MANGROVES IN INDIA

IDENTIFICATION MANUAL

BOTANICAL SURVEY OF INDIA

MANGROVES IN INDIA

IDENTIFICATION MANUAL

L. K. Banerjee, A. R. K. Sastry & M. P. Nayar

BOTANICAL SURVEY OF INDIA

Date of Publication : 20th November, 1989

Price

Line drawings by Shri D. P. Saha, Artist, BSI

Published by the Director, Botanical Survey of India, P-8, Brabourne Road Calcutta-700 001 and Printed by M/s. Venus Printing Works, 52/7, Bipin Behari Ganguly Street, Calcutta-700 012.

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

ACKNOWLEDGEMENTS

We are privileged to record our gratitude to Shri Mahesh Prasad, Secretary, Ministry of Environment & Forests, Prof. H. Y. Mohan Ram, Chairman, Programme Advisory Committee for BSI & ZSI and Dr. A. C. Ray, former Additional Secretary and Shri A. K. Narayanan, Director, Ministry of Environment & Forests, for their keen interest in this work. Our sincere thanks are also due to our colleagues for photographs, to Shri S. C. Pal, Publication Officer and members of the staff of the Publication Section, for help in this publication. Finally, it gives us great pleasure to thank Shri T. K. Mitra, Venus Printing Works, and the staff members for the care taken in printing this book.

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, molluscs 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 conlitutes 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 moluccensis (Lamk.) Roem.
Xylocarpus mekongensis Pierre

Myrsinaceae

Aegiceras corniculatum (L.) Blanco

Plumbaginaceae

Aegialitis rotundifolia Roxb.

Pteridaceae

Acrostichum aureum L.

Rubiaceae

Scyphiphora hydrophyllacea Gaertn 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 wilhout 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*

2b. Flowers 3—4-merous ; seeds with 1 cotyledon :

16a. Small trees or shrubs, stems monopodial ; leaves pinnately or palmately divided ; flowers in one or more sheathing spathes ... *Arecaceae (Palmae)*

16b. Perennial grasses ; culms slender ; branching ; leaves simple ; flowers in spike-lets with imbricating bracts ... *Poaceae (Gramineae)*

1b. Non-flowering plants ... ... *Pteridaceae*

KEY TO THE GENERA & SPECIES OF THE FAMILIES

RHIZOPHORACEAE

Represented by 4 genera and 10 species in Indian mangroves.

KEY TO THE GENERA

1a. Flowers ebracteolate ; calyx 8—13-lobed : petals 2-lobed ... *Bruguiera*

1b. Flowers bracteolate ; calyx 4—6-lobed ; petals not lobed :

2a. Calyx 4-lobed ; petals without apical appendages ; anthers opening with a ventral valve ... ... *Rhizophora*

2b. Calyx 5-lobed ; petals with apical appendages ; anthers not opening with a ventral valve :

3a. Calyx lobes ovate ; stamens 10—12 ; hypocotyle ridged, short, upto 25 cm long ... ... *Ceriops*

3b. Calyx lobes linear-oblong ; stamens more than 12 ; hypocotyle smooth, upto 40 cm long ... *Kandelia*

Bruguiera Lamk.

KEY TO THE SPECIES

1a. Flowers solitary, 3—4 cm long :

2a. Petioles, midribs, pedicels and flowers reddish or scarlet ; mature calyx-tube not distinctly ribbed ; each petal lobe with 1—4 apical cilia exceeding the lobe apices ... ... *B. gymnorrhiza*

2b. Petioles, midribs, pedicels and flowers yellow ; mature calyx-tube distinctly ribbed ; each petal lobe with 0—2 apical cilia not exceeding the lobe apices ... *B. sexangula*

1b. Flowers (2-)—3—(-5), less than 2 cm long :

3a. Calyx tube smooth ; lobes equal to tube, completely reflexed in fruit/hypocotyle ... ... *B. cylindrica*

3b. Calyx tube ribbed ; lobes ½ the length of tube, slightly reflexed in fruit/hypocotyle ... ... *B. parviflora*

Rhizophora Linn.

KEY TO THE SPECIES

1a. Leaf-tip acute, not rolled up ; inflorescence 2-flowered ; petals glabrous ; stamens 12 ... ... *R. apiculata*

1b. Leaf-tip blunt, always rolled up ; inflorescence more than 2-flowered (4—8) ; petals hairy ; stamens mostly 8 :

2a. Style 0.5—1 mm long ; free part of ovary emerging beyond the disk ... ... *R. mucronata*

2b. Style 3—5 mm long ; free part of ovary enclosed by the disk ... ... *R. stylosa*

Ceriops Arn.

KEY TO THE SPECIES

1a. Petals with 3-clavate appendages ; anthers shorter than the filaments ... ... *C. tagal*

1b. Petals without clavate appendages, fringed ; anthers longer than the filaments ... ... *C. decandra*

Kandelia (DC.) Wt. & Arn.

Kandelia candel (Linn.) Druce, a monotypic genus.

SONNERATIACEAE

Represented by one genus with 4 species in Indian mangroves.

Sonneratia Linn. f.

KEY TO THE SPECIES

1a. Petals absent :

2a. Calyx 4-lobed, leaves narrowly elliptic ... *S. apetala*

2b. Calyx 6—8-lobed, leaves obovate to sub-orbicular ... *S. griffithii*

1b. Petals present :

3a. Leaves mucronate with distinct apical nobs ; flowers reddish-purple with flattened calyx-tube ... *S. caseolaris*

3b. Leaves emucronate, without apical nobs ; flowers white with cup-shaped calyx-tube ... ... *S. alba*

AVICENNIACEAE

Represented by one genus with 3 species and a variety in Indian mangroves.

Avicennia Linn.

KEY TO THE SPECIES

1a. Stem blackish in colour ; leaves lanceolate ; inflorescence spicate ; capsules ellipsoid ... ... *A. alba*

1b. Stem greyish in colour ; leaves obovate or elliptic ; inflorescence umbellate ; capsules ovoid :

2a. Trees, 10—30 m tall ; leaves obovate ; capsules broadly ovoid, beaked ... ... *A. officinalis*

2b. Shrubs or small trees, 0.5—6 m tall ; leaves elliptic ; capsules apiculate :

3a. Small trees, 3—5 m tall ; leaves petiolate, acute or obtuse at apex ... *A. marina* var. *marina*

3b. Bushy shrubs, 0.5—1 m tall ; leaves sessile or subsessile, sharply acuminate at apex ... *A. marina* var. *acutissima*

STERCULIACEAE

Represented by one genus with three species in Indian mangroves.

Heritiera Dryand.

KEY TO THE SPECIES

1a. Trees with buttressus, without pneumatophores ; leaves broadly

ovate-oblong, upto 24 cm long ; fruit ellipsoid with a dorsal rudder-like crest or wing ... ... *H. littoralis*

1b. Trees without buttressus ; with pneumatophores ; leaves elliptic-lanceolate, upto 14 cm long ; fruit globose or sub-globose without a dorsal rudder-like crest or wing :

2a. Fruit sub-globose, smooth, dorsally flat, with a prominent transverse circular ridge ... ... *H. fomes*

2b. Fruit globose, rough, not-dorsally flat, without a transverse circular ridge ... ... *H. kanikensis*

MELIACEAE

Represented by two genera and four species in Indian mangroves.

KEY TO THE GENERA

1a. Leaves imparipinnate, leaflets 7—11 ; seeds with fleshy aril ... *Aglaia*

1b. Leaves paripinnate, leaflets 1—3-jugate ; seeds without aril ... *Xylocarpus*

Aglaia Lour.

Only one species, viz., *A. cucullata* (Roxb.) Pellegrin occurs in mangrove forests of Sunderbans and Mahanadi estuarine areas in India.

Xylocarpus Koen

KEY TO THE SPECIES

1a. Buttresses present; root-suckers absent; bark yellowish-white with papery flakes ; leaflets obovate ; staminal teeth prominent; fruits 20—35 cm across ... ... *X. granatum*

1b. Buttresses absent ; root- suckers present ; bark dark-red with thick flakes ; leaflets not obovate ; staminal teeth obscure; fruits less than 20 cm across :

2a. Leaflets ovate ; stigma cupular ; fruits 5—7 cm across ... *X. molluccensis*

2b. Leaflets elliptic-oblong ; stigma discoid ; fruits 8—15 cm across ... ... *X. mekongensis*

COMBRETACEAE

Represented by *Lumnitzera* with two species in the mangroves of India.

Lumnitzera Willd.

KEY TO THE SPECIES

1a. Plants without knee-like pneumatophores, flowers white, sessile, in axillary racemes; stamens and petal-lobes equal in length ... ... *L. racemosa*

1b. Plants usually with knee-like pneumatophores, flowers red, pedicellate, in terminal racemes; stamens longer than petal-lobes ... ... *L. littorea*

ACANTHACEAE

Represented by a single genus *Acanthus* with 2 species in Indian mangroves.

Acanthus Linn.

KEY TO THE SPECIES

1a. Plants erect; leaves pinnatifid, with spinescent marginal teeth; flowers bracteolate, corolla blue ... ... *A. ilicifolius*

1b. Plants twining; leaves entire; flowers ebracteolate, corolla white ... *A. volubilis*

FABACEAE

Commonly represented by 4 genera with one species under each, in the Indian mangroves.

KEY TO THE GENERA

1a. Calyx united; standard uppermost; stamens in 1 or 2 bundles;

2a. Anthers dimorphus; pods usually beset with stinging hairs ... *Mucuna*

2b. Anthers uniform; pods never beset with stinging hairs:

3a. Leaflets opposite; pods usually winged ... *Derris*

3b. Leaflets alternate; pods not winged ... *Dalbergia*

1b. Calyx divided ; standard lowermost ; stamens free :

4a. Leaves 2—3-jugate ; petals 5 ; stamens 10 ... *Cynometra*

4b. Leaves 1—2-jugate ; petal 1 ; stamens 3 ... *Intsia*

ASCLEPIADACEAE

Mostly represented by a monotypic genus, *Finlaysonia* and two species of *Sarcolobus* along the mangrove fringes in India.

KEY TO THE GENERA

1a. Corona present ; follicles ovoid, narrowed into a curved beak ; seeds with coma ... ... *Finlaysonia*

1b. Corona absent ; follicles globose, not beaked ; seeds without coma ... ... *Sarcolobus*

Sarcolobus R. Br.

KEY TO THE SPECIES

1a. Branches slender ; leaves obovate-lanceolate or linear-oblong ; corolla yellow, brown-dotted, glabrous within ; follicles ellipsoid, keeled ... ... *S. carinatus*

1b. Branches rather thick ; leaves ovate-acuminate, apiculate ; corolla purplish, pubescent within ; follicles globose, not keeled ... ... *S. globosus*

ARECACEAE (PALMAE)

Represented by one species each of the genera *Nypa* and *Phoenix* in the mangrove forests of India.

KEY TO THE GENERA

1a. Stemless palm, leaf-segments lanceolate, plicate ; fruits hexagonal ... *Nypa*

1b. Soboliferous palm, 4—8 m tall, leaf-segments ensiform with induplicate margin ; fruits oblong, terete ... *Phoenix*

POACEAE (GRAMINEAE)

Represented by three genera with one species under each in Indian mangroves.

KEY TO THE GENERA

1a. Leaves terete, tips spiny ... ... *Urochondra*

1b. Leaves not terete, tips not spiny :

2a. Stems densely tufted, erect from a stout sheathed root-stock ; leaf-margin smooth ; ligule absent ; spikelets 1-flowered ... ... *Myriostachya*

2b. Stem not tufted, erect from a creeping rhizome ; leaf-margin scaberulous ; ligule present ; spike-lets many flowered ... *Porteresia*

The families : Tiliaceae, Plumbaginaceae, Myrsinaceae, Bignoniaceae, Apocynaceae, Euphorbiaceae and Polypodiaceae are so far represented by one species each in the mangrove forests in India.

Acanthus ilicifolius Linn. ACANTHACEAE

Local names : Hargoza (Hind.), Marandi (Mar.), Alsi, Akhi (Tel.). Sea Holly (Eng.).

Erect or rarely scandent shrubs upto 2 m tall ; stems several, stout, glabrous, base with stilt roots. Leaves glabrous, shining, 5—11 × 3—8 cm, various, usually ovate-oblong, elliptic or ovate-lanceolate, pinnatifid or toothed, rigid, narrowed at base, obtusely spinous at apex, marginal teeth spinous, nerves strong. Flowers sessile, 3.5—4 cm long, in terminal or pseudo-axillary densely strobilate spike ; bracts 1—2 cm long, acute, ovate, glabrous ; calyx 4-segmented, lobes glabrous, shortly connate in two opposite pairs ; corolla 5-segmented, 3—4 cm long, blue or bluish-violet, segments connate, 2-lipped, hairy outside ; stamens with thick filaments, anthers densely bearded. Capsule ovoid-oblong, upto 3 cm long, compressed, apiculate, brown, shining.

Gregarious along the tidal swamps in the sheltered mangrove areas, mostly as a secondary formation. Rarely seen along fresh water swamps in the coastal areas indicating its ecological amplitude and tolerence. Flowering and fruiting from April—August. Distributed all over the tidal forests in S. E. Africa, India, Sri Lanka, Bangladesh, Burma, Malesia, Java, Indonesia and Australia. Fruit pulp is used as a blood purifier and leaf paste in rheumatism.

Notes : The species is easily recognisable in the field from its holly-like leaves and attractive bluish flowers.

References :

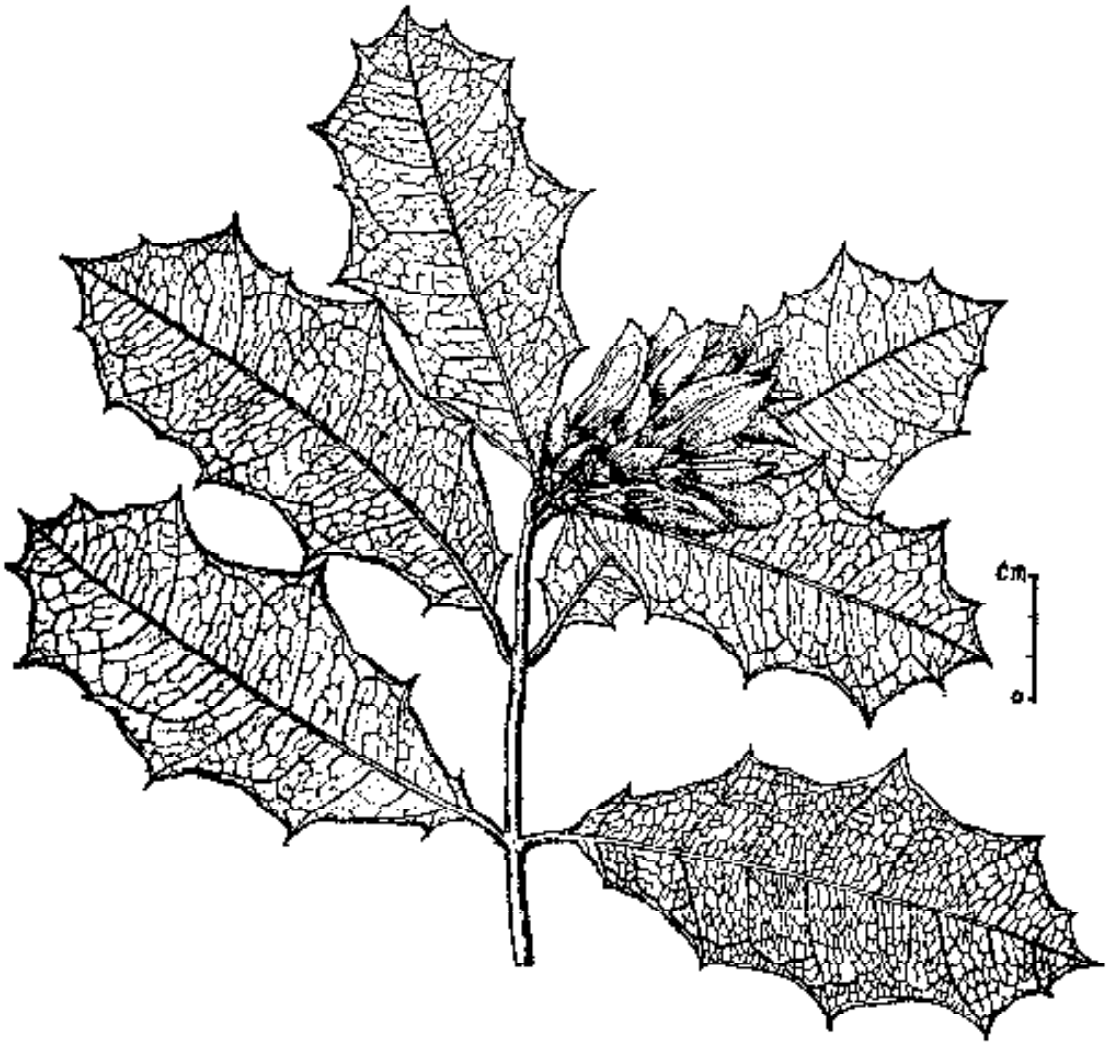
1. Bremekamp, C. E. B. (1962). *Densk. Bot. Arkiv.* 20 : 64.

2. Clarke, C. B. (1884). *In :* J. D. Hooker, *Fl. Brit. India* 4 : 481.

3. Cooke, T. (1967). *Fl. Pres. Bombay* 2 : 427 (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Gamble, J. S. (1967). *Fl. Pres. Madras* 2 : 712. (2nd repr. ed.). Botanical Survey of India, Calcutta.

5. Wight, R. (1846). *Icon.* t. 459.



Acanthus ilicifolius Linn.

Avicennia marina in Mahanadi tidal forests. Photo: L. K. Banerjee, BSI.

Sonneratia caseolaris in Mahanadi tidal forests. Photo: L. K. Banerjee, BSI.

Bruguiera gymnorrhiza during high tide in S. Andaman Island.

Courtesy : BSI, ANC., Port Blair.

Rhizophora apiculata—showing the entire tree and intricate root-system and stilt-roots during low tide in S. Andaman Island.

Courtesy: BSI, ANC., Port Blair.

Sonneratia caseolaris in flowers & fruits. Photos: Dr. T. A. Rao.

Acanthus volubilis Wall. ACANTHACEAE

Unarmed glabrous twining shrubs upto 8 m tall, stem-base supported by slender stilt-roots arising from basal nodes. Leaves 7—9 × 2.5—3 cm, oblong, ovate-oblong or elliptic, leathery, margins entire, cuneate at base, obtuse or mucronulate at apex. Flowers 1.9—2.5 cm long, arranged in 10—12 cm long spikes ; spikes simple or branched ; bracts lanceolate, subtending the calyx, caducous ; calyx 4-lobed, shortly cuneate below in two opposite pairs, outer sepals larger than the inner sepals ; corolla white, 2-lipped, connate, 5-lobed, lower lip obovate, shortly 3-lobed ; stamens 4, didynamous, anthers densely bearded. Capsule *ca* 2.5 cm long, ellipsoid, compressed, mucronate at apex.

Rather sporadic and rare in tidal forests and swamps, growing in sheltered mangrove areas often climbing on mangrove tree species like *Avicennia officinalis* and *Ceriops decandra*. Flowering and fruiting from April—August. In India the species is distributed only in the Sunderbans and Andaman Islands. Also occurs in Burma, Thailand and Java. Its leaves are used for dressing boils and wounds.

Notes : A. volubilis is easily distinguished from *A. ilicifolius* by its twining habit, entire non-spinescent leaves and white flowers. It is recently collected from Sajnakhali in Sunderbans, West Bengal (*Banerjee* 13907, CAL.) in 1983 and appears to be a rediscovery of this rare species after a gap of 90 years from West Bengal Sunderbans.

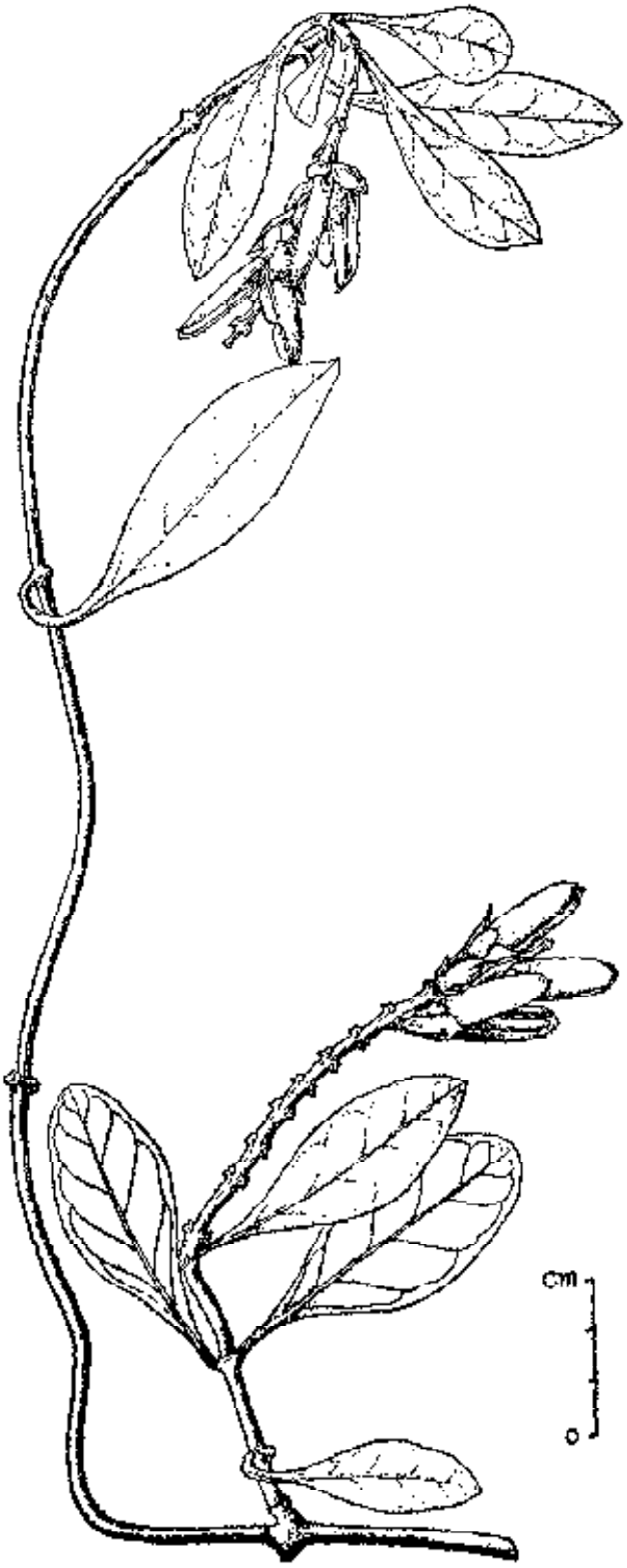
References :

1. Clarke, C. B. (1884). *In :* J. D. Hooker, *Fl. Brit. India* 4 : 481.

2. Kurz, S. (1877). *For. Fl. Burma* 2 : 242.

3. Prain, D. (1963). *Bengal Pl.* 2 : 596. (repr. ed.). Botanical Survey of India, Calcutta.

4. Wallich, N. (1830). *Pl. Asia. Rar.* 2 : 56, t. 122.



Acanthus volubilis Wall.

Cerbera manghas Linn. APOCYNACEAE

(*C. odollam* Gaertn.)

Local names : Dakur (Beng.), Pani ambo (Or.), Sakuru (Mar.), Ulalam (Mal.), Kadama (Tam.)

Small trees, 4—6 m high, stem soft, glabrous with milky juice. Leaves alternate, closely set or whorled at the apices of branchlets, 10—15 × 3—5 cm, ovate-oblong or oblanceolate, acuminate at apex, rounded at base. Flowers large, bracteate, 3—4 cm long, arranged in terminal paniculate cymes, funnel-shaped, white with yellow throat, turning purple or red on ageing. Fruits large, 7 - 9 × 4—6 cm, globose-ovoid or ellipsoid, drupaceous with fibrous pericarp ; seeds 1 - 2, each 2 2.5 cm across, broad, compressed, fibrous.

