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SOME OBSERVATIONS ON THE ECOLOGY OF AN ESTUARINE MANGROVE OF GOA

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ABSTRACT

The ecology of a fringing mangrove in Zuari estuary, Goa, was studied. The mangrove represents a typical tropical estuarine ecosystem with a strong monsoonal and tidal influence. Heavy precipitation lowers the salt content considerably and increases the sediment load. The nutrients, especially inorganic phosphate, exhibit an inverse relationship with the sediment load. Large seasonal changes in phytoplankton and benthic production were observed. Despite the large fluctuations in the environmental factors, the mangrove ecosystem remains rich in organic matter.

INTRODUCTION

Mangrove is one of the major specialized ecosystems on the west coast of India (Dwivedi *et al.*, 1975). Some observations on the distribution, ecology and the environmental features of the mangroves from two major estuarine systems of Goa have been reported earlier (Untawale *et al.*, 1973). Mangroves of the Mandovi estuary have been classified into swamps and fringing mangroves on the basis of their dynamic or static nature (Dwivedi *et al.*, 1974).

The mangroves play an important role in the formation of detritus which is consumed by variety of marine and estuarine organisms. At the same time the specialized root systems of mangroves develop muddy or silty substrata as a result of accretion. Keeping all important factors in view, an attempt has been made here to study the effect of some of the environmental factors in the mangroves at Borim (Zuari estuary) so that the suitability of mangroves for aquaculture could be assessed.

The upper reaches of the banks of Zuari estuary are covered with fringing mangroves (Fig. 1). These areas are partially exposed during the low tide and their substrata consist of fine silty mud. During the high tide a water column of 1 m to 1.5 m covers the area depending on the gradient of the bank and the tidal range. The mangroves extend 8 — 10 m from the water front into the land.

ENVIRONMENTAL FACTORS

The data on climatological parameters have been obtained from the Panaji Observatory of India Meteorology Department and the average values for the last 30 years have been shown in Fig. 2. The air temperature varies seasonally with the highest and lowest values in November and January, respectively. The southwest monsoon in Goa has its peak activity in June-July. The high average rainfall (about 3000 mm annually) results in high relative humidity, ranging from 65% to 92% (Fig. 2). The wind speed attains its maximum in the peak month of south west monsoon (July).

The following environmental parameters were studied, at fortnightly interval for one year from June 1971 to May 1972.

Temperature:- Water and soil temperatures showed similar variations recording the highest values in May and lowest value in December (Fig. 3). The mean values were highest in premonsoon; moderate in monsoon and lowest in postmonsoon.

Salinity:- Low salinity values were recorded during the monsoon (June to September) ranging from 0‰ to 5‰. From October, however, the salinity showed a constant increase and reached maximum (35‰) in May.

Oxygen:- Oxygen concentration was minimum (2.5 ml/l) in May and maximum

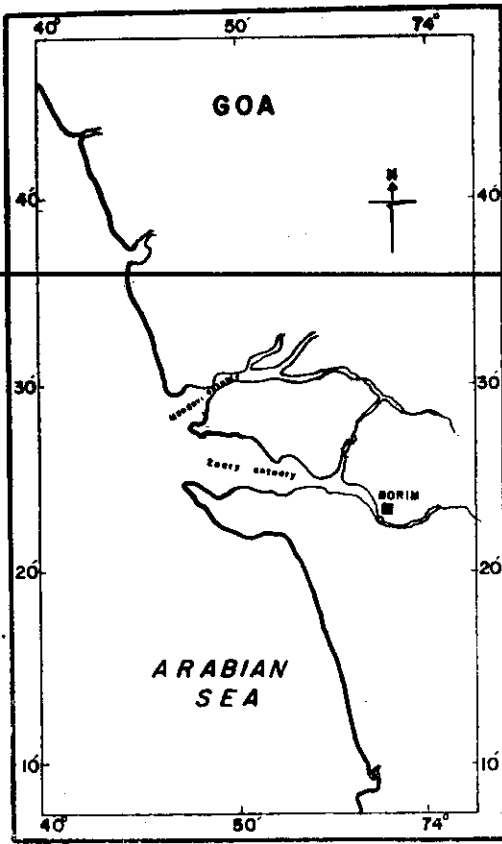


Fig. 1 : Borim mangroves in Zuari estuary, Goa.

