MANGROVES IN INDIA

IDENTIFICATION MANUAL

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DEDICATION

The Botanical Survey of India dedicates this work to the memory of late Dr. B. P. Pal, F.R.S., F.N.I., former Director General, Indian Council of Agricultural Research, and Chairman of the former National Committee on Environmental Planning and Coordination, and National Man and Biosphere Committee, as a tribute to his yeoman contributions to plant science and conservation programmes in India.

AUTHORS' NOTE

Studies on plants of the Indian coast including those in the estuarine areas have not been made in a perspective they deserved, although different floras deal them. Realising the importance of the coastal ecosystems and to fulfil this lacuna, the Ecology Section, Botanical Survey of India under the leadership of Dr. T. Ananda Rao, a former Ecologist, conducted studies on the Ecology of the Indian Coastal Vegetation (1960-74). This concerted effort had yielded fruitful and interesting data on the plant-life in the different coastal zones. Based on this, a series of papers and more detailed classification of the Indian coastal vegetation type with explicit ecological parameters were published at a time when concern on this dwindling resource was building up.

It is, perhaps, not an exaggeration to state that the naturalness of the coastal regions worldover has been greatly altered during the last one century rendering them as one of the most vulnerable. This situation, often inescapable, has largely been due to the pressing needs of ever increasing human populations for urbanisation, agriculture, fuel and recreation. But for the gregariousness and wide distribution, many a mangrove species would have been a thing of the past by now.

It would not be also out of context to recall the efforts made from time to time to remedy this situation. As a first step, the Union Ministry of Food & Agriculture convened a Mangrove symposium (16-19 October, 1957) at Calcutta, in which several valuable papers on the botanical, silvicultural and management aspects were presented and recommendations made. However, nothing worthwhile seems to have been the follow up, as evident from the present state of mangroves. In keeping with the efforts elsewhere, several renewed measures have been initiated. Firstly, the Department of Science & Technology, Government of India, constituted a panel of experts on mangroves and their conservation and published: *State-of-the-Art-Report on Mangrove Ecosystems* in 1979. Later, the Ministry of Environment & Forests, New Delhi vigorously followed these and revised the *Status Report on Mangroves of India* (December, 1987) and also published: *Conservation of Mangroves in India* (June, 1989) with extensive information. The National Committee on Mangroves has been reconstituted in December, 1988 with the Secretary, Ministry of Environment & Forests as its Chairman, to advise the Government on different appropriate measures for research and conservation of mangroves. Presently 10 man-

grove Steering Committees in different States and Union territories are in function and programmes on 15 selected areas have been taken up. The progress made on these was reviewed at a meeting convened on 6-7 July, 1989 by the Ministry at Kakinada, Andhra Pradesh. Along side of these developments, the need for a publication on the easy identification of the important and common mangroves as a pre-requisite for researchers, forest managers and conservationists was also realised and the task was entrusted to the Botanical Survey of India. It is hoped that this manual would fulfil the needs imperative to a reasonable measure.

In this publication, a brief general introduction on the floristics of the different mangroves in India ; identification keys to the families, genera and species ; species-wise data-sheets with recent botanical names (in bold print ; synonyms in *italics),* its family, local names, short botanical descriptions, notes on ecology, distribution and economic uses, etc. have been provided. Relevant commonly consulted floras have been given under references. At the end a list of common mangrove-associate species (which do not exhibit true mangrove adaptative characteristics), a glossary of botanical terms and some important references suggested for reading, have been appended. An index is dispensed with and an alphabetical arrangement of the families, genera, species and varieties has been followed for easy reference, irrespective of their positions in the taxonomic keys. Colour and black and white photographs and habit sketches for many species are included for familiarising the users of this manual on the beauty and richness of mangroves both collectively and individually. It is hoped that this publication will provide the information on their identity and in choosing the appropriate species for the efforts on scientific management, afforestation and conservation.