Frequent along the intertidal banks of creeks and channels in mangrove forests ; prefers and more frequent in situations inundated by more fresh water flow from the rivers and often in association with *Heritiera fomes*. Flowering and fruiting from March—August. In India the species occurs in all the east and west coast mangrove forests. Also extends into the mangrove forests in Sri Lanka, Malesia, China and Australia. Bark and sap (milky latex) are used as a purgative and for relief in rheumatism ; a medicinal oil is extracted from the seeds.

References :

1. Bakhuizen van Den Brink, R.C. (Jr.) (1950). *Blumea* 6 : 386.

2. Cooke, T (1967). *Fl. Pres. Bombay* 2 : 190. (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Gamble, J. S. (1967). *Fl. Pres. Madras* 2 : 566. (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Hooker, J. D. (1882). *Fl. Brit. India* 3 : 638.

5. Wight, R. (1841). *Icon.* 1. 441

Finlaysonia obovata Wall. ASCLEPIADACEAE

Local names : Dudi-lata (Beng.), Kansharinata (Or.).

A large spreading climber, stems glabrous with milky latex. Leaves opposite, 5—16.5 × 3—6 cm, broadly obovate, leathery, rounded or emarginate at apex, cuneate at base. Flowers in axillary trichotomously branched cymes, 3—4 mm across, white or purple. Fruit a follicle, 7–9 × 4—5 cm, ovoid, divaricate, 2—3-winged, narrowed into a curved beak at apex ; seeds 2.5—3 cm long, ovoid, flattened, with a tuft of silky long hairs.

Frequent in the intertidal areas of creeks and channels in the mangrove fringes and estuarine island lets. Flowering and fruiting from October—March. Distributed in the Sunderbans and Mahanadi mangrove forests in India ; also occurs in Bangladesh, Burma (Tenasserim), Malaya, Java and Malacca. The leaves are used for relief from asthma in Bengal and Orissa.

Notes : A monotypic genus (represented by a single species) easily distinguished in the field by its stout reddish-brown twining stems, foetid flowers, and divaricate winged follicles. The species is treated by some under a separate family Periplocaceae.

References :

1. Bakhvizen van Den Brink, R. C. (Jr.) (1950). *Blumea* 6 : 369.

2. Hooker, J. D. (1885). *Fl. Brit. India* 4 : 7.

3. Prain, D. (1963). *Bengal Pl.* 2 : 508. (repr. ed.). Botanical Survey of India, Calcutta.

4. Wallich, N. (1831). *Pl. Asiat. Rar.* 2 : 48, t. 162.

Sarcolobus globosus Wall. ASCLEPIADACEAE

Local names : Baoli-lata (Beng.), Pasurlata (Or.).

Twining shrubs with stout glabrous branches, root-stock thick, fleshy ; roots thick. Leaves 3—6 × 2—4.5 cm, ovate or oblong, thick and fleshy, acute or obtuse at apex, rounded at base. Flowers small, starry, crowded, in axillary corymbose cymes, 2—3 mm across ; corolla purplish, lobes pubescent inside. Follicles brown, 4—5 cm across, sub-globose ; seeds many, flattened.

Frequent on muddy intertidal areas in mangrove forests often in association with and climbing on *Phoenix paludosa*. Flowering and fruiting during June—September. In India the species occurs in the Sunderbans, and Mahanadi mangrove forests as undergrowth ; also reported from Nicobar Islands. Distributed in Mergui and Malacca. Its leaves and rhizomes are used in medicine.

Notes : Another closely allied species, viz., *Sarcolobus carinatus* Wall. also occurs in mangroves of India along the east coat. *S. carinatus* is readily recognised by its slender branches and yellow brown-dotted corolla of the flowers and is also seen distributed in the mangrove areas of the Sunderbans, Mahanadi and has been collected from the Coringa tidal forests in Andhra Pradesh; extending into the Andaman Islands and Mergui. It is not reported from West Coast mangroves in India.

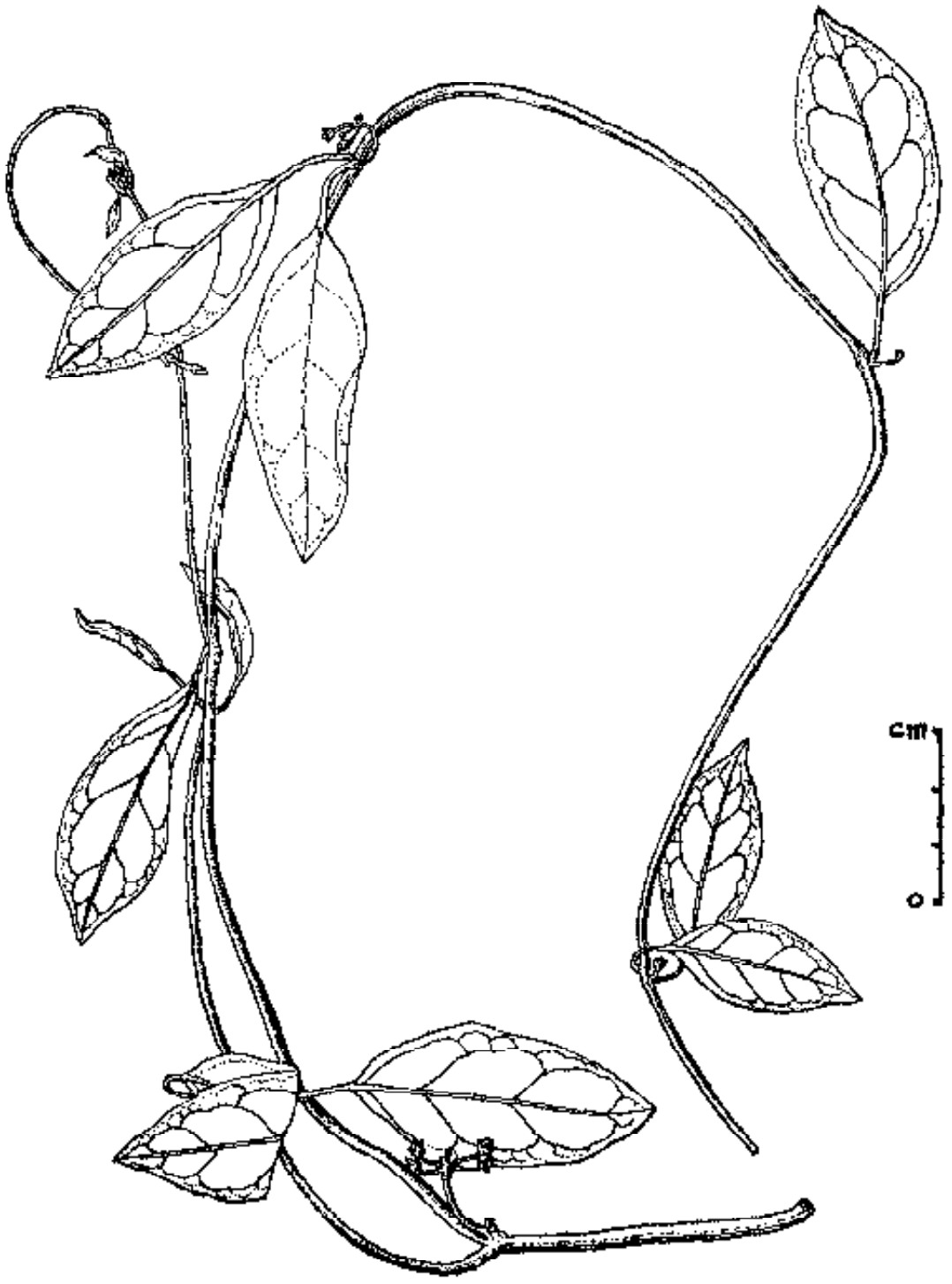
References :

1. Hooker, J. D. (1876). *Fl. Brit. India* 4 : 27-28.

2. Prain, D. (1963). *Bengal Pl.* 2 : 514 (repr. ed.). Botanical Survey of India, Calcutta.

3. Rintz, R. E. (1980). *Blumea* 26(1) : 72.

4. Wallich, N. (1816). *Asiat. Res.* 12 : 570, t. 4.



Sarcolobus carinatus Wall.

Nypa fruticans Wurumb. ARECACEAE

Local names : Gulga, Golpati, Gairea (Beng.), Gulga (Hind.), Nipamu (Tel.), Water Coconut (Eng.).

Gregarious, stemless palms, root-stock prostrate, thick, long, branched. Leaves arising from the root-stock, pinnatisect, 5—6 m long, leaflets linear-lanceolate, plicate, 1.5—2.5 m long, waxy-glaucous underneath, with bifurcate, soft spine-like scales along the under surface of the midrib, petioles 1.5—2 m long, stout. Spathes many ; spadix terminal, branched, erect in flower, drooping in fruit. Flowers monoecious, male flowers minute, mixed with bracteoles, arranged in catkins on lateral branches of the spadix ; female flowers larger, arranged in globose terminal heads. Fruits 12—16 × 6—10 cm ovoid or globose, syncarpous, with hexagonal 1-seeded carpels and pyramidal tips ; pericarp fleshy, fibrous ; endoacrp spongy.

Often forms gregarious colonies along the sheltered intertidal regions of creeks and channels in the mangrove forests. Flowering and fruiting from May—September. In India, the species is distributed only in Andaman & Nicobar Islands and Sunderbans. Its doubtful occurrence in the Mahanadi mangrove areas in Orissa (Haines, 1961) has not been confired inspite of repeated field surveys and the species apparently does not grow there. It is distributed in Sri Lanka, Bangladesh, Burma, Malesia, Philippines and extends upto Australia. Its leaves are extensively used in thatching roofs of huts and are reported to last for about 10 years. Its sap is extensively extracted for sugar, alcohol and vinegar industry. An over-exploited palm.

References :

1. Anon. (1948-1952). *Wealth of India* 1, 2 & 3. New Delhi.

2. Beccari, O. & Hooker, J. D. (1892). *In :* J. D. Hooker, *Fl. Brit. India* 6 : 424.

3. Haines, H. H. (1961). *Bot. Bih. & Orissa* 3 : 825. (repr. ed.). Botanical Survey of India, Calcutta.

4. Hans Tralau (1964). *In : Kungl. Svenska Vetenska Psakademiens Handlingar. Fjarde Serien.* Band 10 NR 1.

5. Prain, D. (1963). *Bengal* Pl. 2 ; 823-824. (repr. ed.). Botanical Survey of India, Calcutta.

Phoenix paludosa Roxb. ARECACEAE

Local names : Hital, Hatal (Beng.), Hantal (Hind.), Haltal (Or.), Sea date-palm (Eng.).

Gregarious, bushy, soboliferous or dwarf stemless palms, upto 4 m high. Stem base 20—25 cm in diam. supported by spongy, needle-like, perforated breathing roots. Leaves forming a crown, 2—3.5 m long, imparipinnate with many ensiform segments, segments waxy, glabrous, midrib strong, ending into strong sharp spine at apex, few pairs of lower segments modified into sharp spines. Inflorescence a spadix ; spadices thickly coriaceous, simple branched, arising in between leaves ; spathes 20—30 cm long, brownish, enclosing the flowers. Flowers dioecious, yellowish-white, small, tri-merous; stamens 3 (in male flowers) ; carpels 3 (in female flowers). Fruits drupaceous, 10—12 mm, oblong or ellipsoid, 1-seeded, shining black when ripe.

Common on elevated muddy swamps along lee-ward coastal areas. Often forms pure stands on elevated muddy intertidal estuarine areas and extends upto 15 km inwards. Flowering and fruiting from March—August. In India it is distributed only in the east coast mangroves in the Sunderbans, Mahanadi and in Andaman and Nicobar Islands. Extends into Thailand and Vietnam. Its leaves are extensively used for thatching, mats and wicker work and forms a good resources in cottage industry. Ripe fruits are not eaten for the blackish pulp is intolerable in taste (Haines).

References :

1. Anon. (1959). *Proc. Mangr. Symp. Calcutta*, pp. 1-136. Government of India Press, Faridabad.

2. Beccari, O. & Hooker, J. D. (1892). *In :* J. D. Hooker, *Fl. Brit. India* 6 : 427.

3. Haines, H. H. (1961). *Bot. Bih. & Orissa* 3 : 924. (repr. ed.). Botanical Survey of India, Calcutta.

4. Prain, D. (1963). *Bengal* Pl. 2 : 825. (repr. ed.). Botanical Survey India, Calcutta.

Avicennia alba Bl. AVICENNIACEAE

(*A. officinalis* Linn. var. *alba* Cl.)

Local names : Dulia baen (Beng.), Bain (Hind.), Kala baen (Or.), Tivar (Mar.), Gundu mada, Vilava mada (Tel.).

Small trees, upto 5 m tall, much branched, bark brownish-black, lenticelled, stem-base without prominent buttresses ; pneumatophores many, spongy, narrowly pointed, straight or hooked, 8—15 cm long, pencil thick. Leaves 8—13 × 2—3.5 cm, lanceolate, pale-green above, silvery papillose below, acute at apex, cuneate at base. Flowers in axillary or terminal spikes, yellow, small, fragrant. Capsules 3—4 cm long, tomentellous, ellipsoid, narrowly acuminate and curved at apex into a short beak. Seeds often germinate while attached to the mother tree (incipiently viviparous).

Frequent in the intertidal areas of riverine and estuarine mangrove swamps often forming a second-line-zone behind *Avicennia marina* communities ; sporadic in sheltered mangrove forests on newly formed mud banks. Flowering and fruiting from June—August. In India the species occurs in mangrove forests along the east and west coasts from Sunderbans upto Maharashtra. It is however not recorded from Saurashtra and Kutch areas. Distributed in Sri Lanka, Burma, Malesia, Java, Philippines, China and N. Australia. The species of *Avicennia* have been extensively over-exploited for fuel wood. Its leaves form a good source for fodder and fish-food and its flowers are a rich source of honey and bee-wax.

Notes : The species is readily identified from the other two in India by its lanceolate-acute leaves and narrow-ellipsoid fruits.

References :

1. Anon. (1959). *Proc. Mangr. Symp. Calcutta*, pp. 1-136. Government of India Press, Faridabad.

2. Bole, P. V. & Pathak, J. M. (1988). *Fl. Saurashtra*, pt 2 : 197 Botanical Survey of India, Calcutta.

3. Cooke, T. (1967). *Fl. Pres. Bombay* 2 : 517 (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Gamble, J. S. (1967). *Fl. Pres. Madras* 2 : 774 (2nd. repr. ed.). Botanical Survey of India, Calcutta.

5. Clarke, C. B. (1885). *In :* J. D. Hooker, *Fl. Brit. India* 4 : 604 (as *A. officinalis* var. *alba*).

6. Moldenke, H. N. (1960). *Phytologia* 7 : 151.

Avicennia alba Bl.

Avicennia marina var. **marina** (Forsk.) Vierh. AVICENNIACEAE

Local names : Boro baen, Sada baen (Beng.), Peara bain (Or.), Tivar (Saurash.), Venkandan (Tam.), Mada (Tel.).

Shrubs or small bushy trees, evergreen, upto 4 m high ; bark smooth, yellowish-brown, lenticellate in younger parts. Leaves 3—6× 2—2.5 cm, elliptic-oblong or elliptic-ovate, glabrous, pale green above, closely tawny-tomentose beneath, acute at apex, rounded or tapering towards base ; petioles 3—5 mm long, glabrous. Flowers 2—4 mm across, sessile, pale-yellow, in condensed terminal cymes ; calyx deeply lobed, hairy tomentose ; corolla lobes ovate-acute ; stamens included ; ovary villous, style short, stigmas 2. Capsules 12—15 mm long, ovoid, apiculate, greyish-tomentose, compressed, viviparous.

Gregarious forming pure stands in the intertidal areas in the estuarine mangrove swamps. It often grows as a pioneer species towards sea-ward areas subjected to high wave action, high salinity and silt deposition and stabilizes intertidal land mass. Flowering and fruiting from April—August. Distributed in the mangrove forests to down southwards from the Sunderbans along the east coast and along the west coast upto Saurashtra. Extends from E. Africa to Australia through Egypt, Arabia, Pakistan, India, Sri Lanka, S. E. Asia and China. Extensively exploited for fuel wood and fodder ; decomposed leaves constitute fish-food, and flowers an excellent source of honey and bee-wax.

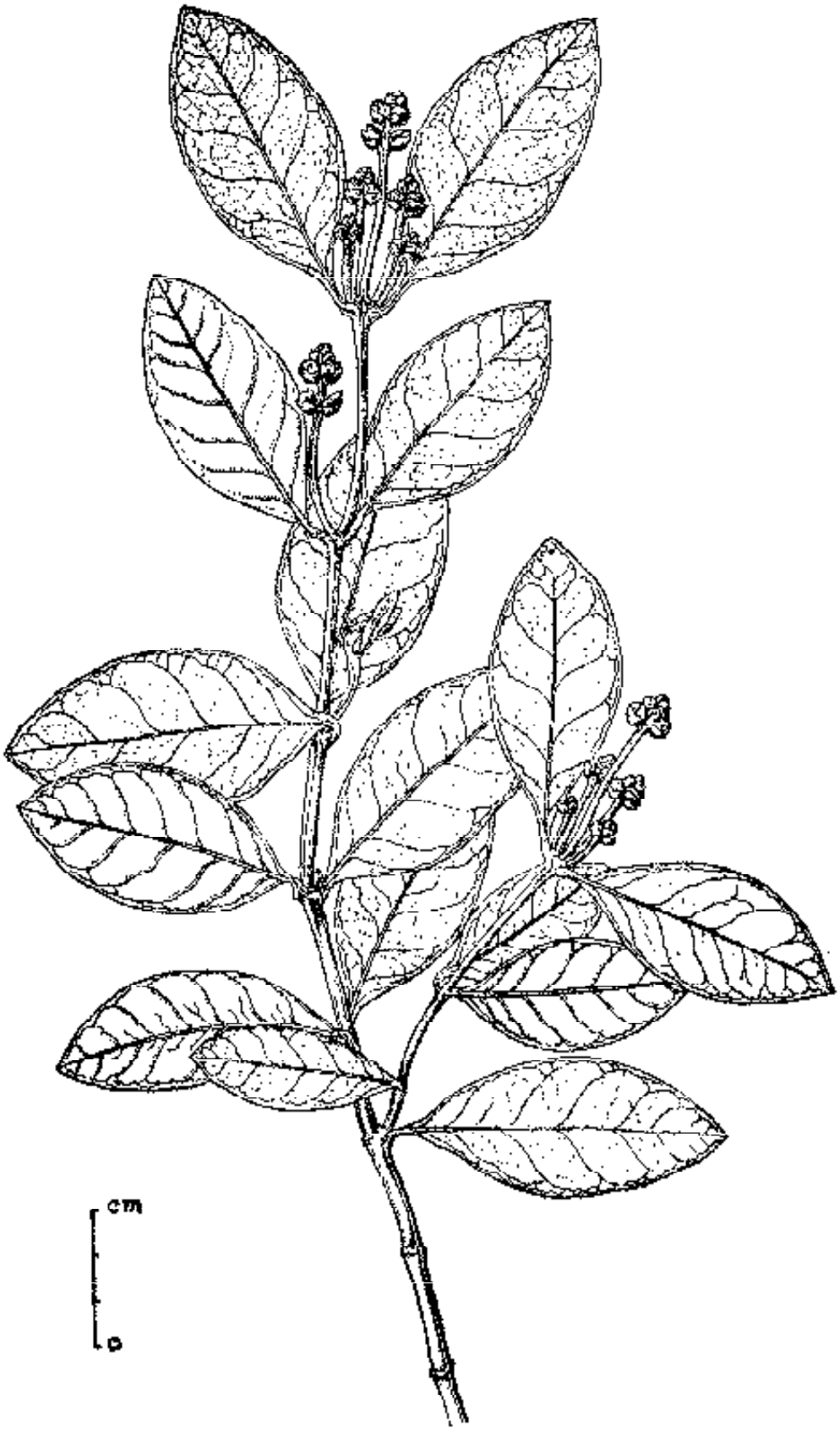
Notes : A. marina var. *marina* can be distinguished from the other species of *Avicennia* in India by its elliptic-oblong or elliptic-ovate leaves and apiculate fruits.

References :

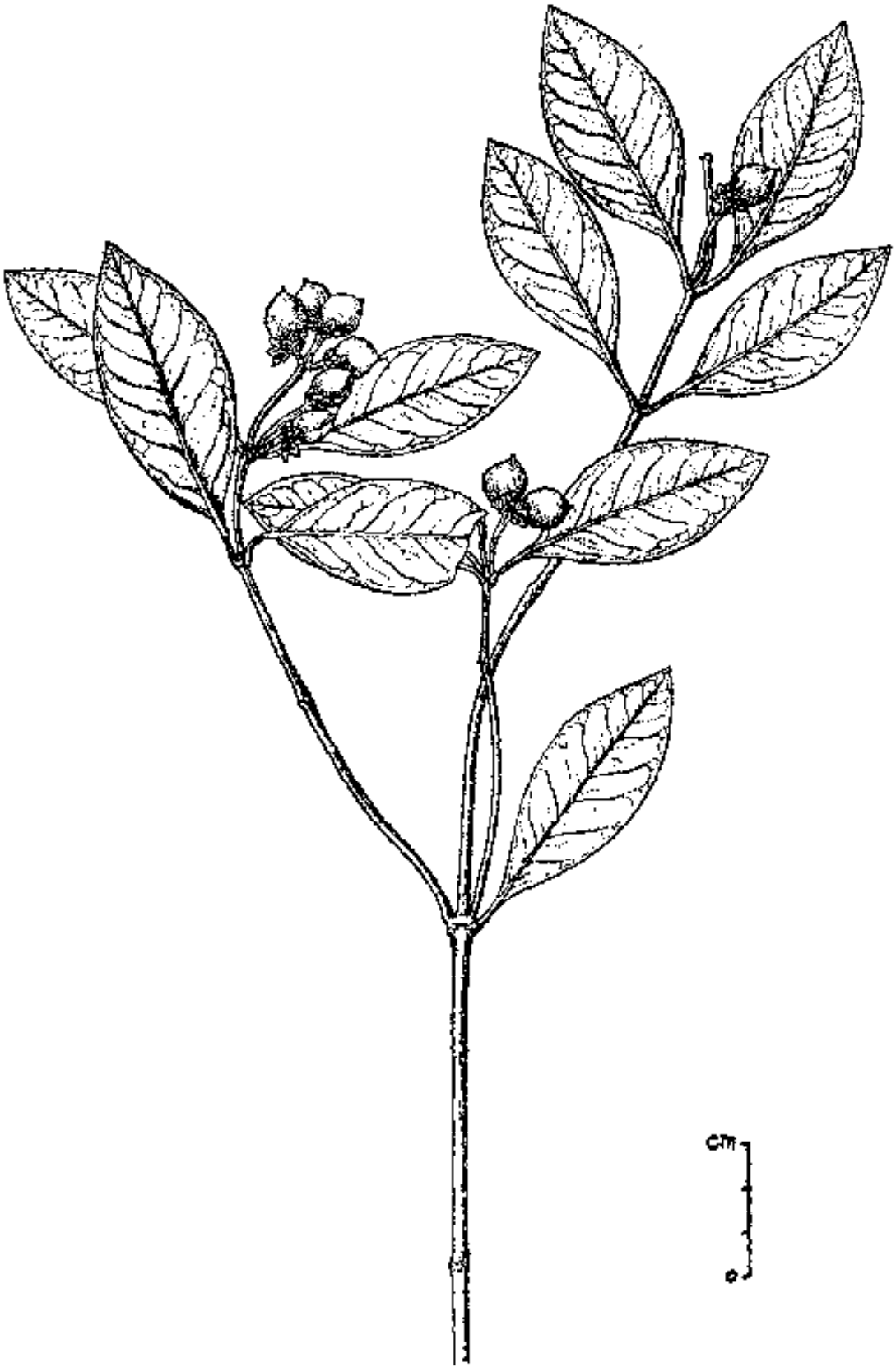
1. Bole, P. V. & Pathak, M. J. (1988). *Fl. Saurashtra*, pt. 2 : 197-198. Botanical Survey of India, Calcutta.

