

A PRELIMINARY STUDY OF THE MANGROVE FOREST ON PULAU RAMBUT, JAKARTA BAY

by

KUSWATA KARTAWINATA¹⁾ and EKO B. WALUJO¹⁾

ABSTRACT

Pulau Rambut (\pm 56ha) is one of the islands of the Pulau Seribu group. It is a coral island covered by disturbed forest and secondary growth at the center, and mangrove forest at its periphery. A study in a 290 x 10 m transect running south to north across the mangrove forest shows a distinct zonation as follows : the *Scyphiphora hydrophyllacea* - *Lumnitzera racemosa* community on coral flat with patchy shallow soils on the interior, the *Rhizophora mucronata* community on relatively deep soil overlaying coral formation, and the *R. mucronata* - *R. stylosa* community on periodically submerged coral flat. Profile diagrams established along the transect show structural changes also. The *R. mucronata* forest is the most developed community and appears to be the most prevalent. *R. stylosa* forms the pioneer species on this island.

INTRODUCTION

The mangrove forest of Indonesia covers a total area of about one million hectares (ANONYMOUS 1972), but so far only small portions of it have been studied (BECKING *et al.* 1922; DE HAAN 1931; LUYTJES 1923; MEINDERSMA 1923, SOERIANEGARA 1968, 1971). The mangrove forest on the islands at the Jakarta Bay is also very little known and has been only described briefly (ANONYMOUS 1953, KAMERLING 1912). In view of the current development activities at and around the city of Jakarta that will undoubtedly bring about various negative effects on the aquatic biological communities in the Jakarta Bay, it is urgently necessary to initiate the baseline studies for monitoring the possible biological changes. The present study of the mangrove forest of Pulau Rambut constitutes a part of these baseline studies within the framework of the Man and Biosphere (MAB) project no. 5 : "Ecological effects of human activities on the value and resources of lakes, marshes, rivers, deltas, estuaries, and coastal zones". The present paper represents a preliminary report of this initial study.

METHOD

Pulau Rambut is one of the islands of the Pulau Seribu group, located on the Bay of Jakarta. It is a nature reserve, covering a total area of about

1) Herbarium Bogoriense, Lembaga Biologi Nasional, LIPI, Bogor

25 hectares (ANONYMOUS 1957), but judging from the aerial photo the total land surface is estimated to be about 56 hectares. The island is surrounded by coral reefs and its vegetation consists of the depleted dryland tall forest dominated by *Sterculia foetida* and *Chisocheton pentandrus*, secondary growth dominated by climbers (a species of Cucurbitaceae, *Wedelia biflora*, and *Merremia* sp.), *Scyphiphora hydrophyllacea* — *Lumnitzera racemosa* scrub, mangrove forest, *Ipomoea pes-caprae* community and littoral sea-grass community dominated by *Thalassia hemprichii* and *Enhalus acoroides* (Fig. 1).

A transect of 290 x 10 m, running south to north across the mangrove forest on the northern part of the island, was established. All trees with diameter equaled to or greater than 10 cm were identified, counted and measured. Saplings were analysed with a series of continuous plots of 10 x 2 m each, and seedlings with subplots of 2 x 1 m each arranged systematically at 10 m intervals. Composite soil samples were collected along the transect at every 10 m. Profile diagrams along the transect were prepared.

RESULTS AND DISCUSSION

Along the transect only 10 tree species are recorded, *i.e.* *Ceriops decandra*, *C. tagal*, *Lumnitzera racemosa*, *Pemphis acidula*, *Rhizophora mucronata*, *R. stylosa*, *Scyphiphora hydrophyllacea*, *Xylocarpus moluccensis*, *Excoecaria agallocha*, and *Thespesia populnea*. The latter two species are not typical mangrove species, they usually occur on dryland beach. On the inland bordering the mangrove, *Heritiera littoralis* (not found in the transect) and *Xylocarpus moluccensis* are very common. During the reconnaissance study carried out earlier (SOEMODIHARDJO *et al.* 1977), other mangrove species, *i.e.* *Rhizophora apiculata*, *Bruguiera gymnorrhiza*, *Sonneratia alba*, *S. caseolaris*, *Avicennia alba*, *A. marina*, and *A. officinalis*, are recorded also.

