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# Web Database of Threatened Fish Species

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**Abstract:** The database of threatened fishes of India is a compilation from different data sources and provides the information about the threatened fish species found in the different ecosystems. The database covers 531 fish species of 6 classes and 149 families reported from Indian waters. Besides data saving, updating and viewing, the database has been developed with the objective for planned data redundancy, better data consistency and sharing. The database can be much useful resource for management and conservation of threatened fishes. The database has been developed on the open source platform using the open source languages and database management system. The web application of the database integrates tools for registering users, viewing and browsing the information by registered users only. This has been done to maintain the privacy and security of the database.

**Index terms:** Threatened Fish Species, Web Database, Species, application, Development, Search

## I. INTRODUCTION

India has been blessed with vivid water resources in the form of numerous rivers, streams and associated wetlands. In India, a few states like West Bengal, Bihar, Assam, Andhra Pradesh etc are rich in floodplain wetlands. The major source of freshwater include the lotic water bodies (rivers and streams), lentic water bodies (ponds and lakes), the ground water zones, and the ecotonal water bodies where the aquatic resources meet to form certain new water bodies viz. wetlands, marshes and estuaries (Palmet et al., 1997). In India, human population is expanding rapidly, due to which, there is a striking effects on the available resources, creating a number of problems with reference to food supply and nutritional security.. The poor people of India cannot afford milk, eggs, therefore aquatic community fishes, prawns, crabs and bivalves particularly play an important role in human welfare in providing cheap sources of proteins. The inland water has now become the focus of special attention in application of ecological data in obtaining more food in the form of fishes, prawns, crabs and bivalves. Fish apart from its food and other economic importance forms the highest species diversity among all vertebral groups and accounts almost 25% of the global vertebrate diversity. Globally, more than 32300 fish species are reported (Froese and Pauly, 2012) out of which India alone contributes 11.72% of globe fish biodiversity (Lakra, 2010). Aquatic germplasm resources of India comprise whole lot of organisms, both animals and plants origin, it is mainly the fin and shellfish species which have actual and potential value for both capture fisheries and aquaculture (Jena and Gopalakrishnan, 2012).

Novel species, which are of great conservation concern, are also being exported. These include, '*Gonoproktopterus thomassi*', which is a critically endangered species that has a restricted distribution, and endangered species '*Glyptothorax housei*', that comes from a single location in the Western Ghats. India has no law that protects freshwater fish per se.

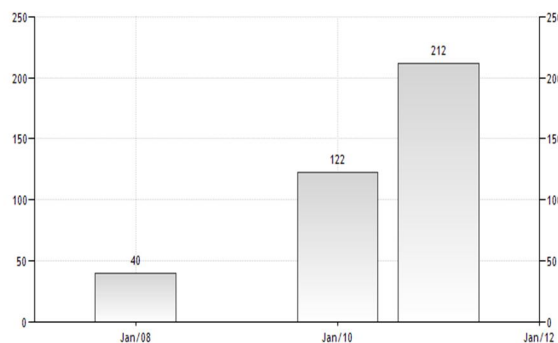


Figure 1: Bar graph of threatened species over different years

Therefore scientific information about species, conservation status and ecosystem is essential for moving towards more sustainable use, trade and scientific conservation efforts of our valuable biological resources. Hence, it is essential to have the information in the form of species-specific database. The species-specific database on Indian fish species can play the major role in protecting the threatened fish species and securing the IPRs related to the fish biodiversity. In view of this the present study highlights about the development and implementation of the database on the threatened fish species of India in the public domain. The Database technology has been widely used in plants and agriculture research to store information such as morphological description (Arthur Villordon, et al. 2007) , growth data (Antonios N. Psomas, et al. 2012), karyological data (Naresh Sahebrao Nagpure, et al. 2012) , gene information (Eva Huala, et al . 2001), etc. Therefore, the objective of this work was to explore the web-based information system for threatened fish species of India to share the data and communicate among fisheries researchers, academicians, planners and managers. The database has been developed using the SQL technologies in integration with Java and PHP. The database presently covers 531 of 6 classes and 149 families reported from Indian waters. As an important tool of data saving, updating and viewing this database has various advantages compared with traditional file system, such as program-data independence, planned data redundancy, better data consistency and sharing, improved decision support, etc (Jeffery A. Hoffer, et al., 2008).

