

## Mapping of biodiversity in the Mumbai port using GIS

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### ABSTRACT

The Marine Information System is designed to represent, query and analyze the marine species data collected from Mumbai Port region. This system provides the end users with query-based interface to help them analyze the data effectively.

Two customized tools are provided along with the predefined tools in Arc View 3.2a to query the data. The species data collected in the study region are stored in MS Access. Arc View 3.2 is basically used to display the port map and display the stations in the study region from where data were collected. Of the two, one tool is used to query on map, using which, user can select any one station, and query data for that station. The other tool allows the user to query data and view the data in the form of tables or to view the distribution of a particular species in the port region. The distribution of the species from two different periods shows an increase or decrease in number of species for a particular period in the study region. It also allows the user to view the image of the species.

The data were collected in the Mumbai Port region during November 2001, April 2002 and October 2002. This data were compiled and stored in Access database. Scripts were written in Arc Avenue to connect the database with GIS and to prepare user-friendly interface to query data. Scientists in our institute can view and query the base map of Mumbai Port with different layers and attributes posted in the website using Arc IMS.

## **INTRODUCTION**

The introduction of harmful aquatic organisms and pathogens to new environments via ships ballast water and other sources has been identified as one of the greatest threats to the world oceans (Anil et. al, 2003). The various ballast water discharge, environmental matching and risk species data were processed by the database with other risk factors including voyage duration and tank size, to provide preliminary indication of the relative over all risk posed by each ballast water source port, and which destination ports appeared most at risk from any ballast water uplifted at the demonstration site.

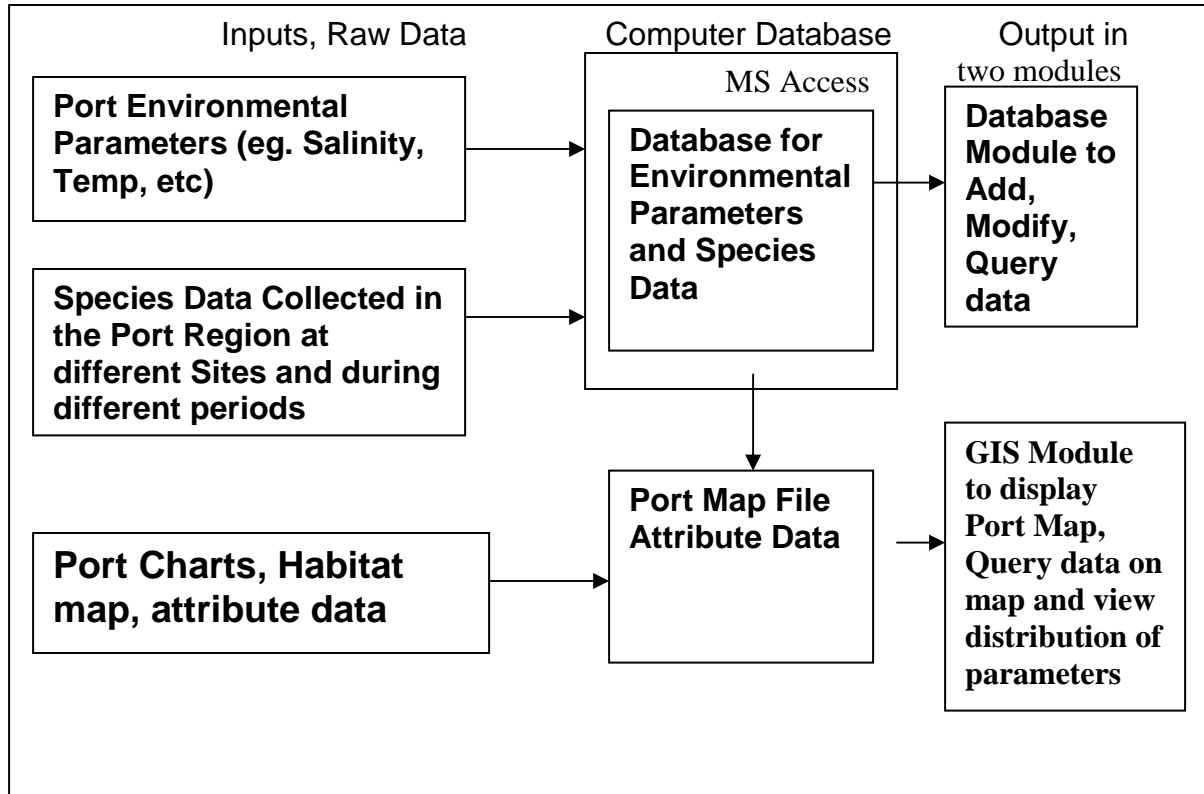
This paper presents how GIS is used to characterize biodiversity of the marine ecosystem in the Mumbai port region with the objectives of rapid assessment for monitoring of biodiversity loss/gain and mapping of biological richness to understand its spatial nature that helps in planning and execution.