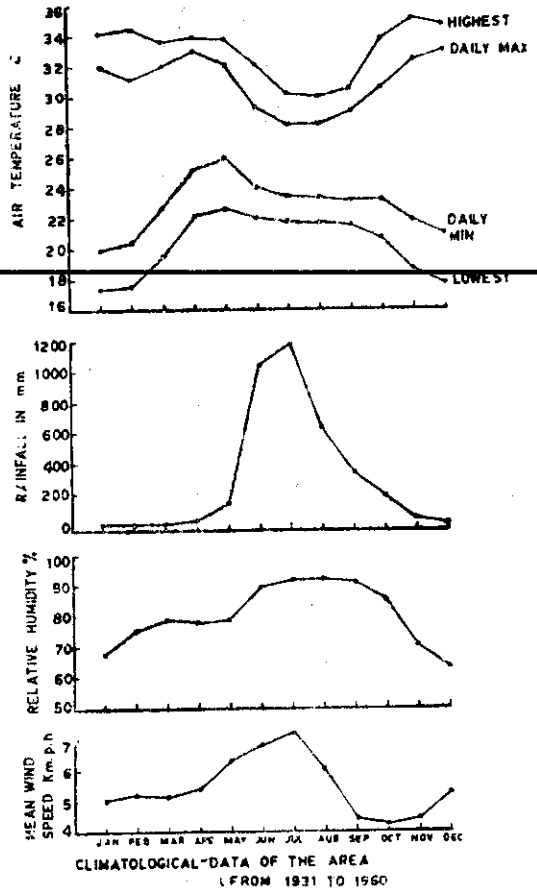


Fig. 2 : Climatological data for Goa area.

(5.3 ml/l) in October. Except for these, there was no well marked fluctuation in any season.

Sediment load:- Due to enhanced land runoff the sediment load of the estuary increases during the monsoon months. This phenomenon associated with a strong wave action and tidal influence creates highly turbid conditions in the mangroves. During June-August the sediment load ranges from 0.45 to 0.75 g/l. Thereafter, from September to February, it varies from 0.25 to 0.40 g/l, while from March onwards it decreases to 0.1 g/l (Fig. 3).

Phosphates:- The phosphate concentration in the surface and bottom waters of the mangroves shows a definite seasonal pattern and the values range from 0.5 to 2.25 μg at/l. From June to November, the

phosphate concentration decreases (except in September and October) from 0.5 to 2.0 μg at/l. However, from December it progressively increases showing a maximum of 2.25 μg at/l in May. Both the surface and bottom concentrations followed a similar trend throughout the period of investigation (Fig. 3).

Nitrates:- Apart from the high values in July and March, the average nitrate concentration was low and showed little variation during the year (Fig. 3).

BIOTIC FACTORS

Phytoplankton:- The phytoplankton distribution studied as cell counts showed three peaks in June, October and May. The counts were low during August, September and November (Fig. 3, Table 1). In all, 12

Table 1 : Percentage composition of phytoplankton species at Borim mangroves.

Month	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	Mean
Total Cells/l	6000	3000	300	200	4600	1000	1500	3000	3500	3000	4000	5800	3016.66
<i>Species.</i>													
1. <i>Navicula</i> sp.	50.2	40.8	...	42.5	7.1	8.3	11.1	30.5	40.7	35.2	42.8	52.8	30.37
2. <i>Nitzschia</i>	2.5	3.2	...	5.8	32.7	2.7	33.3	20.6	10.4	8.1	...	5.2	10.37
3. <i>Diploneis</i> sp.	...	...	...	...	6.6	6.5	...	7.9	3.5	...	...	...	2.04
4. <i>Bacillaria</i> sp.	...	2.3	...	3.2	6.6	...	...	10.3	5.1	6.4	...	4.2	3.17
5. <i>Cosinodiscus</i> sp.	22.3	21.4	3.2	...	12.3	52.4	...	...	3.5	9.4	10.2	8.4	11.92
6. <i>Grammatophora</i> sp.	...	1.5	63.4	...	...	...	11.1	...	3.5	6.4	7.3	...	7.76
7. <i>Amphopora</i> sp.	5.2	...	...	...	...	8.4	...	3.5	3.5	...	...	...	1.71
8. <i>Cymbella</i> sp.	...	...	...	...	...	5.5	11.1	...	7.0	...	...	3.0	2.21
9. <i>Rhabdonema</i> sp.	...	...	...	...	...	5.5	...	...	7.0	...	...	...	1.04
10. <i>Fragillaria</i> sp.	...	...	...	...	...	...	11.1	6.5	6.0	20.7	4.5	4.2	4.41
11. <i>Biddulphia</i> sp.	5.2	...	...	...	...	10.2	...	2.1	...	...	7.3	...	2.06
12. <i>Pleurosigma</i> sp.	14.5	30.8	33.4	48.5	34.7	2.5	22.2	20.6	10.8	13.8	25.5	20.2	23.11
Total species observed	6	6	3	4	6	9	6	8	11	7	6	7	