## II. MATERIALS AND METHOD

### A. Data Source

The Database is developed from the published data sources which is available on Internet and published literatures (journals and books) of fish. All these are used to collect the data on threatened fish species reported from Indian waters. To collect the data, Standardized data collection sheet were prepared and was further used to populate the data into database. Fishbase 2012 available at URL <http://www.fishbase.org> and the report published on "Threatened freshwater fishes of India by Lakra *et. al.* 2012 were referred frequently in collecting the data.

### B. Database Application Development

1) *Design of database structure:* Based on the normal forms (Codd, E.F., 1971), data from data collection sheets were organized and an entity relationship model was designed to describe the structure of the database. The database has 6 tables out of which 2 tables cover the information about the threatened fishes and 4 tables are for administrative purpose in order to create users and authenticate users to access the database application. Table 1 describes about the tables designed to cover the information.

Table name	Primary key	Description
admininfo	adminid	Contains login information for the user
fishinfo	fishid	Contains information about the threatened fishes
taxonomy	taxonid	Contains information about the taxonomy of threatened fishes
user	userid	Contains detail information about the user
Signup	signid	Contains information for the user wish to sign to access the database

Table 1: Description of tables and primary keys in the database

2) *Design of application interface:* The web application of the database was developed using PHP for accessing the data from the database. The increasing popularity of PHP for open source application development and deployment is tremendous. The web application of the database has pages describing about the database as well as integrated various search and data management tools to search the information of interest and manage the data into the database. The tools use interactive control interfaces allowing the user to search and control the access of data with ease

## III. RESULT

The database covers 531 fishes belonging to 149 families reported from marine and freshwaters of India. Out of 149 families phylum chordata covers 135 families, mollusca covers 12 families and anthropoda covers 2 families. Out of 531 fishes, 326 fishes belong to marine, 205 fishes belong to freshwater and 20 fishes belong to both marine and freshwater. Table 2 shows the different threatened status of the fishes covered in the database. In the database there are 3.6% of fishes categorized as 'data deficient'. Further 52.79 % of fishes have been categorized as 'not evaluated' and 15.5 % categorized as 'not estimated'.



Threatened status	Percentage of fishes
Endangered	1.8
Critically endangered	0.54
Near threatened	3.42
Vulnerable	3.42

Table 2: Threatened status of fishes covered in the database

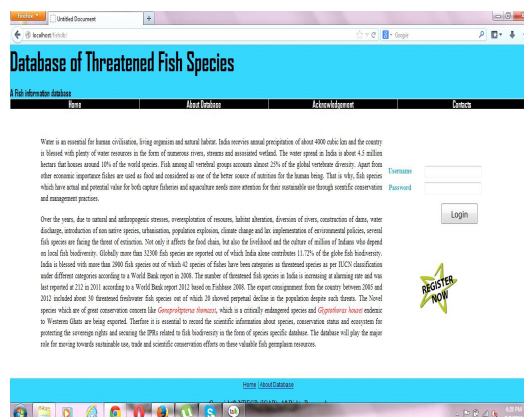


Figure 2: Home page allowing sign up for new user and login for an authenticated user

The home page displays the e general information about the water, fish and fisheries of the world, impact of disturbances on fish and fisheries resources and status of fisheries in India and globe. Additionally, the application interface facilitates for the authenticated users to login into the database as well as registration for the new users. This is the main page which has link to other pages and provides the link to work with the database.

#### A. Accessing the database

The access to the database has been provided only to the registered/ authenticated users. This has been done to increase the security and privacy of the database and keep track on the users accessing the database.

**Figure 3** shows the page that integrates view, search and database statistic options. Additionally feedback option with in this page has been included to receive the feedback about the database from the individual users.

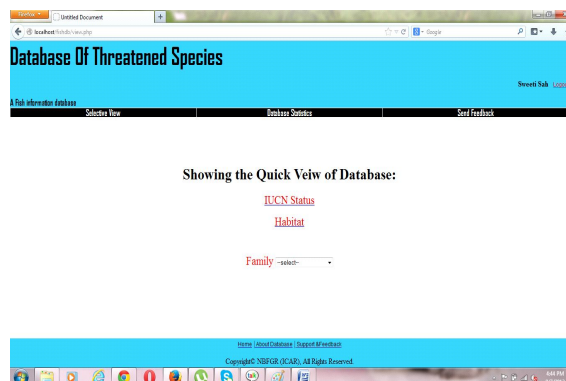


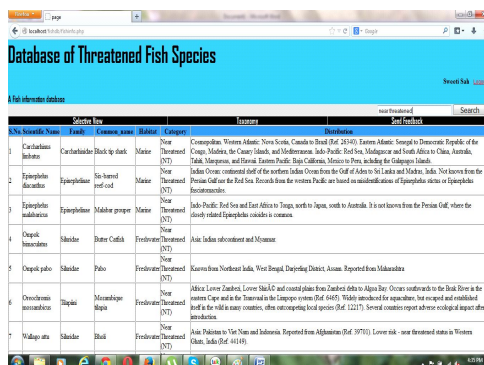
Figure 3: Web page allowing to access the database using different options

