# bioSearch : A glimpse into marine biodiversity of Indian coastal waters

Kakodkar A P, Alornekar A, D'Souza R, Thomas T R A, Divekar R, Nath I V A, Kavlekar D P,
Ingole B S & P A Loka Bharathi*

Biological Oceanography Division, National Institute of Oceanography, Council of Scientific & Industrial Research, Dona Paula,
Goa 403004, India

*[E-mail: loka@nio.org]

bioSearch is a database application developed to digitize marine biodiversity of Indian coastal waters. A user can obtain information on organism's binomial and common names, synonyms, taxonomy, morphology, ecology, economic importance, geographical distribution, images and reference literature. As on date 25 September 2013 bioSearch manages 19,760 records. It should be noted that the database is continuously being validated and updated. In this article we discuss structure, working and salient features of bioSearch (www.biosearch.in).

[**Keywords:** biodiversity information, database, marine biodiversity, Indian coast]

## Introduction

In 2005, Venkataraman and Wafar[1] have estimated the total number of marine species in the Indian coastal ecosystem to be more than 13,000. A major portion of this information is confined to public libraries, museums and personal collections. In order to avail this information to potential users, a sustained effort is being made to digitize marine biodiversity information[2]. With the ever-newer advances in Internet Technology and World Wide Web (WWW); web-based information management systems have simplified accessibility and improved management efficiency of biodiversity data. bioSearch is a step in this direction. It aspires to bring Indian marine biodiversity information to masses through the World Wide Web.

A prominent source of the taxonomic and biogeographic information utilized by bioSearch is retrieved from the Indian Ocean Node of the Ocean Biogeographic Information Systems (IndOBIS). Ocean Biogeographic Information System (OBIS)[3] is a global initiative, which aggregates data from its various regional nodes and disseminates it through a central portal (www.iobis.org). This data is mainly a representative of geographical occurrence of an organism. However, bioSearch also provides information on morphology, ecology and economic significance. Thus, based on this statistics of the current available records, such a venture would help in developing strategies for the conservation of endemic and endangered species[4]. In the following sections we take a look at the working and present status of bioSearch.

## Materials and Methods

bioSearch web application constitutes of two user interfaces. A general front-end search interface and a password protected back-end data management interface. In a user query, search variables are passed from a XHTML (Extensible HyperText Markup Language)[5] interface to a PHP (HyperText Pre Processor)[6] script. This PHP script queries data stored in a MySQL (Structured Query Language)[7] database. Information retrieved as a result of the query is rendered to the end-user browser as XHTML (Fig. 1).

Front-end interface enables users to perform various queries on stored data. Simple queries include binomial name and common name searches. More advanced queries include information regarding habitat, commercial importance and/or threats to the organisms. Biogeographic queries represent searches with scientific names or commons against a locality. Taxonomic queries include searches for all the organisms from a particular kingdom, phylum, class or family. In addition to the available search features, users can browse database content using scientific name, common name and synonym indices, where the names are indexed in the order of first alphabet in the name (Fig. 2).

In the Indian context, published literature represents most of the currently available marine biodiversity information[2]. Thus, major source of organism records in bioSearch is published literature and online scientific databases. This literature
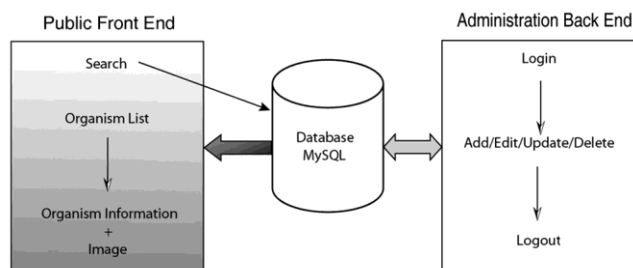


Fig. 1 — Data flowchart of bioSearch. Front end access to the public enables any anonymous user to search species information. Back end access exclusively to administration enables an authenticated user to insert/update and delete organism information.

includes peer-reviewed articles, monographs, books, species checklists, Ph.D. thesis and reports of surveys and technical studies. However, it is important to note that the quality of digitized data depends upon level of accuracy of baseline data[8]. To maintain data accuracy and uniformity, each data manager is given a short training in data management using the back-end interface. This enables a data manager to effectively manage data, while keeping human error to a minimum. Periodic reviews of individual records are often carried out. Using the back-end data management interface a designated subject expert can review and validate records. A small indication on each organism record page mentions status of its validity. Taxonomic information is validated using the World Register of Marine Species (WoRMS)[9].

End-user requirements for the application include an Internet enabled computer with a web browser.