BORIM

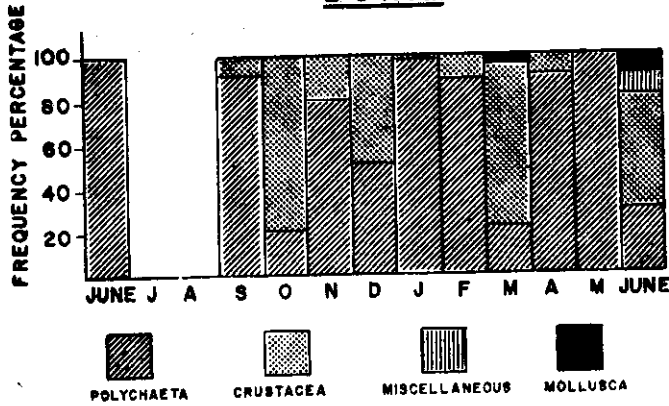


Fig. 3 : Environmental and biotic factors in Borim mangroves during 1971-72.

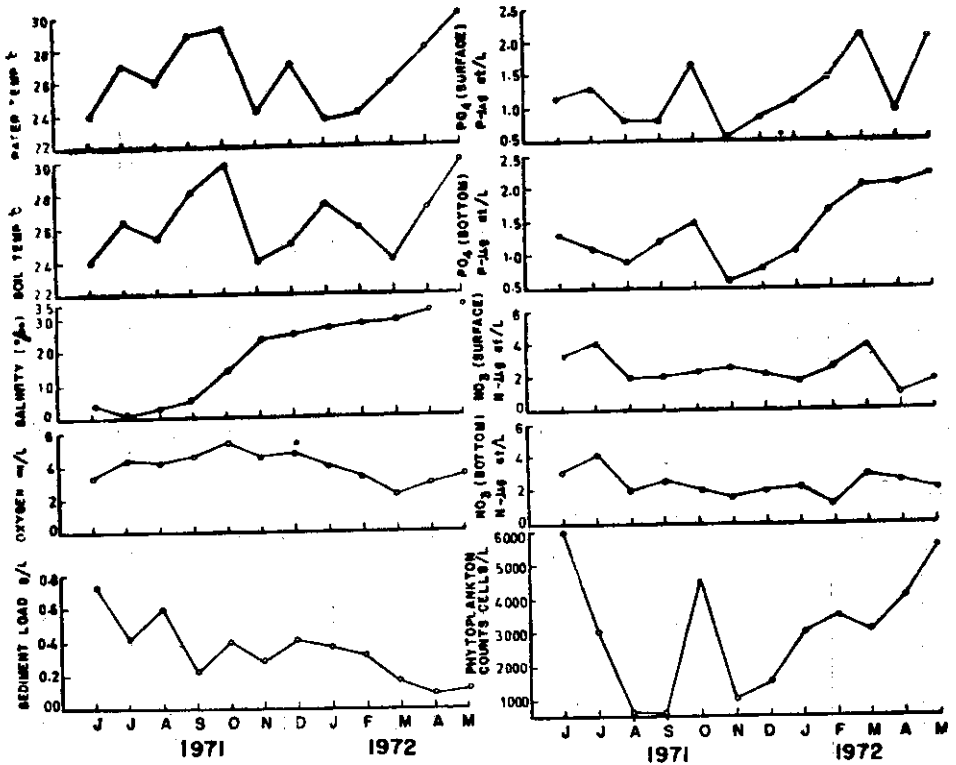


Fig. 4 : Distribution of fauna in Borim mangrove, Goa.

phytoplankton species were present. *Navicula* sp. occurred throughout the year followed by *Pleurosigma* sp. Organisms occasionally recorded were *Rhabdonema* sp., *Amphopora* sp., *Diploneis* sp. and *Biddulphia* sp. Maximum number of species were observed in February, while in August and

September only a few organisms were present (Table 1).