Along the transect, three communities may be recognized from the inland towards the sea : (1) *Scyphiphora hydrophyllacea-Lumnitzera racemosa* community, (2) *Rhizophora mucronata* community, and (3) *Rhizophora mucronata-Rhizophora stylosa* community, which occur on different habitats.

The *Scyphiphora hydrophyllacea-Lumnitzera racemosa* community is composed of only five species and only four species have diameters greater than 10 cm (Tables I and II). The total basal area of trees is only 2.3 m²/ha and density is 151 trees/ha. The leading species, *i.e.* species with high basal area are *Scyphiphora hydrophyllacea* and *Lumnitzera racemosa* (Table I). No scrubs and herbs are recorded, but an epiphytic orchid, *Aerides*

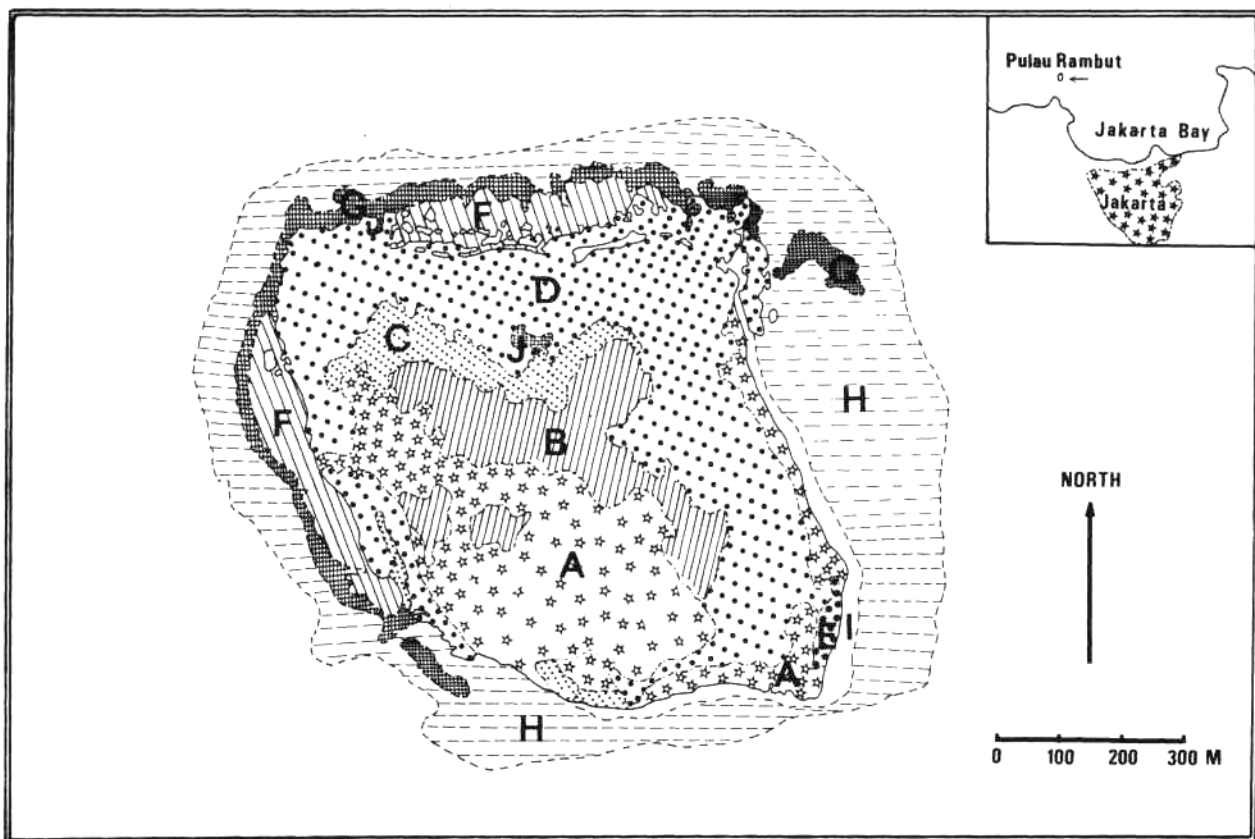


Figure 1. A map of Pulau Rambut showing its vegetation and surroundings: (A) dryland forest, (B) dryland secondary forest, (C) *Scyphiphora-Pemphis* community, (D) mangrove forest, (E) *Ipomoea pes-caprae* community, (F) *Thalassia-Enhalus* community, (G) lagoon, (H) coral reef, (I) sandy beach, and (J) cleared mangrove forest. The map was prepared from an aerial photograph that was made available through the courtesy of Mr. Jan Wind.

Table I. The basal area (cm²) and the number of trees per hectare in the *Scyphiphora hydrophyllacea-Lumnitzera racemosa* community

