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ORIGINAL ARTICLE

STUDIES ON MANGROVE DIVERSITY IN CORRELATION WITH SOIL SAMPLES OF SAJINAKHALI WILDLIFE SANCTUARY, WEST BENGAL

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ABSTRACT

The present study aims to make a quantitative study of the mangrove diversity along with soil quality analysis of Sajinakhali Wildlife Sanctuary inside the Sundarban Biosphere Reserve. Total 28 plant species belonging to 19 genera under 15 families were found. The most dominant family is Rhizophoraceae and the most dominant species is *Ceriops decandra* showing highest frequency, abundance and density. The soil is mainly sandy-loam in nature. The soil pH values are in the alkaline range and vary from 7.3 to 7.6. This alkaline nature is due to high salt content of the soil. The differences between pH values of the soils are not very prominent. Soil salinity inside Sajinakhali ranges from 2.4 ppt. to 2.6 ppt.
Keywords: Mangrove, wildlife sanctuary, salinity, biosphere reserve.

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INTRODUCTION

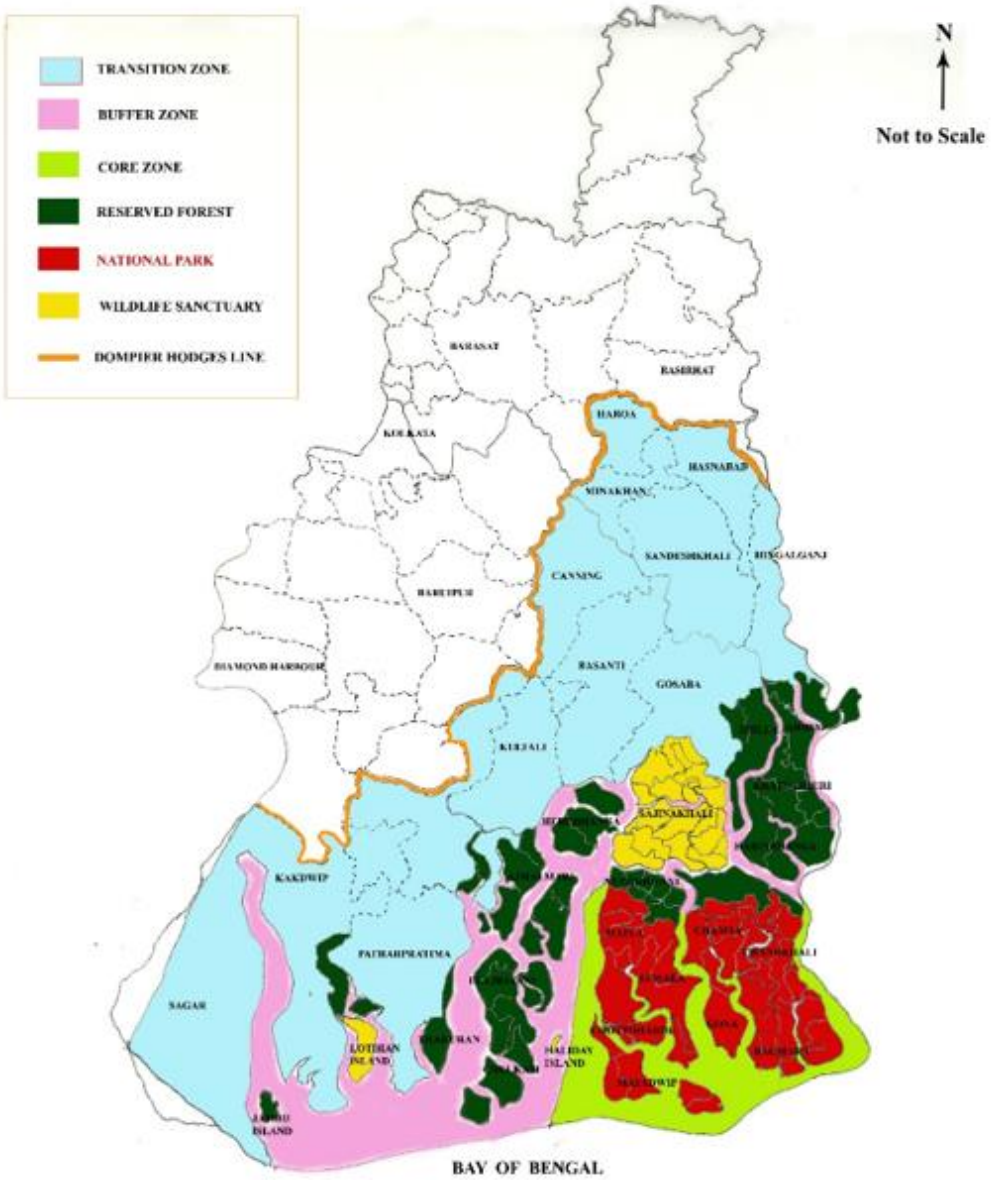
Mangroves are ecosystem of hope, bridging land, freshwater and sea. These ecosystems are an important indicator of biodiversity health, and critical for climate mitigation and adaptation. This unique mangrove forest ecosystem, situated at the interface between land and sea, supports genetically diverse groups of aquatic and terrestrial flora and fauna. Mangroves are distributed in about 112 countries of the world in the tropical and subtropical zones, covering a total area of about 18 million hectares.

