

Seminar on
Environmental Application of GIS & Remote Sensing



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**Venue : Institute of Chemical Engineers' Auditorium
Dr. H. L. Roy Building, Jadavpur University
Kolkata - 700 032**

Joint Organiser :

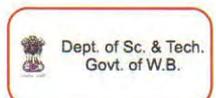
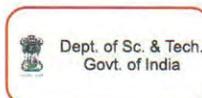


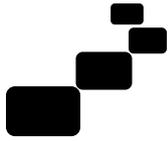
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Biodiversity in West Bengal & Demography: A GIS Study

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Introduction

Biological diversity is that immense variety and richness of living forms on this planet, which is undoubtedly declining at an undesirable pace with no chance of replenishment. Human-induced changes on the global environment have triggered the extinction of many life forms resulting into widespread alterations in the distribution of organisms all over the world.

There is a need to assess the magnitude and trend of loss in biodiversity on earth. But before that, it is most important to know the current status of biodiversity at national as well as regional level. It is also necessary to support our managers, planners and policy makers with baseline information so that they can identify the current weaknesses and utilise the knowledge and value of biodiversity in designing the future of mankind. This is an attempt in that direction representing the biodiversity of an Indian state with a demographic approach. However, human component is a great determinant while applying the knowledge of biodiversity to the management of biological resources (Nandy *et al.*, 2000; Alfred *et al.*, 2001; Sarkar, 2003; Kumar, 2003).

Considering the importance of GIS application in analysis of biodiversity, the data pertaining to flora and fauna so far generated from various studies in West Bengal – an Indian state with varied

ecosystems have been analysed with some demographic parameters.

Study Area

The database prepared during this study is the result of an extensive effort of survey over the years by several scientists covering the different terrestrial and aquatic habitats in West Bengal. It is the only state in India that touches the Himalaya in the North and shorelines on the south. The study area also includes 5 National Parks, 15 Wildlife Sanctuaries, 2 Tiger Reserves, 1 Biosphere Reserve and 1 Elephant Reserve located in different parts of the state having natural assemblage of diverse life forms. It was an uphill task to cover each and every part of this landscape of 88,752 sq. km. have a human population of nearly 8.5 crores. Efforts were made to prepare a baseline data from all the 17 districts (now it is considered 19). All terrestrial parts starting from the alluvial Gangetic plain, Northwestern plateau region, coastal plain and up to the Himalayan mountain region and foothills were considered while assessing the occurrence and distribution of various plants and animals. The aquatic systems considered for the study includes both freshwater and marine habitats encompassing riverine, swampy and estuarine habitats.

Methodology

The methodology adopted in order to fulfill the objective commenced with an analysis of the collected available information. Information were collected extensively from various surveys, records from different published and unpublished sources, national collections of Zoological and Botanical Survey of India; and survey trips were undertaken in different protected areas of the state (Ghosh, 1992-2001). At first a detailed and systematic data pool was created with baseline data for easy access to computer analysis. It was further processed in a representable way into a smaller database. Non-spatial characteristics (attribute data / textual data) were managed and accessed through a database management system, which was designed and developed in *MS-Access*. The studies involved parameters and variables, which are dependent on each other spatially and at the same time non-spatially. GIS allows the analysis of biodiversity parameters like species richness, species composition and few demography related parameters like population, forestry, agricultural land use, etc. in spatial and non-spatial form in a common denominator. A taluk level map (1990) of Survey of India (*ESRI ArcInfo e00* format) at 1:250,000 scale was taken as the base map which was imported in *ESRI ArcView* and converted into *ESRI shape* file. District level map was created in *ArcView* by summarizing the taluk level map. This spatial data, characterized by information about position are connected with other features and details of non-spatial characteristics using *ArcView* (Sarkar, 2003). An open database connectivity (ODBC) was maintained, so that the link between the database of *MS-Access* and *ESRI shape*, and continuous updation, analyses and

accessing the data spatially and at the same time non-spatially is possible. Though the entire project has been developed using *ArcView* and *MS-Access*, but it can be easily exported and analysed in any other desktop GIS software.

