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Phytosociological studies of mangroves from western Maharashtra of India

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ABSTRACT

The mangroves are the dominant flora of the estuarine ecosystem, showing different adaptations with unrelated species. Therefore in present investigation attempts were made to study vegetation characters of the mangroves from Western Maharashtra of India. The area is unique due to its diversity and dominant species occurred at different sites. It mainly consists of species like *A. marina, A. officinalis, Rhizophora mucronata* etc. with dominance occurring commonly at all the study sites. Sensitivity and adaptability of the species in the critical ecosystem become important to assess the vulnerability of a species.

Introduction

Mangrove forests are one of the most productive and bio diverse wetlands on earth. Growing in the inter-tidal areas and estuary mouths between land and sea, mangroves provide critical habitat for a diverse marine and terrestrial flora and fauna. In India, mangroves occur on the West Coast, on the East Coast and on Andaman and Nicobar Islands, but in many places they are highly degraded. Although the mangrove vegetation consists of mostly of taxonomically unrelated plant species, they have similar physiognomy, physiological characteristics and structural adaptations to the habitat (Tomlinson, 1986). They normally grow poorly in stagnant waters and have luxuriant growth in the alluvial soil substrates with fine- textured loose mud or silt, rich in humus and sulphides. They can also be found in substrates other than muddy soil such as coastal reefs and oceanic islands. In such areas, the mangrove plants grow on peat, which is derived from decayed vegetation. They find it difficult to colonize the coastal zone with waves of high energy and hence they normally establish themselves in sheltered shorelines (Kathiresan & Bingham, 2001). Forest Survey of India (FSI, 2003) further showed that mangrove vegetation in Kerala is now restrained largely to river mouths and tidal creeks and that there has been no significant mangrove cover south of Cochin in Kerala coast.

The mangrove vegetation of West coast is sparse, less extended, and confined to patches due to scanty upstream freshwater supply, excessive amount of silt-clay deposition, low average rainfall and relatively low tidal fluctuation (Blasco & Aizpuru 1997; Naskar & GuhaBakshi 1987; Untawale 1984). Therefore in the present work, the main aim was to study of mangroves with respect to phytosociology studies like distribution, dominance, species diversity, complexicity and association of the different species.

Material and Methods

Study Area

The present study is carried out from the coastal Maharashtra which is situated along the central west coast of India. The study region lies between 15^{O} 44' to 20^{O} 08' N latitude. This region is well known as "Konkan". The region is a part of Deccan plateau. The estuaries are drowned valleys (Wagle, 1982). In the present investigation more attention was given to South-Western Maharashtra such as Are, Kalabadevi and Bhatye, Ganpatipule, Girye- Padel, Kalawali and Kolamb estuaries.

Methods

The phytosociological studies were carried out with the help of different standard methods. Distribution and dominance was calculated by quadrat method (Trivedy *et al*., 1987) with respect to total number of individuals and their occurrence, species diversity, complexicity index by Holdridge (1967) and association of the different species by Krebs method (1978). Twenty five quadrats were laid out at each site. Each site was divided into 5 segments of 1 km each along tidal line from the riverbank. The quadrats were laid randomly at 0, 50, 100, 150, 200 and 250 m interval towards the landward side for the phytosociological analysis.

Result and discussion

In the present investigation it was observed that the distribution of mangroves is confined to creeks, estuaries and at some places to the backwaters. This variation in the distribution may be due to influence of tides, salinity, shelter, wind and topography of the area. The study area occupies more than 28 mangroves and their associates (Table:1). The *Avicennia marina* is an exclusive mangrove distributed all over the study region. This species is most adaptive because of its wide range of salinity tolerance (Macnae, 1968). In the study region *A. marina* distributed luxuriantly at the mouth region of various estuaries of south western Maharashtra. This species shows 100% occurrence in the estuaries surveyed, showing its adaptability to different environmental conditions. Similarly *Rhizophora mucronata* is also a widely distributed species from the study region with 100% occurrence. It is distributed commonly at the mouth and middle region of the estuaries or creeks. Sindhumathi (2009) reported the domination of *Rhizophora mucronata* in the mangroves of Chetuwai of Thrissur district, Kerala. Singh *et al*., (1986) has shown *Rhizophora* distribution near by the sea water from the Andaman and Nicobar Island. Kathiresan *et al*., (1996) showed that *Rhizophora mucronata* seedlings do better in salinities of 30 % and also concluded that *Rhizophora* species have better chances of survival even in aged mangrove soil high in H_2S.