In India, the mangroves are mainly restricted to the East and West coasts and in Andaman and Nicobar Islands. The total mangrove area in India is reported as 6,756 sq. km. Out of which 5,890 sq. km. is in the east coast and 866.25 sq. km. in the West coast (Anonymous,1987). Sundarbans in India, alone covers about 62% mangrove area of the East coast. Indian Sundarbans was declared as a Biosphere Reserve in the year 1989.

Sundarban Biosphere Reserve in India covers an area of about 9,630 sq. km. including 3 Wildlife Sanctuaries- Sajinakhali, Lothian Island and Haliday Island. Out of these three, Sajinakhali is the largest wildlife Sanctuary in Sundarbans, covering an area of 362.80 sq. km. It was notified as a Wildlife Sanctuary in 1976.

Geography of Sajinakhali

Sajinakhali Wildlife Sanctuary is situated at the confluence of Matla and Gumdi rivers within the buffer zone. It is located inside the Sundarban Tiger Reserve between 22º00′ to 22º12′ N latitudes and 88º38′ to 88º49′ E longitudes. It consists of 12 compartments of two forest blocks Pirkhali (7 blocks) and Panchmukhani (5 blocks) of Sundarban Tiger Reserve (Map 1).



MAP 1 - SUNDARBAN BIOSPHERE RESERVE (PRESENT AREA WITHIN NORTH AND SOUTH 24-PARGANAS) IN WEST BENGAL, INDIA

MATERIALS AND METHODS

The survey was conducted only in the mangrove forests, not in the reclaimed lands. A detailed survey was undertaken in all the 12 compartments under Sajinakhali Wildlife Sanctuary. Quantitative study was undertaken by quadrate method (Misra, 1968) to find out frequency, abundance and density of individual plant species. Size of quadrate sampled was determined by "Species Area Curve" method (Oosting, 1958). 10 x 10 m quadrates were laid down randomly at accessible areas in selected zones of the forest floor and the phyto-sociological data were tabulated in the field. Plant species from each forest block were grouped in to different percentage frequency classes (Raunkiaer ,1934).

Soil quality analyses

The soil samples were collected following standard methodology (Jackson, 1973). Samples were mainly collected from the spots of quadrate studies to find out correlation between species composition and soil parameters.

Profile pits were excavated till 60 cm depth in the forest floor to reveal the principal features affecting plant growth. But this depth could not be followed in some tiger prone inaccessible areas inside the Sundarbans Tiger Reserve. In such cases, the surface soil of up to 12 cm depth was removed and then samples were collected. Same volume of soil was collected from each profile pit, thoroughly mixed and brought to the laboratory for further analysis. At least 2 replicates were sampled to ensure a more uniform result.