Species	Basal area	Number of trees
<i>Scyphiphora hydrophyllacea</i>	8,328	50
<i>Lumnitzera racemosa</i>	7,862	25
<i>Pemphis acidula</i>	6,172	63
<i>Ceriops decandra</i>	157	13
Total	22,519	151

Table II. The number of plants per hectare according to the diameter classes in the *Scyphiphora hydrophyllacea-Lumnitzera racemosa* community

	Diameter class (cm)							
	<2	2-4.9	5-7.9	8-10.9	11-13.9	14-16.9	17-19.9	>20
<i>Ceriops</i>								
<i>decandra</i>	11,250	26,250	2,500	100				
<i>tagal</i>		8,125	625					
<i>Lumnitzera</i>								
<i>racemosa</i>	625	625		13				13
<i>Pemphis</i>								
<i>acidula</i>	625		625	25	25	13		
<i>Xylocarpus</i>								
<i>moluccensis</i>	625		625					
<i>Scyphiphora</i>								
<i>hydrophyllacea</i>				25	25			

odorata, may be occasionally found. The community is open and low, where trees and saplings are scattered (Fig. 2a).

Most of the plants in this community are in the lower diameter classes and in the transect only *Lumnitzera racemosa* reaches diameter greater than 20 cm (Table II). Outside the transect some *Scyphiphora hydrophyllacea* trees with diameter of more than 20 cm are observed. It is evident from Table II that only *Ceriops decandra* has a good regeneration. This species