2. Gamble, J. S. (1967). *Fl. Pres. Madras* 2 : 773-774. (2nd repr. ed.) Botanical Survey of India, Calcutta.

3. Moldenke, H. N. (1960). *Phytologia* 7 : 225.



Avicennia marina var. *marina* (Forsk.) Vierh.—in flowers.



Avicennia marina var. *marina* (Forsk.) Vierh—in fruits.

Avicennia marina (Forsk) Vierh. var. **acutissima** Stapf & Mold. AVICENNIACEAE

Local names : Chota bani (Or.), Tivar (Mar. & Saurash.).

Shrubs, 5—10 m tall, bushy ; stems glabrous, yellowish-white. Leaves 6—7.5 × 2.5—3 cm, elliptic, shining above, white pulverulent beneath, sharply acuminate at apex, cuneate at base, sessile or very shortly petiolate (1—3 mm). Flowers 2—3 mm across, yellow, in terminal cymes. Capsules ovoid, apiculate at apex.

Frequent on elevated tidal flats. Flowering and fruiting during May—July. The variety is reported from Salsette island and adjoinings of Bombay, Saurashtra areas in western India and extends into the Sind in Pakistan and Egypt. Some specimens collected from the Barua estuarine area in Orissa resemble this but require critical taxonomic study. Used for fuel and fodder purpose.

Notes : This taxon differs from var. *marina* in its sessile and sharply acuminate leaves.

References :

1. Bole, P. V. & Pathak, M. J. (1988). *Fl. Saurashtra*, pt. 2 : 197-198. Botanical Survey of India, Calcutta.

2. Moldenke, H. N. (1960). *Phytologia* 7 : 225.

Avicennia officinalis Linn. AVICENNIACEAE

Local names : Kalo baen (Beng.), Bain (Hind.), Kala bani, Dhala baen (Or.), Orei (Mal.), Tivar (Mar.), Tavariya, Tivar (Saur.). Upatlha (Tam.), Nallamada (Tel.). White mangrove (Eng.).

Moderate sized trees, upto 20 m high, stem upto 100 cm in diam at base, bark smooth, whitish-grey lenticellate, peeling off papery ; wood brown or grey, hard. Pneumatophores many, simple or forked, spongy, often hooked at apices. Leaves 6—10 × 3—6 cm, broadly ovate-oblong or obovate, coriaceous obtuse at apex, tapering at base, glabrous, shining above, minutely and densely brownish-pubescent beneath. Flowers yellow, small, 5—6 mm, in trichotomous sessile heads ; ovary shortly hairy. Capsules 2.5—4 × 1.5—2 cm, ovoid, compressed, beaked at apex ; seeds dark-green, shining, pubescent on one side, often germinating on the trees.

Sporadic in the inner mangrove areas ; never forms pure stands. The leaves become black on drying. Flowering and fruiting from June—August. In India the species occurs in the mangrove areas and tidal creeks along both the coasts and in the Bay islands. Also distributed in Burma, Sri Lanka, Malesia, Java, China and in the islands of Pacific and Indian Oceans. The wood is hard, heavy and gives much heat for which it is extensively felled for fuel wood purpose ; also used for building houses and boats. Its leaves are used as fodder to increase milk in cattle and the dry leaves are smoked by the local people in Kutch and Saurashtra for relief from asthama and the plant is used to cure leprosy. Its bark yields a dye and ash from its wood is used for washing and reportedly removes stains and blotches. The flowers are a rich source of honey. The kernel of the fruit is reportedly edible and the bark resin considered medicinal.

Notes : A. officinalis is readily recognised from the other Indian Avicennias by the large sized trees and obovate or ovate-oblong leaves which turn black on drying and almond-shaped fruits.

References :

1. Anon. (1959). *Proc. Mangr. Symp. Calcutta,* pp. 1-136. Government of India Press, Faridabad.

Avicennia officinalis in flowers showing white-barked stem and numerous breathing roots at base.

Courtesy : BSI, ANC., Port Blair.

A full grown tree of *Kandelia candel* in Andaman mangrove forests.

Courtesy : BSI, ANC., Port Blair.

Nypa fruticans forming small communities in tidal forests in Andaman Islands.

Courtesy : BSI, ANC., Port Blair.

Excoecaria agallocha in full bloom in Mahanadi tidal forests.

Photo: L. K. Banerjee, BSI.

Acrostichum aureum-Excoecaria agallocha asscies in Mahanadi tidal forests.

Photo: L. K. Banerjee, BSI.

2. Bole, P. V. & Pathak, M. P. (1988). *Fl. Saurashtra*. pt. 2 : 195-199.

3. Clarke, C. B. (1885). *In* : J. D. Hooker. *Fl. Brit. India* 4 : 604.

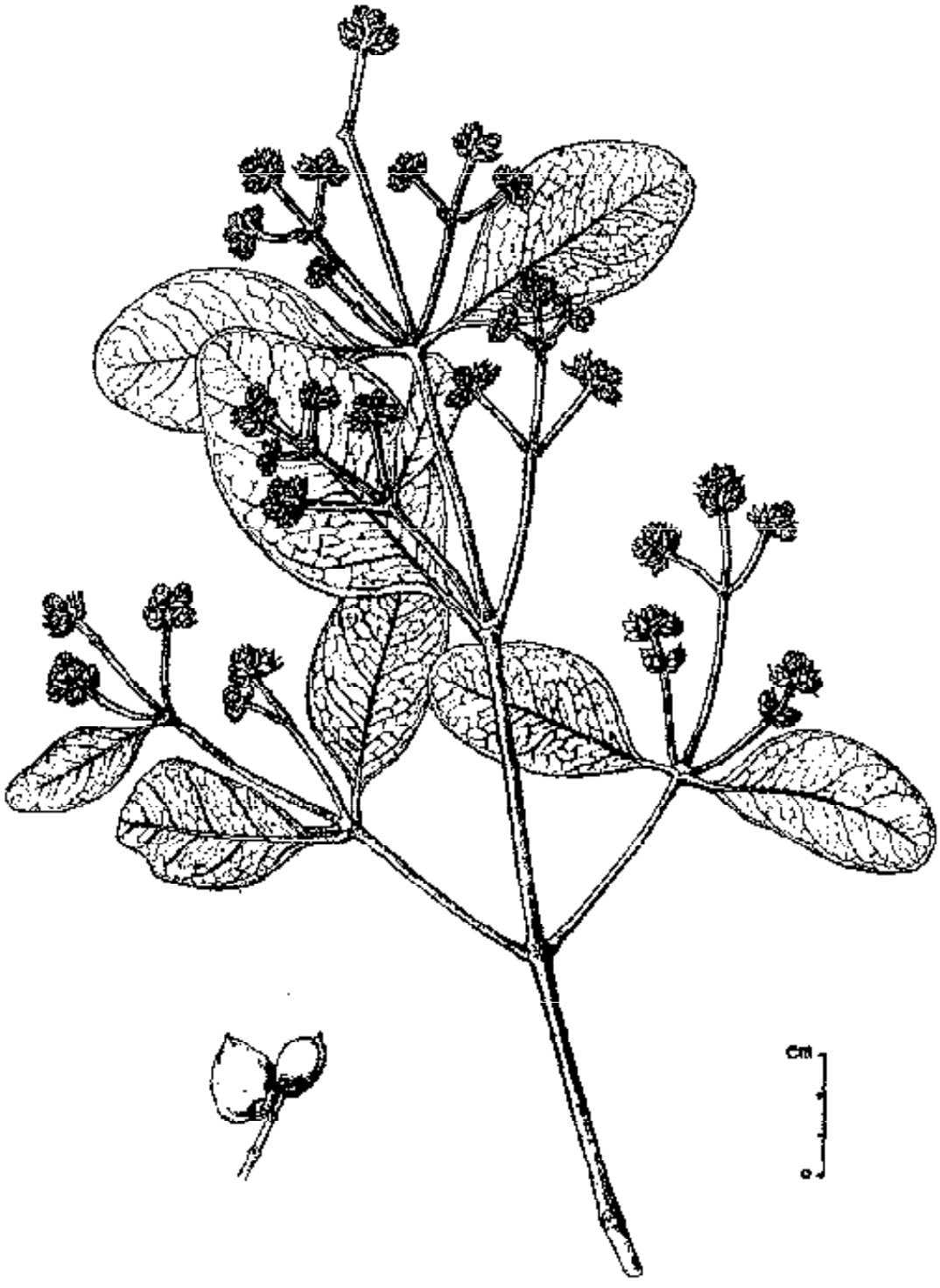
4. Cooke, T. (1967). *Fl. Pres. Bombay* 2 : 516. (2nd repr. ed.). Botanical Survey of India, Calcutta.

5. Gamble, J. S. (1967). *Fl. Pres. Madras* 2 : 774. (2nd repr. ed.). Botanical Survey of India, Calcutta.

6. Haines, H. H. (1961). *Bot. Bih. & Orissa* 2 : 760. (repr. ed.). Botanical Survey of India. Calcutta.

7. Prain, D. (1963). *Bengal Pl.* 2 : 626. (repr. ed.). Botanical Survey of India. Calcutta.

8. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*. p. 218.



Avicennia officinalis Linn.

Dolichandrone spathacea (Linn. f.) K. Schum. BIGNONIACEAE

(*D. rheedii* Seem.)

Local names : Gouru singha (Beng. & Or.), Nir pongiliun (Mal.), Vilpadri (Tam.)

Trees, upto 20 m tall, stem about 30 cm in diam at base, fluted, bark white or grey, wood soft. Leaves imparipinnate, leaflets 5—9, acuminate-rhomboid, 5—15 × 4—6 cm, thin, glabrous above, hairy below, caudate-acuminate at apex, unequal sided at base. Flowers in terminal racemes of 3—6 large, 10—16 cm wide, white, salver-shaped ; calyx conical, beaked, spathaceous, corolla 5-lobed ; stamens included in the corolla tube ; style exerted. Fruits 30—60 cm long, straight or twisted, capsule with flattened pseudoseptum ; seeds grey, rectangular, in many rows, with corky wings.

The species is rather sporadic and confined to elevated central areas in mangrove forests. It is usually associated with *Cerbera manghas, Sonneratia caseolaris* and *Heritiera fomes,* which prefer areas inundated more with riverine water. Flowering and fruiting from April—August. In India this species occurs in the mangrove swamps along the Malabar coast in Kerala, Sunderbans in West Bengal and Mahanadi tidal forests in Orissa and Andaman Islands. Distributed in tropical S.E. Asia, extending through Malesia. New Guinea, Micronesia and New Caledonia, but is not reported from Australia and Polynesian islands in the Pacific. The wood is used for charcoal making and the species can be grown along river banks and coastal areas to check erosion and for its beautiful white flowers. Its wood being soft can be used for making match-sticks and toys.

Notes : Its flowers open during night and usually fall off at sunrise.

References :

1. Gamble, J. S. (1967). *Fl. Pres. Madras* 2 : 700 (2nd repr. ed.). Botanical Survey of India, Calcutta.

2. Haines, H. H. (1961). *Bot. Bih. & Orissa* 2 : 690 (repr. ed.). Botanical Survey of India, Calcutta.

3. Hooker, J. D. (1885). *Fl. Brit. India* 4 : 379.

4. van Steenis, C. G. G. J. (1977). *In* : C. G. G. J. van Steenis, *Fl. Malesiana* 8(2) : 142.

5. Wight, R. (1848). *Ic.* t. 1339.

Lumnitzera littorea (Jack.) Voigt COMBRETACEAE

(*L. coccinea* Wt. & Arn.)

Trees, 8—15 m tall with knee-bent aerial roots from the base of the stem. Leaves 1.5—4.5 × 0.8—1.5 cm, ovate or ovate-elliptic, coriaceous, emarginate at apex, cuneate at base. Flowers 10—12 mm long, red, shortly pedicelled, in terminal racemes. Fruits 9—12 mm long, ellipsoid-oblong, longitudinally ribbed.

Rather uncommon and is mostly restricted to elevated interior areas of mangrove forests. Flowering and fruiting during May—July. The species is distributed in the Andaman & Nicobar Islands in India and extends into Burma, Malesia, N. Australia and Polenesian mangroves. Its reported occurrence in the tidal marshes at Bombay and Salsette Islands along the Konkan Coast is doubtful. The species is used for the same purposes as those of *L. racemosa*.

Notes : The species is easily distinguished from *L. racemosa* by its red-flowered racemes.

References :

1. Clarke, C. B. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 452.

2. Excell, A. W. (1954). *In :* C. G. G. J. van Steenis, *Fl. Malesiana* 4 : 586.

3. Mahabale, T. S. (1987). *In :* K. K. Chaudhari (ed.). Botany and Flora of Maharashtra. *Maharashtra State Gazetters*, Pt. 4 : 450.

4. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 168.

5. Sahni, K. C. (1959). *In : Proc Mang. Symp., Calcutta*, p. 117. Government of India Press, Faridabad.

Lumnitzera racemosa Willd. COMBRETACEAE

Local names : Kripa (Beng.), Tunda (Or.), Tipparathai (Tam.), Kadivi, Thandara (Tel.).

Large shrubs or small trees upto 8 m tall, glabrous ; bark brownish, lenticellate. Leaves sessile, thick, crowded at branch endings, 4—8 × 1.5—3.5 cm, oblanceolate or obovate, entire, emarginate at apex, tapering at base. Flowers sessile, in short, lax, axillary spikes, 9—11 mm long, white ; calyx-tube produced above the ovary ; petals 5 ; stamens 10 or rarely fewer ; ovary 1-celled, inferior. Fruits 8—10 × 4—6 mm, ellipsoid, woody, crowned with persistent calyx-lobes, 1-seeded.

Frequent in the muddy or sandy elevated fringe areas in the estuarine and back water mangroves, often in association with *Ceriops tagal* or forming pure stands. Flowering and fruiting during the period from April—July. In India, this species occurs in the mangrove swamps along both the coasts from Sunderbans downwards and upto Maharashtra, but is not reported from Kutch and Saurashtra areas. It occurs in the tidal forests in Andaman and Nicobar Islands. Its geographical distribution extends from tropical E. Africa to N. Australia and Polynesia through India, Sri Lanka and S. E. Asia. Its wood is used for fuel purpose and for extracting tanning.

Notes : Lumnitzera racemosa is easily identified in the field from its reddish-brown bark of the stem, thick oblanceolate or obovate leaves crowding at ends of branch-lets, white flowers and woody compressed fruits. Another closely allied species, *L. littorea* (Jacq.) Voigt reported from the Andaman and Nicobar Islands, does not occur in the mainland mangroves in India.

References :

1. Clarke, C. B. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 452.

2. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 514. (2nd repr. ed.). Botanical Survey of India, Calcutta.

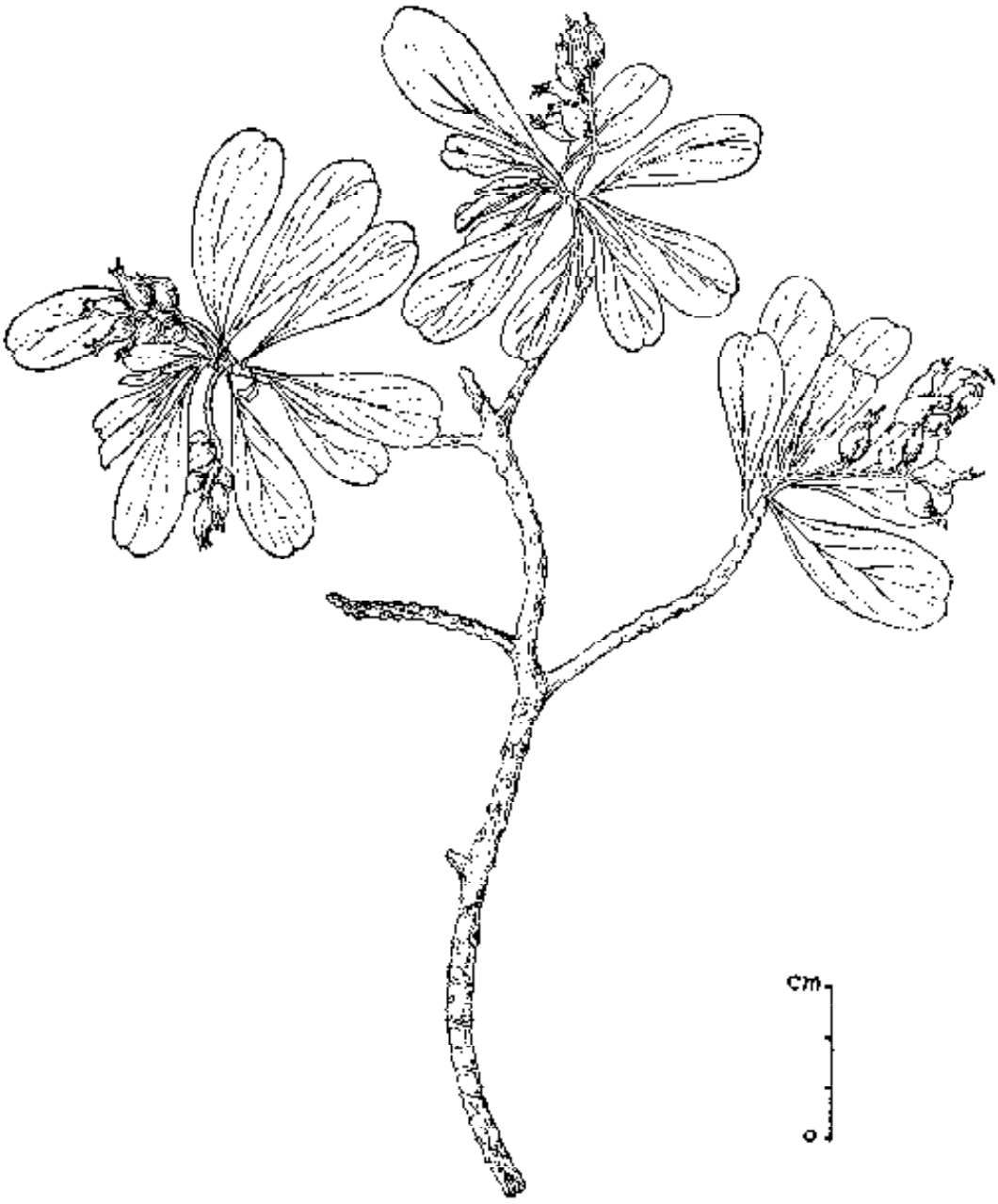
3. Exell, A. W. (1954). *In :* C. G. G. J. van Steenis, *Fl Malesiana* 4 : 588.

4. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 331 (2nd repr. ed.). Botanical Survey of India, Calcutta.

5. Haines, H. H. (1961). *Bot. Bih. & Orissa* 2 : 372 (repr. ed.). Botanical Survey of India, Calcutta.

6. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 168.

7. Prain, D. (1963). *Bengal Pl.* 1 : 351. (repr. ed.). Botanical Survey of India, Calcutta.



Lumnitzera racemosa Willd.

Excoecaria agallocha Linn. EUPHORBIACEAE

Local names : Goan (Beng.), Gangwa (Hind.), Komatti (Mal.), Geva (Mar.), Gango (Or.), Tilai (Tam.), Tilla (Tel.), Blinding tree (Eng.)

Evergreen trees or large shrubs, often 15 m tall, trunk upto 70 cm in diam at base, bark greyish, lenticelled, wood soft, light; plant parts with milky sap; root-system without a prominent main root, many laterally spreading, superficial, snake-like roots producing elbo-shaped pegs from supraterranean bends. Leaves 3—8 × 1.5—3 cm, ovate, ovate-elliptic or ovate-oblong, greenish turning red before shedding, acute or obtuse at apex, narrowed at base. Flowers unisexual, fragrant; male flowers 2—3 mm, yellow, in axillary catkin-like spikes; female flowers 2.5—3.5 mm, pedicellate, in axillary few-flowered racemes. Capsules 1—1.5 cm across, depressed-globose, 3-lobed, dehiscent; seeds sub-globose or 3-gonus.

Common in the intertidal forest, often extending into muddy seashore; in association with *Avicennia officinalis*. Flowering and fruiting from March—July. The species occurs along both the coasts from Sunderbans to south of Narmada estuary in the tidal swamps and in the Bay Islands. Distributed in the mangrove forests in India, Sri Lanka, Burma, tropical S. E. Asia, N. Australia and New Caledonia. Its wood is used in making paper pulp for boards and in soft-wood industry. The milky juice of the plant is highly acrid and produces blisters on skin and causes blindness.

Notes : The species is readily known in the field from its light green leaves turning reddish on ageing, cat-tail like male inflorescences and above all from the poisonous milky juice of the plant which readily exudes on injuring any plant part.

References :

1. Cooke, T. (1967). *Fl. Pres. Bombay* 3 : 122 (2nd repr. ed.). Botanical Survey of India, Calcutta.

2. Gamble, J. S. (1967). *Fl. Pres. Madras* 2 : 940 (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Hooker, J. D. (1878). *Fl. Brit. India* 5 : 472.

4. Wight, R. (1852). *Ic.* t. 1865B.

Cynometra ramiflora Linn. FABACEAE

Local name : Shingara (Beng. & Or.)

Trees, 6—10 m tall. Leaves 2-jugate or 1-jugate, leaflets 2—4.5 cm, variable in shape, usually ovate-oblong or sub-orbicular, oblique at base, emarginate at apex. Flowers 4—6 mm across, purplish, in condensed axillary racemes and on old exfoliate branches. Pods 4—8 in a raceme, each 1.5—2.5 cm long, obliquely elliptic, wrinkled, 1-seeded ; seeds flat, smooth.

Frequent along intertidal areas in the mangrove forests of the Sunderbans, Mahanadi in association with *Heritiera fomes* and in Andaman and Nicobar Islands in India. Flowers and fruits from September—February. Distributed in Malesia, Sri Lanka, Philippines and N. Australia. Its wood is used for timber and fuel purposes and the seeds are roasted and eaten like ground-nuts.

Notes : The species is distinguished in the field from the flowering racemes arising on old leafless stems and from the curiously wrinkled pods (fruits).

References :

1. Baker, J. G. (1978). *In : J. D. Hooker, Fl. Brit. India* 2 : 267.

2. Prain, D. (1963). *Bengal Pl.* 1 : 318. (repr. ed.). Botanical Survey of India, Calcutta.

3. van Meeuwen, M. S. K. (1970) *Blumea* 18 : 29.

4. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 153.

5. Santapau, H. & A. N. Henry (1973). *Dict. Fl. Pl. India*, p. 49. CSIR, New Delhi.

Cynometra ramiflora Linn. in flowers and pods.

Dalbergia spinosa Roxb. FABACEAE

Local names : Chulia kanta, Kanta gucha (Beng.), Chila kanta (Or.), Chillingi (Tel.).

Shrubs or small trees, 3—6 m tall, branches stiff and horizontal, ending in sharp spines. Leaves 6—9 cm long, crowded at nodes of the spinous branchlets ; leaf-lets 9 × 11, alternate, each 1—2 × 0.5—1 cm, elliptic-ovate, obtuse or emarginate at apex, cuneate at base. Flowers purplish-white in short dense corymbose clusters in the leaf axils. Pods flat, 2.5—3 cm long, kidney shaped, brownish, 2-seeded.

The species is more common in the intertidal mangrove forests along the east coast. Flowering and fruiting during May—November. Cooke (1958) reported it from Konkan region on the authority of Talbot but remarked that he had not seen any specimens from throughout Bombay Presidency. The species certainly does not occur in the tidal forests of Gujarat, Saurashtra and Kutch region. It is distributed in India, Bangladesh, Burma and Malaysia. The leaves are used as fodder for cattle and the woody branches as fuel.

Notes : The species is identified in the field from its branchlets ending into sharp spines and kidney shaped pods.

References :

1. Baker, J. G. (1876). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 238.

2. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 426 (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 269 (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Prain, D. (1963). *Bengal Pl.* 1 : 294 (repr. ed.). Botanical Survey of India, Calcutta.

5. Thothathri, K. (1987). *Tax. Rev. Tribe Dalbergieae Ind. Subcont.*, p. 192-193. Botanical Survey of India, Calcutta.

Derris trifoliata Lour. FABACEAE

(*D. uliginosa* Benth.)