## **STUDY AREA**

The ports of Mumbai-JNU are located on the west coast of India at 18° 54"N, 72° 49'E. These ports are located on either sides of the Thane creek, which covers the greater city area of Mumbai. This tidal channel separates Mumbai Island from the mainland and is linked to various creeks and coastal drainages including the Amba River.

## **SYSTEM OVERVIEW**

The graphical representation of the overview of the system is shown in fig.1.



**Fig.1**

The final output (application) developed in GIS using Arc View 3.2a shown in fig.1 is enable us to view the Port Map having different layers like habitat, bathymetry, coastline, anchorages etc., Query data on the map with respect to sites, View the distribution of different species related to biodiversity, physical and chemical parameters in the Port region and view the image of the species.

## **METHODOLOGY**

### **Developing the Port Map:**

The Mumbai Port Map was developed (Sarkar, 2003) from three different hydrographic charts. The hydrographic chart for approaches to Mumbai was of 1:60,000 scale, and the other two charts, Mumbai port and JNPT, were of the scale 1:20,000 each. The Port map in Arc View displays the navigational and infrastructure features along with the coastal habitats and resources. For clarity and convenience of data management and display, each type of data is shown in different layers.

## **Compilation of Data and Design the Database:**

The compilation of data and its design is a very critical step in creating the database. The data collected by the MCMRD, NIO at the site were used in this paper. This data were compiled in a format acceptable to GIS and the database was designed to avoid redundancy of data. This data were then stored in the MS Access database (Table1).

## **Link the Database With Arc View:**

To display the data from the Access database on the map, Arc View needs to access the Database using ODBC (Open Database Connectivity). For this a data source is created. This data source holds the connection to the database.

## **Customization of Arc View GIS:**

Two new tools are added to the tool bar provided in Arc View, to provide an interface for the database running at the backend. Using these tools, the data are queried directly for the database or on the map. The distribution of species, physical and chemical parameters in the port region are viewed and also the images of the species. Arc Avenue (Anon, 2001) is used to write scripts to achieve all these.

## **Creation of Website:**

Marine Information System is a stand-alone package for analysis of marine species data and mapping the biodiversity. This system can be uploaded on the website, and can be made available to the users, provided the scripts written in Arc Avenue are converted to web enabled scripts, using any standard scripting language like ASP, PHP etc. The Mumbai Port map is uploaded on the website (Fig. 6) in NIO's intranet.

| Siteno | Site_Name                 | Latitude | Longitude | Parameter | Value |
|--------|---------------------------|----------|-----------|-----------|-------|
| 6      | Victoria Dock-1           | 18.95745 | 72.84697  | Medusa    | 13    |
| 8      | Princes Dock-1            | 18.96242 | 72.84687  | Medusa    | 13    |
| 11     | Ferry Wharf-1             | 18.95657 | 72.84758  | Medusa    | 23    |
| 13     | Kasara Basin              | 18.96903 | 72.85190  | Medusa    | 3     |
| 16     | Old Pirpua-1              | 18.99175 | 72.90947  | Medusa    | 7     |
| 18     | New Pirpua-1              | 18.98170 | 72.91735  | Medusa    | 2     |
| 20     | JNP Channel Marker Buoy   | 18.97677 | 72.94802  | Medusa    | 7     |
| 21     | Elephanta-1               | 18.96312 | 72.91800  | Medusa    | 10    |
| 23     | Jawaharlal Nehru Port CB1 | 18.96285 | 72.95028  | Medusa    | 20    |
| 31     | Jawahar Dweep B-3         | 18.95303 | 72.90773  | Medusa    | 35    |
| 33     | MP Channel Marker Buoy    | 18.92088 | 72.84972  | Medusa    | 99    |
| 36     | Spoil Ground-FD           | 18.87667 | 72.73323  | Medusa    | 3     |
| 35     | Spoil Ground-EBB          | 18.78822 | 72.82667  | Medusa    | 9     |
| 35     | Spoil Ground-EBB          | 18.78822 | 72.82667  | Medusa    | 19    |
| 37     | Control                   | 18.95538 | 72.76835  | Medusa    | 19    |
| 37     | Control                   | 18.95538 | 72.76835  | Medusa    | 3     |
| 1      | Sasson Dock               | 18.90943 | 72.82826  | Medusa    | 97    |
| 2      | Apollo bandar             | 18.91840 | 72.83713  | Medusa    | 5     |
| 3      | Harbor wall Berth-20      | 18.93562 | 72.84320  | Medusa    | 25    |
| 11     | Ferry Wharf-1             | 18.95657 | 72.84758  | Medusa    | 5     |
| 14     | Break Yard                | 18.96953 | 72.85305  | Medusa    | 4     |
| 14     | Break Yard                | 18.96953 | 72.85305  | Medusa    | 4     |
| 15     | Mahul Creek               | 18.98580 | 72.88570  | Medusa    | 12    |
| 15     | Mahul Creek               | 18.98580 | 72.88570  | Medusa    | 3     |