Mangrove flora:- Mangroves were represented mainly by two species — *Rhizophora mucronata* and *Avicennia officinalis*. However, a few trees of *Bruguiera gymnor-*

hiza, *Sonneratia acida*, *Kandelia rheedii* and *Excoecaria agallocha* are also present. The ground flora consisted of *Acanthus ilicifolius*, *Bruguiera parviflora* and rarely *Aegiceros corniculata*.

The prop roots of *R. mucronata* and pneumatophores of *A. officinalis* were found to be covered with algae, largely with *Caloglossa* sp. Occasionally patches of blue green algae such as *Nostoc* sp., *Anabena* sp. and *Vaucheria* sp. were observed on the substratum and on the trunks of mangrove trees, which remain moist because of tidal spray. The mangrove trees on both the banks were found to be in 4 to 8 rows, while their density was 17 plants /10 m². The height of the trees ranged from 10 to 15 m.

Benthic fauna:- Benthic fauna showed wide variations seasonally and from one area to the other. During the monsoon period, there was a total depletion of benthic fauna. In the premonsoon season (October-January) the benthic organisms were maximum. A gradual decline in their abundance occurred during the premonsoon months (February-May). The large seasonal variations in their abundance were mainly due to rapid changes in salinity. Polychaetes dominated the faunal composition. These were followed by crustaceans (crabs, prawns and alphids).

Molluscs formed a negligible component with a restricted distribution. Similarly the other faunal elements comprising mainly of epifaunal organisms, were represented in the form of a patchy and scanty distribution (Fig. 4).

The fringing mangroves in Goa (Borim) represent a typical estuarine system with a strong tidal and monsoonal influence. Ranwell (1972) showed that the mangroves form a mixed type of environment largely depending upon climatic conditions

As reported elsewhere (Untawale *et al.*, 1973), heavy rainfall in the Goa region, dilutes the sea water and causes erosion. Other climatic factors such as wind, humidity, etc. do not seem to have much effect on the mangrove of this region.

A marked correlation was found between the seasonal rainfall and changes in salinity at Borim. It is the amount of rainfall

and not the tidal influence which determines the salinity changes, as has been found earlier in the salt marshes (Ranwell *et al.*, 1964). The heavy rainfall increases the turbulence and introduces a heavy load of suspended material. When the rainfall, decreases after September, the salinity increases and the sediment load decreases. The sedimentation of suspended matter is probably due to the 'flocculation effect' of increased salinity on the silt (Pricé and Kendrick, 1963).

Further, it was observed that when the salinity increases and suspended matter decreases, phosphate concentration shows a gradual increase. The values ranged between 1.25 to 2.25 $\mu\text{g at/l}$.

The phytoplankton crop during the premonsoon and postmonsoon months was high. Probably the clarity of water and an increase in phosphate are responsible for the growth of phytoplankton in mangrove waters.

The benthic algae present on the muddy substratum and the detritus derived from the mangrove foliage were the principal food of fish, prawns and other organisms found in this region. This confirms the findings of Odum and Heald (1975). Some molluscs (*Littorina* sp.) and gobioid fishes (*Periophthalmus* sp.) were seen grazing on these patches. Pomeroy (1959) found that the 'mud algae' make a major contribution of salt march ecosystem.

Salinity variations between 0‰ to 30‰ play an important role in the distribution of halophytes in Borim mangrove. Species with a high salinity tolerance such as *R. mucronata* and *Sonneratia acida* are also found along with such species which grow in less saline water i.e. *Aegiceros corniculata*, *Excoecaria agallocha* etc.

The dominance of polychaetes in the mangrove fauna and the near absence of mollusca can be attributed to the silty clay substratum at Borim, which favours the abundance of tube-dwellers such as polychaetes, but has an adverse effect on diggers and burrowers (molluscs), especially bivalves. Crustaceans and other animals are epifaunal in nature with a detritivorous habit. The presence of these faunal groups, which includes a number of

commercially important organisms like crabs and prawns, reflects the richness of organic matter in the Borim mangrove swamp. The occurrence of a number of post-larval forms of crustaceans and fishes also indicates the importance of mangrove swamps as nursery ground for prawns, crabs and fishes.

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