

MANDATE: A DATABASE ON INDIAN MANGROVES

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ABSTRACT: Conservation and sustainable use of biodiversity became a buzzword after the Earth Summit in Rio in the year 1992. Since then the attention of the scientific community, policy makers and political leaders in many countries provided impetus to this area of knowledge. The identification, monitoring and sharing of biodiversity information became the primary requisite. Many biodiversity information systems for various geographic areas and ecosystems are busy in compiling data.

Mangrove ecosystems, typical of tropical and subtropical coastlines in many parts of the world, are biodiversity-rich geographic areas. A database for Indian mangroves (*MANDATE*) is developed to provide biodiversity and related information pertaining to mangrove ecosystems of India. This database is now available on the Internet with adequate entry-level points. This paper describes the development process of the *MANDATE*, its usefulness and future plans.

1. Introduction

The concept of the conservation of nature is not new to the Indian society. The sacred books of the religions that flourished in India very strongly recognise and support the need for conservation. Several 'Deorais' (sacred grooves) exist even in modern India with a concept that they belong to the mighty. The social understanding prohibits even plucking flowers in these areas. Barring such exceptions, however, the anthropogenic pressures and modern living styles have been set to destruction of the rich biodiversity.

The 1992 Earth Summit at the Rio de Janeiro provided impetus to the conservation of the ecosystems world over. One of the key agreements adopted at Rio was the Convention on Biological Diversity (CBD). This was for the development of comprehensive strategy for 'sustainable development' – meeting our needs while ensuring that we leave a healthy and viable world for future generations. The Article no. 7 of the CBD recognises the need for the identification and monitoring of the ecosystems and the species within the ecosystems whereas Article no. 17 deals with the exchange of information (<http://www.biodiv.org/convention/articles.asp>). This triggered actions such as the birth of CoML (Census of Marine Life) and then OBIS (Ocean Biodiversity Information System) – a programme of CoML established in 1999. The OBIS provides information on over 860,000 marine species and is diversifying plans to increase the scope geographically and quantitatively (<http://www.coml.org/descrip/obis.htm>).

In response to the Rio summit, the Indian Government passed the Indian Biodiversity Act in the year 2002 (http://www.forests.tn.nic.in/biodiversity_act.htm). The Chapter IX Article 36(1) conforms to the national strategies of the government: '...for the conservation, promotion and sustainable use of biological diversity including measures for identification and monitoring of areas rich in biological resources...'

Mangroves of the world span over 30 countries in tropical and sub-tropical regions. In India, they are spread all over the coastline in varying quantities. The estimates of 1997 indicate that mangroves in India have covered 4827 sq. km area (Singh, 2000). The ecosystems at Sundarbans, Andaman Islands and Gujarat are famous for their size. A significant number of scientists are involved in the biodiversity programmes launched since Rio. On an experimental basis, a project to catalogue the identified biodiversity in the mangrove ecosystems all over India from published literature was taken up as a part of an information programme. The subject experts are traditionally doing this. Library and information (L&I) professionals at this institute accepted the challenge to do it with their skills in information organisation. This paper describes how the information is being collected and made available.

2. Tools

Source information tool:

The abstracts database of published literature on Indian Ocean (*IndOcean*), compiled and being updated routinely at this institute, formed the base source for the literature on the Indian mangrove ecosystems. The database at present has over 35000 records and also covers the areas adjacent to the Indian Ocean waters. This is developed using CDS/ISIS – the commonly used textual DBMS software in the libraries and uses 'Delphi-ISIS' as search engine for the data on CD. While adding the records to the *IndOcean*, it was ensured that every full-text item, being catalogued, is available in the library. In case of non-availability, the item was procured.

DBMS:

Over 1,200 items published in various journals and monographs were pulled out from *IndOcean* to form a Database on the Indian Mangroves (*MANDATE*). The flexibility of CDS/ISIS was further explored for the biodiversity information by creating additional fields for each floral or faunal group most commonly existing in the ecosystem and the specific subject areas that the ecosystem is being studied for. The reason for staying with CDS/ISIS was (a) comfort level and (b) possibility of working on the database on a stand-alone system especially for data entry and then porting it over Windows/Linux servers for web searching. It was also realised that the standard formats are yet to set in the biodiversity information system. The scope and coverage of the existing databases also vary from one to other.

