

A FLORISTIC STUDY OF HALOPHYTES OF THE PICHAVARAM MANGROVES

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INTRODUCTION

A detailed description of the study area (Pichavaram) can be had from earlier publications (Krishnamurthy, 1971; Krishnamurthy and Sundararaj, 1973 and Caratini *et al.*, 1973). Because of the interacting ecological influence in the system, it is of interest to study the floristic composition and zonation of the main coastal vegetation including the mangrove forest of the area. The present account gives a detailed and comprehensive description of the salient features, emerging from such a study.

MATERIALS AND METHODS

Many transects were randomly selected, covering the whole study-area and, the floristic pattern was noted along with the shore profile, soil-texture and depth and breadth of the waterways. The habit, habitat and relative abundance of the various species of plants in the transects were noted along with their size.

RESULTS

The mangrove vegetation formations (based on transects) were studied. The occurrence of some interesting mangrove flora encountered in these forests is also dealt with. The study area shown in Fig. 1 also includes the areas covered by different formations. A diagrammatic representation of vegetation from the transect studies is shown in the Fig. 2.

I. Formation of Mangrove Vegetation :

(a) Formation I

Avicennia marina (Forsk.) Vierh was dominant and shrubby in this region, where the soil is principally sandy mud. But the sandy areas of this region are dominated by the halophytes. *Salicornia brachiata* Roxb., *Suaeda maritima* (L.) Dunn., *Sesuvium portulacastrum* L., *Arthrocnemum indicum* (Willd.) Moq., and *Excoecaria agallocha* L., are some other plants, which are sporadically distributed here. Sand heaps are of frequent occurrence in this region and these heaps do not get flooded. Loose and less saline soil heaps are colonized by many terrestrial plants such as *Boerhavia diffusa* L., *Clerodendrum inerme* Gaertn., *Croton* sp., *Eragrostis* sp., *Geniosporum tenuiflorum* (L.) Merr., *Ipomoea pes-caprae* Sweet, *Mollugo pentaphylla* L., *Oldenlandia umbellata* L., *Opuntia* sp., *Phyla nodiflora* (L.) Greene, *Spinifex littoreus* Merr., *Thespesia populnea* Correa and *Vernonia cinerea* (L.) Less. All the plants represented in this formation do not exceed 0.5 m in height.

(b) Formation II

The bank of three creeks (lying parallel to sea shore) show gradation of floristic components from shoreline inwards. The eastern bank of the first creek shows three belts, viz. : 1. barren shoreward belt, 2. middle *Salicornia*

brachiata belt and 3. in-ward *Avicennia marina* belt. The eastern bank of the second creek also presents three belts, viz.: 1. the shoreward belt with *Salicornia brachiata* and shrubby *Avicennia marina*, 2. the middle belt with *Salicornia brachiata* and 3. the inward belt with *Rhizophora apiculata* and *Avicennia marina* trees. The eastern bank of the third creek also possesses three belts, viz.: 1. the outer belt with *Rhizophora apiculata* and *R. mucronata* Lamk., 2. the middle belt with *A. marina* (shrubs and trees) and 3. the inner belt with *Excoecaria agallocha* and *Salicornia brachiata*. The western bank of the third creek presents barren sandy area leading to terrestrial vegetation inland. *Arthrocnemum indicum* occurs in patches in this formation which might probably colonize the 'blanks'.

(c) Formation III

Luxuriant mangrove vegetation exists in this formation with maximum number of mangrove species. The fringes of the channels are bordered by *Rhizophora apiculata*, *R. mucronata*, *R. apiculata* is dominant along the main channels, while *R. apiculata* and *R. mucronata* are co-dominants along the fringes of other waterways. Immediately behind the *Rhizophora* communities, *Bruguiera cylindrica* (L.) Bl. and *Ceriops decandra* (Griff.) Ding Hou are common in shrubby habit, *Excoecaria agallocha* also occurs. Just behind the fringe communities of *Rhizophora* and other plants, three types of communities can be observed as follows:

- a) Exclusively consisting of *Suaeda maritima* community,
- b) Mixed communities of *S. maritima* and *Avicennia marina* (shrubs) and
- c) Exclusively consisting of *Avicennia marina* (trees) community.