The collected soil samples were air dried in the laboratory. It was then grinded with the help of wooden mortar and passed through 2 mm and 80 mm mesh. The collected samples were then subjected to chemical analysis.

Determination of texture

I. A weighed quantity of air-dry soil equivalent to 100 gm oven dry soil was taken in a 500 ml. beaker.
II. About 200 ml. water and 15 ml. 0.5 (N) sodium oxalate were added to it. The mixture was stirred thoroughly till uniform dispersion was obtained.
III. After about 20 minutes of stirring, the mixture was washed into a sedimentation cylinder and the suspension was diluted to 1 litre using distilled water.
IV. The suspension was stirred thoroughly.
V. A buoyaceous hydrometer was placed inside the sedimentation cylinder.
VI. The time of commencement of sedimentation was noted.
VII. The percentage of silt and clay in suspension was determinedly noting the hydrometer reading after 5 minutes of the commencement of sedimentation.
VIII. The percentage of clay was determined from hydrometer reading taken 5 minutes after sedimentation.
IX. When the temperature of suspension differs from the initial one (x^o C), corrections were made to the scale reading by adding 0.3 units for per degree above x^o C or subtracting the same amount for each degree below x^o C.

Determination of pH:

I. Soil suspension was prepared in 1:2 ratio using distilled water.
II. The suspension was stirred thoroughly using a glass rod and put in a shaker for 5 minutes.
III. Then the suspension was poured in a conical flask and kept in a stable condition for 20 minutes.
IV. Then the suspension passed through Whatman No. 42 filter paper and the filtrate was collected.
V. pH of the filtrate was determined with an electrically operated pH meter.

Determination of salinity

I. Soil suspension was prepared in 1:5 ratio using distilled water.
II. The suspension was stirred thoroughly using a glass rod and put in a shaker for 5 minutes.
III. Then the suspension was poured in a conical flask and kept in a stable condition for 20 minutes.
IV. Then the suspension passed through Whatman No. 42 filter paper and the filtrate was collected.
V. Salinity of the filtrate was determined using a hand refractometer.

RESULTS AND DISCUSSION

The study has been conducted in two phases- quantitative study of mangrove diversity and qualitative study of soils. The findings of quantitative quadrate analysis are presented in the table 1 below. In this table, average data of the different quadrate sampling in the 12 blocks under Sajinakhali Wildlife Sanctuary has been presented in Table 1.

Table 1: Quantitative structure of mangroves present in Sajinakhali

Sl. No.	Name of plant species	Total number of individuals of each species	Total no. of quadrat of occurrence	Total no. of quadrat studied	Frequency (%)	Abundance	Density	A/F Ratio
1.	*Acanthus ilicifolius*	144	10	22	45	14.4	6.5	0.32
2.	*Acrostichum aureum*	25	4	22	18	6.25	1.14	0.35
3.	*Aegialitis rotundifolia*	86	9	22	41	9.55	3.9	0.23
4.	*Aegiceras corniculatum*	133	7	22	32	19.0	6.04	0.59
5.	*Avicennia alba*	206	12	22	55	17.17	9.36	0.31