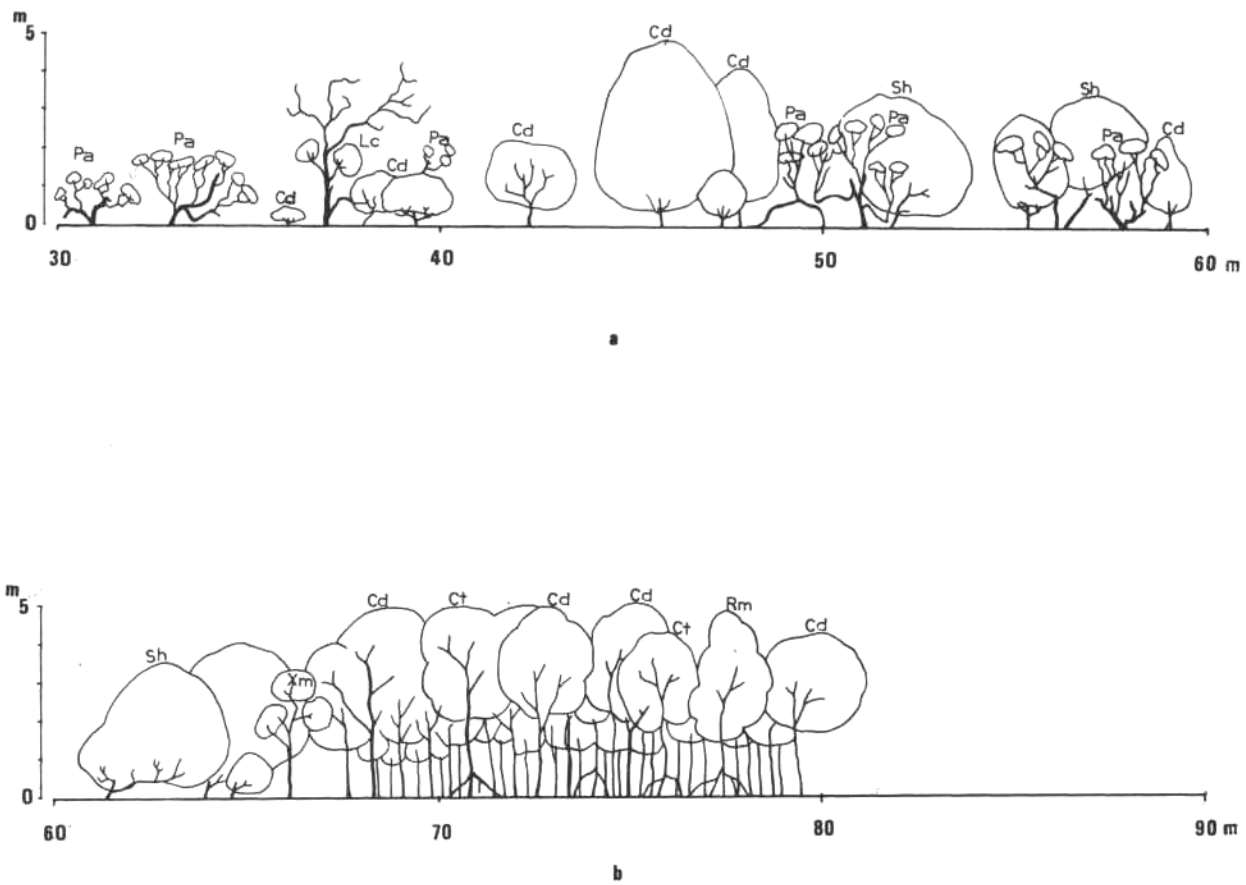


Figure 2. The profile diagram of the *Scyphiphora-Pemphis* community showing the typical portion (a) and the portion adjoining the clear-cut mangrove forest (b). The species represented in the profile are *Ceriops decandra* (Cd), *C. tagal* (Ct) *Lumnitzera racemosa* (Lc), *Pemphis acidula* (Pa), *Rhizophora mucronata* (Rm).

occurs abundantly on more muddy places close to the *Rhizophora mucronata* community, and it will perhaps become dominant in the community. The *Scyphiphora hydrophyllacea-Lumnitzera racemosa* community occurs on coral flatland with soils occurring as firm mud or on depressions not more than 20 cm deep on the inland part of the transect next to the coastal dryland forest. Reconnaissance around the island reveals that this community does not always occur on the inland part of the island between the coastal dryland forest and the *Rhizophora mucronata* community, but it may occur also near the beach or raised ground consisting of corals and mud. The soil under this community primarily consists of sand and a small amount of silt and clay and contains a little amount of organic matter, N, K, and Mg, but a high amount of P and Ca (Table IV).

Table III. Basal area (cm²) and the number of trees per hectare in the *Rhizophora mucronata* community

Species	Basal area	Number of trees
<i>Rhizophora mucronata</i>	63,180	434
<i>Ceriops decandra</i>	82	33
<i>Lumnitzera racemosa</i>	82	33
<i>Thespesia populnea</i>	90	33
Total	63,434	533

The *Rhizophora mucronata* community extends for about 100 m along the transect. It is a pure community of *Rhizophora mucronata*, although *Ceriops decandra*, *Lumnitzera racemosa*, *Excoecaria agallocha*, and *Thespesia populnea* may also be occasionally present, but are insignificant and confined to the edges of the community (Figs. 3a & b). The total basal area of trees is 6.34 m²/ha and density is 535 trees/ha, of which 6.32 m²/ha and 434 trees/ha are occupied by *R. mucronata* (Table III). The number of saplings and seedlings amount to 2,634/ha and 16,333/ha, respectively. Figure 4 shows the population structure of *Rhizophora mucronata* in this forest. Most of the trees have diameters between 10 and 20 cm, and the largest tree recorded is 24.7 cm in diameter with the height of about 12 m. The forest is dense and the average canopy height is about 8 m. The height of the trees in this community is very much lower than that in the well-developed mangrove forest, where *R. mucronata* may reach the height of 35 — 40 m (VAN STEENIS 1958).