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Sonneratia alba favours many estuaries and creeks of study region. It mostly prefers sheltered and protected areas especially at shallow basins where water enters and recedes slowly. It is commonly distributed at the places not facing direct attack of high energy tidal waves. The site where species is distributed is rich in litter content and with high capacity of nutrient cycling. At Bhatye and Are estuaries, the species is fringing the shallow boundary of estuary. It occurs on raised flat surfaces along the main stream at Navanagar from Bhatye and also at Chinchkheri an Takala sites. At Kalabadevi the species is predominant and and spread in the shallow Shirgaon creek. In general, *Sonneratia alba* distributed at daily inundated areas. The species cannot form monotypic stands in any estuary from all over the study region. According to Untawale (1985) *S. alba* favours sandy clay and mesohyaline silty caly soil. The maximum range of distribution of this species has been mentioned earlier from the Goa region of India by Jagtap (1986).

Besides these species, *Excoecaria agallocha* and *Aegeceras corniculatum* are more or less common in their occurrence along the study region. They rarely occur at the mouth region and commonly raised above the mean high water levels. *Kandelia candel, Bruguiera gymnorrhiza, Sonneratia apetala* and *S. caseolaris* are not common in their distribution along the estuaries of South-West Maharashtra.

Table 1: Occurrence and distribution of mangrove species along some estuaries of South Western Maharashtra

Species	Family	Estuary						
		Kolamb	Kalawali	Girye- Padel	Bhatye	Kalabadevi	Are	Ganpatipule
Rhizophora mucronata Poir.	Rhizophoraceae	+	+	+	+	+	+	+
R. apiculata Blume		-	-	+	+	+	+	-
Bruguiera gymnorrhiza (L) Savigny		-	-	+	-	-	-	+
B. parviflora (Roxb.) Wight		-	-	-	+	-	-	-
Ceriops tagal (Perr.) C. B. Rob		+	+	+	+	+	+	+
Kandelia candel (L.) Druce		-	+	+	+	-	-	-
Avicennia marina (Forsk.) Vierh	Avicenniaceae	+	+	+	+	+	+	+
A. officinalis Blume		+	+	+	+	+	+	+
Sonneratia alba Smith	Sonneratiaceae	+	+	+	+	+	+	+
S. apetala Buch- Ham		-	-	-	-	-	-	+
S. caseolaris (L.) Engl.		-	-	+	-	-	-	-
Aegiceras corniculatum (L) Blanco	Myrcinaceae	+	+	+	+	+	+	+
Acanthus ilicifolius L.	Acanthaceae	+	+	+	+	+	+	+
Excoecaria agallocha L.	Euphorbiaceae	+	+	+	+	+	+	+
Lumnitzera racemosa Willd.	Combrataceae	+	+	+	+	+	+	+
Clerodendrum inerme (L.) Gaertn	Verbenaceae	-	-	+	+	+	+	+
Premna integrifolia L.		-	-	-	-	+	+	-
Salvadora persica L.	Salvadoraceae	-	-	-	+	+	+	+
Derris heterophylla (Willd.) Back	Fabaceae	-	+	+	+	+	+	+
Pongammia pinnata Vent.		-	-	-	+	-	-	-
Caesalpinia nuda L.	Caesalpiniaceae	-	-	-	+	+	+	+
Thespesia populnea (L.) Soland	Malvaceae	+	+	+	+	+	+	+
Porteresia coarctata (Roxb.) Takeoka	Gramineae	+	-	-	-	-	+	+
Aleuropus lagopoides (L.) Trin		+	-	-	+	+	+	+
Halophila beccarii Aschers	Hydrocharitaceae	-	-	-	+	-	-	-
Ipomea pescarpe Sweet.	Convolvulaceae	-	-	-	-	+	+	+
Stenophyllus barbata Roftb.	Cyperaceae	-	+	-	-	-	-	-
Acrostichum aureum L.	Polypodiaceae	+	-	-	-	-	+	-

Table 2: Association of different mangrove species along some estuaries of South Western Maharashtra