Botanical Survey of India
Calcutta, 10th October, 1989 Authors

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INTRODUCTION

The term mangrove is derived from the word 'mangal' and the Portuguese word for mangroves is 'mangue'. Mangroves are a group of salt tolerant plant species which occur in the tropical and sub-tropical intertidal estuarine regions, sheltered coast-lines and creeks and are dominated by partly submerged sclerophyllous plant species which are taxonomically unrelated. Mangroves constitute a dynamic ecosystem with a complex association of species both of flora and fauna of terrestrial and aquatic systems and the vegetation presents an evergreen type with varied life-forms. While the families Rhizophoraceae, Sonneratiaceae, Avicenniaceae are dominant with gregarious growth of their species, different other species are also commonly distributed belonging to the families : Combretaceae, Arecaceae, Sterculiaceae, Acanthaceae, Meliaceae, Fabaceae, Myrsinaceae, Asclepiadaceae, Euphorbiaceae, Plumbaginaceae and a few others. Salt tolerant plant associates or halophytes commonly growing on a relief that is situated above the tide level and mostly remains dry in the mangrove ecosystem are usually seen in the families : Chenopodiaceae, Acanthaceae and Plumbaginaceae. As a result of convergent evolution due to habitat stress, mangrove species have similar physiology and structural adaptations (Fortes, 1988).

The best mangrove formations are seen where the tidal regime is normal with a constant mixing of sea water and fresh water and where the temperature does not optimally go below 20°C. Typical mangroves are plants which have partly reached the sea-estuarine interphase on stilts or props with adaptations like viviparous germination and pneumatophores for survival in the partly saline and partly submerged coastal ecosystem.

Mangroves stabilise loose soil and detritus and act as a filter for land runoffs, and function as a bulwork against sea erosion and protect the hinterland from tidal surges, cyclonic storms and high velocity winds. Rao (1986) mentioned four major roles of

mangroves : (i) mangroves help in soil formation by trapping debris, (ii) they serve as a seive for rich organic soil washed down through river systems into sea, (iii) provide appropriate ecosystem and refuge for fish, marine invertebrates, mollusca and birds, (iv) they contribute detritus enhancing the productivity of the ecosystem.

Mangroves besides acting as stabilizers of wind and sea wave action along the coastal belts, also help to dissipate the wave energy. Thus large portion of open sea fronts wherein mangroves could establish are converted into close placid sea-river interphases. Mangroves in the estuarine interphase buffer high salinity, regulate rich organic-laden water flows, stabilize the alluvial soil brought from the river systems, fix the sediments of the sea with the detritus, thus producing one of the richest productive ecosystems. Mangroves also function as a buffer against the oil-slicks washed down from the sea.

It is seen that the mechanism of salinity tolerance and salt acceptability is regulated by mangroves through (i) higher salt concentration/tolerance of their cell sap, (ii) storage in older leaves, (iii) secretion of excessive salts through excretory glands, leaves and roots. These features make mangroves as one of the highly efficient productive systems which use the salt stress environment.

The striking features of some mangrove species (*Rhizophora*) is the development of aerial or prop or stilt-roots which arch from the main trunk in different directions and strike the ground to act as a supporting system. Some genera like *Avicennia* though do not possess prop-roots, have an underground system of horizontal radiating roots which produce upwardly growing finger-like branches called 'pneumatophores' or breathing roots. These tangle of prop-roots, pneumatophores, and underground network of root-systems constitute an unusual and safe habitat for algae, sponges, oysters, fishes, shrimps, crabs, lobsters, polychaetes, etc. The leaf fall and other plant detritus decomposed due to microbial activity contitutes a rich source of food for fish and invertebrates. Mangroves also provide an ideal place for nesting of migratory birds, Ridley's tortoises and crocodiles.

Viviparous seedlings (germinating of seeds into seedlings while attached to the parental plant) and dispersal of seedlings through water is another important adaptation in some mangroves. Some of the seedlings can float in water for more than 12 months and under suitable ecological conditions get implanted in the muddy substratum and grow into individual plants.

The important mangrove families represented in India are Avicenniaceae, Combretaceae, Arecaceae (Palmae), Rhizophoraceae and

Sonneratiaceae. The following species occur in Indian mangrove systems :

Avicenniaceae

Avicennia alba Bl.
Avicennia marina (Forsk.) Vahl
Avicennia marina (Forsk.) Vahl var. *acutissima* Stapf & Mold.
Avicennia officinalis L.