6.	*Avicennia marina*	94	6	22	27	15.66	4.27	0.58
7.	*Avicennia officinalis*	242	17	22	77	14.23	11	0.18
8.	*Bruguiera gymnorrhiza*	37	4	22	18	9.25	1.68	0.51
9.	*Bruguiera parviflora*	39	3	22	14	13.0	1.77	0.93
10.	*Bruguiera sexangula*	48	6	22	27	8.0	2.18	0.3
11.	*Ceriops decandra*	417	20	22	91	20.85	18.95	0.23
12.	*Ceriops tagal*	30	3	22	14	10.0	1.36	0.71
13.	*Clerodendrum inerme*	45	5	22	23	9.0	2.04	0.39
14.	*Derris trifoliata*	25	4	22	18	6.25	1.14	0.35
15.	*Derris scandens*	37	6	22	27	6.16	1.68	0.23
16.	*Excoecaria agallocha*	143	13	22	59	11.0	6.5	0.19
17.	*Kandelia candel*	36	5	22	23	7.2	1.63	0.31
18.	*Nypa fruticans*	14	3	22	14	4.66	0.63	0.33
19.	*Phoenix paludosa*	87	7	22	32	12.42	3.95	0.39
20.	*Rhizophora apiculata*	41	4	22	18	10.25	1.86	0.57
21.	*Rhizophora mucronata*	25	3	22	14	8.33	1.14	0.6
22.	*Sarcolobus globosus*	46	4	22	18	11.5	2.09	0.64
23.	*Sonneratia apetala*	85	14	22	64	6.07	3.86	0.09
24.	*Sonneratia caseolaris*	25	3	22	14	8.33	1.14	0.6
25.	*Suaeda nudiflora*	93	5	22	23	18.6	4.22	0.81

26.	*Viscum orientale*	23	8	22	36	2.87	1.04	0.08
27.	*Xylocarpus mekongensis*	25	3	22	14	8.33	1.14	0.56
28.	*Xylocarpus granatum*	38	4	22	18	9.5	1.72	0.53

A total of 28 plant species belonging to 19 genera under 15 families were found from Sajinakhali Wildlife Sanctuary. The most dominant family is Rhizophoraceae having 4 genera and 8 species.

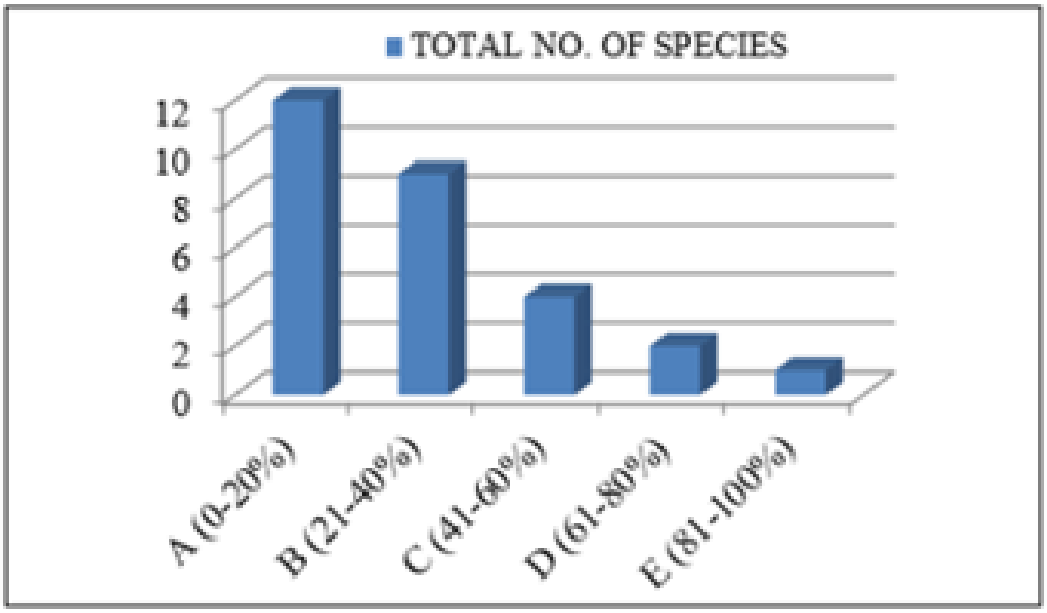


Figure 1: Raunkiaer's frequency diagram of mangroves in Sajinakhali

The Raunkiaer's frequency diagram (Figure 1) indicates that 12 species fall under Class A (0-20%), 9 under Class B (21-40%), 4 under Class C (41-60%), 2 under Class D (61-80%) and only 1 under Class E (81-100%). So, in Sajinakhali frequency class A> B> C> D> E which resembles Raunkiaer's normal frequency diagram except that number of species in class D is greater than that of Class E. *Ceriops decandra* showed the highest frequency (91%), abundance (20.85) and density (18.95). Lowest abundance is shown by *Viscum orietale* while *Nypa fruticans* showed lowest density (0.63). No *Heritiera fomes* population was found in wild inside this wildlife sanctuary.