Aegiceras corniculatum (L.) Bl., *Bruguiera cylindrica*, *Ceriops decandra* and *Lumnitzera*

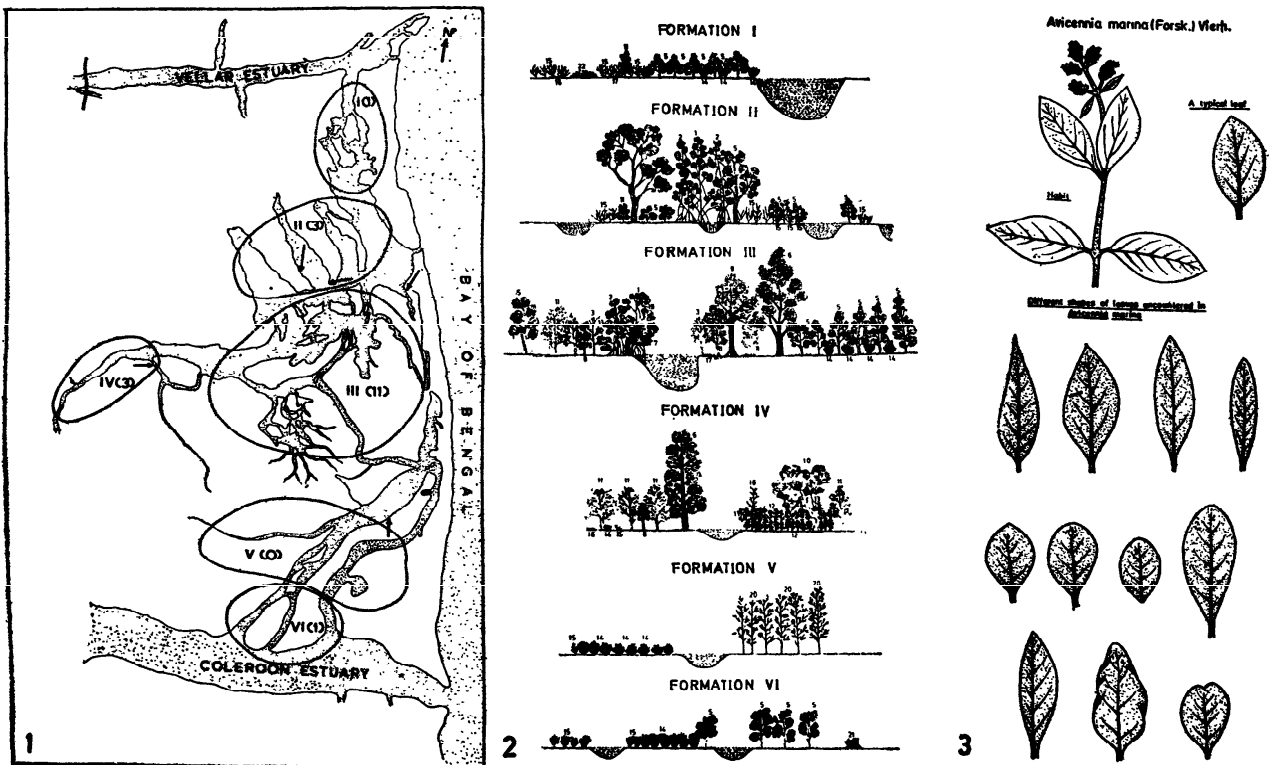
racemosa Willd. var. *racemosa* seen in this zone are distinct on the edges immediately behind the *Rhizophora* plants. *Aegiceras corniculatum* peeps through *Rhizophora* plants. Few plants belonging to *Suaeda maritima* are found along *Rhizophora* zone with an abnormal size of 5 m height. (*Rhizophora* trees give support for these thin stemmed plants). Along certain banks which appear being eroded, the fringes are bordered by *Avicennia marina*, *Bruguiera cylindrica*, *Ceriops decandra*, *Excoecaria agallocha*, *Lumnitzera racemosa*, *Suaeda maritima*, *Sesuvium portulacastrum* and *Xylocarpus mekongensis* Pierre. *Dendrophthoe falcata* (L. f.) Etting., is the only parasitic angiosperm observed on the branches of *Rhizophora*. In the places where *Avicennia marina* is found, the soil is clayey and hard with occasional flooding during spring tides. Crustose and fruticose lichens upon *Excoecaria agallocha*, *Rhizophora apiculata* and *R. mucronata* in certain areas may serve the function of nitrogen fixation where the soil nitrogen content is low.

(d) Formation IV

This fresh water zone is generally dominated by *Acanthus ilicifolius* L. The vegetation on the two banks of the Thiruvasaladi fresh water channel varies considerably. The northern bank is dominated by *Acanthus ilicifolius* along with a few representatives of *Dalbergia spinosa* and *Derris heterophylla* (Willd.) Back, climbing on *Acanthus ilicifolius*, *Excoecaria agallocha* and *Sonneratia apetala* Buch.-Ham. On the southern bank, there is sporadic occurrence of big *Avicennia officinalis* L., trees with the mixed communities of *Arthrocnemum indicum*, *Excoecaria agallocha*, *Lumnitzera racemosa*, *Salicornia brachiata* and *Suaeda maritima*.