Combretaceae

Lumnitzera littorea (Jack.) Voigt
Lumnitzera racemosa Willd.

Arecaceae (Palmae)

Nypa fruticans (Van.) Wurumb.
Phoenix paludosa Roxb.

Rhizophoraceae

Bruguiera cylindrica (L.) Bl.
Bruguiera gymnorrhiza (L.) Lamk.
Bruguiera parviflora (Roxb.) Wt. & Arn. ex Griff.
Bruguiera sexangula (Lour.) Poir.
Ceriops decandra (Griff.) Ding Hou
Ceriops tagal (Perr.) Robin.
Kandelia candel (L.) Druce
Rhizophora apiculata Bl.
Rhizophora mucronata Lamk.
Rhizophora stylosa Griff.

Sonneratiaceae

Sonneratia alba J. Sm.
Sonneratia apetala Buch.-Ham.

Sonneratia caseolaris (L.) Engl.
Sonneratia griffithii Kurz

The following species constitute other 'semi-mangrove' (Tansley & Fritsch) components of the mangrove vegetation in India :

Euphorbiaceae

Excoecaria agallocha L.

Meliaceae

Xylocarpus granatum Koen.
Xylocarpus molluccensis (Lamk.) Roem.
Xylocarpus mekongensis Pierre

Myrsinaceae

Aegiceras corniculatum (L.) Blanco

Plumbaginaceae

Aegialitis rotundifolia Roxb.

Pteridaceae

Acrostichum aureum L.

Rubiaceae

Scyphiphora hydrophyllacea Gaerin f.

Sterculiaceae

Heritiera fomes Buch.-Ham.
Heritiera kanikensis Banerjee & Majum.
Heritiera littoralis Dryand. ex Ait.

Species which are not strictly mangroves but are usually associated with mangroves and grow along the banks of creeks and in salt marshes are represented by the following species :

Acanthaceae

Acanthus ilicifolius L.
Acanthus volubilis Wall.

Apocynaceae

Cerbera manghas L.
Cerbera odollam Gaertn.

Asclepiadaceae

Finlaysonia maritima (Bl.) Backer ex Heyne
Sarcolobus carinatus Wall.
Sarcolobus globosus Wall.

Poaceae (Gramineae)

Myriostachya wightiana Hook. f.
Porteresia coarctata (Roxb.) Tateoka
Urochondra setulosa (Trin.) Hubb.

Fabacae (Leguminosae)

Cynometra ramiflora L.
Dalbergia spinosa Roxb.
Derris heterophylla Willd.
Intsia bijuga (Colebr.) Kuntze

In all about 59 species under 41 genera and 29 families comprise the major and significant part of the Indian mangrove flora. Of these, 34 species belonging to 25 genera and 21 families are present in the mangrove and tidal vegetation along the east coast. There are about 25 mangrove species along the west coast.

The total floral components in the mangroves are estimated to be as follows :

Algae : 30 genera, 47 species.

Sea grasses : 7 genera, 10 species.

Mangroves : 41 genera, 59 species.

The major mangrove areas in India with the important taxa components are found along the east coast. These are : the Gangetic Sunderbans Complex with the Hooghly--Harinbhanga estuarine system ; the Burabalanga tidal estuary ; the Mahanadi estuarine complex comprising the Devi and the Dhamra rivers ; the Godavari and the Krishna estuarine systems and the Cauvery estuarine system. Along the west coast no major riverine estuaries are present, except for the small estuaries of the Narmada and Tapti and a few other hypersaline shallow estuaries in Saurashtra and Kutch. The west coast mangroves are seen confined to the backwater systems, innumerable interconnected canals, three major lakes and eight minor lakes in Kerala and several creeks in Maharashtra. Thus the richness and diversity of mangrove vegetation along the east coast is due to its vast deltaic situations with large intertidal mudflats rich in organic sediments, whereas it is poor in quality and in extent due to its confinement to narrow sea-inlets, small river mouths, lagoons, and back water systems along the west coast.

