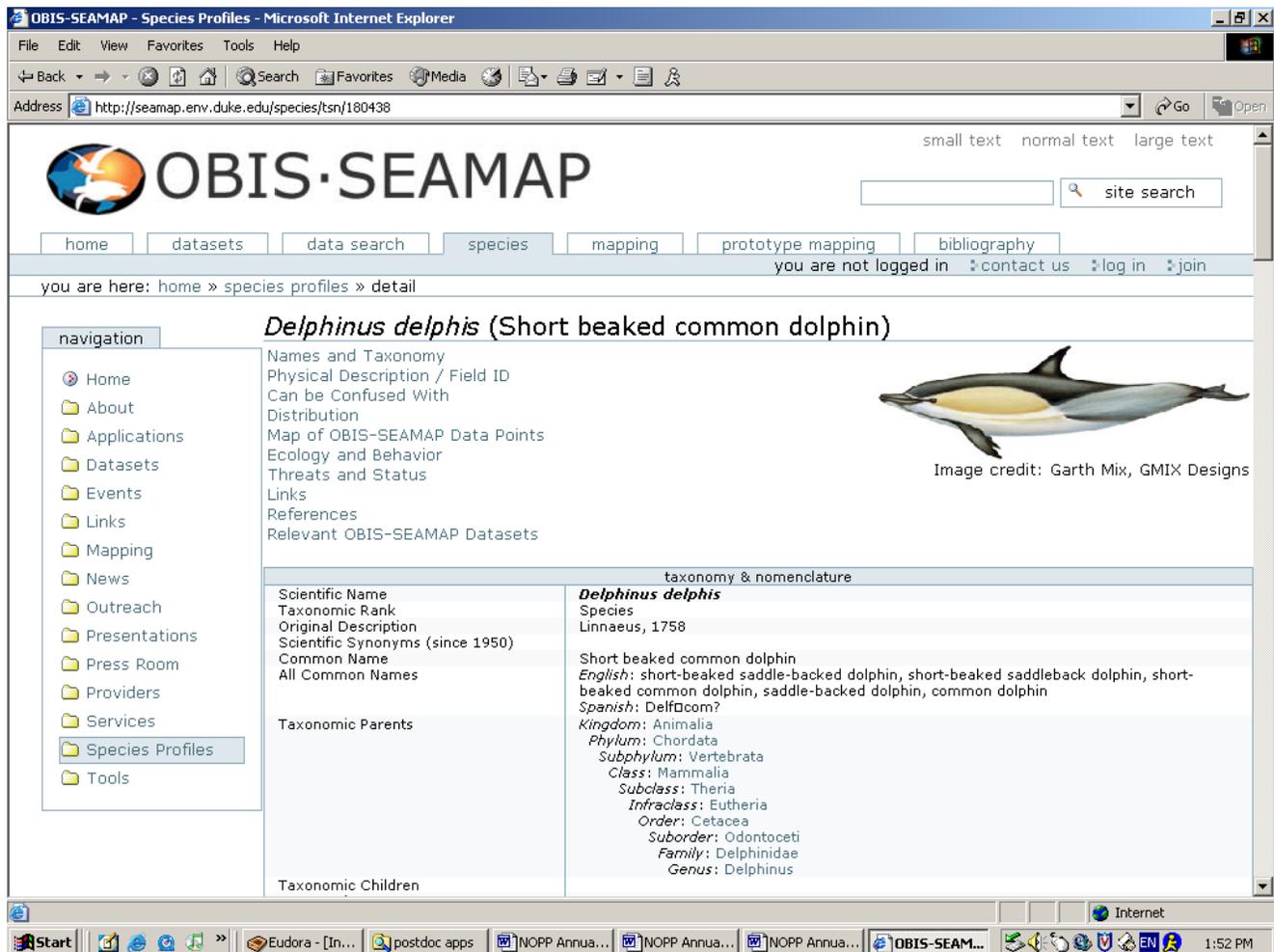


Figure 2. An example of an OBIS-SEAMAP species profile web document. This *Delphinus delphis* (the short-beaked common dolphin) profile includes a color illustration of the animal, full taxonomic data, and links to more information like behavior, threats, distribution, and relevant OBIS-SEAMAP datasets.

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

National Security

By providing the most inclusive database of marine mammal sightings, OBIS-SEAMAP laid the groundwork for project members' current research which will assist the US Navy in planning military readiness exercises in US coastal waters. We are currently developing predictive habitat models based on widely available environmental data that will assist the Navy in identifying where and when they can complete their practice missions with the lowest probability of interacting with marine mammals.

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 (\$ 1,452,196) commenced April 2004 and will end March 2008. This research project builds 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.

Investigators Read, Halpin and Good were awarded funding from the NMFS-NEFSC Right Whale Research Program. This grant (\$257,000) commenced September 2004 and will end August 2007. This research builds upon the spatial database efforts of OBIS-SEAMAP in an effort to predict habitat use for right whales off the coast of New England.

Project staff member Hyrenbach leads a new initiative to explore and characterize the habitat hotspots for the threatened black-footed albatross population off the west coast of North America. This project demonstrates the type of species management measures which can be implemented based on species distribution data like that provided by OBIS-SEAMAP. This research grant (\$59,000) commenced in July 2004 and will end in June 2005.

Investigators Crowder, Read and Hyrenbach participated in a study of warm temperature eddies in the mid-Atlantic to determine whether these habitats were biologically productive or barren of top predators. This research cruise in July 2004 was funded by the Duke-UNC Oceanographic Consortium. Sightings data for marine mammals, sea birds, and sea turtles during the cruise will be uploaded to the OBIS-SEAMAP online database.