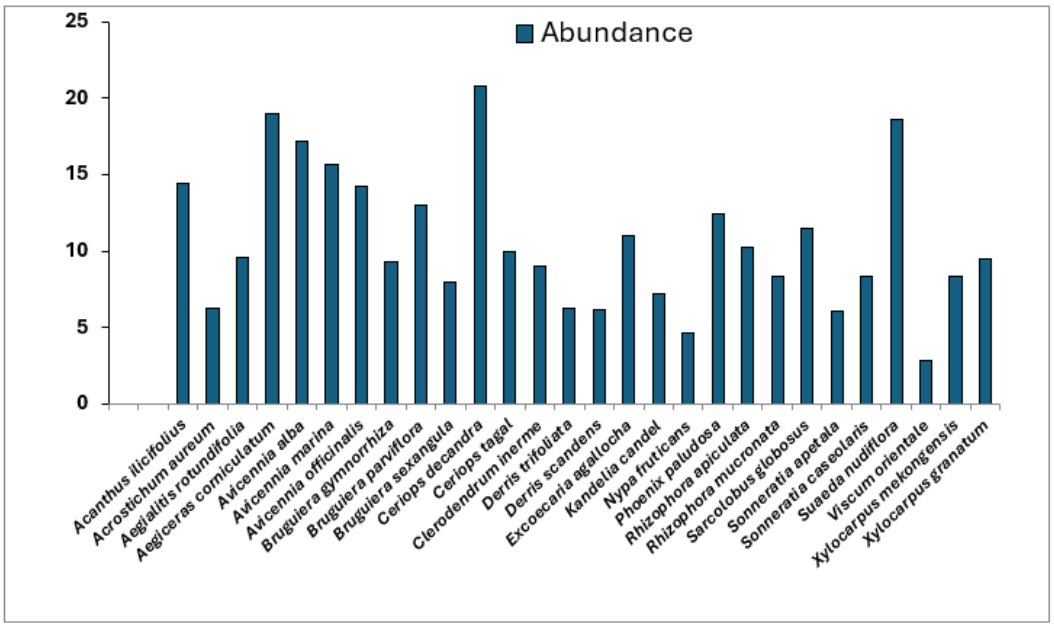


Figure 2: Mangrove species-wise Abundance values in Sajinakhali

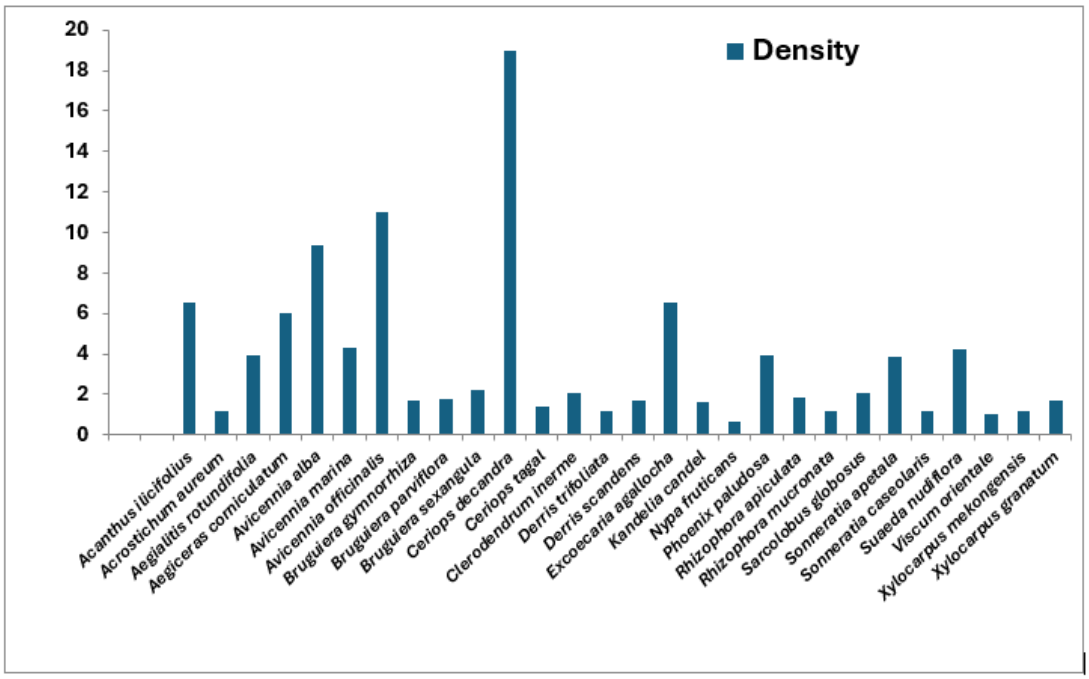


Figure 3: Mangrove species-wise Density values in Sajinakhali

Results of soil studies

Studies were conducted in the two blocks of Sajinakhali Wildlife Sanctuary. The soil analysis data in terms of texture, pH and salinity have been presented in Table 2.

Table 2: Textural and chemical properties of soil samples from different blocks of Sundarban Tiger Reserve (India)

Block Name	Soil Texture			pH	Salinity (ppt)
	Sand (%)	Silt (%)	Clay (%)		
Pirkhali	59	24	17	7.3	2.6
Panchmukhani	62	22	16	7.6	2.1

In the above table the average soil salinity of 3 seasons (pre-monsoon, monsoon and post-monsoon) has been presented because it does not vary too much from one season to the other.

Texture: In soils of all the blocks under Sajinakhali Wildlife Sanctuary the percentage of sand is higher, followed by that of silt and clay. So, the soil is mainly sandy-loam in nature. Such soils have visible particles of sand mixed into the soil. When sandy loam soils are compressed, they hold their shape but break apart easily. Sandy loam soils have a high concentration of sand that gives them a gritty feel. Sandy to sandy loam indicates soil characteristic of low water holding capacity, high permeability and low nutrient storage capacity.

pH: The soil pH values are in the alkaline range and vary from 7.3 to 7.6. This alkaline nature is due to high salt content of the soil. The differences between pH values of the soils are not very prominent. High buffering capacity of the estuarine water (Reid, 1961) probably restricted wide variations in soil pH levels.