For easy retrieval of information on the server, the database has been ported with some applications. One application aggregates the biodiversity resources and provides links to other web resources. The other information retrieval tools are developed using *www.wis*.

3. Scope

The existing databases on biodiversity information on Internet were studied for their strengths and weaknesses.

A Global Database and Mangrove Information System (*GLOMIS*) of the International Society for the Mangrove Ecosystem (*ISME*) was most close to the scope of the subject of *MANDATE*. This database does have comprehensive bibliographic information about published and grey literature, categorised by different subject and geographic descriptors, however, without abstracts of the items so listed. Moreover, the purpose of *MANDATE* is to have an inventory of the flora and fauna available in the mangrove ecosystems of India – core to the ‘biodiversity information’ and not bibliographic information alone. This seemed to be beyond the scope of *GLOMIS*.

NCL Centre for Biodiversity Information (NCBI) – a comprehensive biodiversity information database being developed within India for all flora and fauna seemed to be most close to the geographic area of *MANDATE*. This database also covers the flora and fauna from the mangrove ecosystem along with its taxonomic information. However, again, the source records are detailed to the bibliographic information alone. The comprehensiveness of such source records is also limited. Moreover, the focus is on the taxonomic aspect and not on the literature and therefore, the literature thus identified, is not categorised for its scope (management, biology, threats, etc.).

While compiling *MANDATE*, it was thought appropriate to collaborate with NCBI and avoid repeating the taxonomic information that it already collected and support it in making it more comprehensive by providing information from the mangrove ecosystem.

Databases of national scope do have their strengths in comprehensiveness and local use. The databases at international level have different aims. The ultimate aim of the biodiversity information is to find the ways and means for ‘conservation and sustainable use’ of the available resources. It was felt that the databases on biodiversity, therefore, would be incomplete if they provide only lists of life forms in a given ecosystem. They should also provide and highlight how these could be conserved, used, what are the potential threats for a given specific geographic area, etc. (threats and management info). The biological and ecological studies carried out within the ecosystems also provide basic information in conserving the ecosystem. It was, therefore, felt that the *MANDATE* should address all such aspects and if such database is made available, it would be useful and essential.

The L&I professionals have traditionally been trained to identify and categorise the information. Cataloguing is a matter of routine for them. The trained manpower in the

host institute library with an experience of cataloguing the documents with different descriptors (taxonomic, geographic and subject as standardised by ASFA) was also considered as their strength. This relieved scientific manpower for continued surveys of unexplored areas, etc.

4. *MANDATE*

Over 1200 records at hand describing published and unpublished literature form the basis of the database. The full-text sources of these records are being analysed to identify the flora and fauna from a specific geographic area. Over 700 records have, so far, been analysed and the database is open for search on Internet (<http://www.mangroveindia.org>). It provides links to the topics of biodiversity information (Figure 1) such as:

- Resources,
- Threats,
- Management,
- Biology and ecology,
- Geographic areas, and
- Experts

Resources:

This link provides information on the -- core of the database -- biodiversity that is available in the mangrove ecosystems in India. The biodiversity is categorised in floral and faunal groups prominent to the mangrove ecosystem: Mangroves, Associated flora, Bacteria and viruses, Fungi, Micro- and Macro-algae (seaweeds), Seagrasses, Plankton (zoo- and phytoplankton), (Meio)Benthic organisms, Polychaetes, Molluscs, Crustaceans, Fishes, Reptiles, Birds, Mammals. The least prominent are grouped under miscellaneous floral and faunal categories. One can select any of the groups and list the Genera reported in the literature (Figure 2). From this page, links further open up to:

- (a) the literature that refers a specific genus / species and then to other genera described in the document so listed,
- (b) the NCBI's database for valid scientific and synonymous names, classification, their level of threat, etc., as described earlier. Permission to link to their site considerably reduced the duplication of efforts in finding taxonomic hierarchies of the genera. In a symbiotic relation, on the other side, *MANDATE* provides a list of genera identified in different literature analysed for mangrove ecosystem to NCBI.
- (c) the Google images (a comprehensive photo gallery of the web resources) with which the users may find a choice of photographs, choice of figures and / description to the web sites world over.