Local names : Kali lata, Pani lata (Beng. & Or.), Tekil (Tam.), Nalla tiga (Tel.).

Large woody climbing shrubs, branches wiry, strong, lenticellate. Leaves imparipinnate, 6—15 cm long ; leaflets 5—10 × 2—3.5 cm, ovate-oblong, acute at apex, rounded at base, shining. Flowers white, 4—6 cm across, in axillary racemes. Pods 3—4 cm, flat, narrowly winged along the suture, 1-seeded.

Common in the intertidal forests along the Indian Peninsula and Andaman & Nicobar Islands. Flowering and fruiting during June —September. Distributed from Madagascar to Polynesia through India, Sri Lanka, China, Malesia and S. Australia. The stems and long wiry branches yield strong fibre and are used as ropes. The seeds are used as fish poison.

Notes : The species can be identified by its one-seeded papery pods.

References :

1. Baker, J. G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 241.

2. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 431 (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 273 (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Tholhathri, K. (1982). *In : Fasc. Fl. India* 8 : 30. Botanical Survey of India, Howrah.

Intsia bijuga (Colebr.) O. Kuntze FABACEAE

(*Afzelia bijuga* A. Gray)

Local names : Mahasita, Hinga, Somdal (Beng.).

Trees, 10—15 m tall. Leaves mostly bijugate, leaf-lets sometimes upto 6, each 8—13 × 4—9 cm, ovate-elliptic, inequilateral, subacute or retuse at apex, obliquely rounded at base. Flowers in terminal corymbs, 3—4 cm across, deep purple with a single clawed petal ; stamens 3 ; ovary with sub-truncate stigma. Pods 15—20 × 4—5 cm, obliquely oblong, woody, flattened, septate between the seeds. Seeds 3—8, orbicular, compressed with reddish-brown aril.

Frequent in the tidal forests in areas specially under fresh water flow. Flowering and fruiting from October—March. In India the species occurs only in the Sunderbans, Mahanadi and Andaman Islands. Distributed in Madagascar. Sri Lanka, India, Malesia, Seychelles and Polynesian Islands. The wood is hard and used for house building.

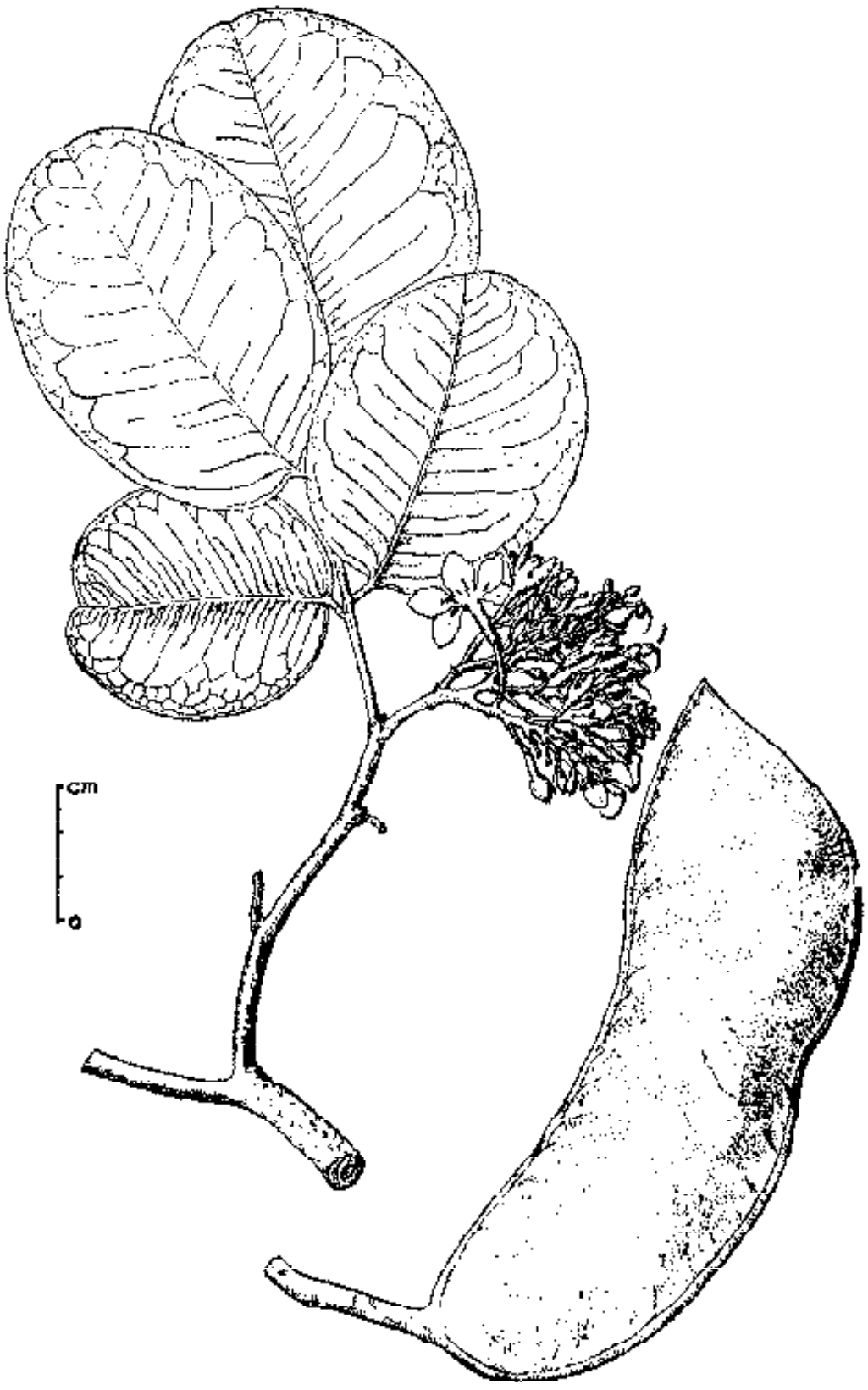
Notes : The tree can be identified by its bijugate leaves, single petal-lobe and flat woody pods.

References :

1. Baker, J. G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 274.

2. de Wit, H. C. D. (1941). *Bull. Jard. Buitz.* Ser. 3 : 17, 139.

3. Parkinson, C. E. (1923). *For. Fl. Andaman Islands,* p. 154.



Intsia bijuga (Colebr.), O. Kuntze in flower; pod separately shown.

Mucuna gigantea (Willd.) DC. FABACEAE

Local names : Alshi lata (Beng.), Kiwach (Hind.), Soui nata (Or.), Poonai kali (Tam.).

Extensively spreading stout woody climbers. Leaves 10—20 cm long ; petioles 8—12 cm long ; leaflets 8—10 × 4—7 cm, ovate-elliptic, unequal-sided, glabrous, acute at apex, rounded at base. Flowers 4—6.5 cm across, yellow, drooping in axillary umbelliform racemes on 15—20 cm long woody peduncles. Pods 8 –15 cm, flattened, broadly winged on both the sutures, clothed with golden-brown irritant bristles. Seeds 2—4, compressed with hilum extending more than half the seed.

Frequent along the intertidal regions of creeks and channels in the mangrove forests and at times in sandy coastal areas. Flowering and fruiting during August—December. In India the species is distributed in the mangrove forests of the Sunderbans, Mahanadi delta and in back-water tidal forests along the Malabar coast in Kerala and Andaman islands. Its occurrence in Konkan in Maharashtra tidal forests is doubtful (Cooke, 1958). It is distributed in the mangrove forests in India, Sri Lanka, extending into Malesia, Java and Philippines. Its seeds are considered medicinal and rich in protein.

Notes : The species is at once recognised in the field by its flattened pods covered with golden-brown bristly hairs which cause immense irritation and itching on contact.

References :

1. Baker, J. G. (1876). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 186.

2. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 389 (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 251 (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Prain, D. (1963). *Bengal Pl.* 1 : 285 (repr. ed.). Botanical Survey of India, Calcutta.

5. Wilmot-Dear, C. M. (1987). *Kew Bull.* 42(1) : 38.

Aglaia cucullata (Roxb.) Pellegrin MELIACEAE

(Amoora cucullata Roxb.)

Local names : Amur, Latmi (Beng.), Angar (Or.).

Medium sized trees, 10 m tall, with numerous vertical blind root-suckers or woody pneumatophores. Leaves large, 30—40 cm long, imparipinnately compound, glabrous, leaflets 7—11, each 9—19 × 4—6 cm, elliptic-oblong, unequal-sided, obtuse at apex, oblique at base, terminal leaflet forming a cup at base. Flowers unisexual, 3—4 mm across, yellow, in axillary panicles ; male inflorescence 20—30 cm long, few-flowered ; female inflorescence 6—15 cm long, few-flowered ; calyx 3-lobed, lepidote, minutely ciliate ; petals 3, elliptic, concave ; staminal tube petuliferous, obovoid ; anthers 6. Fruits 8—12 cm, globose, trilocular capsules ; seeds 3, covered with fleshy orange aril.

Frequent in the intertidal mangrove areas often in association with *Heritiera fomes, Cynometra ramiflora* and *Xylocarpus mekongensis*. Flowering and fruiting almost throughout the year. The species occurs in Sunderbans, Mahanadi deltaic forests and in Andaman Islands. Distributed in Burma and Borneo. Its wood is hard and is used for making toys and cigar pipes.

Notes : The vertical blind root-suckers (woody pneumatophores) and the terminal leaflet with a cupular base readly help in identification of the species in the field.

References :

1. Hiern, W. P. (1875). *In :* J. D. Hooker, *Fl. Brit. India* 1 : 560.

2. Pennington, J. D. & B. T. Styles (1975). *Blumea* 22(3) : 481.

3. Prain, D. (1963). *Bengal Pl.* 1 : 221 (repr. ed.). Botanical Survey of India, Calcutta.

Xylocarpus granatum Koen. MELIACEAE

(*Carapa obovata* Bl. ; *C. molluccensis* Bedd. non Lamk.)

Local names : Dhundul, Pohar (Beng.), Pussur (Hind.), Pitamari (Or.), Somunthiri (Tam.), Chenuga (Tel).

Trees, upto 20 m tall, trunk *ca* 70 cm in diam at base, buttressed ; bark yellowish-white, peeling off as papery flakes. Leaves unijugate or bijugate ; leaflets 6—10 × 3.5 cm, obovate, entire, rounded at apex, tapering at base. Flowers 5—7 mm across, white with a reddish gland within, in axillary thyrses ; calyx 4-lobed ; petals 4, free. Fruits large, 30—40 cm across, globose, septafragal capsules, splitting tardily into 4 valves. Seeds 10—15 in number, pyramid shaped with a corky testa.

Common on sheltered intertidal banks in the mangrove forests in association with *Rhizophora, Kandelia candel* and *Sonneratia apetala.* Flowering and fruiting throughout the year. In India the species occurs in the tidal forests along the east and west coastal areas upto Maharashtra and in Andaman Islands. Distributed in the tropical tidal forests from Africa to N. Australia through India, Sri Lanka and Malayan archipelago. Its timber is used for making furniture, agricultural implements and yields tannin, seed oil is used for illumination and grooming hairs, seed-paste is used for relief of breast tumor.

Notes : X. granatum can be distinguished from the other two species of *Xylocarpus* by its buttressed stem, absence of pneumatophores, obovate leaves and large globose fruits with pyramidal seeds.

References :

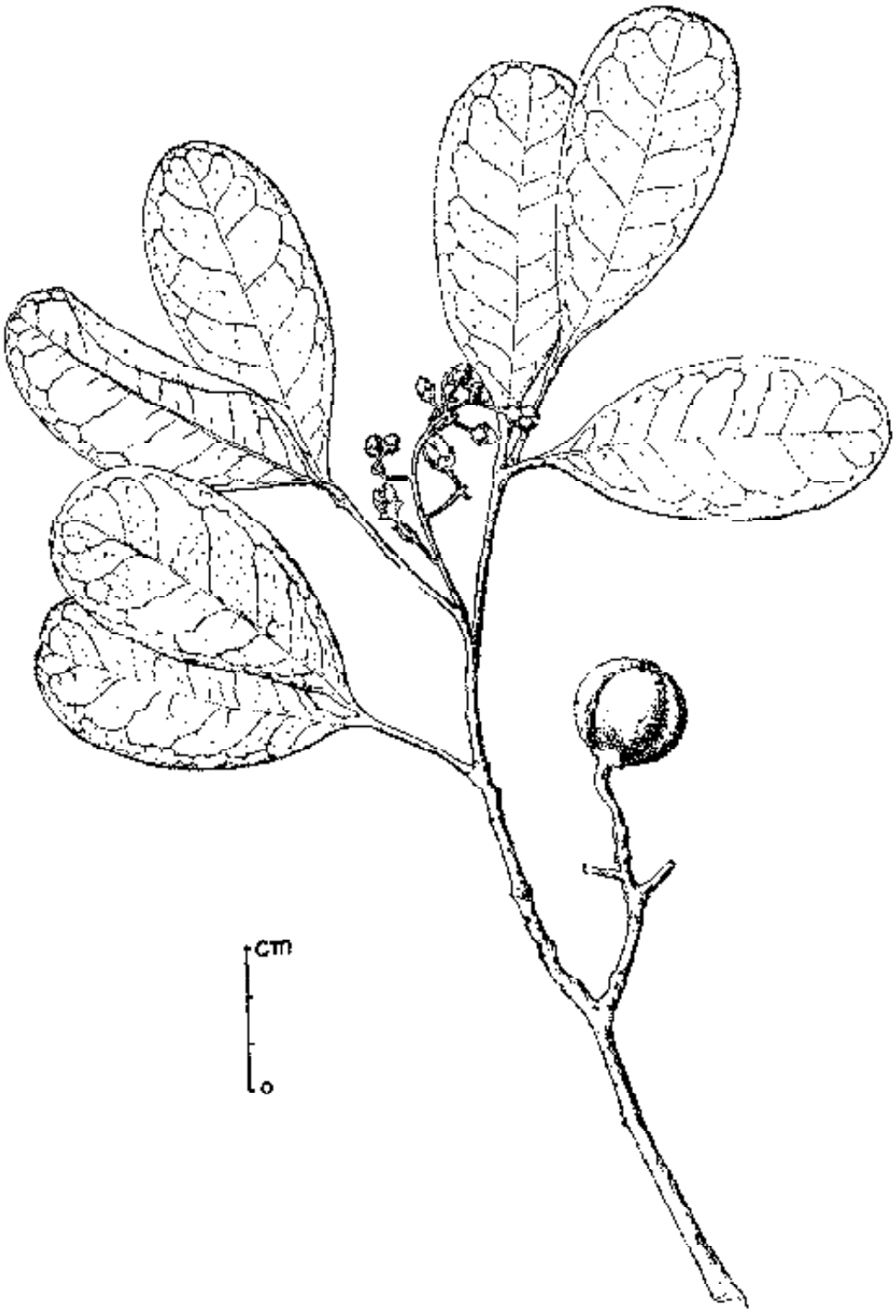
1. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 226 (2nd repr. ed.). Botanical Survey of India, Calcutta

2. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 132 (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Haines, H. H. (1961). *Bot. Bih & Orissa* 1 : 187 (repr. ed.). Botanical Survey of India, Calcutta.

4. Hiern, W. P. (1875). *In :* J. D. Hooker, *Fl. Brit. India* 1 : 561.

5. Prain, D. (1963). *Bengal Pl.* 1 : 222 (repr. ed.). Botanical Survey of India, Calcutta.



Xylocarpus *granatum* Koen. in flowers and fruit.

Xylocarpus mekongensis Pierre MELIACEAE

(*Carapa obovata* Bl. var. *gangeticus* Prain)

Local name : Pitamari (Beng.).

Trees, upto 15 m tall, trunk *ca* 50 cm in diam at base ; bark reddish-brown, peeling off into thick flakes, stem-base with woody pneumatophores or blind root-suckers. Leaves paripinnate, mostly bijugate ; leaflets 2—4-paired, each 9—18 × 4—7 cm, elliptic-oblong, obtuse at both ends. Flowers white, in axillary panicles. Fruits 8—12 cm across, brown, globose, capsular. Seeds tetrahedral.

Sporadic in the interior elevated areas of mangrove forests in association with *Heritiera fomes* and *Bruguiera gymnorrhiza*. Flowering and fruiting during April—July. Distributed in the Sunderbans, Mahanadi and Andamans and extends into Malesia. Its wood is used for furniture making and for extracting tannin.

Notes : X. mekongensis differs from *X. granatum* in the absence buttressed trunk, and in having blind root-suckers, elliptic-oblong leaflets and smaller fruits by which it is easily identified in the field.

References :

1. Harms, H. (1940). *In :* A. Engler & K. Prantle, *Pflanz. Fam.* ed, 2, 19 bI ; 82.

2. Watson, J. G. (1928). *Mal. For. Rec.* 6.

Xylocarpus moluccensis (Lamk.) M. Roem. MELIACEAE

(*Carapa moluccensis* Lamk.)

Local names : Ptakura (Beng.)

Large trees, upto 20 m tall, trunk *ca* 60 cm in diam at base, buttressed ; bark red with thick flakes ; wood red in colour ; pneumatophores woody. Leaflets 7—12 × 3—6 cm, ovate, acute at apex, oblique at base. Flowers 2—3 cm across, white with red glands inside ; staminal teeth obscure, anthers exceeding the teeth ; stigma cup-shaped. Fruits 10—15 cm across, globose.

Rather uncommon and grows on elevated fresh water inundated river banks in association with *Heritiera littoralis*. Flowering and fruiting from June—September. Reported only in the Mahanadi deltaic mangroves and in Andamans (in India). Distributed from tropical Africa to N. Australia through India and Malesia. Its wood is durable and finds application for similar uses as of the other two species of the genus.

Notes : The species is readily recognised from *X. mekongensis* by its buttressed, dark red stem with thick peels of bark, ovate leaflets and obscure staminal teeth.

References :

1. Adelbert, A. G. L. (1948). *Blumea* 6(1) : 314.
2. Hiern, W. P. (1875). *In :* J. D. Hooker, *Fl. Brit. India* 1 : 561.
3. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 118.
4. Watson, J. G. (1928). *Mal. For. Rec.* 6.

Aegiceras corniculatum (Linn.) Blanco MYRSINACEAE

(*Rhizophora corniculata* Linn. ; *A. majus* Gaertn.)

Local names : Khalsi (Beng.), Halsi (Hind.), Teluni (Or.), Kajla (Mar.), Narikandam (Tam.), Dudumara, Guggilam (Tel.)

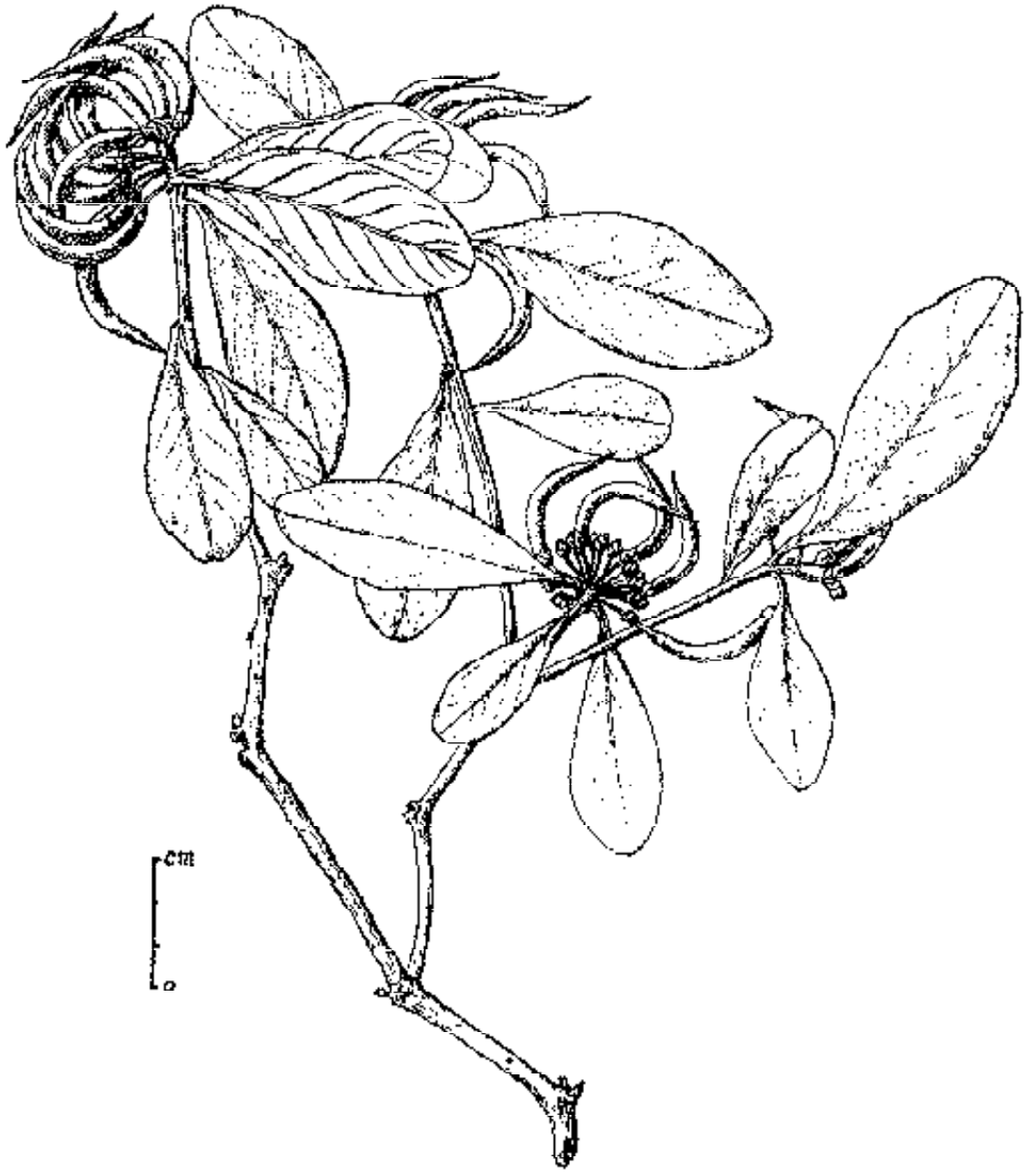
Small trees, upto 6 m tall, stem about 20 cm in diam at base, much branched, supported by many slender broom like stilt-roots. Leaves 4—8 × 2—4 cm, ovate-oblong or obovate, coriaceous, entire, retuse at apex, cuneate at base. Flowers 1.5—2 cm long, white, fragrant, in terminal, axillary or leaf-opposed umbels. Fruits 6—8 cm long, terete, curved or falcate, tapering to a pointed apex. Hypocotyle 3—4 cm long, curved and pointed.

Common along the sheltered intertidal banks of creeks and channels in mangrove forests. The species is often found in association with species of *Rhizophora* and *Ceriops decandra*. Flowering and fruiting during April—September. In India it occurs in the mangrove areas along both the coasts from Saurashtra and Kutch to Sunderbans and in the Bay Islands. A widely distributed species occuring in almost all mangrove areas in the tropics and subtropics of old world and new world countries. The species forms a potential source for high quality honey and bee-wax from its flowers and the wood is used for building huts and for fuel.

Notes : The species with its foliage, fragrant white flowers and curious crescent-shaped yellow fruits in bunches looks elegant and is at once identifiable in the field.

References :

1. Bole, P. V. & J. M. Pathak (1988). *Fl. Saurashtra* 2 : 46. Botanical Survey of India, Calcutta.
2. Clarke, C. B. (1882). *In :* J. D. Hooker, *Fl. Brit. India* 3 : 533.
3. Cooke, T. (1967). *Fl. Pres. Bombay* 2 : 147. (2nd repr. ed.). Botanical Survey of India, Calcutta.
4. Gamble, J. S. (1967). *Fl. Pres. Madras* 2 : 532. (2nd repr. ed.). Botanical Survey of India, Calcutta.
5. Haines, H. H. (1961). *Bot. Bih. & Orissa* 2 : 535. (repr. ed.). Botanical Survey of India, Calcutta.
6. Kurz, S. (1877). *For. Fl. Burma* 2 : 114.