A.m											
-	A.o										
+	+	R.m									
	+	-	R. a								
-	-	+	-	S.a							
-	+		+	-	C.t						
-		-	-	-	+	E.a					
	+	-			+	+	A.c				
-		-		-				L.r			
				-			+		K.c		
	+	+		-	+	+	+		+	A.i	
		-	+	-							B.g

A.m = ***Avicennia marina* (Forsk.) Vierh.,** A. o = ***A. officinalis* Blume,** R.m = ***Rhizophora mucronata* Poir,** R. a = ***R. apiculata* Blume,** S. a = ***S. apetala* Buch- Ham,** C.t = ***Ceriops tagal* (Perr.) C. B. Rob,** E. A = ***Excoecaria agallocha* L.,** A.c = ***Aegiceras corniculatum* (L) Blanco,** L.r = ***Lumnitzera racemosa* Willd.,** K.c = ***Kandelia candel* (L.) Druce,** A.i = ***Acanthus ilicifolius* L.,** B.g = ***Bruguiera gymnorrhiza* (L) Savigny**

These species prefer middle part of the estuaries towards upstream regions. *Aegiceras corniculatum* and *Ceriops tagal* are distributed at distal and middle zones of mangrove vegetation of many estuaries considered for the present investigation. However, *Lumnitzera racemosa* found to be distributed only in the distal zones of the mangrove vegetation along many estuaries. The brackish water fern *Acrostichum aureum* is found only at extreme upstream sites of many estuaries.

The studies of dominance of different estuaries of South Western Maharashtra were calculated on the basis of total area occupied by individuals of different species. The variations were observed at different sites and this may be due to species environment present at study region. At the study region *A. officinalis* is dominant species occupying maximum area in upstream area of the estuary. *A. marina* and *R. mucronata* shows less dominance. There is gradual decrease in the dominance from mouth to upstream. Shrubs and scrubs like *A. ilicifolius, A. corniculatum, C. Tagal* and *L. racemosa* show relatively low dominance as compared to tree species. The dominance of the species changing at different sites. It is evident from foregoing discussions that the dominance of mangroves from the study region is governed by different conditions like salinity, tidal inundations, exposure to high energy tidal waves etc. It is also observed that dominant species exert some effect on other species and this was observed when dominants are removed from the region.

The complexity index is studied with respect to stands at different study sites. The index is under control of many conditions. The higher index is neither shown by monospecific healthy stands nor by the stands having higher species diversity. The maximum complexity index was observed in the stands which are undisturbed (Singh *et al*., 1986), where there is no felling in the stands and stands are protected by people and sheltered from adverse environmental factors. In the present study, it is also seen that young as well as more diversed communities, contributing little of the basal area show lower complexicity. However, mature, healthy, most protected communities with *A. officinalis* as most dominant species and sheltered habitats are not promoting the growth of monospecific community and having moderate range of inundations and salinity which favours few species to become dominant, showing high complexicity. The complexicity index indicates that there is no uniformity in the community.

While studying association (Table. 2) it is evident that *A. marina* shows positive association with *R. mucronata* only. This may be due to their common habitat with range of tolerance of salinity and tidal waves. The species *A. officinalis* has wide affection amon all the species with species like *R. mucronata, R. apiculata, C. Tagal, A. cornuculatum* and *A. ilicifolius*. However it shows strong negative association with *S. alba*. The secondary vegetation forming species like *C. Tagal, E. Agallocha, A. corniculatum* and *A. ilicifolius* show significantly positive association between them. At many places of study region *L. racemosa* occurs either pure patches or mixed with *A. corniculatum* and *C. Tagal*.

Conclusion

Coastal mangrove communities from the study region of South West Maharashtra consist of 15 species of exclusive mangroves. The predominant species are *A. marina, A. officinalis, R. mucronata* and *S. alba*, while *S. caseolaris, S. apetala, R. apiculata* and *K. candle* show restricted occurrence. *B. gymnorrhiza* and *B. parviflora* are on the verge of extinction from the region. *Avicennia marina* is the only species which can tolerate high amplitude tides, strong wind and higher water and soil salinity. *A. officinalis* is a dominant species and occurs throughout the estuaries and creeks preferring middle and distal sheltered zones. Sensitivity and adaptability of the species in the critical ecosystem become important to assess the vulnerability of a species. Adaptive capacity of some of them can be improved by management intervention, especially by planting them in suitable areas after assessing the trend and rate of environmental changes.

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