#### B. Quick/ Selective viewing

Three parameters IUCN status, Habitat and Family were selected to quickly fetch and display the data from the Web database. The 'Selective view' option opens the page displaying these three parameters with data access control and facilitates the users to view the information of interest against the selected parameter. Figure 3 shows the sample screen layout of the page. Figure 4 shows the result page obtained after selecting the family 'Bagridae'.

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Figure 7 and Figure 8 shows the sample screen view of the result after search on keywords "Near Threatened" and "Marine" respectively.



S.No.	Scientific Name	Family	Common Name	Habitat	Category	Distribution
1	<i>Caranx melampygus</i>	Carangidae	Black tip shark	Marine	Near Threatened (NT)	Commonly found in the Indian Ocean, from the Gulf of Aden to the Gulf of Thailand, Indonesia, Viet Nam, and Philippines. It is also found in the Persian Gulf, where it is considered a threatened species.
2	<i>Epiplatys spilargyreus</i>	Epiplatidae	Two-banded cichlid	Marine	Near Threatened (NT)	Indian Ocean, continental shelf of the western Indian Ocean from the Gulf of Aden to Sri Lanka and Maldives. India. Not known from the Persian Gulf or the Red Sea. Research from the western Pacific has based on misidentifications of <i>Epiplatys spilargyreus</i> or <i>Epiplatys spilargyreus</i> .
3	<i>Epiplatys spilargyreus</i>	Epiplatidae	Madagascar cichlid	Marine	Near Threatened (NT)	Indian Pacific: Red Sea and East Africa to Tonga, north to Japan, south to Australia. It is not known from the Persian Gulf, where the closely related <i>Epiplatys spilargyreus</i> is common.
4	<i>Oreochromis niloticus</i>	Cichlidae	Butter Catfish	Marine	Near Threatened (NT)	Asia, Indian subcontinent and Myanmar.
5	<i>Oreochromis niloticus</i>	Cichlidae	Butter Catfish	Marine	Near Threatened (NT)	Known from Northeast India, West Bengal, Darjeeling District, Assam. Reported from Maharashtra.
6	<i>Oreochromis niloticus</i>	Cichlidae	Butter Catfish	Marine	Near Threatened (NT)	Africa: Lower Zambezi, Lower Shabie and coastal plain from Zambia into the Congo River, occurs southwards to the Nile River in the eastern Cape and the Nile River in the Nile River valley. It is also found in the Nile River valley. It is also found in the Nile River valley. It is also found in the Nile River valley.
7	<i>Valigiata alata</i>	Valigiata	Blind	Marine	Near Threatened (NT)	India: Pakistan to Viet Nam and Indonesia. Reported from Afghanistan (Ref. 1971). Lower risk - near threatened status in Western Asia, India (Ref. 4114).

Figure 7 : Sample screen view showing the search result of the keyword 'near threatened'

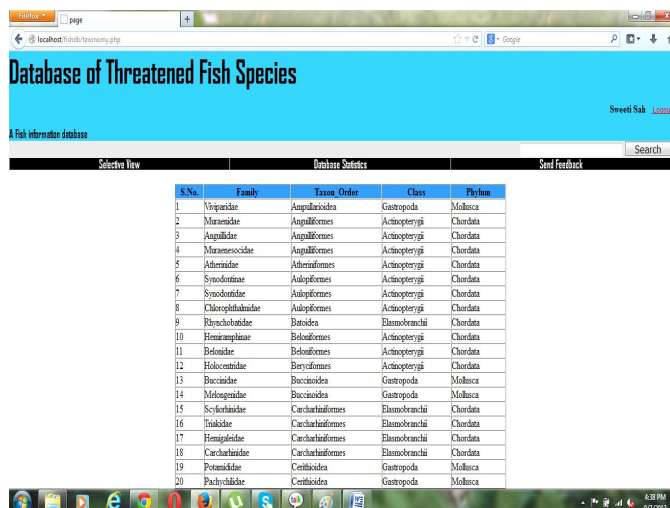


S.No.	Scientific Name	Family	Common Name	Habitat	Category	Distribution
1	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
2	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
3	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
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5	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
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8	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
9	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
10	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
11	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
12	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
13	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
14	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
15	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
16	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
17	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
18	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
19	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).
20	<i>Alopiidae</i>	Pseudocara	Indian Pacific	Marine	Not Evaluated	Indian Pacific: Red Sea and western Africa to the Line and Tuamotu Islands, north to southern Japan, south to Australia. Often confused with the closely related Atlantic species <i>Alopiidae</i> (Ref. 7147). Reported by <i>Alopiidae</i> (Ref. 7147).