(e) Formation V

The western bank of the channel gives a salt-marsh appearance with *Suaeda maritima*



Figs. 1-3 : (1) Showing the study area (circles indicate the major formations. Figures in parentheses show the total number of true mangrove species..... indicates the limits of *Rhizophora* spp. (2) Showing different formations in the zonation. The numbers (1-22) indicate the corresponding species—1. *Rhizophora mucronata*, 2. *R. apiculata*, 3. *Bruguiera cylindrica*, 4. *Ceriops decandra*, 5. *Avicennia marina*, 6. *A. officinalis*, 7. *Aegiceras corniculatum*, 8. *Lumnitzera racemosa*, 9. *Xylocarpus mekongensis*, 10. *Sonneratia apetala*, 11. *Excoecaria agallocha*, 12. *Acanthus ilicifolius*, 13. *Derris heterophylla*, 14. *Suaeda maritima*, 15. *Salicornia brachiata*, 16. *Arthrocnemum indicum*, 17. *Sesuvium portulacastrum*, 18. *Dalbergia spinosa*, 19. *Dendrophthoe falcata*, 20. *Casuarina equisetifolia*, 21. *Pandanus* sp., 22. Terrestrial plant community, (3) Showing polymorphism of leaves of *Avicennia marina*.

which occupies nearly 3 sq. km. and *Salicornia brachiata*. This area is a less elevated place with a vast intertidal area and with lesser number of gullies. Sporadic occurrence of shrubby *Excoecaria agallocha* amidst *Suaeda maritima* community, is noticed. The soil texture, here, is more towards silty mud. On the eastern side of the channel towards the sea-shore, *Casuarina equisetifolia* J. R. & G. Forst. has been introduced for large-scale cultivation.

(f) Formation VI

This formation exists nearer the Coleroon estuary. The channel on the landward side is rich with *Salicornia brachiata*, whereas the channel on the seaward side is occupied by small shrubby *Avicennia marina*. Sand heaps are also noticed with *Pandanus* sp. Before the joining, the two channels near the Coleroon, the intermediate region is occupied by *Avicennia marina*, *Suaeda maritima* and *Salicornia brachiata*.

II. Occurrence of some Interesting Mangrove Flora from Pichavaram :

(a) *Xylocarpus mekongensis* Pierre

Three species of *Xylocarpus* have been reported from the Indian mangroves (Blasco, 1975; Chapman, 1976). *X. granatum* Koenig has been reported from the mangroves of the Cauvery Delta (Gamble, 1957). *X. mekongensis* is presently reported for the first time from the Pichavaram mangroves, thereby establishing the extension of this species right from here to the Sundarbans; it is already known from Malaysia and Java. This species could be well identified by the presence of 1 to 2 pairs of leaflets in the compound leaf, panicle with the central axis and the presence of buttresses and pneumatophores. (Figs. 4 & 5).

(b) *Avicennia marina* (Forsk.) Vierh

The specimens collected from Pichavaram



FIGS. 4 & 5 SHOW THE BOTTOM OF THE TRUNK OF *Xylocarpus mekongensis* WITH ROOT BUTTRESSES AND STOUT AND STUMPY PNEUMATOPHORES. ALSO SEEN ARE THE THIN ELONGATED PNEUMATOPHORES OF *Avicennia marina* AND A SEEDLING OF *Rhizophora mucronata*.

mangroves (South east coast of India) agree well of *Avicennia marina* (Forsk.) Vierh. However, the variety level identification of *A. marina* based on the nature of the leaf blade is found to be difficult due to leaf polymorphism. It is likely that speciation is taking place in *A. marina*, right through its geographical range (Chapman, *personal communication*). In the same plant, in addition to typical leaves, we also commonly find other types of leaf shapes such as rounded, obtuse (var. *rumphiana*) and broadly lanceolate and

elliptic and oblong (var. *resinifera* and var. *acutissima*) and obovate, asymmetrical and with wavy margin. (Fig. 3).

DISCUSSION

In general, the halophytic vegetation observed in the Vellar-Coleroon estuarine and brackish water complex can be broadly classified into :

1. The mangrove community dominated by *Rhizophora apiculata* and *R. mucronata* along the fringes and *Avicennia marina* behind.

2. The sand dune community dominated equally by *Arthrocnemum indicum*, *Clerodendrum inerme*, *Ipomoea pes-caprae*, *Salicornia brachiata* and *Sesuvium portulacastrum*.