So far over 3,000 resources have been identified in the Indian mangrove ecosystem. These of course, include synonymous species as described in the literature. The analysis of the literature is in progress.

It is however, not possible to ensure that every genus listed here would yield a taxonomic hierarchy immediately as the collaborating agency has their priorities. However, over a period of time, this would be possible. There may also be the situation that the Google images picture gallery does not have relevant picture of specific genus so linked. In absence of a best alternative, *MANDATE* is depending on these bases for the additional information.

Threats:

The threats to the mangrove ecosystem are broadly grouped into two: (a) natural and (b) anthropogenic. These affect the ecosystem as a whole or any one entity within the system.

The natural threats include:

- Climatic changes such as global warming resulting in sea level rise, etc.,
- Cyclones (actually the cyclone is due to variations in climate but grouped separately for its importance), and
- Physical processes like change in the river directions, sedimentation, siltation, changes over geological time scale, etc.
- Diseases,
- Deterioration,

whereas the anthropogenic threats to the ecosystem are:

- Pollution,
- Grazing,
- Culture practices (agriculture, and aquaculture), and
- Reclamation for urbanisation, tourism, etc.,

Studies concerning these aspects are grouped under appropriate threat parameters and can be searched using geographic area as a choice from *MANDATE* using drop down menus. A button on specific reference also opens up to describe what all genera have been discussed in the indicated source item.

Management:

The literature that discusses management issues specific to the conservation and sustainable use of the ecosystem can be searched under this category. The actual experimental results or the suggestions from the top management form the core of such literature. The subdivisions concerning conservation and sustainable use are as follows

(a) Conservation of the ecosystem:

- Afforestation (distinct conservation effort),
- Legislation (including laws and policies),
- Monitoring and Surveys (land and aerial, etc.),
- Protection (including conservation, parks and reserves development, etc.),
- Recommendations,
- Soil conservation, and
- Status studies

(b) Sustainable use:

- Culture (Agriculture, Aquaculture - capture fisheries, culture fish, etc.),
- Natural products (useful for medicinal purposes, drugs, etc.),
- Other products (timber, salt production, honey, etc.),
- Socio-economic aspects, and
- Tourism

Drop down menus allow selecting specific management issues (Figure 3) to list the relevant literature that provide such information. Similar to the threats links, a button on specific reference also open up what all genera have been discussed or described in the indicated source item.

Biology / Ecology:

There are large numbers of studies on the biology and/or ecology of the Indian mangroves. They have been grouped with the traditional subject categorisation methods of ASFA under:

- *Biology*: General aspects of biology and the items which can't be classed in any one of following:
 - *Distribution*: Quantified / identified distribution of identified flora and fauna
 - *Taxonomy and Morphology*: Include taxonomy, identification, nomenclature, new taxa, new records, check lists, morphology, anatomy, cytology, ultrastructure, etc.
 - *Physiology and Biochemistry*: Include physiology, biochemistry, biophysics, metabolism, respiration, cytochemistry, histochemistry, etc.
 - *Reproduction and Development*: Include pollination, germination, gametogenesis, sporogenesis, embryology, fertilization, mutation, etc.
 - *Genetics and Evolution*: Include heredity, nucleic acids, genes, genomes, genotypes, chromosomes, karyology, ploidy, mutation, hybridization, etc. including speciation and bioselection

- *Ecology*: General category when the item can not be placed in one ecological aspect:
 - *Energetics*: Include energy cycles, biogeochemical cycles, food chains and webs, energy flow through populations, communities and ecosystems, nutrition and feeding habits, and utilization of food
 - *Productivity studies*: Related to primary and secondary production, turnover rates, algal blooms, seasonal changes in production, etc.
 - *Palaeontology*: The aspects related to pollen fossil and geological studies of past.