Figure 8 : Sample showing the search result of the keyword i.e Marine

#### D. Viewing taxonomy

To view the taxonomy of the fish species a separate link has been included that facilitates to browse and view the taxonomical information of all the fishes covered in the database. The taxonomy provides information on Phylum, Class, Order, and Family. Figure 9 shows the sample screen view of the taxonomy information covered in the database.



S.No.	Family	Taxon Order	Class	Phylum
1	Vibrionidae	Anguilliformes	Gastropoda	Mollusca
2	Muraenidae	Anguilliformes	Actinopterygii	Chordata
3	Anguillidae	Anguilliformes	Actinopterygii	Chordata
4	Muraenocichlidae	Anguilliformes	Actinopterygii	Chordata
5	Aluteridae	Aluteriformes	Actinopterygii	Chordata
6	Synodontidae	Aulopiformes	Actinopterygii	Chordata
7	Synodontidae	Aulopiformes	Actinopterygii	Chordata
8	Chlorophthalmidae	Aulopiformes	Actinopterygii	Chordata
9	Rhinochordidae	Batoidea	Elaenobranchii	Chordata
10	Hemiramphidae	Batoidea	Actinopterygii	Chordata
11	Belontiidae	Belontiiformes	Actinopterygii	Chordata
12	Holocentridae	Beryoniformes	Actinopterygii	Chordata
13	Bucconidae	Bucconiformes	Gastropoda	Mollusca
14	Muraenidae	Bucconiformes	Gastropoda	Mollusca
15	Scorpaenidae	Carchariaformes	Elaenobranchii	Chordata
16	Trachidae	Carchariaformes	Elaenobranchii	Chordata
17	Hemipodidae	Carchariaformes	Elaenobranchii	Chordata
18	Carchariaformes	Carchariaformes	Elaenobranchii	Chordata
19	Potamidae	Certhiidae	Gastropoda	Mollusca
20	Pachychelidae	Certhiidae	Gastropoda	Mollusca

Figure 9 : Sample screen view of the taxonomy information of the fishes included in the database

#### IV. DATABASE STATISTIC

This option provides the quantitative information about the database such as number of records, number of species, number of families and information about the threatened status of fishes. In a nut shell, it provides the quantitative summary of the database.

##### A. User registration and login

To provide the fetch database to the authenticated users a registration link has been created in the Home page that open a form and allows the user to fill in the personal information along with user name and password. The submission of information provided by the user in the registration form send an email to the user communicating the successful registration with user name and password fill in by the user. After getting the successful registration message the user can work with database by logging with user name and password.

##### B. Feedback

The feedback option opens a web page that permits the authenticated member to provide the feedback related to content and operation of the database. This section has been created to improve the database based on the feedback provided by the users.

##### C. Discussion

Biodiversity being under threat has become the major issue and Convention on Biological Diversity (CBD) tackles the conservation and other aspects of biodiversity of earth planet. It has been seen that all over the world, the aquatic environments are experiencing various threats due to which ichthyofauna of the aquatic environments has adversely been affected. The effect has created massive loss to ichthyofaunal resources, which is one of the prime base of human life. There is a global concern to know about the biological resources and their status. In view of the significance of ichthyofaunal resource. In order to promote and efficiently carry out the strategies and plans for securing intellectual property rights (IPRs) related issues for these bio- resources; it is essential to have the information in the form of species -specific database. The user friendly web application of the database is species specific web database and provides useful information about the threatened fishes from three phylum. This information can be used by the conservationists to plan and implement the appropriate conservation measures to save and increase the population of threatened species. Though there are several biological databases on fishes provide different type of information, this database is a subset of these databases exclusively made for threatened fishes reported from Indian subcontinent. Because of the time constraint many fishes of other groups could not be covered. The database much unique in its way of providing the information as it provides quantitative and qualitative information both, what the other databases hardly disseminate. Further the web application of the database secures the database from the unauthenticated users.

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