Aegiceras corniculatum (Linn.) Blanco, with curved hypocotyles.

Aegialitis rotundifolia Roxb. PLUMBAGINACEAE

Local names : Satari (Beng.), Bana ruar (Or.).

Shrubs or small trees upto 7 m tall, stem base about 20 cm in diam. swollen and with numerous stilt roots ; stems straight with leaf-scars, branching only towards apex. Leaves alternate, 2.5—9 × 3—9 cm, rounded or broadly ovate or sub-orbicular, thickly leathery, shining, obtuse or shortly apiculate at apex, abruptly cuneate at base, petiole 4—8.5 cm long, thick, dilated at base clasping the stem, glandular. Flowers 15—20 mm long, white, arranged in leafy-panicles ; calyx 5-lobed, tubular ; corolla white, united at base forming a short tube with staminal bases ; stamens 5. Fruits capsular, 8—10 cm long, linear, 5-ribbed, slightly curved, 1-seeded, dehiscing from top along the ribs, hypocotyle about 6 cm long, white, with plumular cap and a long funiculus.

Gregarious along estuarine tidal swamps and muddy sea-shores. Flowering and fruiting from February—June. In India it is found in the tidal forests in the Sunderbans, Mahanadi and Andaman-Nicobar Islands. Distributed in Burma and Malesian Islands. The species is exploited for its pole-like stems for building huts and small houses and for extracting salts from the ash of its burnt wood and leaves.

Notes : *A. rotundifolia* is distinguished by its sub-orbicular or rounded leaves with stem-clasping petioles, straight unbranched conical based stems.

References :

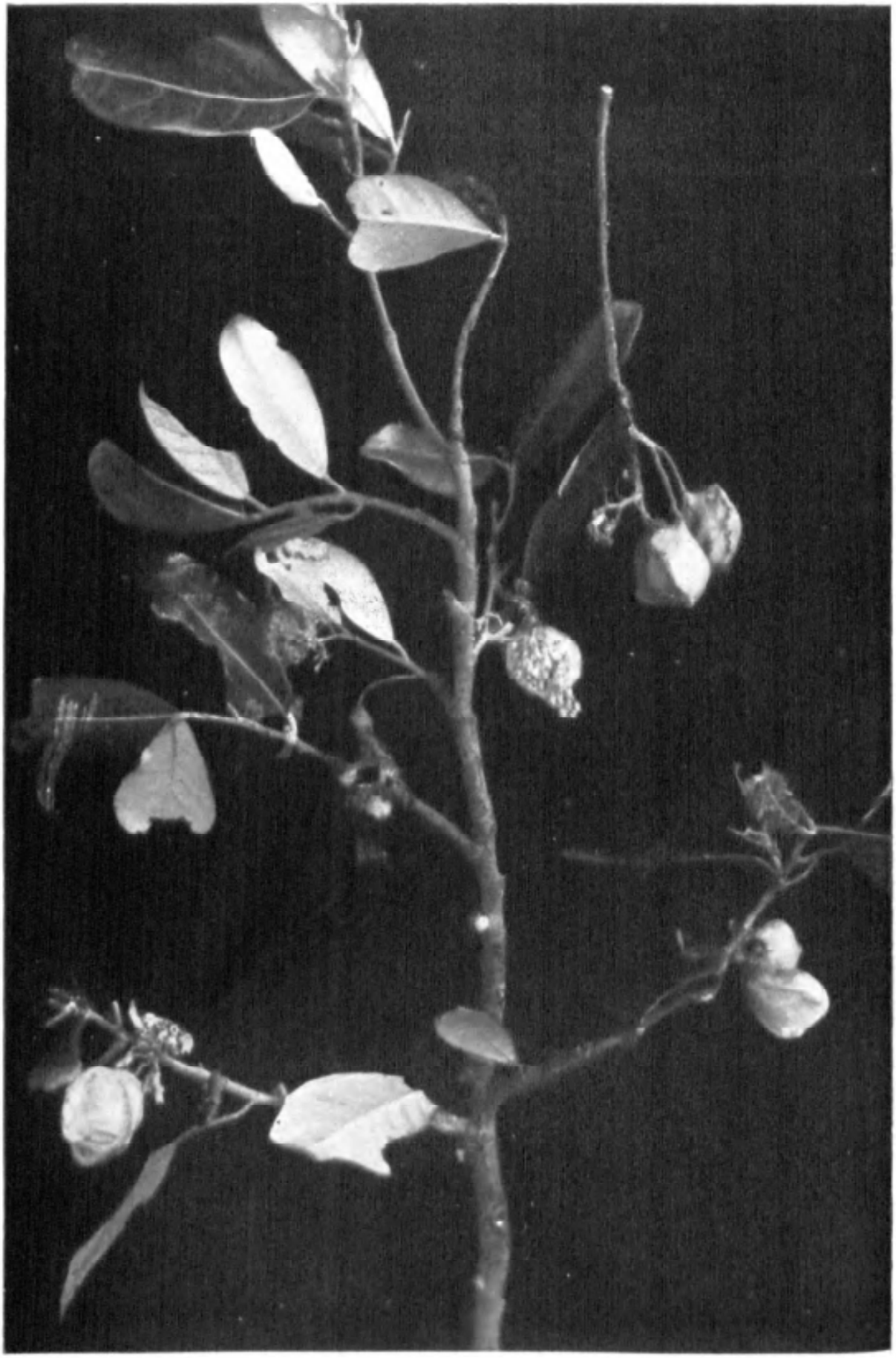
1. Clarke, C. B. (1882). *In* : J. D. Hooker, *Fl. Brit. India* 3 : 479.
2. Haines, H. H. (1961). *Bot. Bih. & Orissa* 2 : 529 (repr. ed.). Botanical Survey of India, Calcutta.
3. Prain, D. (1963). *Bengal Pl.* 1 : 470. (repr. ed.). Botanical Survey of India Calcutta.
4. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 193.
5. Roxburgh, W. (1832). *Fl. Indica* 2 : 111.
6. van Steenis, C.G.G.J. (1949). *In* : C. G. G. J. van Steenis, *Fl. Malesiana* 4 : 108.

Avicennia officinalis, stem-base with smooth white bark and numerous spongy pneumatophores, in Andaman Islands.

Courtesy: BSI, ANC., Port Blair.

Xylocarpus mekongensis showing peeling bark, buttressed stem and woody pneumatophores, in Mahanadi tidal forests.

Photo: L. K. Banerjee. BSI.



Heritiera fomes in flowers and crested fruits; leaves silvery-white underneath, in Sunderbans.

Photo: L. K. Banerjee, BSI.

Ceriops tagal with long slender hypocotyles, in Sunderbans.
Photo: L. K. Banerjee, BSI.

Xylocarpus granatum with mamillate fruits, in Sunderbans.
Photo: L. K. Banerjee, BSI.

Excoecaria agallocha in flowers and with long horizontal roots, in Sunderbans.

Photo: L. K. Banerjee, BSI.

Myriostachya wightiana (Nees ex Steud.) Hook. f. POACEAE

Local names : Multhaghas (Beng.), Pani ghas (Or.).

Gregarious perennial grass, culms 2—3 m tall, densely tufted from a sheathing root-stock with long, flexible branching fibrous roots. Leaves linear, smooth, acuminate. Spikelets pedicellate, 6—12-flowered, racemose on short branchlets of a narrowed panicle. Glumes 1 & 2 unequal, 1-nerved, keeled with a long awn ; lodicules minute, retuse ; stamens 3. Grain obliquely ovoid with a large scutellum.

Abundant often as a pioneer along the muddy banks of creeks and channels in the intertidal regions of mangrove swamps. Flowering and fruiting during July—August. Distributed in the east coast mangroves of Indian peninsula and in Andaman Islands, extending into Burma, Malesia and Vietnam. It is a potential source of good fodder and thatching material and its long wiry flexible roots are used for cordage.

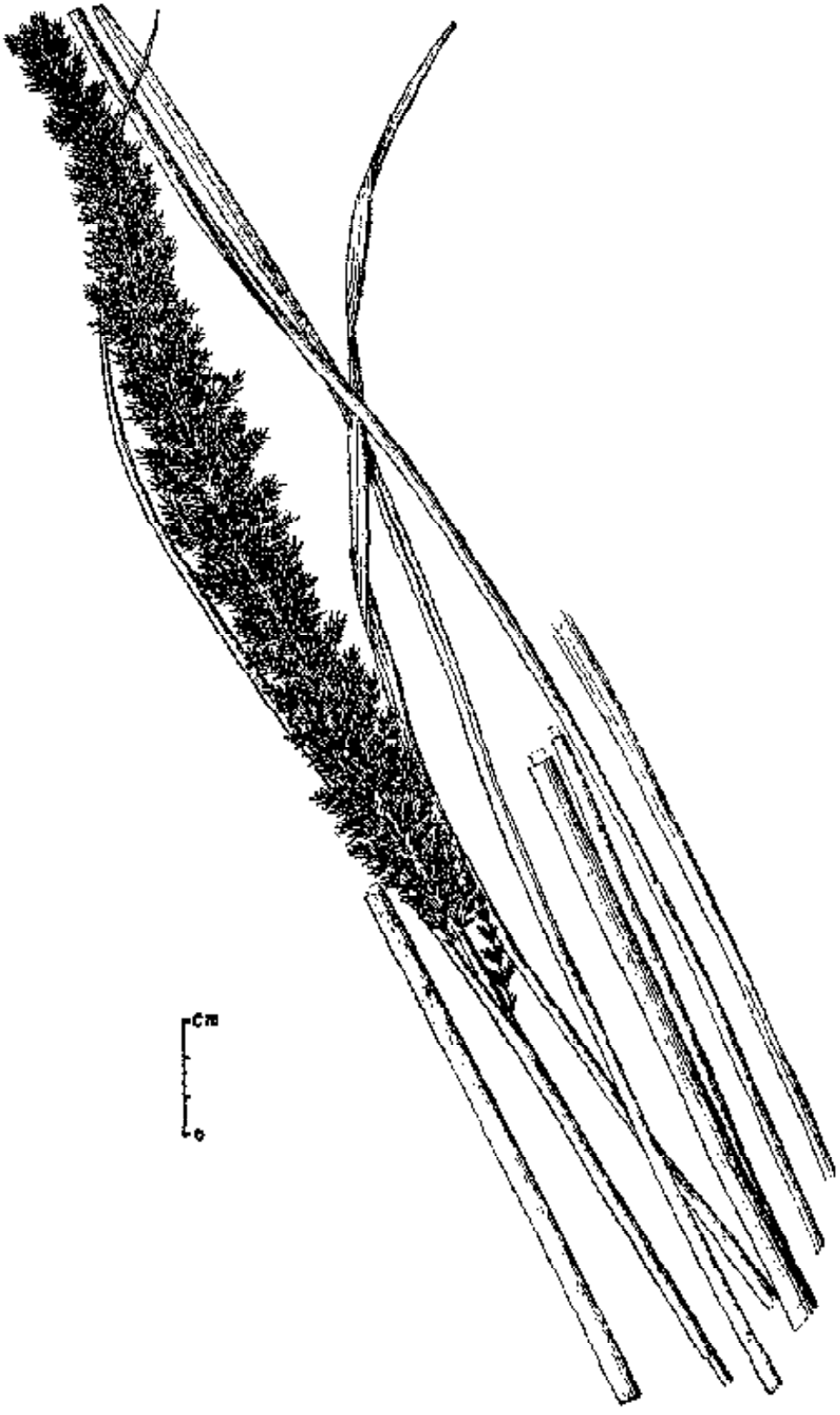
Notes : M. wightiana is distinguished from its pedicillate spikelets with long awns.

References :

1. Bor, N. L. (1960). *Grasses of Burma, Ceylon, India and Pakistan*, pp. 1-607.

2. Hooker, J. D. (1897). *Fl. Brit. Brit. India* 7 : 327.

3. Rao, T. A. & L. K. Banerjee (1970). *Journ. Bombay Nat. Hist. Soc.* 66(3) : 659.



Myriostachya wightiana (Nees ex Steud.) Hook. f., showing flowering spike.

Porteresia coarctata (Roxb.) Tateoka POACEAE

(*Oryza coarctata* Roxb.)

Local names : Dhani Ghas (Beng. & Or.), Harakata (Beng.).

Perennial grass, 1—2 m tall, rhizome thick, creeping. Leaves linear, coriaceous with spinulose margins. Panicles spiciform, branched, each with a few flowers ; glumes 1 and 2 setaceous, glume 3 smooth, dorsally winged into an awn ; lodicules subquadrate, membranous.

Common on newly formed alluvial mud flats in the intertidal regions of mangroves. Flowering and fruiting from May—August. Distributed in the east and west coast mangroves of the Indian peninsula. Also reported from Burma and Malesia. The grass is used as fodder and for paper pulp making and thatching.

References :

1. Bor, N. L. (1960). *Grasses of Burma, Ceylon, India and Pakistan*, p. 604.

2. Cooke, T. (1967). *Fl. Pres. Bombay* 3 : 565 (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Fischer, C. E. C. (1967). *In :* J. S. Gamble, *Fl. Pres. Madras* 3 : 1276. (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Hooker, J. D. (1897). *Fl. Brit. India* 7 : 93.

5. Prain, D. (1963). *Bengal Pl.* 2 : 892. (repr. ed.). Botanical Survey of India, Calcutta.

6. Roxburgh, W. (1832). *Fl. Indica* 2 : 206.

Urochondra setulosa (Trin.) Hubb. POACEAE

(Helechloa dura Boiss.)

Stout perennial grass, branches minutely velvety pubescent, ascending, 15—25 cm long. Leaves 7.5—15 cm long, involute, terete, ending in sharp spiny tips; sheaths short; ligule a narrow line of hairs. Inflorescence a spike-like panicle, upto 10 cm long, solitary. Spikelets densely imbricate, about 2.5 mm long; glumes 3, all 1-nerved and with ciliate keels; lower involucral glume about 1.5 mm long, linear-oblanceolate, spiculate; floral glume about 2.5 mm long, elliptic-oblong, obtuse; palea about 2 mm long, 2-fid, with ciliate lobes; stamens usually 2, rarely 3, filaments very long; anthers short.

Frequent on dry elevated salt pans. Flowering in December. The species is reported only from Saurashtra and Gujarat areas in India extending westwards into West Asia.

Notes: The species is readily distinguished from its terete, involute leaves with spine-like pointed tips.

References:

1. Bole, P. V. & J. M. Pathak (1988). *Fl. Saurashtra* 3: 482.

2. Bor, N. L. (1960). *Grasses of Burma, Ceylon, India and Pakistan*, p. 634.

3. Cooke, T. (1967). *Fl. Pres. Bombay* 3: 532. (2nd repr. ed.). Botanical Survey of India, Calcutta (as *Helechloa dura*).

Acrostichum aureum Linn. PTERIDACEAE

Erect terrestrial fern, 1—1.5 m tall ; stipes woody, glabroush, arising from a stout woody rhizome ; fronds unipinnate ; pinnae 8—14, alternate, linear-oblong, rounded or retusely mucronate at apex, cuneate at base, lower sterile, upper ruddy-brown soriferous. Sori densely aggregated along the undersurface, non-indusiate.

Common in elevated disturbed areas in mangrove forests. Sori are formed during June—October. In India this species occurs in a disjunct manner in Sunderbans and Mahanadi estuarine forests along the east coast, in Kerala along west coast and in Andaman & Nicobar islands. Widely distributed in tropical coasts of the world. The fronds are used for thatching.

Notes : This is the only terrestrial fern that grows in mangrove situations.

References :

1. Beddome, R. H. (1883). *Handbook to the Ferns of British India, Ceylon and the Malay Peninsula*, p. 440.

2. Dixit, R. D. & J. N. Vohra (1984). *A Dictionary of Pteridophytes of India*, p. 1. Botanical Survey of India, Howrah.

Brugulera cylindrica (Linn.) Bl. RHIZOPHORACEAE

(*B. caryophylloides* Bl.)

Local names : Sona champa, Thushia (Beng.), Bokul (Or.), Vurudu (Tel.).

Trees upto 20 m tall, stem-base buttressed, producing oval shaped knee-bent roots ; young twigs and bark bronze coloured with many stipular scars. Leaves 8—15 × 2—6 cm, oblanceolate, acute at apex, cuneate at base ; petioles green. Flowers 1—1.5 cm long, white, 3, in axillary pedunculate cymes ; calyx-tube smooth, cup-shaped with 8—10 reflexed lobes ; petals bilobed with a bristle in the sinus, each lobe with 3 apical cilia, margins hairy. Hypocotyle 10—14 cm, cylindric, obscurely ribbed and slightly curved towards apex.

Common along estuarine mouths in the mangrove forests, often growing immediately behind *Avicennia marina* communities. Occasionally in pure stands or in association with *Brugulera parviflora* in sheltered estuarine parts of mangroves. Flowering and fruiting from May—August. It is distributed in the mangrove areas of Malabar (west coast) and in the east coast of Indian peninsula and in Andaman islands, extending into Sri Lanka, S.E. Asia and Australia. It is a potential source of timber for poles, fuel and tannin, and bark as a condiment.

Notes : This species is distinguished from *B. parviflora* from its bronze-coloured twigs, glabrous calyx-tube which equals its lobes in length.

References :

1. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 467.

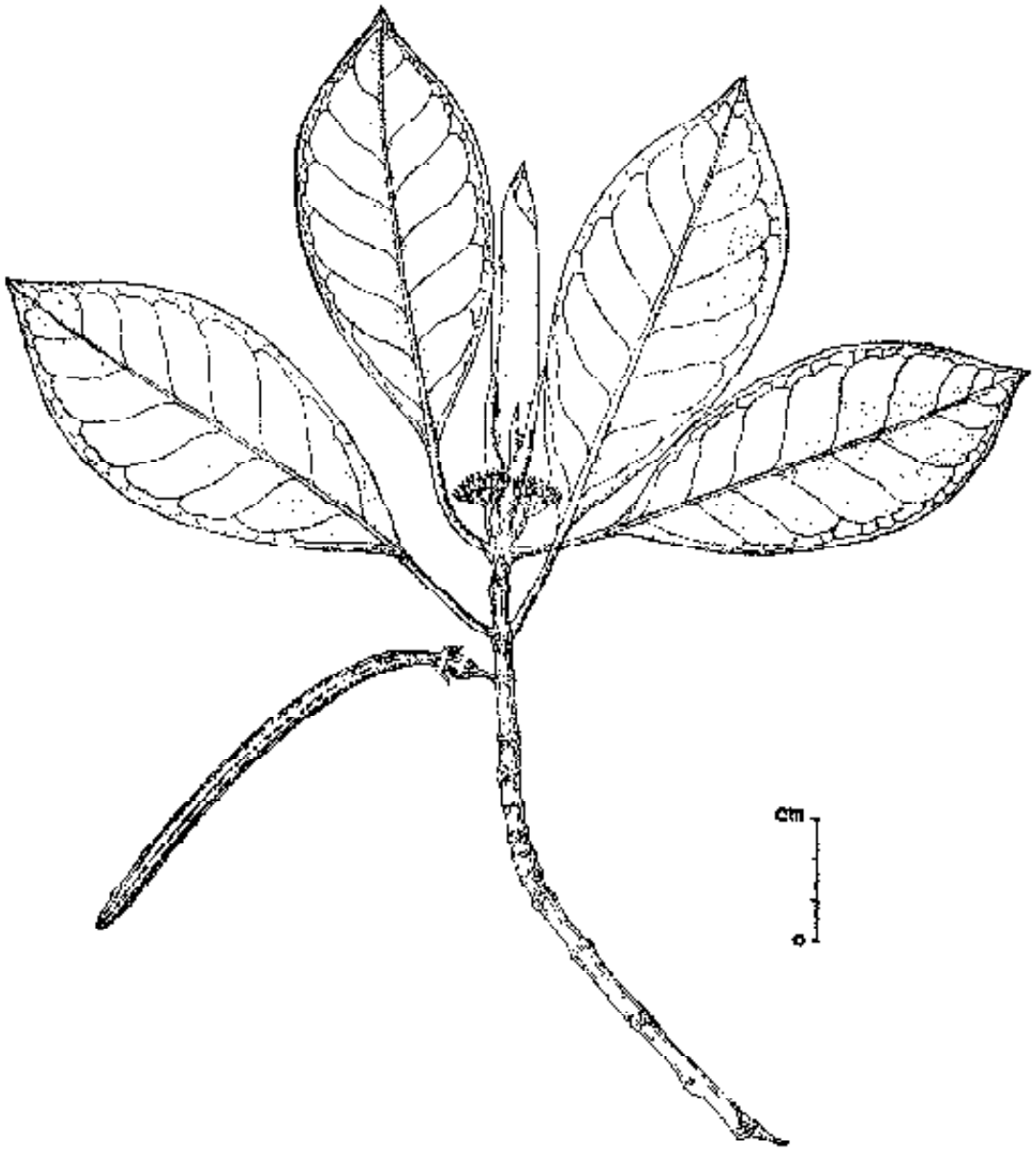
2. Henslow, G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 438.

3. Kurz, S. (1877). *For. Fl. Burma* 1 : 450.

4. Mitra, R. L. & L. K. Banerjee (1979). *Bull. Bot. Surv. India* 21 : 142.

5. Trimen, H. (1894). *Fl. Cegl.* 2 : 154.

6. Watson, J. G. (1928). *Mal. For. Rec.* 6 : 110. t. 15 & 16.



Bruguiera cylindrica (Linn.) Bl with reflexed calyx-lobes and obscurely ribbed hypocotyle.

Bruguiera gymnorrhiza (Linn.) Savingay RHIZOPHORACEAE

Local names : Kankra, Nalinga (*Beng.*), Kakra (Hind.), Banduri (Or.), Thuddupoma (Tel.).

Large trees upto 30 m tall, stem-base with many knee like bent roots. Leaves 7.5—15 × 4—6 cm, elliptic-oblong, coriaceous, acute at apex, obtuse at base ; stipules and petioles reddish. Flowers 3—5 cm long, scarlet, axillary, solitary ; calyx 10—16-lobed, lobes usually 1/5th of the length of the calyx-tube ; petals 10—15 mm long, stiff, bilobed with a bristle in the sinus, bristle shorter than the lobes, each petal-lobe with 3—4 apical 1.5—4 mm long cilia, outer margins of petals fringed with white silky hairs. Hypocotyle 10—15 cm long, cigar-shaped, obscurely ribbed.

Frequent on elevated interior parts of mangrove forests, often in association with species of *Rhizophora* and *Ceriops*, in the inter-tidal regions. Flowering and fruiting throughout the year. In India this species occurs in tidal swamps along the both the coasts of the Peninsula and in the Andaman & Nicobar Islands. The species is distributed in the tropics of Africa to Pacific isles through Egypt, Indus, India, Sri Lanka, Trop. Asia and Australia. The species is exploited for its hard-wood stems used in building fishing boats and houses, electric poles and for charcoal making and yields tannin. Its leaves are used as fodder.

Notes : B. gymnorrhiza is distinguished from the other species of the genus by its red coloured petioles, mid-rib of leaves and flowers.