A PRELIMINARY STUDY OF THE MANGROVE FOREST

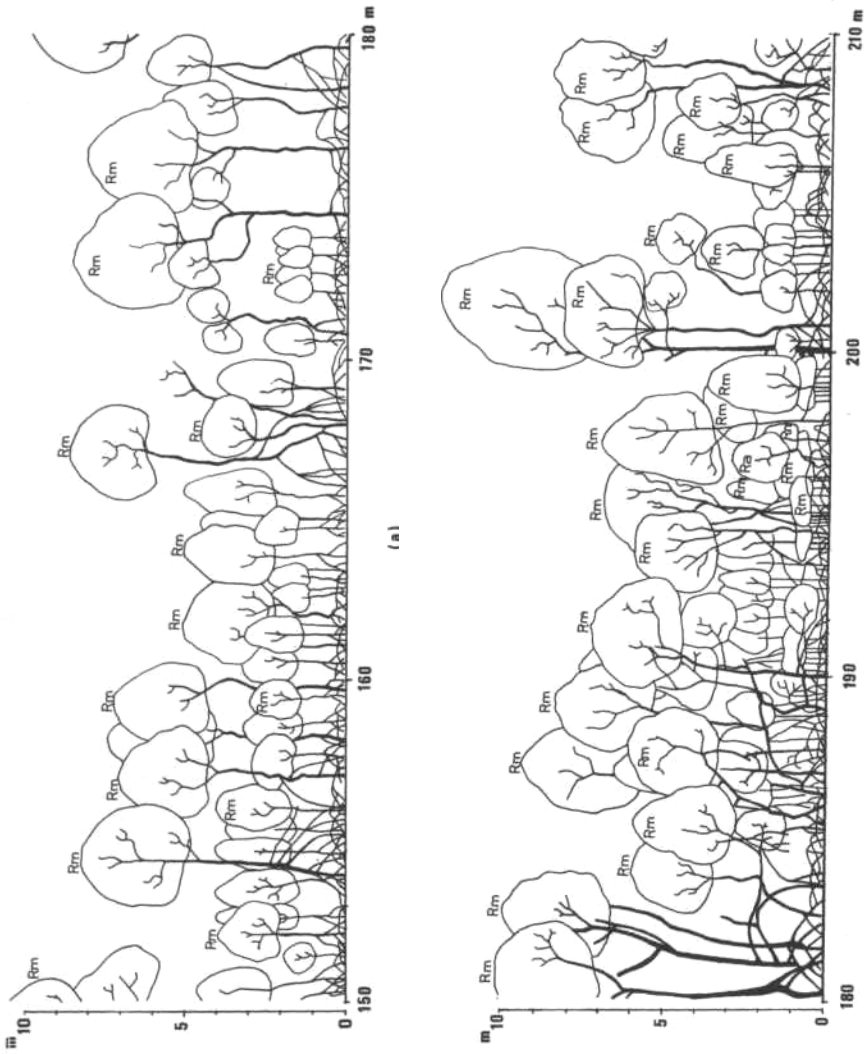


Figure 3. The profile diagram of the *Rhizophora mucronata* (Rm) community.