Results & Discussion

Maintaining the highest number of species without considering their taxonomic position makes little sense in terms of biodiversity. For example 80% of the total species on earth occur in terrestrial ecosystems mainly because vascular plants and insects are so numerous on land accounting for 72% of all described species in the world. But the sea contains greater proportion of higher taxonomic units. Marine ecosystems contain representatives of 34 phyla while terrestrial environments are home to only 28 phyla.

Total species richness of the state is 14,726 that represent 10.98% of 1,34,045 species of flora and fauna recorded so far from India. The diverse ecosystems in the state contain 10,033 faunal species (11.21%) out of 89,451 in India (Alfred *et al.*, 1998). The floral diversity also comprises 4,613 species (10.34%) out of a total 44,594 in India. A total of 80 species of bacteria have also been recorded from the state. Among the faunal groups, Arthropoda shows highest species richness (6,222), whereas Dicotyledons figure with highest species count (1,994) in flora. All these interpretations are based on the information recorded so far from the state, though the database is being gradually built up and will be updated accordingly.

In terms of faunal diversity (Fig. 1) Medinipur district tops the list with representations of 18

major and minor phyla among the total 19 phyla recorded so far from the state. South 24 Parganas also have a diversity level nearest Medinipur district with the occurrence of 16 phyla. However diversity is much less in Murshidabad and Puruliya with representation of only 8 phyla in each of these districts. If the species richness is considered, Darjiling district comes first with 4166 species of which 3166 species are of Arthropods and Kolkata shares the next position with 2456 species that also includes 1396 Arthropod species.

Besides the Arthropods, Protozoa (969) and Birds (649) are the next major groups in the state fauna. Among the vertebrates, fishes (564) are the largest group next to birds. It is closely related with the quality and span of aquatic systems all over the state. It has often been observed in the recent past that unscientific and exploitative aquaculture, encroachment and contamination of water bodies have damaged the ecosystems in

many parts of the state. The long-term effect of this damage will result into a certain decline in fish diversity.

There is direct interaction and even conflict with both the major and minor animal groups in different parts all over the state in which a sq. km. area is occupied by 904 human individuals. Conserving those faunal elements occurring outside the protected areas matters more because they are equally valuable in maintaining the biodiversity in totality. Human population density in different districts of the state shows a negative correlation ($r = - 0.226$) with the species richness comprising flora and fauna together (Fig.2). It has been noticed that there is a positive correlation ($r = 0.242$) between total forest cover and faunal richness in the districts (Fig. 3). It is also true that agricultural land shares a major part of total land area of the state, which obviously influences the distribution of fauna.