The important components of mangrove species in different areas are as follows :

A. Mangroves of the East Coast

1. The Gangetic Sunderbans, West Bengal :

Sunderbans is the largest mangrove belt most of which falls in Bangladesh. The Indian Sunderbans comprise about 4,200 sq km of mangrove forest. It is generally considered that Sunderbans derive their name from the word 'Sundari', the local name for the tree, *Heritiera fomes* which at one time was abundant.

Rhizophora apiculata, Rhizophora mucronata, Ceriops decandra, Bruguiera cylindrica, Bruguiera gymnorrhiza, Bruguiera parviflora, Kandelia candel, Avicennia alba, Avicennia marina, Avicennia officinalis, Aegiceras corniculatum and *Xylocarpus granatum* are the dominant species seen in the tidal mangrove zone.

Aegialitis rotundifolia colonises areas nearer the sea, whereas *Porteresia coarctata*, a saline grass related to rice abundantly grows

on newly formed areas and tidal mudflats along the banks. *Nypa fruticans,* the feather palm grows gregariously forming hedges along the banks of protected upstreams and attains bigger size under fresh water inundation. *Phoenix paludosa* is seen dominant on elevated fringes and on drier border-lands.

On the banks of smaller creeks where there is a mix of sea and fresh water, mixed forests of *Sonneratia apetala, Bruguiera gymnorrhiza, Aglaia cucullata, Brownlowia tersa, Lumnitzera racemosa, Heritiera fomes, Clerodendrum inerme, Dalbergia spinosa, Caesalpinia crista, Xylocarpus moluccensis, Excoecaria agallocha, Thespesia populnea,* etc. are predominantly seen. *Myriostachya wightiana,* a tall grass, is seen along the wet banks, whereas *Acrostichum aureum,* a mangrove fern, generally colonises slightly elevated drier areas in the mangrove forests. *Acanthus ilicifolius* with its attractive mauve-coloured flowers and spiny-edged leaves grows along banks of creeks under high salinity areas of apparent dry and wet conditions. Seen with it are the halophytes like *Suaeda nudiflora, Suaeda maritima, Atriplex* sp., *Salicornia brachiata, Arthrocnemum indicum, Aeluropus lagopoides,* etc.

The mangroves in Sunderbans present complex ecological conditions due to their vastness in extent and innumerable ramifications of the riverine systems resulting in the formation of several islandlets with varied habitat conditions which are ideal for the growth of maximum number of mangrove species forming different associations and zonations. Such vegetation groupings are less pronounced in other mangrove areas in the country and consequently the floristic diversity or the richness of species also gradually tapers from Sunderbans to southwards along the east coast and is much less along the west coast from down south in the Kerala region to Saurashtra and Kutch regions in the north.

2. *Mahanadi mangroves, Orissa :*

The Mahanadi mangroves cover an area of about 200 sq km and they are in a degraded state due to habitat alteration for agricultural systems and development of port facilities at Paradweep. Dense mangrove forests are seen in the Bhitar Kanika estuarine mudflats and along deltaic creeks between the rivers Devi and Dhamra. As in Sunderbans, *Phoenix paludosa, Porteresia coarctata* and *Aegialitis rotundifolia* occur more towards estuarine conditions. *Rhizophora mucronata, Avicennia alba, Avicennia marina, Avicennia officinalis, Ceriops decandra, Ceriops tagal, Sonneratia alba, Bruguiera gymnorrhiza, Bruguiera parviflora, Bruguiera cylindrica, Xylocarpus granatum, Kandelia candel* grow luxuriently in the tidal mangrove zone.

Heritiera fomes, Brownlowia tersa (with golden-brown scaly leaves), *Tamarix gallica, Sonneratia apetala, Sonneratia griffithii, Sonneratia caseolaris, Cynometra ramiflora, Aglaia cucullata, Hibiscus tiliaceus, Excoecaria agallocha, Dalbergia spinosa, Caesalpinia crista, Heritiera littoralis, Lumnitzera racemosa, Derris trifoliata, Intsia bijuga, Finlaysonia maritima*, etc. are more pronounced under a more fresh water regime in these tidal forests. *Acrostichum aureum* is seen as colonies in disturbed habitat conditions and indicates secondary conditions. The reported occurrence of *Nypa fruticans* in Mahanadi region (Haines, 1921) is yet to be confirmed as this is not collected by others in recent years.