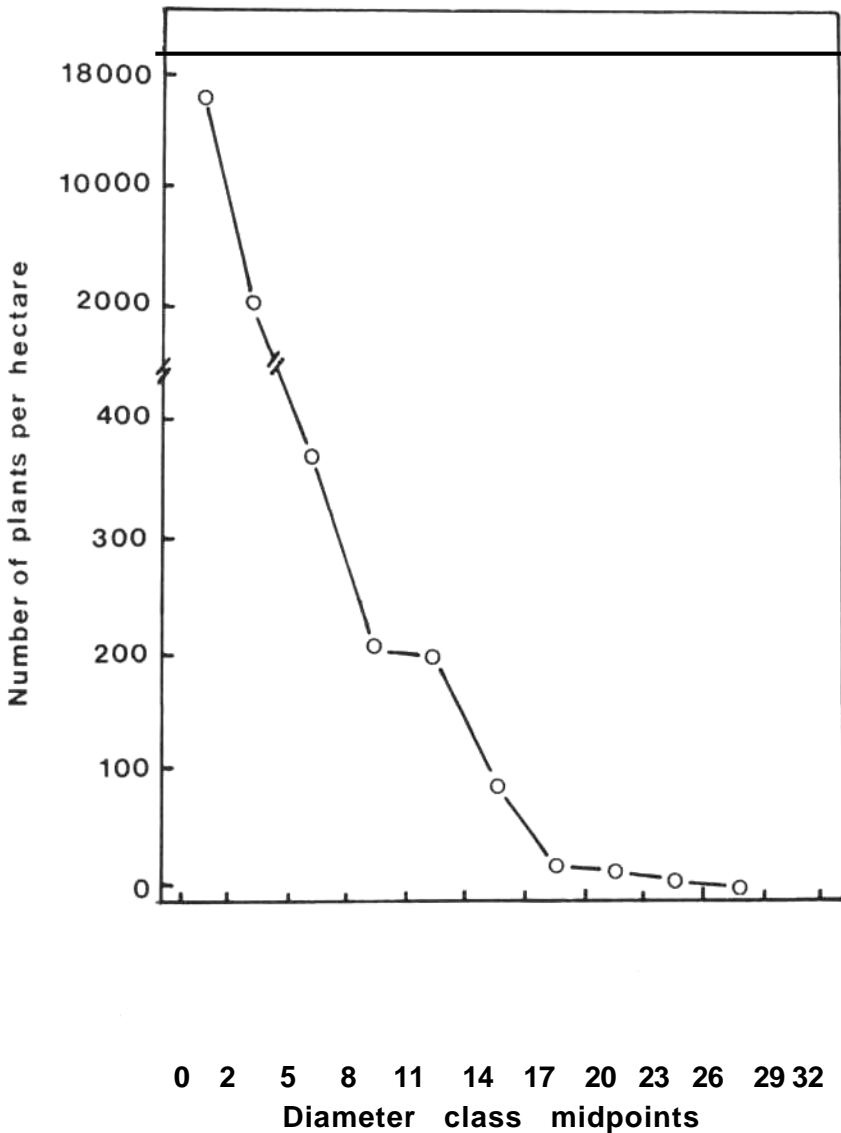


Figure 4. Diameter class distribution of *Rhizophora mucronata*

This community occurs on dark brown soil overlying coral deposit and its depth ranges from 30 to 50 cm. The soil is composed of equal fraction of clay and silt. The content of K, Ca, and Mg and organic matter is high (Table IV). The average amount of P to the depth of 50 cm is relatively low (0.075 %), but on the surface (0-10 cm) it is higher (0.156 %).

The *R. mucronata* community forms the most extensive mangrove forest on the island and always occupies the areas with deep soft soil and

A PRELIMINARY STUDY OF THE MANGROVE FOREST

Table IV. Chemical and physical properties of the soil

Soil properties	<i>Scyphiphora</i> <i>Pemphis</i> community	<i>R. mucronata</i> community	<i>R. mucronata</i> <i>R. stylosa</i> community
Soil depth (cm)	0 - 1 0	0 - 5 0	0 - 1 0
Texture (%)			
Sand	71.5	11.3	90.0
Silt	17.5	44.7	6.0
Clay	11.0	44.0	4.0
pH	7.6	6.7	7.6
Organic matter (%)	7.8	62.1	2.0
Nutrients (%)			
N	0.28	1.26	0.10
P ₂ O ₅	0.282	0.075	0.054
K ₂ O ⁵	0.082	0.283	0.040
CaO	47.962	11.357	49.723
MgO	0.776	1.704	0.874
Exchangeable cations (m.e.)			
Ca	33.9	68.8	27.1
Mg	14.2	69.5	7.5
K	1.3	6.4	0.8
Na	29.5	149.3	21.4
Total	79.1	292.4	56.8
Adsorption capacity	23.5	84.4	5.6