Another drop-down window on *MANDATE* provides choice for selecting the life form among the groups described in resources section (Figure 4). The traditional researchers can find this combination of interest in searching relevant studies.

Geographic areas:

The geographic areas from where these mangroves have been studied are grouped here. Nine states and three union territories of India border seas. The ecosystems within these states can also be selected from drop-down menus.

This search feature provides the comprehensive literature as per geographic area. While a large concentration of biodiversity is in three major areas: Sundarbans (in West Bengal), Gujarat and Andamans, large numbers of studies have been carried out in the areas like Tamil Nadu and Goa. This is so because the two major institutions are located in these areas: CAS in Marine Biology (Annamalai Univ.) at Parangipettai, Tamil Nadu and the National Institute of Oceanography at Goa.

The output from this link is similar to the output of other aspects like threats, management and Biological / ecological studies.

Database of experts:

The authors who have published during last three years have been pulled from the database to develop a page on experts. Attempts are on the way to obtain information about the mangrove experts involved in management as well.

4. Future

Continuous monitoring of the published literature would be continued. The factor concerning 'sustainable use' of the resources in biodiversity information is equally important. Searching and linking patents that use the mangrove ecosystem resources listed in the database is also in a future plan. India is a large country and the mangrove studies are being conducted in various research organisations and universities. Involvement of the experts and organisations in making the database comprehensive is something that is considered essential. Possibility of the digitisation of the referred

literature on this ecosystem and making it available on membership basis or by other means is being studied. It is hoped that this tool becomes a handy source of information to the governmental and non-governmental agencies in making policy decisions. Establishment of links to the international biodiversity databases (for information sharing) would certainly add another dimension to *MANDATE*.

This experiment should give a confidence to other L&I professionals that they can play a major role in Biodiversity information system - a new area for work.

5. Acknowledgements

Thanks are due to the Director, NIO for constant encouragement and permission to venture in new experiments. This work would not have been possible without the financial support from Ministry of Environment and Forests, Govt. of India, who generously funded the project. A number of scientists helped in checking the scientific names and spellings of the flora and fauna so grouped are gratefully acknowledged. Thanks are also due to the colleagues in library for resource building.

6. Reference

Singh, H.S. 2000. *Mangroves in Gujarat*. GEER Foundation, GandhiNagar, India. 10-11.