References :

1. Ding Hou (1958). *In :* C.G.G.J. van Steenis. *Fl. Malesiana* 6 : 461.

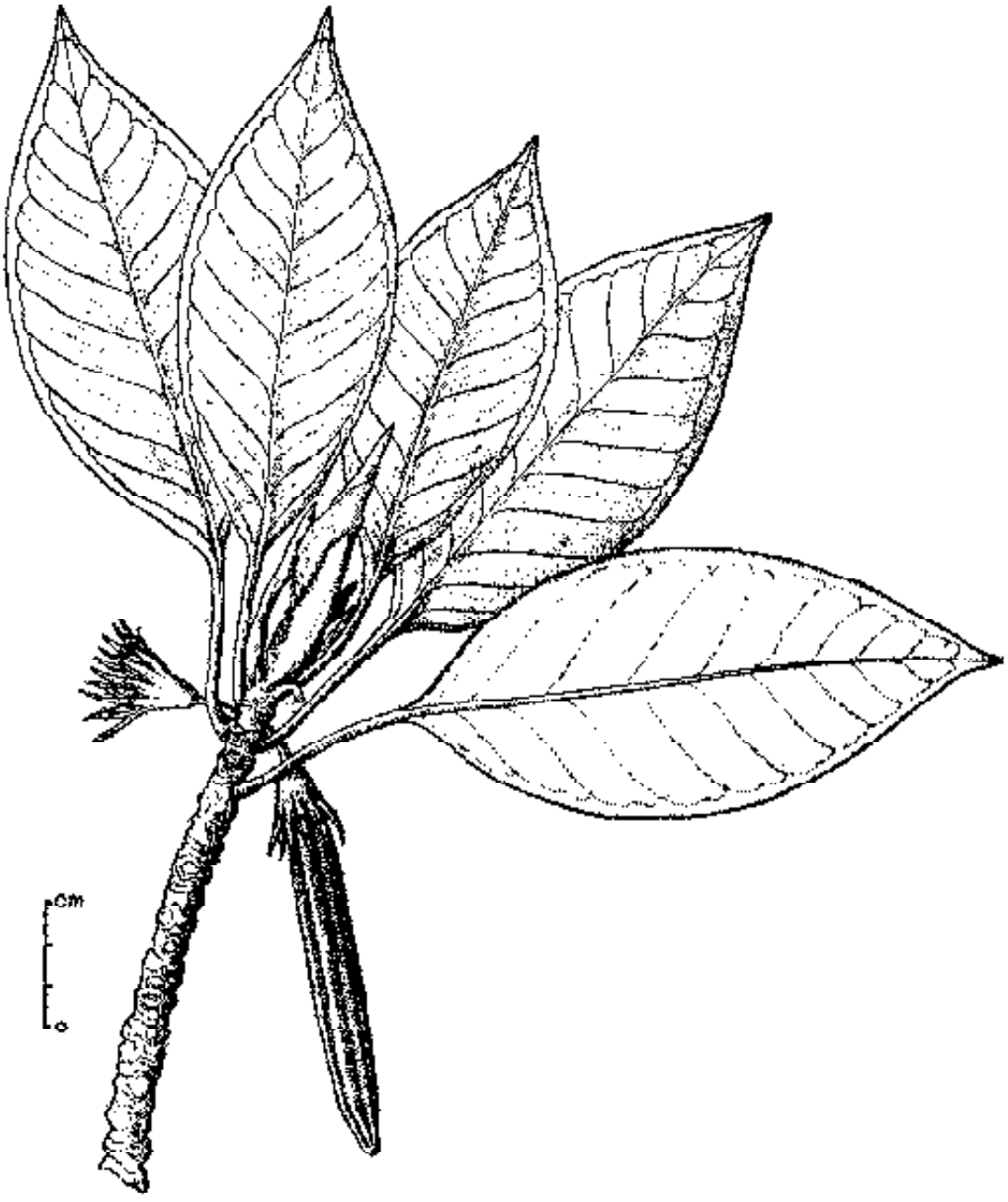
2. Henslow, G. (1878). *In :* J. D. Hooker. *Fl. Brit. India* 2 : 437.

3. Kurz, S. (1877). *For. Fl. Burma* 1 : 450.

4. Mitra, R. L. & L. K. Banerjee (1979). *Bull. Bot. Surv. India* 21 : 142-150.

5. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 164.

6. Watson, J. G. (1928). *Mal. For. Rec.* 6 : 110, t. 15 & 16.



Bruguiera gymnorrhiza (Linn.) Savingay with cigar-shaped hypocotyle.

Bruguiera parviflora (Roxb.) Wt. & Arn. ex Griff. RHIZOPHORACEAE

Local names : Champa (Beng.), Bon bakul (Or.).

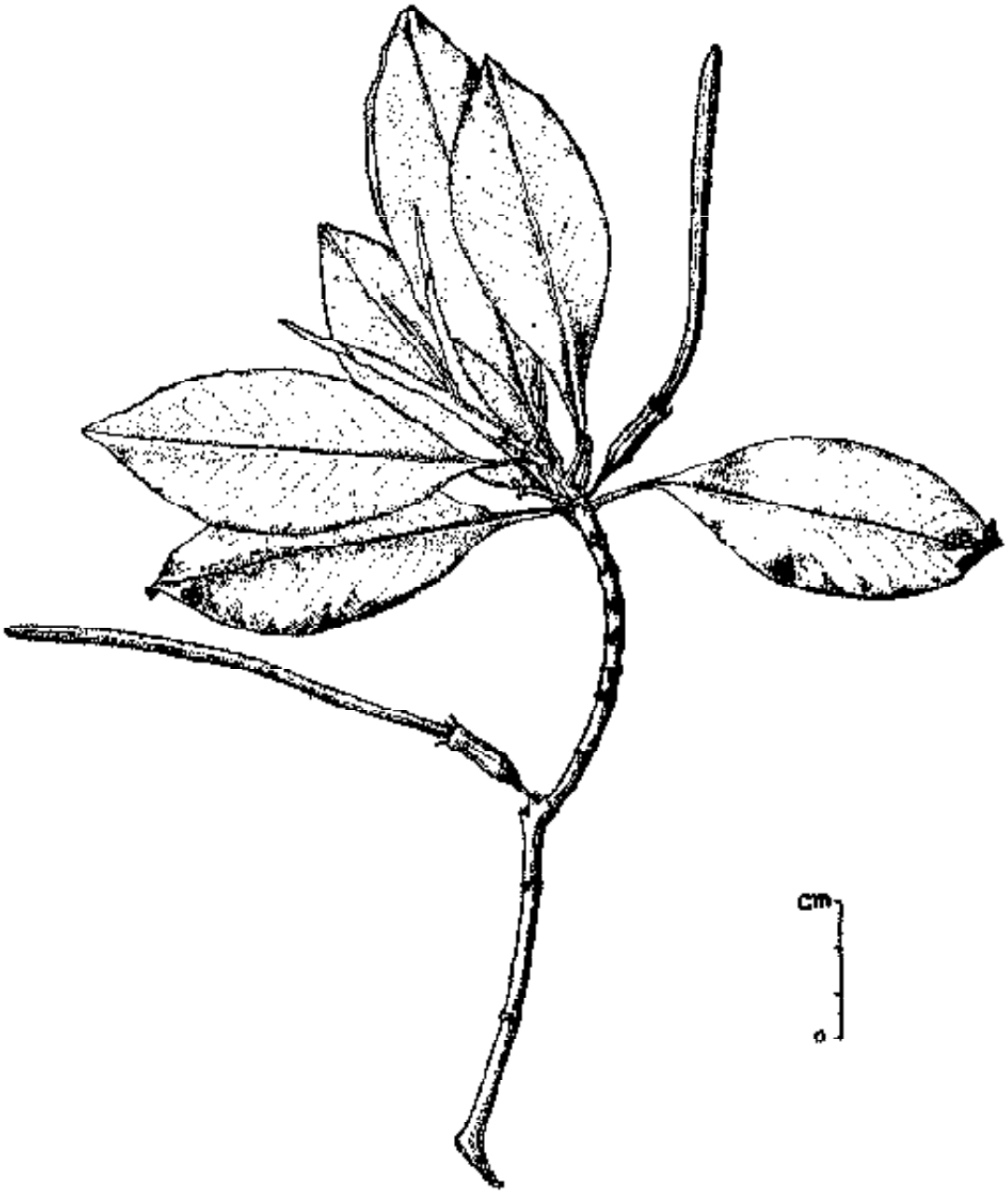
Trees, upto 18 m tall, with many upright branches ; stem-base buttressed with flesh-coloured knee-like bent roots. Leaves 6.5—10.5 × 2.5—4 cm, elliptic-oblong, retuse at apex, attenuate at base, petioles 2—2.5 cm long, yellowish. Inflorescence axillary, peduncu-late cyme, 2—3-flowered ; flowers greenish-white ; calyx-tube upto 2 cm long in fruit, narrow, ribbed ; petals 1.5—2 mm, white, bilobed, apex of the petal-lobe with 3 long cilia ; sinus with a bristle, petal margins sparsely hairy. Hypocotyle 7—12 cm long, smooth, cylindri-cal, slightly curved in the middle.

Frequent along intertidal regions of estuarine banks in man-grove forests and usually grows in sheltered parts behind *Avicennia marina* communities. Flowering and fruiting from April—September. The species is distributed in tidal forests of the Indian peninsula, Andaman Islands ; S.E. Asia and Australia. The species is exploit-ed for its straight-boled stems for poles, fuel, timber, and is used in charcoal making. The fruits are used in making a medicine for eye diseases and its knee-bent roots yield a perfume.

Notes : B. parviflora is easily recognised from *B. cylindrica* from its yellowish petioles; ribbed, narrow calyx-lube and articulate pedi-cels of flowers.

References :

1. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 464.
2. Henslow, G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 438.
3. King, G. (1898). *J. As. Soc. Beng.* 66(2) : 315.
4. Kurz, S. (1877). *For. Fl. Burma* 1 : 449.
5. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 164.
6. Watson, J. G. (1928). *Mal. For. Rec.* 6 : 111, t. 17 & 18.



Bruguiera parviflora (Roxb.) Wt. & Arn ex Griff. showing slender hypocotyles.

Bruguiera sexangula (Lour.) Poir. RHIZOPHORACEAE

(*B. gymnorrhiza* Lamk. ; *B. eriopetala* Wt. & Arn. ex Arn.).

Local names : Banduri, Kankra (Beng.) ; Kekra, Rasinia (Or.).

Trees, upto 12 m tall ; trunk about 40 cm in diam at base, buttressed ; bark smooth, grey to pale brown, lenticellate on buttressus and stilt-roots. Leaves 9 –15 × 3–6 cm, elliptic-oblong, oblong or oblanceate, acute at apex, cuneate or rarely obtuse at base ; petioles 2–3.5 cm long, orange-yellow. Flowers 3–3.5 cm long, axillary, solitary ; calyx 10—13-lobed, orange-yellow ; petals 10—13, 1.5–2 cm long, bilobed towards the apex, fringed with white hairs along the outer margins. Hypocotyle 7—13 cm long, 1.5—2 cm thick, cigar-shaped, rarely slightly curved, obscurely grooved.

Frequent along the outer fringes of tidal forests inundated more with fresh water ; sporadic on newly formed mudflats and along channels in the interior of mangrove areas. Flowering and fruiting almost throughout the year. In India the species occurs in almost all the tidal swamps on both the coasts and in the Andaman and Nicobar Islands. It is widely distributed in the mangrove swamps of Africa, West Asia, tropical Asia, S.E. Asia, Australia and the Pacific. The species is extensively used for timber, fuel wood, tannin extraction and fodder purposes.

Notes : It is easily identified by orange-yellow petioles and midribs of the leaves and solitary orange-yellow flowers in the leaf-axils.

References :

1. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 463. f. 17 m & 18.

2. Henslow, G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 438 (as *B. eriopetala* Wt. & Arn.).

3. Mitra, R. L. & L. K. Banerjee (1979). *Bull. Bot. Surv. India* 21 : 148.

4. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 164.

5. Watson, J. G. (1928). *Mal. For. Rec.* 6 : 109, t. 11a.

6. Wight, R. (1839). *Ic.* 239B.

Ceriops decandra (Griff.) Ding Hou RHIZOPHORACEAE

(*C. roxburghiana* Arn.)

Local names : Goran (Beng., Hind.), Garlah (Or.), Chiru Kandal (Tam.), Gallharu (Tel.).

Shrubs or small trees, 2—4 m tall ; bark light-grey, peeling off into thin flakes ; stem-base pyramidal with many stilt-roots. Leaves 4—10 × 2—6 cm, elliptic-oblong or obovate, emarginate at apex, cuneate at base. Flowers 3—4 mm across, white, in axillary condensed cymes ; calyx 5—6-merous, each 3—4 mm long ; petals 5—6, each 2.5 mm long, apex tipped with many ciliae. Hypocotyle 10—12 cm long, angular, sulcate.

Common along sheltered parts in the interior of tidal swamps, sporadic towards outer mangrove areas. Flowering and fruiting almost throughout the year. In India the species is more common in the mangrove forests along the east coast and is less frequent in the mangrove areas in Kerala on the west coast. Its geographical distribution extends from E. Africa to Australia through Madagascar, India, Bangladesh, Sri Lanka, Burma, Thailand and Malesia. The bark of the species is an excellent source of tannin and its wood is used for boat building, fuel purposes, and its flowers are a source of good quality honey.

Notes : C. decandra is dinstinguished from *C. tagal* by its shrubby form, petals fringed with many ciliae and anther-lobes longer than the filaments.

References :

1. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 471, t. 24, f—h.

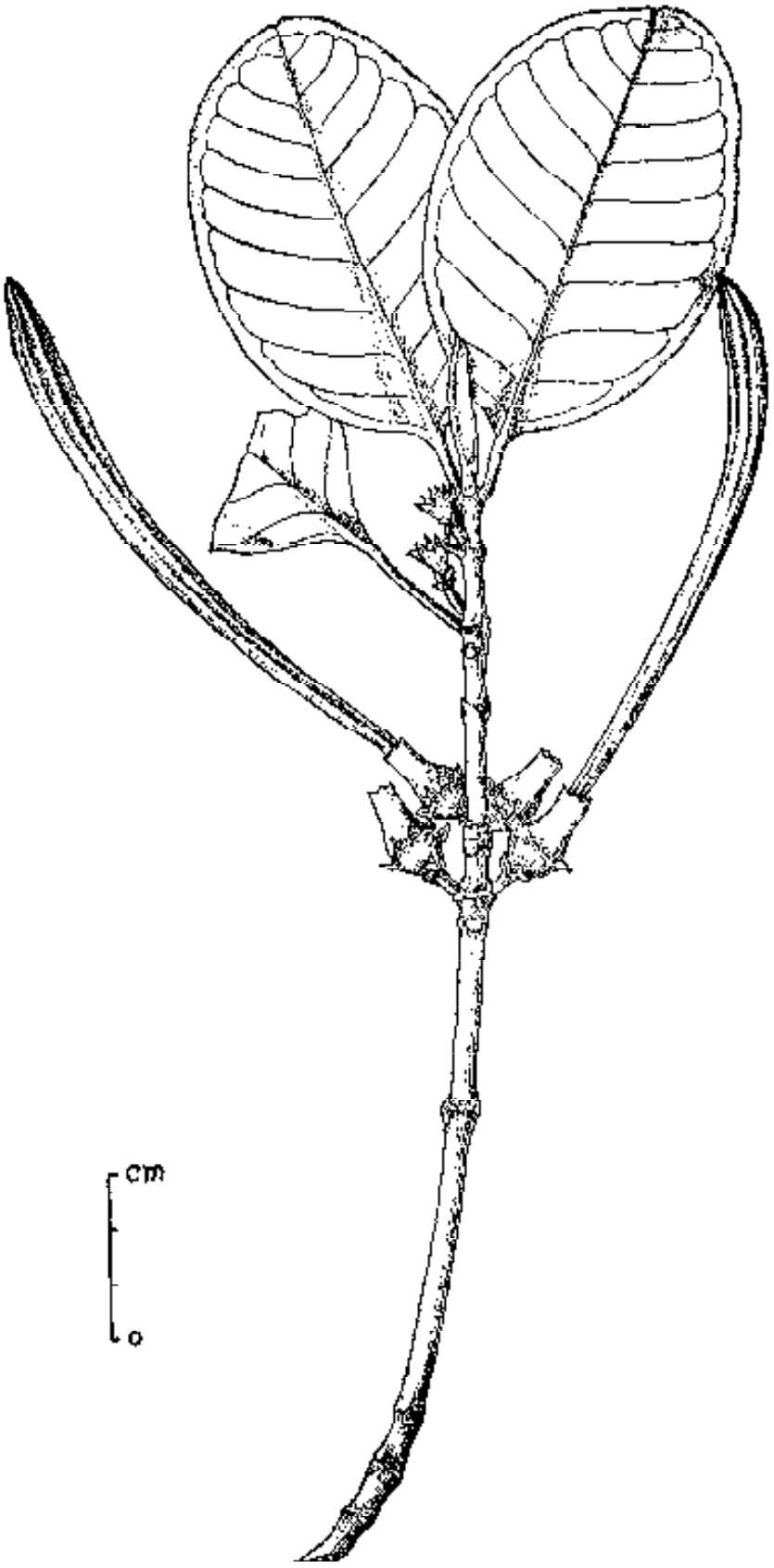
2. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 323. (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Henslow, G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 436.

4. Kurz, S. (1877). *For. Fl. Burma* 1 : 448.

5. Trimen, H. (1894). *Fl. Ceyl.* 2 : 153.

6. Wight, R. (1840). *Ill. Ind. Bot.* 1 : 209.



Ceriops decandra (Griff.) Ding Hou, with sulcate hypocotyles.

Ceriops tagal (Perr.) C. E. Robin. RHIZOPHORACEAE

(*C. candolleana* Arn.)

Local names : Goran, Mat goran (Beng.), Kandal (Mal.), Kirrari, Chauri (Mar.), Gari goran (Or.), Pandikutti (Tam.).

Small trees, upto 6 m tall, much branched, stem-base pyramidal in outline, buttressed and with stilt-roots. Leaves 6—12 × 3—6 cm, ovate-oblong or obovate, leathery, emarginate or rounded at apex, cuneate at base. Flowers 5—7 mm across, white, resinous, in upper axillary condensed cymes ; calyx 5-lobed, lobes linear ; petals 5, each 3—3.5 mm long with 3 clavate appendanges at the tip and uncinate hairs at base ; stamens 10, alternately long and short. Fruit slightly conical. Hypocotyle 20—25 cm long, gradually thickening towards the pointed apex, deeply grooved and ribbed, reddish-brown.

Common along the intertidal banks of mangrove swamps, more so in areas nearer to and under estuarine influence. Flowering and fruiting during March—August. Distributed in almost all the tidal swamps along both the coasts of Indian peninsula and Andaman and Nicobar Islands. It is widely distributed from East Africa to Australia and the Pacific. The species is exploited for its bark supplies an excellent tanning material and a decoction of it is used to stop haemorrhage and as an application to malignant ulcers. A decoction of the shoots is used as a substitute for quinine in Africa (Cooke, 1967) ; its wood is used as fuel, for boat building and yields an adhesive ; flowers are a rich source of honey and bee wax.

References :

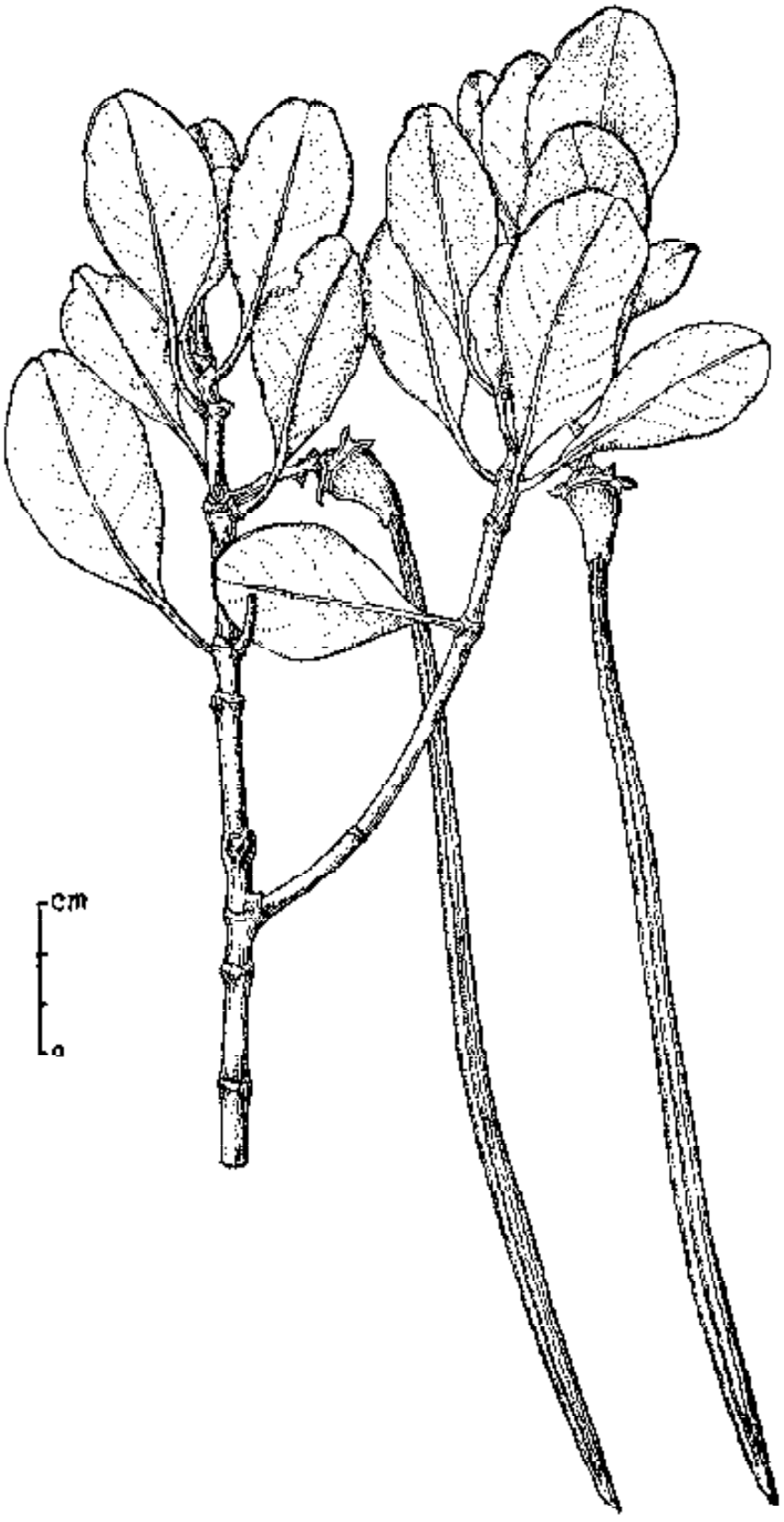
1. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 503. (2nd repr. ed.). Botanical Survey of India, Calcutta.

2. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 469. t. 24.

3. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 323. (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Henslow, G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 436.

5. Parkinson, C. E. (1923). *For. Fl. Andaman Islands,* p. 165.



Ceriops tagal (Perr.) Rob. with long ribbed hypocotyles.