forms a more or less concentric band around the island (Fig. 1). In many places the inner boundaries do not lie side by side with the *Scyphiphora hydrophyllacea-Lumnitzera racemosa* community, but with the coastal dryland forest or the secondary growth. Similarly on the sea side it does not always border with the *R. mucronata* -- *R. stylosa* community, but with the dryland beach vegetation also. On the inner side of the transect, there is an opening which is completely devoid of plant cover and this apparently is the result of clear cutting. At present there is no regeneration or any sign of it being taken over by other species, such as *Avicennia* spp. which are pioneer species on such a habitat (VAN STEENIS 1958).

The *R. mucronata* — *R. stylosa* community occurring on the transect is the pioneer community consisting of only saplings and seedlings. The average height of the plants is about 2 m (Fig. 5). The number of saplings of *R. stylosa* and *R. mucronata* is 500/ha each and that of the seedlings is 5,000/ha and 3,333/ha respectively. It occurs on coral flat, where the

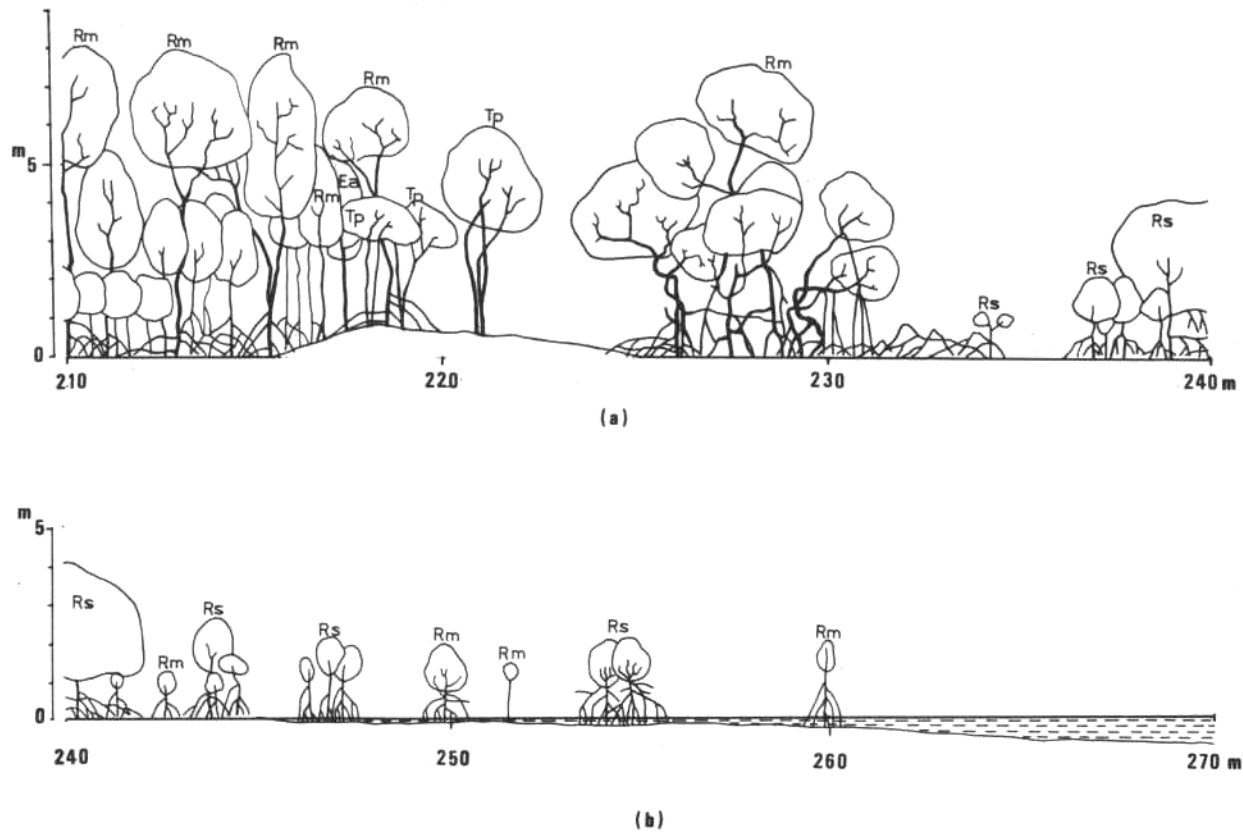


Figure 5. The profile diagram of the *Rhizophora mucronata*-*Rhizophora stylosa* community showing the portions adjoining the *R. mucronata* community (a) and on a small lagoon (b). The species represented in the profile are *Rhizophora mucronata* (Rm), *R. stylosa* (Rs), *Thespesia populnea* (Tp) and *Excoecaria agallocha* (Ea).

A PRELIMINARY STUDY OF THE MANGROVE FOREST

substratum in which saplings and seedlings grow is 90% sand and is very low in the organic matter and nutrient contents. This community is affected by daily tidal movement. Adjacent to the transect and elsewhere on the island, there are older and better developed stands.