Salinity: Soil salinity inside Sajinakhali ranges from 2.4 ppt. to 2.6 ppt. Soil salinity level may be partially responsible for differential distribution of species (zonation) observed in mangrove landscapes (Feller *et al.* 2003). **Excess salinity in soil water can decrease plant available water and cause plant stress.** How ever, as plants use soil water, the remaining water is held tighter to the soil and becomes progressively more difficult for plants to obtain. As the water is taken up by plants through transpiration or lost to the atmosphere by evaporation, soil water salinity increases because salts become more concentrated in the remaining soil water.

CONCLUSION

The soil texture, nutrient availability and salinity vary between different forest blocks which is reflected as variation in species abundance and diversity. *Ceriops decandra* is the dominant species in Pirkhali block while *Avicennia alba* is dominant in Panchmukhani block. After considering results of quadrat studies of the two blocks together, it has found that *Ceriops decandra* is the most dominant species inside Sajinakhali, 43% of the species found in quadrat studies, belong to class A, 32% to class B, 14% to class C, 7% to class D and only 4% to the class E. Spatial variation in species occurrence and abundance is frequently observed across environmental gradients in many ecosystems (Davis, 1940; Smith, 1992; Mendelssohn & McKee, 2000). Interestingly, no *Heritiera fomes* population was observed during the field study in Sajinakhali.

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