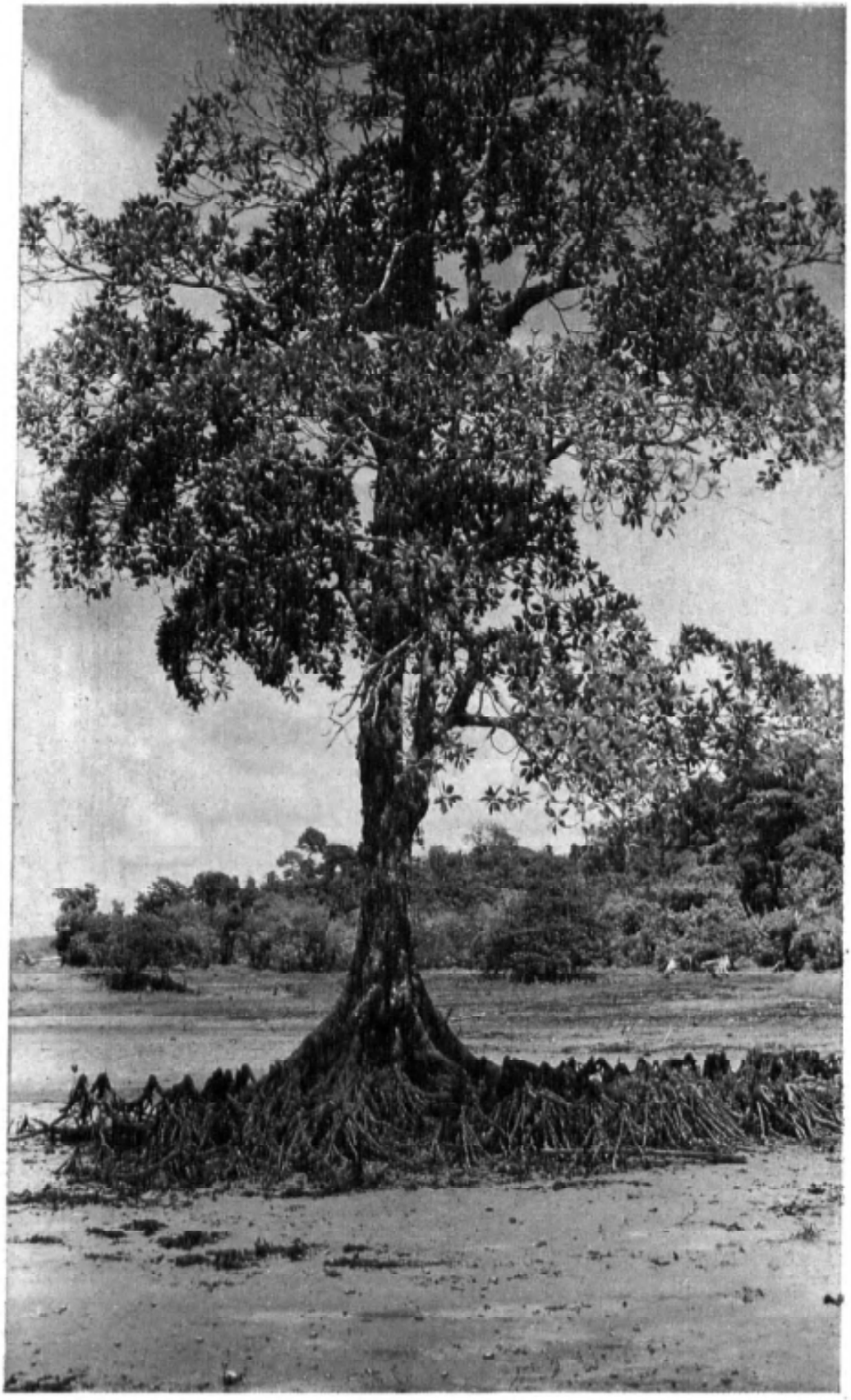
Rhizophora apiculata showing drooping hypocotyles, in Mahanadi tidal forests.
Photo : L. K. Banerjee, BSI.

Rhizophora mucronata showing vivipary in Pichavaram tidal forests.
Courtesy : BSI, SC., Coimbatore.

Rhizophora mucronata, full grown trees supported by stilt-roots, along tidal creeks in Andaman Islands.
Courtesy : BSI, ANC., Port Blair.

Phoenix paludosa stand in Mahanadi tidal forests. Photo: L. K. Banerjee. BSI.

Heritiera fomes with woody pneumatophores at stem-base, in Bhitarkanika, Mahanadi tidal forests. Photo: L. K. Banerjee. BSI.



Bruguiera gymnorrhiza—full grown tree with buttresses and knee-roots at stem base, during low tide in S. Andaman Island.

Courtesy: BSI, ANC., Port Blair.

Kandelia candel (Linn.) Druce RHIZOPHORACEAE

(*K. rheedii* Wt. & Arn.)

Local names : Goria (Beng.), Bakul Rasunia (Or.), Thuvar Kandan (Tel.).

Small trees, upto 6 m tall, much branched, branches erect, thick, brittle, stem-base buttressed with stilt-roots. Leaves 8—12 × 2.5—4.5 cm, oblong, dark green above, light reddish-brown beneath, rounded at apex, obtuse at base. Flowers in axillary dichotomously branched cymes, 8—9-flowered ; flowers 1—1.5 cm long, white ; calyx 12—15 mm long, 5-lobed, reflexed ; petals 5, each 8—10 mm long, each divided into numerous capillary segments. Fruits about 3 cm long, conic-ovoid, 1-celled, single seeded. Hypocotyle 30—60 cm long, spindle-shaped, pointed towards the radicle end.

Gregarious along the banks of intertidal creeks and channels in the mangroves forests. Flowering and fruiting from April—September. In India the species is found in all the tidal forests on the east and west coasts and Andaman and Nicobar Islands. It is distributed in the mangrove forests of Bangladesh, Sri Lanka, Burma and Malesia. It is a pontential source of firewood and charcoal and its leaves are used as fodder.

Notes : K. candel is monotypic and is readily recognised from the other species of Rhizophoraceae by its linear-oblong, reflexed calyx-lobes, indefinite number of stamens and the long, smooth hypocotyle.

References :

1. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 504. (2nd repr. ed.). Botanical Survey of India, Calcutta.

2. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 473.

3. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 324. (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Henslow, G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 437.

5. Kurz, S. (1877). *For. Fl. Burma* 2 : 449.

6. Parkinson, C. E. (1923). *For. Fl. Andaman Islands,* p. 165.

Rhizophora apiculata Bl. RHIZOPHORACEAE

(*R. conjugata* auct. non Linn.)

Local names : Garjan (Beng.), Pikantal (Mal.), Kamodumbi (Mar.), Rai (Or.), Kandal (Tam.), Uppu ponna (Tel.).

Trees, upto 30 m tall with pyramidal crowns and many ascending branches ; stem-base supported by numerous branched stilt-roots. Leaves 10—20 × 5—8 cm, elliptic-oblong, coriaceous, entire, acute or apiculate at apex, cuneate at base. Flowers 10—12 mm across, sessile, white or cream-coloured, in pairs of upper leaf-axils ; calyx 4-lobed, concave, accrescent, reflexed in fruit ; corolla 4-lobed, lobes fleshy, glabrous, caducous ; stamens 12, 4 episepalous paired, 4 epipetalous. Hypocotyle 30—50 cm long, cylindrical, clavate.

Frequent or sometimes gregarious along the inter-tidal regions of creeks and channels mostly in the sheltered parts of mangrove forests, nearer to estuarine conditions. Flowering and fruiting during May—September. Distributed throughout the mangrove forests along the east and west coasts of the Indian peninsula and in the Andaman and Nicobar Islands. The species occurs from tropical East Africa to N. Australia through the Indus, India, Sri Lanka, Bangladesh, Burma, S. Asia and S.E. Asia. Its wood forms a potential source of tannin and finds application in plywood, adhesive, dye bark, cellophane, rayon, ferro-alloys, cellulose acetate industries and as a substitute for petroleum coke for calcium carbide, besides being used as fuel-wood and in medicines ; its leaves are used as fodder. The intricate stems with several stilt-roots are effective as tide brakers and check land run off and form an ideal niche for several faunal species.

Notes : R. apiculata is distinguished from the other two species by its acute leaf-tip, 2-flowered inflorescence, glabrous petal-lobes and 12 stamens of flowers.

References :

1. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 452.

2. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 502. (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 323. (2nd repr. ed.). Botanical Survey of India, Calcutta. (as *R. candelaria* DC.).

4. Henslow, G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 436.

5. Kurz, S. (1877). *For. Fl. Burma* 1 : 447.

6. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 164.

7. Prain, D. (1963). *Bengal Pl.* 1 : 344. (repr. ed.). Botanical Surey of India, Calcutta.

Rhizophora mucronata Lamk. RHIZOPHORACEAE

Local names : Same as the preceeding species.

Trees, upto 20 m tall, with many upwardly growing branches ; leaf scars prominent, close ; stem- base supported by numerous branched stilt-roots. Leaves 10—18 × 4—10 cm, broadly elliptic or ovate-oblong, coriaceous, abruptly acute or blunt with a rolled up tip (mucro) at apex, cuneate at base. Flowers in axillary cymes, 4—8 in number, pedicellate, cream-coloured, fragrant ; calyx 12 - 14 mm long, ovate ; petals 9—10 mm long, lanceolate, fleshy, villose ; stamens 6—8 mm long, 8 in number, 4 episepalous, 4 epipetalous ; styles 1—2 mm ; free part of ovary emerging much above the disk. Hypocotyle 30—65 cm long, cylindrical.

Common and often gregarious along the intertidal banks of creeks and channels in sheltered mangrove areas under estuarine influence. Flowering and fruiting from July—October. In India, this species is predominant in the Sunderbans, and other east coast mangrove forests and Andaman and Nicobar Islands and is less known on the west coast. A species of old world tropics distributed from East Africa to the Pacific Isles through S. Asia, S.E. Asia and N.E. Australia. The species is used for similar purposes as those in the case of *R. apiculata*.

Notes : R. mucronata is readily recognised from *R. apiculata* from its axillary cymes with more than two flowers, hairy petals and 8 stamens.

References :

1. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 501 (2nd repr. ed.). Botanical Survey of India, Calcutta.

2. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 453.

3. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 323 (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Haines, H. H. (1961). *Bot. Bih. & Orissa* 2 : 362 (repr. ed.). Botanical Survey of India, Calcutta.

5. Henslow, G. (1878). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 435.

6. Parkinson, C. E. (1923). *For Fl. Andaman Islands*, p. 164.

Rhizophora stylosa Griff. RHIZOPHORACEAE

Local name : Samudra Rai (Or.).

Trees, upto 12 m tall with many sympodial branches ; stem-base supported by many branching stilt-roots. Leaves 6—15 × 5—7 cm, broadly elliptic-oblong, coriaceous, obtuse at apex, cuneate at base. Flowers in dichotomously branching axillary cymes, 8—16 in number, pedicellate ; peduncles 3—5 cm, 4—6 times forked ; calyx lobes 7—9 mm ; petals yellowish, purple tinged at apices, fleshy, 6—7 mm long, densely hairy along the margins ; stamens 8, 4 episepalous, 4 epipetalous ; styles 3—5 mm long, slightly forked. Hypocotyle 20—50 cm long, cylindrical, warty.

Sporadic and rather uncommon, on shallow muddy estuarine banks of rivers. Flowering and fruiting from August—October. In India the species is reported only from the Gahirimata estuary in Orissa coast. It is distributed in Malay peninsula, Java, Formosa and N. Australia. It is also used for the same purposes stated under *R. apiculata*.

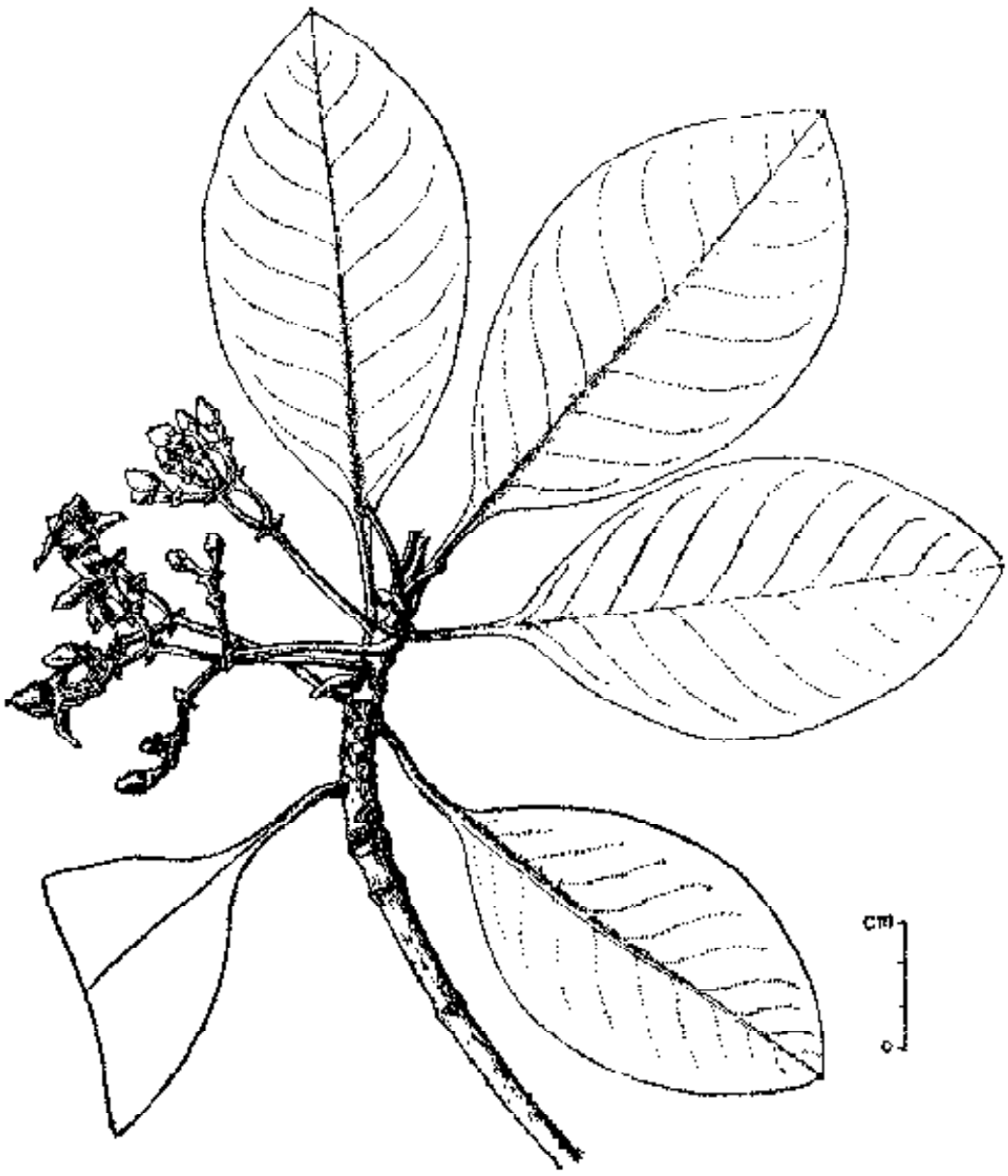
Notes : R. stylosa is recognised from the other two species of *Rhizophora* by its longer style and free part of the ovary seated on the disk.

References :

1. Banerjee, L. K. (1986). *Jour. Bombay Nat. Hist. Soc.* 83 : 271-273.

2. Ding Hou (1958). *In :* C.G.G.J. van Steenis, *Fl. Malesiana* 5 : 456.

3. Ridley, H. N. (1922). *Fl. Malay Penins.* 1 : 693.



Rhizophora stylosa Griff. with pedicellate flowers.

Sonneratia alba J. Sm. SONNERATIACEAE

Small trees upto 5 m tall, much branched, pneumatophores many, corky. Leaves glabrous, coriaceous, 5—7.5 × 4—6 cm, elliptic, oblong or suborbicular, obtuse at apex, narrowed to a short petiole at base ; petiole 3—6 mm long. Flowers 3—5 cm across, white ; calyx-tube cup-shaped, 6—8-lobed, lobes obscure in flower, distinct in fruit ; petals white, small, ovary depressed-globose ; style upto 4 cm long, stigma capitate. Fruit 3 cm in diam, obconical with persistent calyx and pointed style.

Frequent in the intertidal areas in mangrove forests. Flowering and fruiting during April—September. In India the species is reported only from Andaman Islands (possibly also in Nicobar Islands). It is distributed in the tidal forests in tropical Africa, Madagascar, Seychelles, Andamans, Burma, Malayasia, N. Australia and Micronesia.

It is used for the same purposes as in the case of other *Sonneratia* species.

Notes : The species closely resembles *S. caseolaris,* but is distinguished from its ribbed calyx with obconical base.

References :

1. Backer, C. A. & C.G.G.J. van Steenis (1951). *Fl. Malesiana* 2 : 285.

2. Clarke, C. B. (1879). *In* : J. D. Hooker, *Fl. Brit. India* 2 : 580.

3. Kurz, S. (1877). *For. Fl. Burma* 1 : 526.

4. Parkinson, C. E. (1923). *For. Fl. Andaman Islands,* p. 179.

Sonneratia apetala Buch.-H.-m. SONNERATIACEAE

Local names : Keora (Beng., Or.), Marama (Tam.), Kaliogi (Tel.).

Trees, upto 30 m tall, crown large, branches many, drooping, bark thin, light-brown, irregularly fissured ; buttresses not prominent; pneumatophores 60—150 cm long, arising from horizontal roots, corky, forked twice or thrice, associated with anchor roots and nutrition roots. Leaves 4—10 × 2—3 cm, thick, narrowly elliptic-oblong, tapering towards apex, attenuate at base. Flowers 1.5—2 cm across, apetalous, cream-coloured, arranged in axillary, 3-flowered dichasial or 7-flowered cymes from the branch axils ; calyx 4-merous, reflexed ; petals absent ; stamens many ; stigma large, umbrella-shaped. Fruit 2—2.5 cm across, a globose berry sealed on the flattened calyx-tube.

Gregarious along the intertidal estuarine regions of mangrove forests, often as a pioneer species on newly formed mudflats. Flowering and fruiting from March—July. The species occurs in the mangrove forests on both the coasts of India from Bombay to Sunderbans. Distributed in Sri Lanka (Koddiyarstem island) ; and Moulmein in Burma. Its stem is used for paper pulp, matches, and as poles ; leaves as fodder ; its fruits are used as vegetable.

Notes : The species is easily identified from the other two species of the genus by its narrowly elliptic leaves, apetalous flowers, 4-merous calyx and large umbrella-shaped stigma.

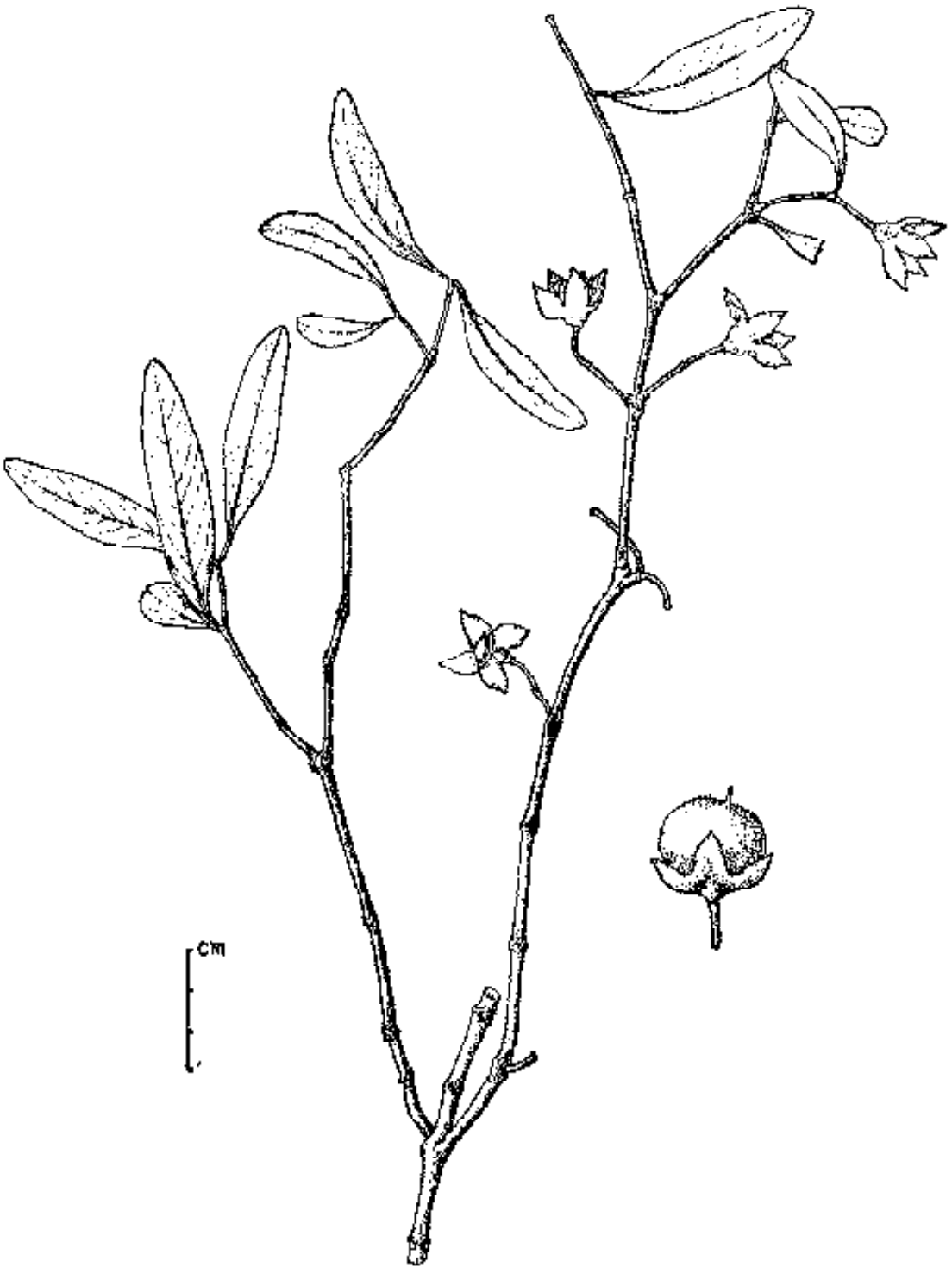
References :

1. Backer, C. A. & C.G.G.J. van Steenis (1951). *Fl. Malesiana* 4 : 286.

2. Clarke, C. B. (1879). *In* : J. D. Hooker, *Fl. Brit. India* 2 : 579.

3. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 547. (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 363. (2nd repr. ed.). Botanical Survey of India, Calcutta.



Sonneratia apetala Buch.-Ham. in flowers ; fruit separately shown.

Sonneratia caseolaris (L.) Engl. SONNERATIACEAE
(*S. acida* Linn. f.)

Local names : Keora (Beng.), Blatti, Thirala (Mal.), Pedda kalingi (Tel.)

Small trees upto 6 m tall, bark white ; branches low and spreading ; pneumatophores many, corky, arising from the horizontal roots. Leaves 5--10 × 3—5 cm, nearly sessile, elliptic-oblong or obovate, mucronate at apex, much attenuated at base. Flowers 4—6 cm across, reddish-purple, solitary and terminal ; calyx-tube flattened, 6-lobed ; petals 6, linear oblong, 2 cm long, membranous ; ovary depressed-globose ; style nearly 3 cm long, stigma capitate. Fruits 4--6 cm in diam, depressed-globose with persistent calyx and pointed style.

Common along the intertidal banks of creeks and channels in mangrove forests, flourishing well in areas under fresh water inundation. Flowering and fruiting duringMarch—July. Occurs in the mangrove forests along both the coasts of the Indian peninsula and in Andaman and Nicobar Islands. Distributed in the tropical mangrove forests of Bangladesh, Sri Lanka, S.E. Asia, Philippines and N. Australia. The species finds application for the uses mentioned under *S. apetala.* Its soft pneumatophores are reportedly used as a substitute for cork in Sri Lanka.

References :

1. Backer, C. A. & C.G.G.J. van Steenis (1951). *Fl. Malesiana* 4 : 283.

2. Clarke, C. B. (1879). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 579.

3. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 547 (2nd repr. ed.). Botanical Survey of India, Calcutta.

4. Gamble, J. S. (1967). *Fl. Pres. Madras* 1 : 364. (2nd repr. ed.). Botanical Survey of India, Calcutta.

Sonneratia griffithii Kurz SONNERATIACEAE

Local name : Ora (Or.).

Large trees, upto 20 m tall, crown large, branches many, drooping ; pneumatophores numerous, corky. Leaves 6—12 × 3—7 cm, obovate or suborbicular, thickly coriaceous, emarginate at apex, cuneate at base. Flowers 6—8 cm across, apetalous, white, solitary at apices of terminal branchlets ; calyx 6—8-merous, spreading in fruit ; stamens many, white. Fruits 5—8 cm across, ovoid-globose, flattened or depressed above, partly enclosed by persistent calyx at base.

Sporadic on muddy banks of estuarine mouths subjected to tidal inundation. Flowering and fruiting from April—September. In India the species is reported only from the Mahanadi tidal forests and Andaman Islands. It is distributed in Africa, Bangladesh (Sunderbans, Chittagong), Burma (Mergui), West Malay Peninsula and Australia. The species is used for the same purposes reported under *S. apetala* and the fruits are reportedly pickled and eaten.