Towards more elevated fringe areas in the mangrove areas, *Acanthus ilicifolius*, the sea-holly, lines up along water margins whereas the true halophytes such as Salicornias and Suaedas occur on drier salt pan areas which are in reality non-mangroves.

Other important area where mangroves grow in Orissa is the small Burabhalanga tidal estuary, with species of *Avicennia, Sonneratia, Rhizophora* and *Phoenix paludosa* and *Excoecaria agallocha*, which form noteworthy elements.

3. The Godavari and the Krishna mangrove forests, Andhra Pradesh :

The mangrove vegetation in these two estuarine formations covers an area of about 200 sq km and shows a regression in the number of mangrove species diversity in comparision to the Mahanadi tidal forests in Orissa.

The mangrove forests are chiefly dominated by *Sonneratia alba, Sonneratia apetala, Avicennia marina, Avicennia alba, Avicennia officinalis, Rhizophora apiculata, Rhizophora mucronata, Bruguiera gymnorrhiza, Ceriops decandra, Xylocarpus granatum, Lumnitzera racemosa, Hibiscus tiliaceus, Derris trifoliata, Excoecaria agallocha*, etc. *Porteresia coarctata* and *Myriostachya wightiana* are more pronounced on newly formed mudflats in the intertidal region. *Nypa fruticans, Phoenix paludosa, Heritiera fomes, Heritiera littoralis, Brownlowia tersa, Aglaia cucullata, Aegialitis rotundifolia* and the mangrove fern *Acrostichum aureum* are absent here. *Scyphiphora hydrophyllacea*, a small shrub along the fringes of creeks towards inland is seen in some places. *Ipomoea tuba* and *Sarcolobus carinatus* are the often seen climbers in these forests.

Much of the mangrove forests have been over-exploited for fuel and fire wood and large deltaic areas have been reclaimed for agri-

Typical view of mangrove forest during high tide in Pichavaram tidal forests.
Courtesy : BSI, SC., Coimbatore.

Myriostachya wightiana, in Sunderbans.
Photo : L. K. Banerjee. BSI.

Rhizophora mucronata in a pure stand along a tidal creek in S. Andaman Island.
Courtesy : BSI, ANC., Port Blair.

Acanthus ilicifolius in Pichavaram tidal forests.
Courtesy : BSI, SC., Coimbatore.

Acanthus volubilis, a climber with stilt-roots, in Sojanakhali, Sunderbans.
Photo : L. K. Banerjee, BSI.

Aegiceras corniculatum in flowers and fruits in Pichavaram tidal forests.

Courtesy : BSI, SC., Coimbatore.

Rhizophora apiculata in flowering in Mahanadi tidal forests.

Photo : L. K. Banerjee, BSI.

culture. Resultantly the mangrove forests have dwindled and are in a state of secondary stage.

4. *The Cauvery mangroves, Tamil Nadu :*

The mangroves of the Cauvery deltaic system are discontinuous in nature and covers an estimated total area of about 150 sq km. Of this, the Kallai including Pichavaram covers an area of about 14 sq km of dense mangrove vegetation, which is a reserved forest with about 20 different mangrove species.

The mangals of Pichavaram show a marked zonation of different species, whereas beautiful pure stands of *Avicennia marina* are seen in the Muthupet due to management practices (Anon., 1979). In Pichavaram, *Rhizophora* grows well along the channels and creeks and is represented by *Rhizophora apiculata, Rhizophora mucronata*, and attains a good height of about 10 m. Mixed in this zone are : *Bruguiera cylindrica, Ceriops decandra* and *Sonneratia apetala,* of which the later attains a height of about 15 m with a clean bole for which reason is systematically felled resulting in its rarity in this area.

In slightly interior areas lying behind the *Rhizophora* and *Bruguiera* community, *Avicennia alba* and *Avicennia officinalis* form a zonation.

Other species that grow in this area are *Lumnitzera racemosa, Aegiceras corniculatum, Derris trifoliata, Dalbergia spinosa, Excoecaria agallocha* and *Acanthus ilicifolius.*

B. Mangroves of the West Coast

As it has been mentioned in the preceeding paragraphs, the mangals of the western coast mostly form a fringe vegetation along different parts of the coast-line where favourable conditions prevail. Only in certain estuarine parts of Goa, Maharashtra and Gujarat dense formations are seen although not varied in species diversity as in the east coast mangrove formations.