Table 1. Sample data used in this paper

## Results

Arc View application of the Mumbai Port map is presented in fig. 2.

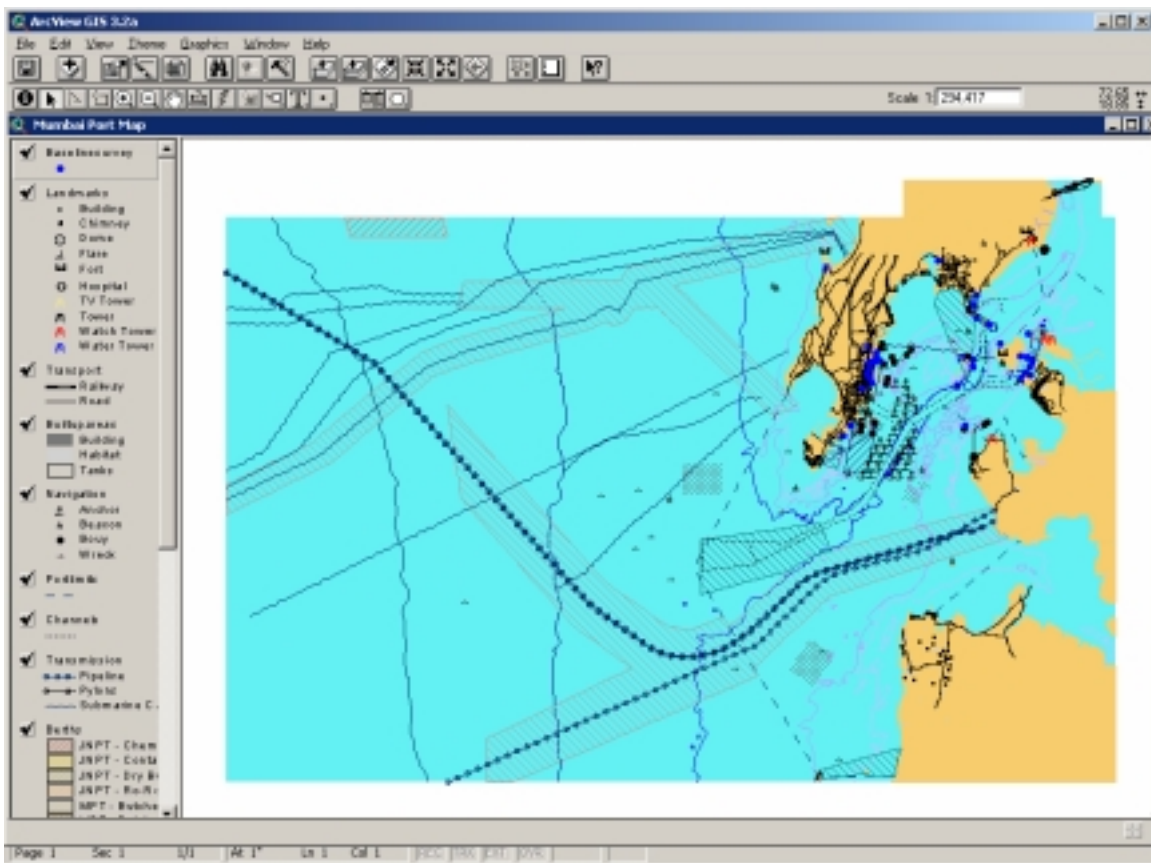


Fig. 2

The data were collected in the Mumbai Port region during November 2001, April 2002 and October 2002. This data were compiled and stored in Access database. Scripts were written in Arc Avenue to connect the database with GIS and to prepare user-friendly interface to query data. This interface allows the user to view the database (Fig. 3), to query the database and view the distribution of species for a particular period (Fig. 4) and also to identify the species on the base map (Fig. 5).