3. The salt marsh community consisting of *Suaeda* spp. and *S. maritima* which covers a vast area in formation-5.

The distribution of various taxa in the different formations could be due to the substratum and tidal regime. The vegetational system recorded can be considered to be similar to an 'interface' ecosystem (Lugo and Snedaker, 1974). This interface ecosystem is influenced by both the upland, terrestrial and coastal estuarine ecosystems.

Avicennia marina is found more towards the marine zone and *A. officinalis* spreads more towards the freshwater zone influenced by the Coleroon estuarine water. *A. marina* occupies a wider area spreading behind the fringe community, whereas *A. officinalis* just borders behind the fringe community only. This differential distribution of the two species can be ascribed to the propagation of seedlings, bearing in view the tidal range and the seasonal periods of flowering. Even though *A. marina* dominates over *A. officinalis* in the study area, *A. marina* plants are always small and shrubby, while *A. officinalis* is exception-

ally big. The maximum diameter of the trunk encountered for *A. officinalis* plant is 90 cm. But the height of that tree is only 3.5 m. The stunted growth was due to mutilation. Overgrazing by the cattle is a common sight in the study area (which also causes dwarfism) along with other biotic factors like demographic pressure, felling for domestic uses etc. The heterophylly existing in *A. marina* reveals that speciation is taking place in our area and this leads to complication in identification at the variety level.

Comparing with sizes recorded for *Rhizophora apiculata*, *R. mucronata*, *Sonneratia apetala*, *Avicennia marina*, *Ceriops decandra* and *Excoecaria agallocha*, the size ranges of these plants in the area of study is very low. (Table 1). The absence of tall trees, here, might be due to the poor tidal amplitude (0.6 m average) and continuous illicit felling or grazing or mineral deficiency due to the combined effect of all these. Also cyclonic storms in this monsoon area could expose the tall trees to uprooting, and dwarfness may be a secondary adaptation.

In places where there is accretion of land, *R. apiculata* seems to be the pioneer community followed by the community of *A. marina*. In formation 3, both *R. apiculata* and *R. mucronata* seem to play equal role in establishing their communities. In 'open glades' or 'blanks' or 'souillere' (see also Bigot, 1971 & Blasco, 1975) plants such as *Arthrocnemum* sp., *Salicornia* sp., *Suaeda* spp. and *Sesuvium* sp. which colonise the area first and their subsequent propagation and their eventual decay, would contribute to the augmentation of organic matter of that place, which slowly becomes a sandy mud in time, paving way to the colonization of *Avicennia marina*. The areas behind the fringe community are found to be colonised by pure community of *Suaeda maritima* followed by mixed community of *Suaeda maritima* and *Avicennia marina*, succeeded by

TABLE 1. THE GEOGRAPHICAL RANGE IN NORMAL SIZES OF SOME MANGROVE VEGETATION.

No.	Plant Species	Height (m)	Width (cm)	Place	Reference	Present Study	
						Height (m)	Width (cm)
1.	<i>Rhizophora apiculata</i>	40	30-40	North-east Sumatra	Macnae (1968)	3-6	20-30
2.	<i>Rhizophora mucronata</i>	35	30-40	Peninsular Thailand	Macnae (1968)	3-8	20-30
3.	<i>Sonneratia apetala</i>	30	90	Godavari & W. Bengal	Blasco (1975)	5-10	25-30
4.	<i>Avicennia marina</i>	10	—	Mozambique	Macnae (1968)	0.3-4	5-30
5.	<i>Ceriops decandra</i>	15-20	—	South-east Asia	Macnae (1968)	1-2	10-15
6.	<i>Excoecaria agallocha</i>	24	—	Papue-New Guinea	Chapman (1976)	3-5	15-30

the pure community of *A. marina*. This indicates the gradual replacement of *Suaeda maritima* rendering the place gradually unsuitable for *S. maritima* by blocking penetration of the sunlight to the ground due to the shade given by *Avicennia*. This prevents growth of other plants.

Salt marsh vegetation and the mangrove vegetation are here rarely juxtaposed as in Australia (Perkins, 1974). This peculiar feature is observed during the present study where the 3 sq. km. salt marsh vegetation located near the Coleroon estuary is found to be juxtaposed with the 15 sq. km. Pichavaram mangrove vegetation.

Broadly speaking, the mangrove vegetation is represented by 110 species belonging to 60 genera and 35 families, of which 30 are new world species, 80 species are of the old world and 5 species, common for both the areas. However, only 50 species are woody plants. About 60 species of trees and shrubs belonging to 40 genera and 30 families are

represented in the Indian mangroves, of which 35 species may be said to form the typical components of mangrove vegetation. Of these 15 species are reported from the present area of study, of which *Xylocarpus mekongensis* is a new distributional record for south-east coast of India.

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