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ASSESSMENT OF MANGROVE DIVERSITY IN SUNDERBAN TIGER RESERVE, INDIA

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Sunderban is the second largest Biosphere Reserve in India to conserve the coastal mangrove ecosystems including many rare, threatened and endangered plant species. This biosphere reserve falls under the Indo-Malayan Realm, Province No. 4.3.1., covering a total area of about 9,630 sq km, of which an area of 2,585.10 sq km was designated as Sunderban Tiger Reserve. The Sunderban Tiger Reserve in India lies within the jurisdiction of the districts North & South 24-Parganas in West Bengal, covering 16 blocks and 71 compartments. The Sunderban Tiger Reserve is bounded in the east by international boundary of Bangladesh formed by the rivers Harinbhanga, Raimangal and Kalindi, Matla in the west and Bay of Bengal in the south. Sunderbans, in the coastal area of West Bengal is well known for having its interesting and extensive highest bio-diversity of mangrove habitat flora and fauna. Lots of studies have been conducted on the Sunderban Tiger Reserve, but these are mainly focused on the tiger habitat, tiger-human conflict and management systems. The whole ecosystem complex of Sunderban Tiger Reserve with a mosaic of vegetational entities, natural habitats and land cover types harbour a unique and rich bio-diversity of both flora and fauna. This ecosystem is so fragile that any interference may lead to extinction of various components and also the ecosystem as a whole. As such, it is felt very much necessary to reassess and describe the mangroves of the Indian Sunderbans, especially the Tiger Reserve in the light of the present scenario.

In view of the above, the present aims to study the floristic diversity, composition, and distribution pattern along with phyto-sociological parameters of mangrove communities growing inside the Sunderban Tiger Reserve. It is hoped that these data will be useful in conservation and management planning.

MATERIALS & METHODS

The study has been undertaken in all the 15 blocks of Sunderban Tiger Reserve by means of random sampling to give most representative composition of the forest. Size of quadrat has been determined on the basis of 'Species Area Curve' method (Oosting, 1956) and is 10 × 10 sq m. Phyto-sociological studies have been carried out in accordance with the standard methods by Misra (1968).

RESULTS & DISCUSSION

Within the study area, a total of 5,804 mangrove and mangrove associate plants have been recorded, which are belonging to 16 families, 20 genera and 30 species. The most dominant family is Rhizophoraceae with 8 species, of which *Ceriops decandra* shows highest frequency (73%) and *Ceriops tagal* shows the lowest frequency (9%) within the Tiger Reserve **Fig. 1**. The phyto-socio-logical parameters like density, abundance, percentage frequency and their spatial distribution pattern as obtained from quadrate analysis have been highlighted in **Table 1.** All the species obtained from the study are further classified into different frequency classes according to Raunkier's Classification.

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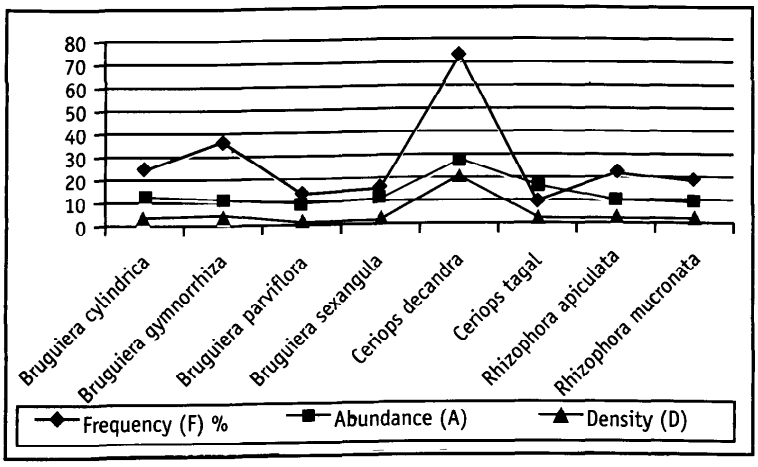


Fig. 1. Frequency, Abundance and Density of the members of Rhizophoraceae in the Sunderban Tiger Reserve

i) Density : In the Sunderban Tiger Reserve, *Ceriops decdandra* shows highest density (20.05 individuals/sq m) followed by *Avicennia alba* (12.89 individuals/sq m) and *Excoecaria agallocha* (12.75 individuals/sq m). Interestingly, the mangrove associates like *Brownlowia tersa, Clerodendrum inerme,* and *Derris scandens* show very low densities (0.31, 0.18, 0.82 individuals/ sq m) in comparison to other mangrove species. Since density indicates the numerical strength of plants in a community and implies the number of plants per unit area, increase in density is usually reflected in poor growth. As such, *Ceriops decandra* with highest density is also found to grow with a very poor and usually stunted growth pattern.

ii) Abundance : The plant, *Suaeda nudiflora,* shows a very high abundance (95) in comparison to other species. But interestingly this mangrove associate shows very low density (3.45 individuals/sq m) and low frequency percentage (4). Whereas, *Brownlowia tersa* is the least abundant (5.67) species in the Sunderban Tiger Reserve.

iii) Frequency Percentage : Raunkier's Law of frequency class is A>B>C> / = / <D<E. In general, higher the class E, greater will be the homogeneity. But it is evident from Table 1 that the frequency distribution in case of mangroves present in Sunderban Tiger Reserve shows the tendency of A>B>C>D>E. Only one species, *Excoecaria agallocha* falls under frequency class-E (89%), followed by *Ceriops decandra* (73%) and *Avicennia alba* (65 %) in the class-D. Therefore, the mangrove stands studied inside the Sunderban Tiger Reserve are relatively heterogeneous. The two endangered mangrove plants, *Heritiera fomes* and *Nypa fruticans* (Guha Bakshi & Naskar, 1991, Naskar & al.1997) also show relatively low frequency percentage (9.0).