Database on biodiversity is linked to GIS as shown in fig. 3.

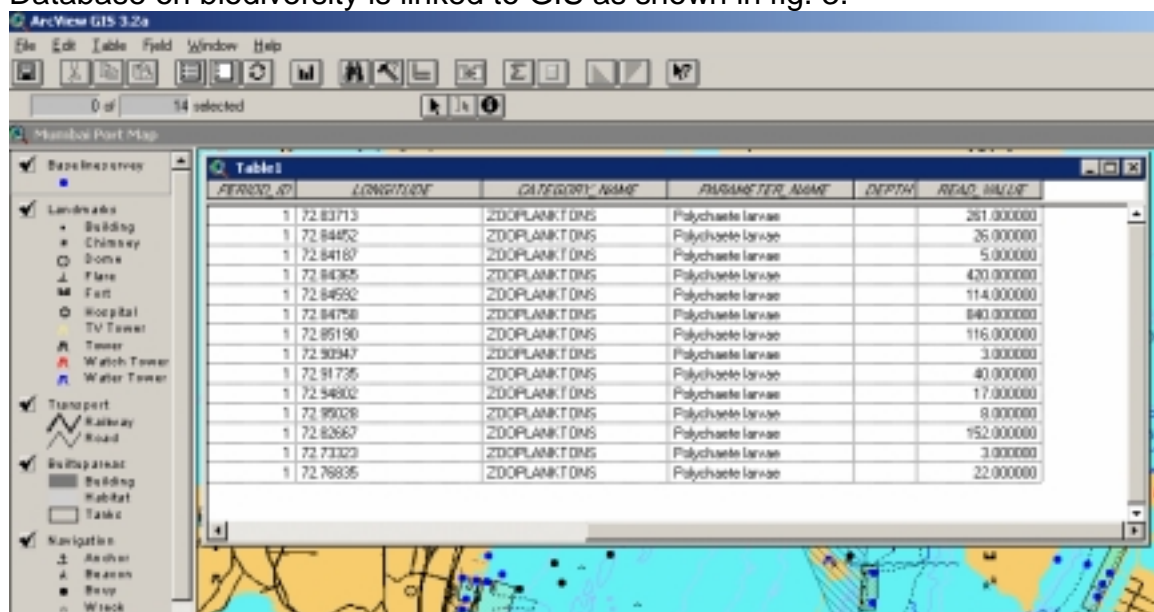


Fig. 3

The distribution of the species in the port region is shown in fig. 4.