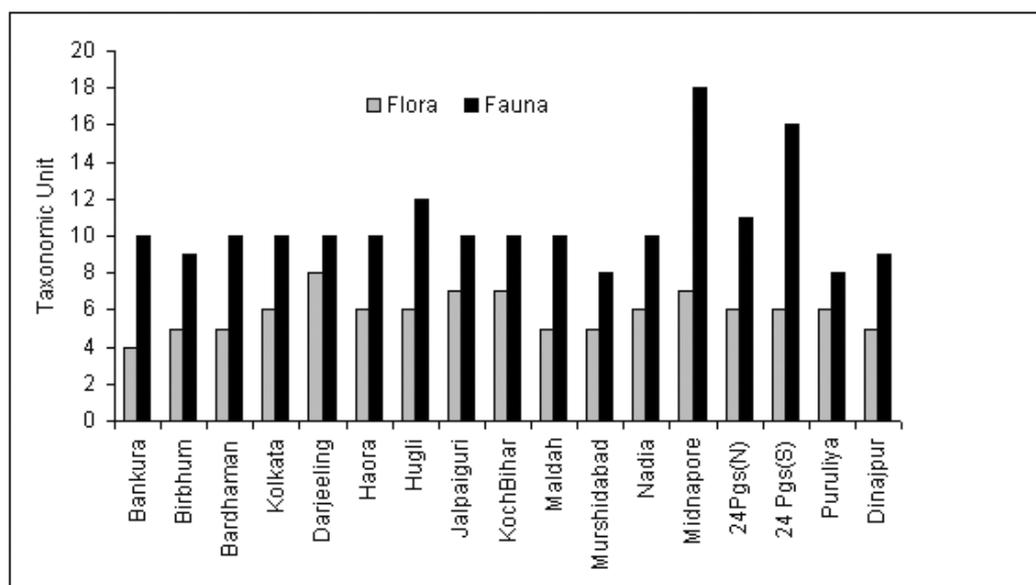


Fig. 1: Diversity level of fauna and flora in different districts of West Bengal

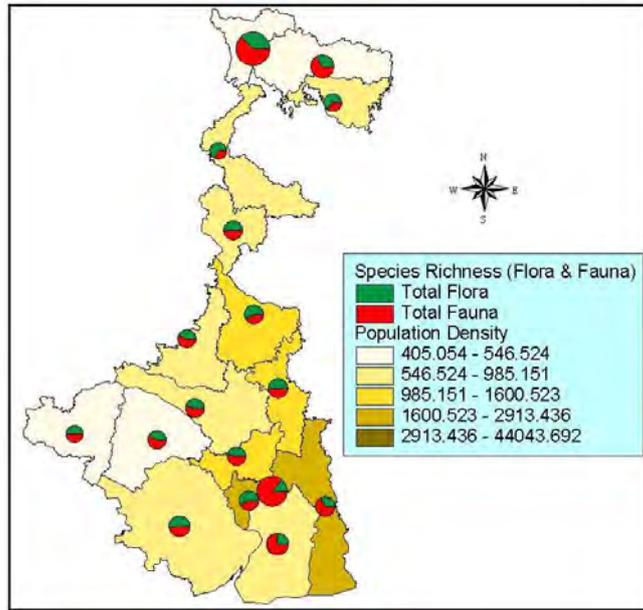


Fig. 2: Human population density (per sq.km) and species richness (flora & fauna) in West Bengal

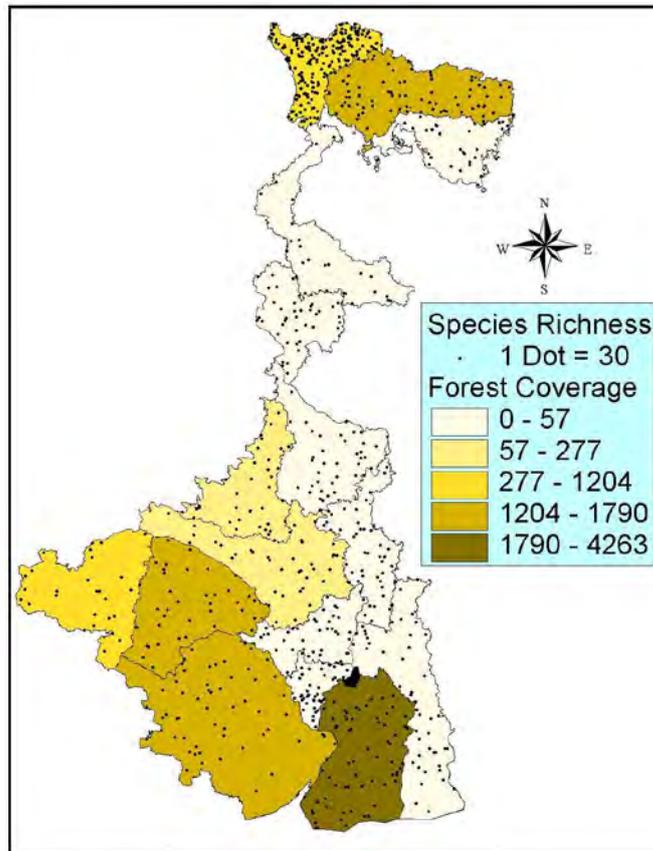


Fig. 3: Status of forest cover (sq. km) and species richness (flora & fauna) in West Bengal

