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Web GIS Enabled Faunal Information System (WGFIS) for Monitoring and Analysis of Species Zoo-Geographic Distribution

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Abstract Animals have distribution in both space and time. A given species occupies a certain geographical range, which may also vary as a function of time, climatic conditions (biotic and abiotic factors) e.g. migratory species of some birds, Monarch Butterflies, Mountain gorilla and whales are some of the animal species that show migration. At present, there is tremendous anthropogenic pressure on various animal species. Therefore, it may be beneficial to know their distribution in space and if possible, to know relational aspect with biotic and abiotic factors. At a time, when only a small percentage (<10 %) of the world's species are known, it is very important to have their GIS mapping to know distributional status of various species belonging to different faunal groups in their entire area of distribution. The proposed system WGFIS aims to offer solution to overcome the issues and will be very useful for monitoring and analysis of Species Zoo-Geographic Distribution. WGFIS will have spatial database of several species in three groups of animals, which will be linked to the requisite attributes for visualization and analysis. WGFIS will have the facility to upload the geo-tagged pictures of the various species to display the actual location on the ground and help in planning, decision making on various conservation measures through objective analysis.

Keywords *Web-GIS; Faunal Species; Zoo-Geographic; Mapping*

1. Introduction

Animals have distribution in space and time. A given species occupies a certain geographical range which may also vary as a function of time, climatic conditions (biotic and abiotic factors) e.g. migratory species such as some of the birds, Monarch Butterflies, Mountain gorilla and whales [1, 2, 3, 4] are some of the animal's species that show migration. These days, there is tremendous anthropogenic pressure on various animal species. Therefore, it may be beneficial to know their distribution in space and if possible, also to know relational aspect with biotic and abiotic factors.

Various new species have been found in parts of Maharashtra, Goa and Karnataka as well as in other parts of country. At a time when only a small percentage (<10 %) of the world's species are known, it is important to have their GIS mapping to know distributional status of various species belonging to different faunal groups in their entire area of distribution. Therefore, it is aimed to create a GIS database of various faunal groups.

2. Aim and Objectives

Main aim of developing the Web GIS enabled Faunal Information System (WGFIS) is to create various types of GIS maps of some species groups such as insecta, invertebrata and vertebrata. Objectives of WGFIS are to monitor and analyze various species, their zoo-geographic distribution such as insecta, invertebrata and vertebrata with layers of anthropogenic and biotic factors to know the species distribution and effect of various factors on species zoogeographic distribution. The proposed system WGFIS will help decision makers and end users with an instant access to spatial and attribute information, query and analysis of distribution of various species zoogeographic distribution over web. Also, WGFIS will take care of:

1) To know differences among various species and taxonomic groups (such as genus, family, sub-family) in their distribution as well as in relationship with some of the biotic, abiotic and anthropogenic factors to throw light on their adaptations.
2) To suggest possible conservation measures for the species.

3. Relevance of the Proposed Web GIS Based Faunal Information System

GIS offers a systematic way for query, monitoring, analysis and display of zoo-geographic distribution of various faunal species. The system will have spatial database of several species in above three groups of animals [5, 6, 7]. This will be linked to all the requisite attributes for interactive visualization and analysis. The system will have the facility to upload the geo-tagged pictures of the various species in the map to display the actual location on the ground. The web system would also help in planning, decision making on various conservation measures through objective analysis. Important features of the proposed system are listed below

- It will facilitate extracting information based on species/animal groups and their distributional data in entire range of zoo-geographic distribution. The system can help researchers/planners to get consolidated information of various faunal species.
- Single System providing comprehensive information about faunal species of Maharashtra, Goa & Karnataka.
- Unique Codes will be designed for faunal species (existing & undiscovered)

4. Methodology

4.1. Spatial and Attribute Data Collection and Updation

Spatial and attribute data of faunal species will be collected & created in digital form. Following activities will be performed to make this data compatible with the new application.

4.2. Spatial Data

- Collection & creation of Faunal data in GIS form (e.g *.shp) [8, 9, 10, 13, 14]
- Review of spatial features for updation
- Verification & Correction of data

4.3. Attribute Data

- Review of all attribute fields and information
- Bringing data into uniform format
- New attributes for new species

4.4. Development of Web GIS Enabled Faunal Information System

System study includes preparation of System Requirement Specifications (SRS). The purpose of this Software Requirements Specifications (SRS) is to provide a detailed description of the requirements for the Web-GIS based Faunal Information System (WGFIS). This SRS will allow a complete understanding of what is to be expected of the Web-GIS tool. The clear understanding of the Web-GIS tool and its' functionality will allow for the effective software to be developed for the end users and will be used for the development of the future stages of the project. This SRS will provide the foundation for the project. From this SRS, the Web-GIS tool can be designed, constructed, and finally tested.

4.5. Development of Web GIS-Based Application

An interactive Web GIS-enabled Faunal Information System (WGFIS) [11, 12] would be developed as per the SRS. The proposed system will maintain entire information about various faunal species. The system will allow users to create new data, update existing data, generate queries, analysis, map visualization, report generation, etc. The system will have following functionalities:

- Provide a GIS data visualization tool
- Provide tools to spatially edit, create, split, merge, and delete the data as per the requirement.
- Link the attribute information to spatial information
- Editing of attribute data functionality would enable the changes made at attribute level to automatically get reflected at spatial level
- Identify/Locate the faunal species & their distribution
- User management with appropriate roles, hierarchy, authentication
- Query building tool with inputs identified as per the end user
- Query driven spatial and tabular reports
- Access to field level staff with proper authentication, to edit the spatial information, update tabular information, download/upload tabular information.

Apart from this, the attribute data, in the form of taxonomic group (e.g. family, sub-family, genus, sub-genus) etc. can be dynamically linked with the spatial data which enables statistical/intelligent query based analysis of the different species. This would induce efficiency and accuracy in monitoring, analysis of the Species & their zoo-geographic distribution. The proposed system will help the end user in possessing a valuable digital database (both spatial and non-spatial) for the entire region of Maharashtra, Goa and Karnataka.

5. Thematic Layers

Following GIS layers are required for the proposed WGFIS (Table 1)

Table 1: *Thematic Layers*

Map Layers	Type
State Boundary	Polygon
District Boundary	Polygon
Block / Tehsil Boundary	Polygon
Forest area Boundary	Polygon
Water body	Polygon
NH, SH, District Road	Line
Drainage	Line
Distribution of Faunal Species	Point
Village	Point

Survey of India (SOI) toposheet at scale of 1:50,000 will be used to create above mentioned layers, while data for faunal species will be created from literature published for the several species in the mentioned three groups of animals. Apart from these, information on various animal groups of a particular geographic region will be also created. Wherever, geographical coordinates are not available with distributional information such as village, taluka, district name, date of collection, number of samples collected, animal gender, which will be obtained from secondary sources of information.

6. Conclusion

The proposed system WGFIS will help researchers, end users across the scientific community to analyze, visualize the zoo-geographic distribution of species such as insecta, invertebrata and vertebrata with layers of anthropogenic and biotic factors. It will also help to study geographically referenced data independently or overlaid and analyzed through multi-criteria analysis. Various spatial data layers can be faunal species, administrative boundaries, village points, species geographic distribution etc. Hence, it is evident that modern tools like GIS technology can be effectively used in studying the various faunal species & their pattern of zoo-geographic distribution.

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