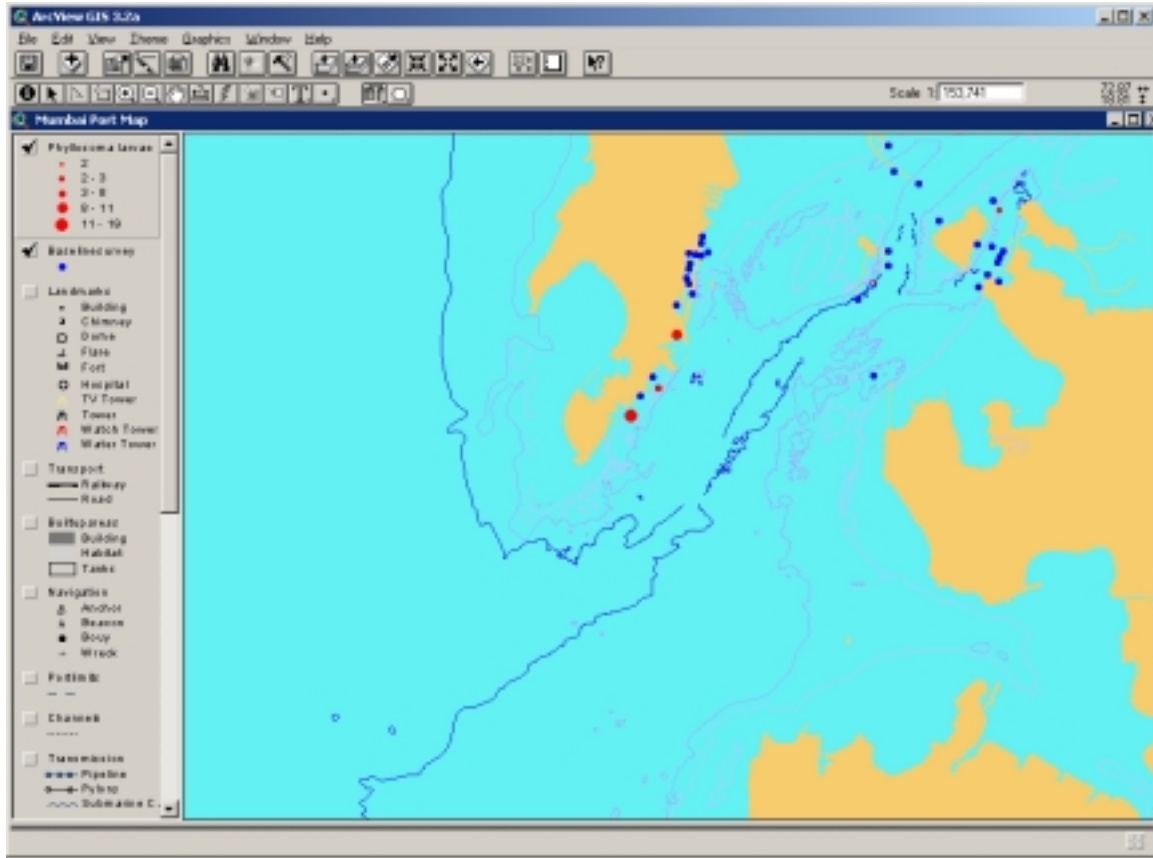
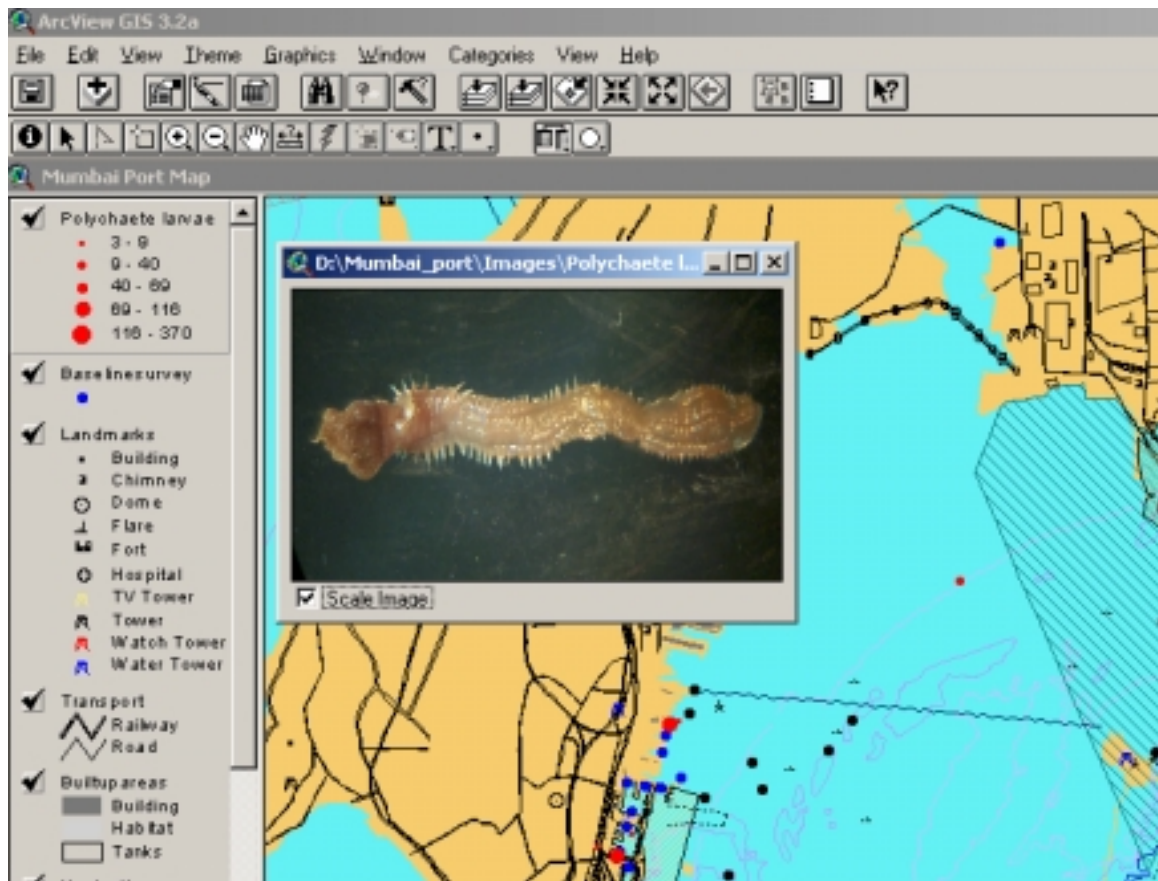


Fig. 4



The species identified on the base map is shown in fig. 5.