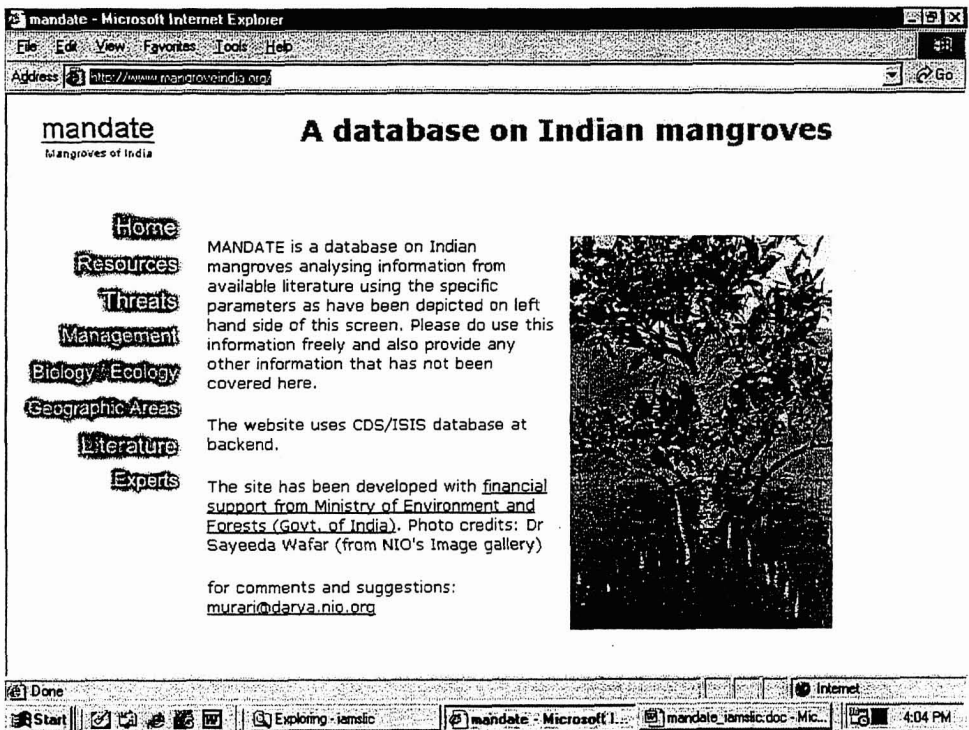


Figure 1: Home page of www.mangroveindia.org

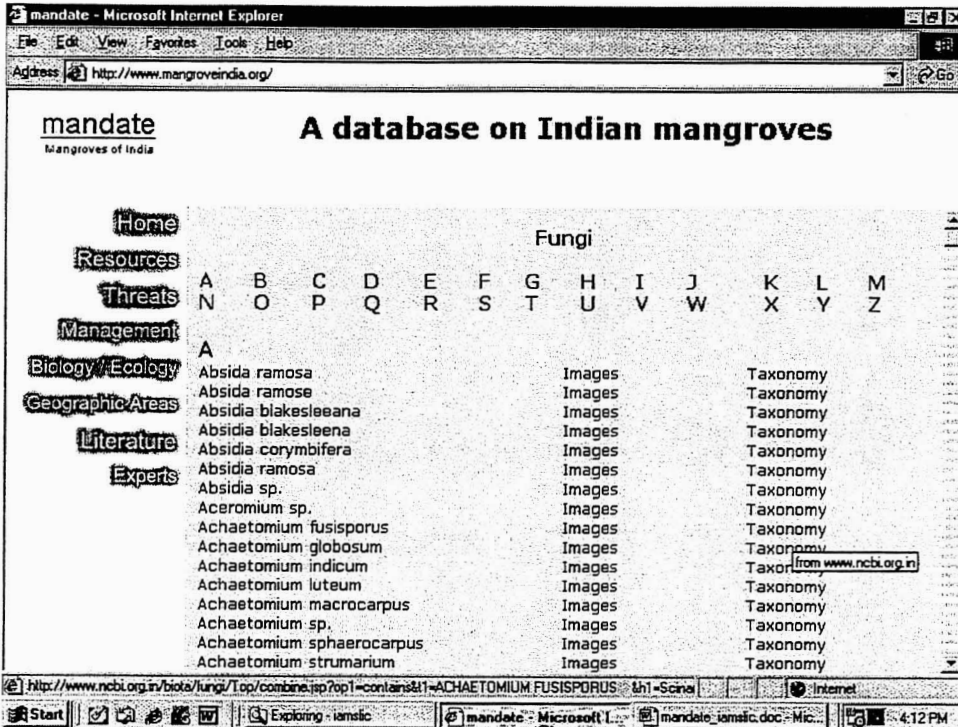


Figure 2: Listing Fungal genera from 'Resources' menu. Names further link to the literature, 'Images' link to Google images and 'Taxonomy' to NCBI's site