The zonation of the mangrove forest on this island is much simpler compared to that in the extensive mangrove forest occurring on estuaries elsewhere. This is apparently attributed to the relatively simple habitat conditions, where the tidal movement is the most important factor, whereas in the estuarine region the river flows from the inland, which affects salinity and brings about silt sedimentation, play an important role also. On this island there are only sand deposition on the beach and organic matter deposition, particularly on areas protected from daily tidal movements. The zonation is related also to the physical and chemical properties of the soil.

REFERENCES

- ANONYMOUS 1953. Een excursie naar Pulau Rambu (Middelburg) in de Baai van Djakarta. *Trop. Natuur* 33 : 143 - 144.
- ANONYMOUS 1957. *Wildlife and nature reserves in Indonesia*. The Forest Service of Indonesia.
- ANONYMOUS 1972. *Forestry in Indonesia*. Directorate General of Forestry, Department of Agriculture.
- BECKING, J.H., L.G. DEN BERGER and H.W. MEINDERSMA 1922. Vloed of mangrove bosschen in Ned. Indie. *Tectona* 15 : 561 - 611.
- DE HAAN, J.H. 1931. De Tjilatjapsche vloedbosschen. *Tectona* 24 : 39 — 76.
- KAMERLING, Z. 1912. De Rhizoohoren. *Trop. Natuur* 1 : 28 - 29.
- LUYTJES, A. 1923. De vloedbosschen van Atjeh. *Tectona* 16 : 575 - 601.
- MEINDERSMA, H. W. 1923. Eenige bijzonderheden over mangrove-bosschen. *Trop. Natuur* 12 : 25 - 31, 39 - 46, 70 - 77.
- SOEMODIHARDJO, S., K KARTAWINATA and S. PRAWIROATMODJO 1977. Kondisi hutan payau di Teluk Jakarta dan pulau-pulau sekitarnya. *Oseanologi di Indonesia* 7 : 1 - 23.
- SOERIANEGARA, I. 1968. The causes of *Bruguiera* trees mortality in the mangrove forest near Tjilatjap, Central Java. *Rimba Indonesia* 13 : 1 - 11.
- SOERIANEGARA, I. 1971. Characteristics and classification of mangrove soils of Java. *Rimba Indonesia* 15 : 141 - 150.
- VAN STEENIS, C.G.G.J. 1958. Ecology of mangrove. In Ding Hou : Rhizophoraceae. *Flora Malesiana* I, 5 : 431 - 441.