Fig. 2 — GUI (Graphical User Interface) of bioSearch. This page displays all the three types of search options available. i.e., organism search, taxonomic search and name indexes

Table 1—Phylum wise species count

| Kingdom | Phylum | Species | Kingdom | Phylum | Species |
|---|---|---|---|---|---|
| Animalia | Myxozoa | 5 | Plantae | Chlorophyta | 374 |
| Animalia | Porifera | 485 | Plantae | Magnoliophyta | 206 |
| Animalia | Cnidaria | 1295 | Plantae | Rhodophyta | 634 |
| Animalia | Ctenophora | 3 | Plantae | Spermatophyta | 7 |
| Animalia | Platyhelminthes | 56 | Plantae | Tracheophyta | 19 |
| Animalia | Gastrotricha | 64 | Fungi | Ascomycota | 331 |
| Animalia | Nematoda | 180 | Fungi | Basidiomycota | 14 |
| Animalia | Cephalorhyncha | 6 | Fungi | Zygomycota | 13 |
| Animalia | Acanthocephala | 1 | Chromista | Bigyra | 3 |
| Animalia | Rotifera | 54 | Chromista | Ciliophora | 235 |
| Animalia | Priapulida | 1 | Chromista | Cryptophyta | 2 |
| Animalia | Mollusca | 3439 | Chromista | Foraminifera | 559 |
| Animalia | Sipuncula | 31 | Chromista | Haptophyta | 3 |
| Animalia | Echiura | 26 | Chromista | Myzozoa | 67 |
| Animalia | Annelida | 1161 | Chromista | Ochrophyta | 955 |
| Animalia | Tardigrada | 8 | Chromista | Radiozoa | 10 |
| Animalia | Arthropoda | 3609 | Bacteria | Cyanobacteria | 275 |
| Animalia | Phoronida | 1 | Bacteria | Protobacteria | 10 |
| Animalia | Bryozoa | 150 | | | |
| Animalia | Brachiopoda | 1 | | | |
| Animalia | Hemichordata | 3 | | | |
| Animalia | Echinodermata | 692 | | | |
| Animalia | Chaetognatha | 30 | | | |
| Animalia | Chordata | 4514 | | | |

This application is designed to enable users to access organism pages at lower Internet connection speeds. This is particularly important as most parts of the country rely on dial-up (56 kbps) connections to the Internet. bioSearch thus allow access to biodiversity information to anyone, anywhere, and at anytime.

## Results

As on 25 September 2013, the data statistics for bioSearch suggest that the database stores 19,760 binomen records from 6,146 genera and 42 phyla (Table 1). Other organism attributes include common names (13,738), synonyms (51,343), biogeography (90,177), morphological and lifecycle descriptions (9,457), ecology (9,508), economic importance (3,250), images (8,708) and source literature (3,899 records). Phyla representing maximum number of organisms include Chordata (4,531 records),

Arthropoda (3,609 records) and Mollusca (3,439 records). Phyla such as Tardigrada, Phoronida and Priapulida represent least numbers of records.

## Conclusion

Thus, bioSearch aggregates scattered marine biodiversity information from various literature sources and presents it in a user-friendly format. There are numerous possibilities of collaborations with the user community and varied applications of bioSearch. Individuals and Institutions could submit their published biodiversity data. Academicians, scientists and taxonomists could actively participate in validating existing information and suggesting plugins for bioSearch. Ecologists could contribute by providing contextual information on ecological aspects. Basic applications of bioSearch could be in the field of academics, research and conservation.

More specialized applications are expected in the fields of pisciculture, remote sensing, geographical information systems (GIS) and ecological niche modeling.   bioSearch as an important baseline information tool to aid conservation and sustainable management of the Indian marine biodiversity. In short participatory involvement of users is invited and encouraged as it would continuously improve the database.

## Acknowledgement

## References

1  Venkataraman K & Wafar M, Coastal and marine biodiversity of India. *Indian Journal of Marine Sciences*, 34 (2005) 57-75.

2  Kakodkar A P, Kerkar S S, Varghese N S, Kavlekar D P & Achuthankutty C T, Darwin Core Based Data Streamlining With Digimus 2.0, *Biodiversity Informatics*, 6 (2009) 1-4.

3  Ocean Biogeographic Information Systems (OBIS), available at http://www.iobis.org 2012.

4  Schalk P H. Management of marine natural resources through by biodiversity Informatics; *Marine Policy*, 22 (1998) 269-280.

5  W3C HTML Working Group, http://www.w3.org/html/wg/ 2012

6  PHP website, http://www.php.net 2012.

7  MySQL website, http://www.mysql.com 2012.

8  Bisby F A, The Quiet Revolution: Biodiversity Informatics and the Internet; *Science*, 289 (2000) 2309-2312.

9  World Register of Marine Species (WoRMS), available at http://www.marinespecies.org/ 2012.