Raunkier's Frequency Classes:

Class A = 1-20 %; **Class B** = 21-40 %; **Class C** = 41-60 %; **Class D** = 61-80 %; **Class E** = 81-100 %.

iv) Distribution Pattern : Analysis of distribution pattern of individual species in terms of abundance/ frequency ratio reveals that 17 species show regular or random distribution and 13 species show contagious distribution, indicating their increasing aggregation.

Thus, the study reflects that the vegetation inside the Sunderban Tiger Reserve is a mixed one, containing trees, shrubs, herbs and climbers and is mainly characterized by *Excoecaria – Ceriops – Avicennia* dominated community. *Heritiera fomes,* one of the threatened plant species of Sunderbans is found to grow in the wild condition only in Chamta and Arbesi Blocks. Its absence in other blocks of Sunderban Tiger Reserve surely suggests some biotic, abiotic or ecological stress on their population. The mangrove palm, *Nypa fruticans* is found in discrete patches along the small creeks of the Tiger Reserve, generally in association with *Excoecaria agallocha* and *Phoenix paludosa.*

Based on the above study, it can be stated that conservation priorities should be focused on the forests of Sunderban Tiger Reserve, especially on plants like *Heritiera fomes* and *Nypa fruticans* which are found in wild condition only inside the Tiger Reserve. In view of the above, a through analysis of different ecological

Table 1. Results of Quadrate Studies conducted in the Sunderban Tiger Reserve, India

Name of the Species	Density (D)	Abundance (A)	Frequency (F)%	Frequency Class	Spatial Distribution Pattern
Acanthus ilicifolius L.	2.60	14.30	18	A	Regular
Acanthus volubilis Wall.	1.73	23.75	7	A	Contagious
Acacia auriculiformis A. Cunn. ex Benth.	0.27	7.50	4	A	Contagious
Acrostichum aureum L.	1.07	14.75	7	A	Contagious
Aegialites rotundifolia Roxb.	3.85	15.14	25	B	Regular
Aegiceras corniculatum (L.) Blanco	3.64	13.33	27	B	Regular
Avicennia alba Blume	12.89	19.69	65	D	Regular
Avicennia marina (Forssk.) Vierh.	2.27	12.50	18	A	Regular
Avicennia officinalis L.	6.49	13.73	47	C	Regular
Brownlowia tersa (L.) Kosterm.	0.31	5.67	5	A	Contagious
Bruguiera cylindrica (L.) Blume	2.84	12.0	24	B	Regular
Bruguiera gymnorrhiza (L.) Lam.	3.80	10.45	36	B	Regular
Bruguiera parviflora (Roxb.) W. & A. ex Griff.	1.05	8.29	13	A	Regular
Bruguiera sexangula (Lour.) Poir.	1.53	10.50	15	A	Regular
Ceriops decandra (Griff.) Ding Hou	20.05	27.57	73	D	Regular
Ceriops tagal (Perr.) C.B. Rob.	1.45	16.0	9	A	Contagious
Clerodendrum inerme (L.) Gaertn.	0.18	10.0	2	A	Contagious
Derris trifoliata Lour.	1.04	14.25	7	A	Contagious
Derris scandens Benth.	0.82	11.25	7	A	Contagious
Excoecaria agallocha L.	12.75	14.31	89	E	Regular
Heritiera fomes Buch.-Ham.	1.53	16.80	9	A	Contagious
Nypa fruticans Wurmb.	1.40	15.40	9	A	Contagious
Phoenix paludosa Roxb.	5.25	14.45	36	B	Regular
Rhizophora apiculata Blume	2.07	9.50	22	B	Regular
Rhizophora mucronata Lam.	1.56	8.60	18	A	Regular
Sarcolobus carinatus Wall.	1.82	16.67	11	A	Contagious
Sonneratia apetala Buch.- Ham.	1.51	13.83	11	A	Contagious
Suaeda nudiflora Roxb.	3.45	95	4	A	Contagious
Xylocarpus granatum Koenig	2.18	9.23	24	B	Regular
Xylocarpus mekongensis (Lam.) Roem.	4.11	9.83	42	C	Regular

parameters associated with mangrove growth pattern need to be given more emphasis. In Sunderbans various afforestation programs have been undertaken since 1989 to retain and increase the biodiversity of the area. Local communities of this area need more awareness and involvement in the Forest Protection Programs and thus will help to promote overall biodiversity conservation efforts in the Sunderban Tiger Reserve, as well as in the entire Sunderbans.

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