The salient components of the floristic composition in different parts are as under :

5. *Back water systems : Veli (a coastal lagoon near Trivandrum, Kerala).*

Avicennia officinalis, Rhizophora mucronata, Rhizophora apiculata and *Bruguiera gymnorrhiza* constitute the tidal mangroves. *Barringtonia racemosa, Sonneratia apetala, Cerbera manghas, Hibiscus tiliaceus, Derris trifoliata* and the Indian screwpine, *Pandanus tectorius* are the important taxa which grow behind the tidal mangrove zone, and are interspersed with a few non-mangrove species. The fern *Acrostichum aureum* grows in degraded habitats. *Acanthus ilicifolius* colonises saline marshes.

The mangrove areas of Kerala region have been subjected to great biotic pressures and have been reportedly replaced by extensive coconut plantations over years, resulting in rarity of some mangroves reported in earlier works (Anon., 1987).

6. Mangroves of Karnataka coast :

The mangrove vegetation in this region consists mainly of *Rhizophora apiculata, Ceriops tagal, Kandelia candel, Avicennia alba, Excoecaria agallocha, Cynometra* sp., *Sonneratia caseolaris, Heritiera littoralis Cerbera manghas, Acanthus ilicifolius*, etc. *Acrostichum aureum* occurs in open situations.

7. Mangroves of Goa region :

It is reported that a total area of about 200 sq km falls under mangrove vegetation (Anon., 1987) covering seven estuarine areas of which the Mandovi and Zuari and the inter-connecting Cambarjua canal harbour about 75% of the mangroves of the region. About 20 species are reported to occur of which *Rhizophora mucronata, Sonneratia alba, Avicennia officinalis*, are dominant associated with *Rhizophora apiculata, Sonneratia caseolaris, Kandelia candel, Bruguiera gymnorrhiza, Bruguiera parviflora, Aegiceras corniculatum, Excoecaria agallocha, Derris* sp., *Acanthus ilicifolius*, etc. (Untawale, 1980, 1982).

8. Mangroves of Maharashtra coast :

An estimated area of about 300 sq km is reportedly covered with mangrove vegetation in this region and is noticeable along the tidal river creeks and in and around Bombay city. Much of the area under mangrove vegetation has been lost in the present century due to land reclamation and over-exploitation for fuel wood purposes. Consequently several species of mangroves reported in earlier

works have become rare and are not seen, as exemplified by *Lumnitzera racemosa* which was reported common in Bandra area in Bombay in the year 1934, but not seen now. Species of *Rhizophora* and *Bruguiera gymnorrhiza* have also become rare or even disappeared in this area and the vegetation is reduced to stunted stands of *Avicennia* species and *Acanthus ilicifolius.*

Avicennia alba, Avicennia officinalis, Avicennia marina, Rhizophora mucronata, Aegiceras corniculatum, Bruguiera gymnorrhiza, Sonneratia apetala, Sonneratia alba, Lumnitzera racemosa, Excoecaria agallocha, Acanthus ilicifolius, etc. are some of the mangrove species reported from this region.

9. Mangroves of Gujarat coast :

In this part, the mangroves are seen on salt marshes, along tidal creeks and on muddy banks. About 260 sq km of area is covered under mangrove vegetation which presents an open mangrove scrub (Anon., 1987 ; Waheed Khan, 1959). Poorly grown plants of *Avicennia officinalis, Avicennia marina, Aegiceras corniculatum, Rhizophora mucronata, Rhizophora apiculata, Bruguiera gymnorrhiza, Salvadora persica* and *Acanthus ilicifolius* constitute the mangrove communities. Non-mangrove halophytes such as *Salvadora persica, Salvadora oleoides, Atriplex stocksii, Salicornia brachiata, Suaeda fruticosa, Suaeda nudiflora, Tamarix troupii,* etc. grow on the interior drier marshes and elevated areas. *Urochondra setulosa,* a grass, forms pure communities along tidal creeks and on shallow back-water mud flats.