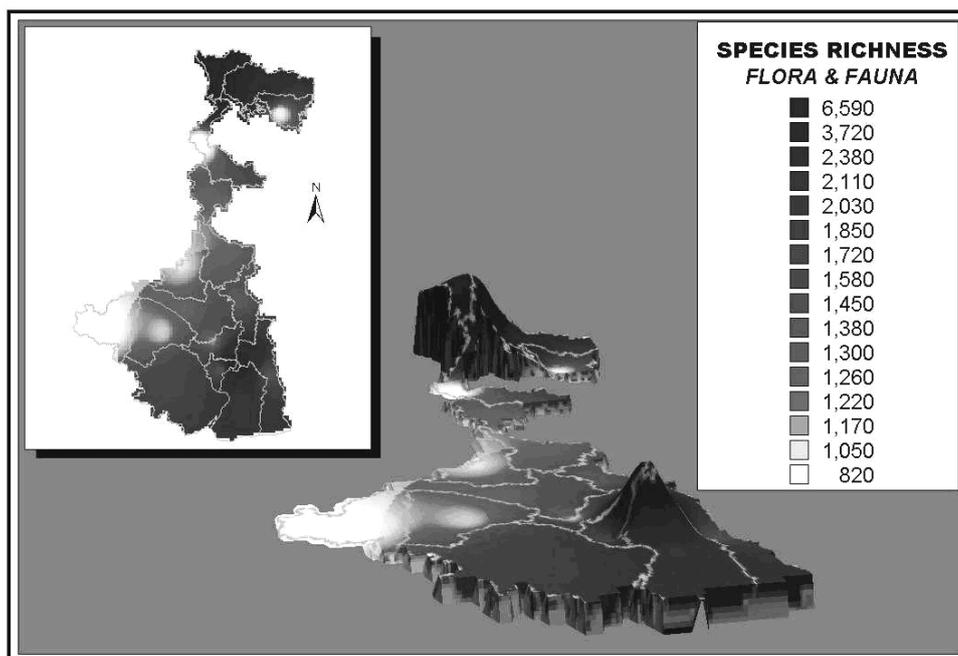


Fig. 4: Grid-wise concentration of species richness in different parts of West Bengal

Floral assemblage is highest in Darjiling district (2439) with respect to species number as well as in diversity level (Fig. 1). Medinipur, Jalpaiguri and Koch Bihar also have higher representations in terms of taxonomic units. Floral richness and total forest cover (Anonymous, 2002) have a positive correlation ($r = 0.109$). Algae and fungi groups are well represented throughout the state having 873 and 539 species respectively.

The present study reflects a diverse fauna in the lower Gangetic plains with highest richness in the hill and foothill regions, whereas the flora so far recorded are rich as well as diverse in the region of Darjiling, Jalpaiguri and Koch Bihar and to some extent in coastal zone and lower Gangetic Plains (Fig. 4).

The faunal and floral species richness shows a positive correlation ($r = 0.677$).

Conclusion

The present status of biological diversity in the State of West Bengal reflects a greater concentration of various species in areas of lower human population density and agricultural land-use. It seems from the data that species richness is highest in two major zones of North and South Bengal. But both these concentration zones have a moderate density of human population and land-use for agricultural purpose. Vegetation clearly shows the highest diversity level and species richness in Darjeeling district, where human population density is much lower besides the two districts (Puruliya and Bankura) with lowest population densities recorded in the state. Intensive study on the biological diversity of these two districts will properly explain the reasons for less faunal and floral richness. Faunal diversity is much higher in Medinipur and South 24 Parganas, where population density is lower compared to

many other parts of the state. Though having the highest population density, Kolkata shares a very rich assemblage of various species due to similarity and suitability of habitat like the above two districts.

In conclusion it may be inferred that the floral and faunal diversity of the state show a direct correlation to anthropogenic effect. Some species including 7 mammals could not be recorded in last 10-15 years in the state, and this is probably due to the reason that their original habitats have been degraded.

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