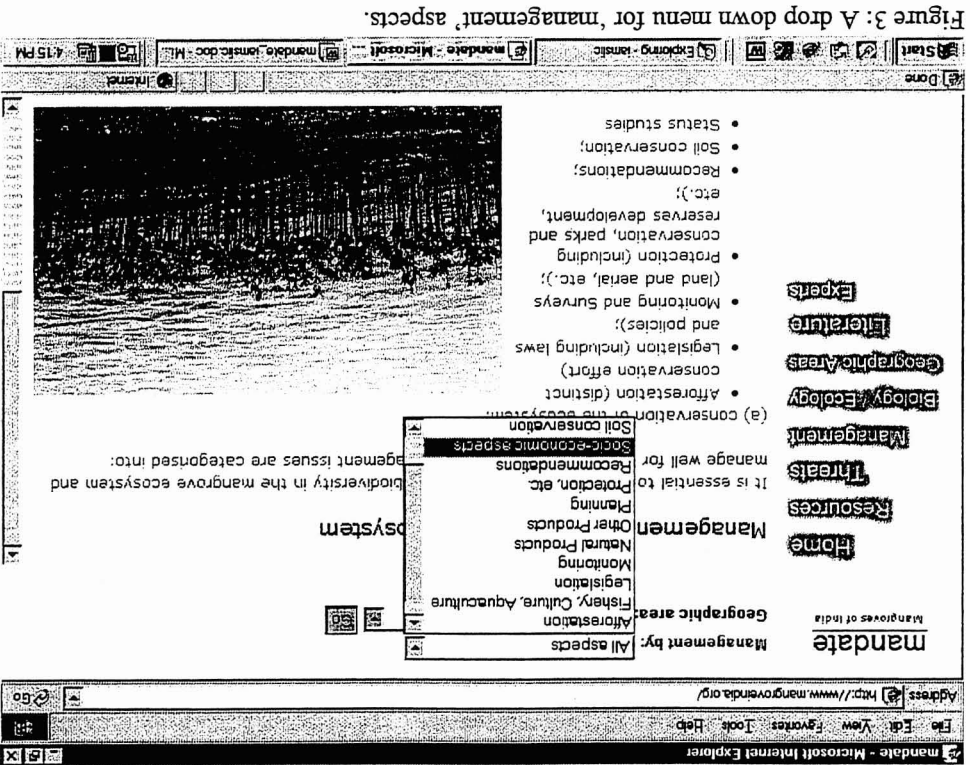


Figure 3: A drop down menu for 'management' aspects.

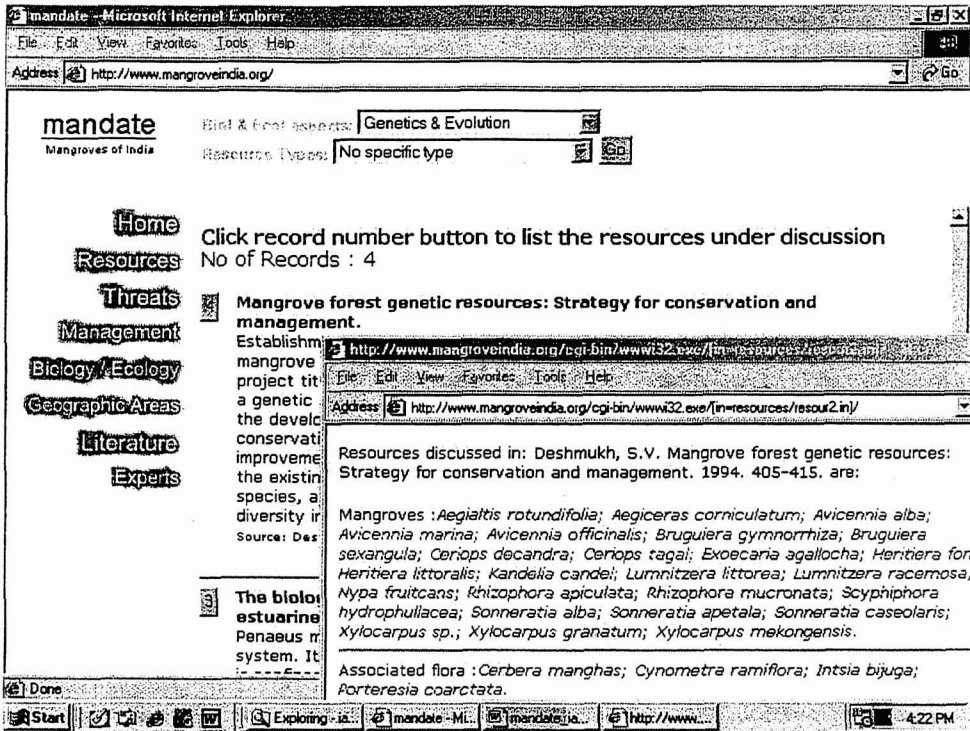


Figure 4: Listing on studies from Biology/ecology. Pop-up page lists genera that have mentioned in a given source (click button pop-up)