C. Mangroves of Andaman and Nicobar Islands

The Andaman and Nicobar Islands harbour some of the best developed mangrove vegetation and are less disturbed due to inaccessibility and remoteness compared to the main-land mangroves. An estimated 1190 sq km area is covered with mangrove forests dispersed in several areas of these islands (Anon., 1987). About 20 species predominate the mangroves. Well grown trees and shrubs of *Rhizophora mucronata, Rhizophora apiculata, Ceriops tagal, Bruguiera gymnorrhiza, Bruguiera parviflora, Xylocarpus granatum, Sonneratia alba, Sonneratia caseolaris, Aegiceras corniculatum, Avicennia officinalis, Cerbera manghas, Brownlowia tersa, Lumnitzera racemosa, Excoecaria agallocha, Acanthus ilicifolius, Heritiera littoralis* (more common along sea shores than in mangrove swamps) make a close canopied impenetrable forests. *Nypa fruticans* and *Phoenix*

paludosa form impressive colonies along tidal creeks. *Acanthus volubilis* is rather uncommon.

Unlike in the mangroves of east coast estuarine areas where the species present a more or less uniform and characteristic zonation, the mangroves in these islands present no similarities and the zonation gets altered in different areas due to ecological conditions.

KEY TO THE FAMILIES

1a. Flowering plants :

2a. Flowers 4-merous ; seeds with 2 cotyledons :

3a. Plants with either stilt-roots or knee-roots or pneumatophores and vivipary :

4a. Plants without pneumatophores ; stilt-roots, knee-roots and vivipary present :

5a. Ovary inferior ; stamens more than 6 ... *Rhizophoraceae*

5b. Ovary superior ; stamens less than 6 :

6a. Style 1; anthers with transverse septa ... *Myrsinaceae*

6b. Styles 5 ; anthers without transverse septa ... ... *Plumbaginaceae*

4b. Plants either with large buttressus or pneumatophores ; stilt-roots, knee-roots and vivipary absent (except for incipient vivipary in Avicenniaceae) :

7a. Buttressus present ; pneumatophores woody ; stamens more or less united :

8a. Leaves on the under surface covered with golden fimbriate scales ; filaments united into a column with 5 fertile stamens alternating with many staminodes ; stigma simple ... ... *Sterculiaceae*

8b. Leaves glabrous and without scales ; filaments united into a tube, stamens not as above ; stigma capitate or discoid ... ... *Meliaceae*

7b. Buttressus absent ; pneumatophores not woody ; stamens free :

9a. Pneumatophores spongy ; stamens 4-5 at corolla throat ; fruit a 1-seeded compressed capsule ... ... *Avicenniaceae*

9b. Pneumatophores corky ; stamens many, inserted on a hypanthium ; fruit a many-seeded berry ... *Sonneratiaceae*

3b. Plants without stilt-roots, knee-roots and vivipary :

10a. Flowers irregular ; fruit a legume or lomentum ... *Fabaceae (Leguminosae)*

10b. Flowers regular ; fruit not a legume or lomentum :

11a. Plants with milky sap ; petals united at least at base ; stamens inserted on the petals :

12a. Pollen aggregated into pollinia ; carpels united at stigmatic disc ; fruit usually of 2 follicles ... *Asclepiadaceae*

12b. Pollen not aggregated into pollinia ; carpels entirely united by styles ; fruit usually drupaceous ... *Apocynaceae*

11b. Plants without milky sap ; petals and stamens free ... ... *Tiliaceae*

13a. Leaves compound ; ovules and seeds many ; seeds winged ... *Bignoniaceae*

13b. Leaves simple ; ovules and seeds not winged :

14a. Plants with acrid milky juice ; flowers usually unisexual ; ovary mostly 3-loculed ... *Euphorbiaceae*

14b. Plants without milky juice ; flowers bisexual ; ovary less than 3-loculed :

15a. Flowers with prominent bracts and bracteoles ; petals united ; fruit not winged ; dehiscent ... *Acanthaceae*

15b. Flowers without prominent bracts and bracteoles ; petals free ; fruit winged, usually indehiscent ... *Combretaceae*