**Fig. 5**

Biodiversity studies are very sparse in this region. The above results are based on the data collected by NIO during certain periods. These are only preliminary results. We tried to create GIS database for biodiversity in this region. This database can be updated as and when the data are available.

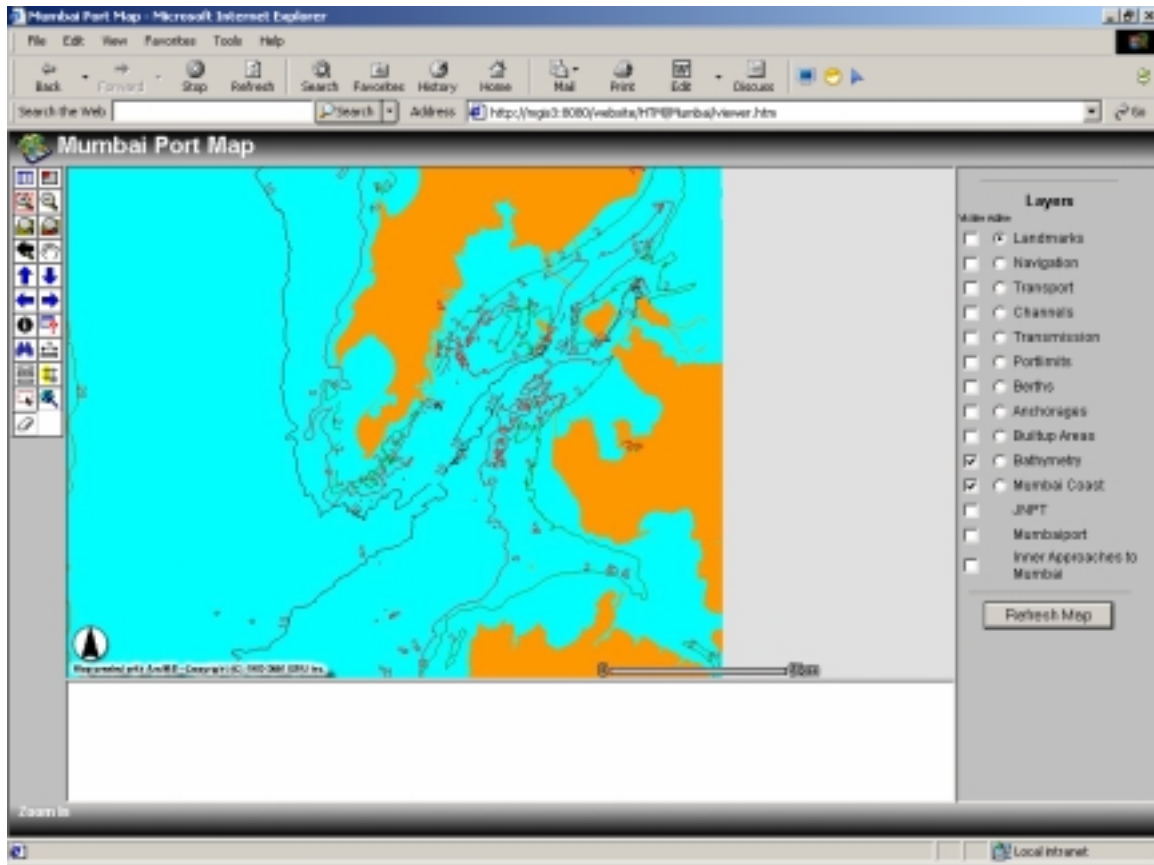


Fig. 6

## Conclusion:

The present study of representation of results in spatial form helps in preparation of management plans. There are some project proposals at national and state level in India to generate database on bio-diversity and make them available in GIS platform. The information generated in the case study would be of immense use if linked together with planning and policy processes that affect bio-diversity.

## ACKNOWLEDGEMENTS:

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