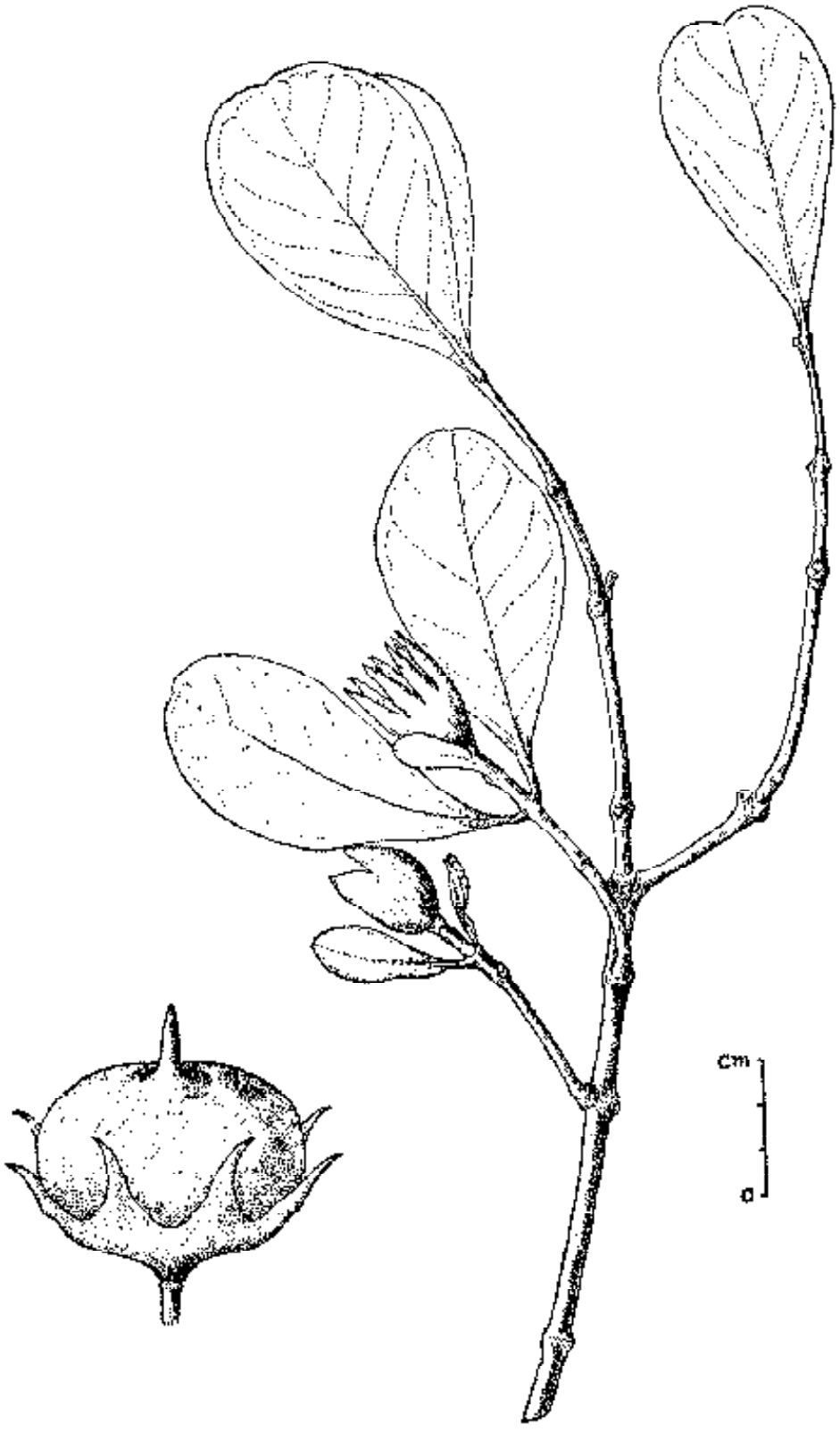
Notes : S. griffithii is distinguished from the other two species (reported from India) from its obovate leaves, large solitary white flowers with white stamens and larger globose fruits flattened or depressed at apex.

References :

1. Backer, C. A. & C.G.G.J. van Steenis (1951). *Fl. Malesiana* 4 : 286.

2. Banerjee, L. K. (1986). *Journ. Bombay Nat. Hist. Soc.* 83 : 271-273.

3. Clarke, C. B. (1879). *In :* J. D. Hooker, *Fl. Brit. India* 2 : 580.



Sonneratia griffithii Kurz, in flower ; fruit separately shown.

Heritiera fomes Buch.-Ham. STERCULIACEAE

(*H. minor* Roxb.)

Local names : Sundari (Beng. & Or.).

Trees upto 20 m tall, trunk about 50 cm in diam at base, prominently buttressed ; blaze dark-red ; young branches covered with shining golden-brown scales ; roots with numerous woody peg-like pneumatophores or blind root suckers. Leaves 5—12 × 3—6 cm, elliptic, upper surface green, lower surface shining with silvery scales, tapering at both the ends. Flowers in axillary panicles, unisexual, densely pubescent, golden-yellow with reddish tinge inside ; calyx 5 or rarely 4—6, toothed ; petals absent ; male flowers : stamens united into a column and anther lobes forming a ring at the top ; female flowers : carpels 5—6, nearly free. Fruit (ripe carpels) 3—4 cm across, subglobose, corrugated, woody, indehiscent, furrowed on the inside and less prominently winged on the outer side.

Common along the inner fringes of mangrove forests on mud flats inundated more with fresh water. Flowering and fruiting during May—August. In India the species is distributed in the Sunderbans and Mahanadi tidal forests. Its distribution extends into the Irrawady deltaic areas in Burma and in tidal forests in Borneo. The species is a potential source of timber and is extensively exploited for boat building, plough making and in viscose rayon industry. Its seeds are reported to be medicinal in curing piles.

Notes : H. fomes is distinguished from its shining silvery under surface of leaves and subglobose fruits with longitudinal and transverse ridges.

References :

1. Haines, H. H. (1961). *Bot. Bih. & Orissa* 1 : 81 (repr. ed.). Botanical Survey of India, Calcutta.

2. Kostermans, A. J. G. H. (1959). *Reinwardtia* 4 : 473.

3. Masters, M. T. (1874). *In :* J. D. Hooker, *Fl. Brit. India* 1 : 363.

4. Prain, D. (1963). *Bengal Pl.* 1 : 188 (repr. ed.). Botanical Survey of India, Calcutta.

Heritiera kanikensis Majumdar *et* Banerjee STERCULIACEAE

Local name : Sundari (Or.).

Medium sized trees, 5—7 m tall ; pneumatophores many from roots at stem base. Leaves 4—10 × 2—5 cm, elliptic-lanceolate, obtuse or rarely acute at apex, tapering towards base, upper surface glabrous, green, lower surface hairy with adpressed shining scales. Male flowers brownish-white, androgynophore 1 mm long; anther lobes 8, united to form a ring, crowned by sterile rudimentary ovaries at apex. Female flowers with *ca* 1 mm long ellipsoid ovaries. Fruits globose, rough, 1.5 --2 mm in diam, without transverse circular ridge or apical crest.

Rare along intertidal banks of tidal creeks and channels in mangrove forest at Bhitarkanika, Mahanadi delta, Orissa. Flowering and fruiting from May—August. The species is so far known from the Mahanadi tidal forests in Orissa, India. Its wood is used in building fishing boats, making ploughs and in viscose rayon industry.

Notes : The species is closely allied to *H. fomes* but is readily recognised from the other two species of *Heritiera* by its rough globose fruits devoid of any ridge and crest.

Reference :

1. Majumdar, N. C. & L. K. Banerjee (1985). *Bull. Bot. Surv. India* 27 : 150-151.

Heritiera littoralis Dryand. STERCULIACEAE

Local names : Sundri (Mal.), Bara sundari (Or.). The looking-glass plant (Eng.).

Large trees upto 25 m tall, trunk 30—80 cm in diam at base, buttressed, bark thin, grey, longitudinally fissured. Leaves 7—2.5 × 10—20 cm, coriaceous, broadly elliptic or ovate-elliptic, acute or acuminate at apex, obliquely cordate at base, upper surface green, glabrous, lower surface covered with white fimbriate scales. Flowers in axillary panicles, golden-yellow, tinged with red inside, stellate-pubescent, unisexual ; male flowers 3—4 mm across, androgynophore white, ringed by the anther lobes ; female flowers 4—5 mm across, with sterile anthers at the base of ovary. Fruits (ripe carpels) 8—12 cm across, ellipsoid, smooth, light brown, inner side flat with a prominent midrib bending towards the apex, outer side with a well developed rudder-like crest or wing.

Rather less frequent ; on sandy tidal banks in the back mangrove region associated with *Hibiscus tiliaceus* and *Xylocarpus granatum*. Flowering during November—January and fruiting from February—June. In India the species occurs on the Malabar, N. Kanara, S. Konkan coasts, in the Bhitarkanika area of the Mahanadi tidal forests in Orissa and in the coastal forests of Andaman Islands. It is not collected so far from the Sunderbans. Its reported inland distribution extending into Khasi and Cachar hills is interesting (Masters, 1874). The species is distributed from tropical Africa to Australia through India, Sri Lanka, Burma, Thailand, Vietnam, Java and Malesia. Its wood is dark red, heavy and durable and forms a potential source of timber used for making boats, furniture and in viscose rayon industry.

Notes : This species is recognised from *H. fomes* by its larger leaves with oblique bases, 8—12 cm long smooth ellipsoid fruits with a well developed wing on the outer side and a keel on the inner side.

References :

1. Cooke, T. (1967). *Fl. Pres. Bombay* 1 : 134. (2nd repr. ed.). Botanical Survey of India, Calcutta.

2. Gamble, J. S. (1967). *Fl. Pres. Bombay* 1 : 74. (2nd repr. ed.). Botanical Survey of India, Calcutta.

3. Masters, M. T. (1874). *In :* J. D. Hooker. *Fl. Brit. India* 1 : 363.

4. Kostermans, A. J. G. H. (1959). *Reinwardtia* 4 : 465.

5. Parkinson, C. E. (1923). *For. Fl. Andaman Islands*, p. 102.

Brownlowia tersa (Linn.) Kosterm. TILIACEAE

(*B. lanceolata* Benth.)

Local names : Bola sundari, Kedar sundari (Beng.), Pani sundari (Or.).

Shrubs, 2—3 m tall, much branched ; young twigs brown-scaly. Leaves 10—15 × 3—4 cm, lanceolate, densely dull silvery-scaly underneath, acuminate at apex, rounded at base. Flowers 3—4 mm across, flesh-coloured, in axillary or terminal cymes ; calyx 4—5-lobed, connate below ; petals 5, free ; stamens many, alternating with 5 petaloid staminodes opposite the petals. Fruits 1—1.5 cm across, pyriform, woody with a line separating the 2-valved carpels, brown-scaly.

Sporadic along the intertidal regions of creeks and channels in the back mangrove areas of tidal forests. It often grows along the banks in stands and remains submerged nearly to half during high tide, withstanding the tidal surge by its intricate root system. Flowering and fruiting from May—September. It occurs in the tidal forests in the Sunderbans, Mahanadi and Andamans and Irrawadi delta, Burma. Its wood is used for fuel and fruits are considered medicinal.

Notes : B. tersa is readily recognised in the field from its brown-scaly twigs, lanceolate leaves with dull silvery under surface and pear-shaped, 2-valved carpels (fruits).

References :

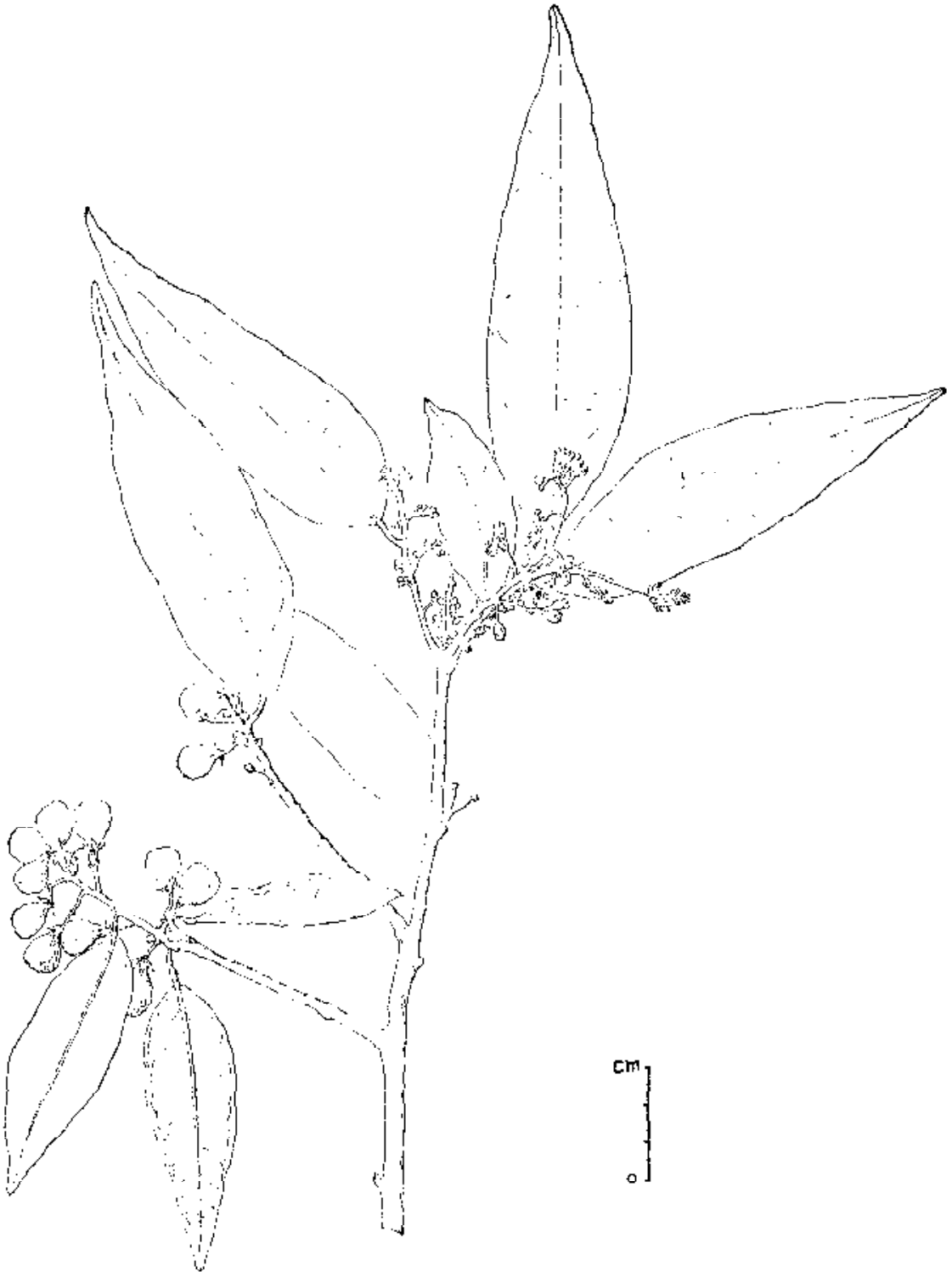
1. Haines, H. H. (1961). *Bot. Bih. & Orissa* 1 : 87 (repr. ed.). Botanical Survey of India, Calcutta.

2. Kostermans, A. J. G. H. (1959). *Reinwardtia* 4 : 536.

3. Masters, M. J. (1874). *In :* J. D. Hooker, *Fl. Brit. India* 1 : 381.

4. Parkinson, C. E. (1923). *For. Fl. Andaman Islands,* p. 105.

5. Prain, D. (1961). *Bengal Pl.* 1 : 192. (repr. ed.). Botanical Survey of India, Calcutta.



Brownlowia tersa (Linn.) Kosterm., in flowers and fruits.

MANGROVE ASSOCIATE PLANT SPECIES

The following plant species which are not strictly mangroves are usually seen in hinterland parts of tidal swamps under fresh water conditions along coastal districts in India.

Barringtonia racemosa Roxb. (Barringtoniaceae).

Small ornamental trees with cream coloured flowers in pendent racemes. Common along river banks. Throughout the coastal regions in India, South-east Asia, Polynesia.

Caesalpinia bonduc (L.) Roxb. (Caesalpiniaceae).

Prickly climbers with yellow flowers. Frequent on bushes along forest margins. All over coastal districts in India ; tropical coasts all over world.

Clerodendrum inerme Gaertn. (Verbenaceae).

Straggling shrubs with white flowers. Common along tidal forests, coastal areas. Often planted as a hedge plant. Throughout India at low levels ; Indo-China.

Fimbristylis ferruginea (L.) Vahl (Cyperaceae).

Tufted sedge with brownish spikelets. Common on mud flats and hinterland clearings in the vicinity of mangrove forests. Throughout India ; tropics and sub-tropics of world.

Hibiscus tiliaceous L. (Malvaceae)

Medium sized trees with yellow bell-shaped flowers having a crimson-coloured eye inside, changing to brownish-red. Common on banks of tidal rivers in hinterland. Throughout coastal areas in India and Sri Lanka.

Ipomoea tuba (Schl.) G. Don (Convolvulaceae).

Extensively spreading climber with large cordate leaves and showy white flowers in hinterland vegetation along river banks, in the vicinity of mangrove forests. Throughout India near tidal swamps ; Indo-China, Malesia.

Merope angulata (Willd.) Swingle (Rutaceae).

Thorny sub-shrubs with white flowers and egg-shaped 3-angled fruits. Frequent along river banks in the hinter-land tidal forests only at Batighar, Mahanadi delta, Orissa in India ; Malacca.

Pandanus odoratissimus Linn. f. (Pandanaceae).

Dichotomously branching large shrubs with long spinulose-margined leaves crowned at branch ends; inflorescence sweet-scented. Common all over coastal parts in India, often cultivated.

Pluchea indica Less. (Asteraceae).

Aromatic undershrubs with white flower heads. Common along back mangrove areas in Sunderbans; Malesia, China.

Salacia chinensis L. (Hippocrataceae).

Climbing shrubs with greenish-yellow flowers. Rare in hinterlands of tidal swamps and coastal areas in India; Burma, Malesia, Indo-China and China.

Salvadora persica L. (Salvadoraceae).

Shrubs or small trees with white flowers. Frequent in degraded mangrove swamps and saline blanks. All over the West Coast of India; West Asia.

Scyphiphora hydrophyllacea Gaertn. f. (Rubiaceae).

Small trees resembling *Lumnitzera racemosa* with white flowers. Rare, only along east coast of Indian peninsula and Andaman Islands.

Stenochlaena palustre (Burm.) Bedd. (Polypodiaceae).

Climbing fern with dimorphic fronds. Rare, only seen on sandbars of tidal forests in Mahanadi delta, Orissa; Sri Lanka, South China and Polynesia.

Stictocardia tiliifolia (Desr.) Hall. f. (Convolvulaceae).

Climbing shrubs with large rose-purple flowers. Frequent in hinterland thickets of tidal forests in Bengal and along west coastal areas in India; Malesia and Philippines.

Thespesia populnea (L.) Sol. ex Correa (Malvaceae).

Handsome trees with showy yellow flowers. Common all along coastal areas and often planted. Tropics of Old World.

Thespesia populneoides (Roxb.) Kostel (Malvaceae).

Small trees with yellow flowers. Frequent in hinterland areas of tidal swamps and muddy coastal areas along east coast of India and Andaman and Nicobar Islands. Tropics of Old World.

Tylophora tenuis Bl. (Asclepiadaceae).

Slender twining herbs with scarlet flowers and divergent follicles. Frequent in Sunderbans, Mahanadi tidal swamps ; Java and Borneo.

HALOPHYTES OF SALT PANS AND BLANKS

Aeluropus lagopoides (L.) Trin. (Poaceae).

Small much branched grass with terminal globose flower-heads. Common all along coasts and interior salt pans in Punjab ; Arabia and West Asia.

Arthrocnemum indicum (Willd.) Moq. (Chenopodiaceae).

Fleshy leafless sub-shrubs with jointed stems and tiny flowers. Common in salt marshes in mangroves and muddy coasts of Indian Peninsula ; Sri Lanka, tropical Africa.

Salicornia brachiata Roxb. (Chenopodiaceae).

Fleshy leafless herbs with jointed stems and minute flowers. Common on saline mud flats and degraded mangrove areas. Throughout India ; Sri Lanka.

Scirpus littoralis Schrad. (Cyperaceae).

Tall sedge with terminal umbels. Frequent along muddy banks of tidal creeks in hinterlands of mangroves. Throughout India ; West Asia, Africa.

Sesuvium portulacastrum L. (Aizoaceae).

Succulent creeping herbs with purple flowers. Frequent all along Indian coast and in muddy tidal flats. Pantropical.

Suaeda maritima (L.) Dumort. (Chenopodiaceae).

Undershrubs with fleshy terete leaves and small flowers in globose clusters. Common all along the Indian coast on mud-flats and salt marshes. Pantropical.

Suaeda monoica Forsk. ex Gmel. (Chenopodiaceae).

Small erect or decumbent herbs with linear leaves and small flowers. Common on tidal mud-flats and salt marshes along Indian coasts. West Asia to tropical Africa.

Suaeda nudiflora (Willd.) Moq. (Chenopodiaceae).

Perennial undershrubs with linear-ovate leaves falling off early and small flowers in globose axillary clusters. Common on salt marshes and tidal blanks in Indian mangroves and coastal areas; Sri Lanka, Malesia, Australia, N. Africa and N. America.

Tamarix troupii Hole (Tamaricaceae).

Shrubs with subulate stem-clasping leaves and pinkish-white flowers. Frequent along river-banks and mud-flats in tidal forests all along the Indian coasts; Burma, tropical Africa, West Asia, N. Europe.

GLOSSARY OF BOTANICAL TERMS USED

Accrescent : increasing in size with age (usually of calyx).

Acuminate : tapering to a pointend apex.

Androgynophore : an internode of the floral axis between the corolla and stamens bearing the stamens and the pistil.

Anther-lobe : pollen containing sac of the stamen.

Apetalous : without petals or corolla.

Apiculate : with a short, but not rigid point.

Aril : an appendage arising from the hilum and covering the seed.

Attenuate : narrowed, tapered (usually at base).

Awn : a bristle-like terminal appendage, as in wheat.

Axillary : situated in the axil, usually in the axil of stem and leaf.

Berry : a pulpy fruit with embeded seeds.

Bract : a modified reduced leaf on an inflorescence with a flower in its axil.

Bracteole : a bract-let or a small bract, often on the petiole or immediately below the calyx.

Bracteolate : (flowers) with a bracteole.

Caducous : falling off early.

Calyx : the outermost series of the parts of a flower.

Capitate : knob-like.

Capsule : a dry dehiscent fruit.

Carpel : a modified leaf forming an ovary bearing the ovules.

Catkin : a type of inflorescence having usually of unisexual flowers without petals, solitary or twin in the axils of bracts.

Caudate : with a tail-like ending.

Cilia : a marginal hair.

Ciliate : hairy along margins.

Clavate : club shaped.

Clawed : with a narrow, tapering base, especially of petals.

Column : a solid body formed from fusion of stamens and styles.

Coma : a tuft of hairs at the end of seeds.

Compound : formed of similar parts grouped in a whole, usually of leaves consisting more than one separate leaflet.

Connate : united to one another.

Convolute : rolled up along the margins.

Cordate : deeply notched at base, conventional heart-shaped.

Coriaceous : leathery.

Corolla : the interior series of the *perianth*.

Corona : an inner appendage to the corolla or petals sometimes appears like a second corolla, or a ligular outgrowth of the stamens.

Corymb : a type of inflorescence with several flower-stalks arising at different levels which reach more or less the same level at the top.

Cotyledon : leaf of an embryonic plant in the seed stage.

Culm : the stem of a grass or bamboo.

Cuneate : wedge-shaped.

Cyme : a type of inflorescence in which the secondary or lateral branches continue to grow and may extend beyond the main axis.

Dehiscence : the condition of splitting into definite parts on ripening, usually of a capsular fruit. (opp. indehiscent).

Dichasial : a condition of inflorescence in which all the axes end in flowers from below which lateral opposite branchlets arise.

Dichotomous : forked.

Didynamous : in two unequal pairs.

Dimorphous : occurring in two different forms.

Dioecious : male and female flowers segregated on different plants.

Disk : a swollen portion of the axis of the flower inside the calyx and under the pistil.

Discoid : with a disk (or disc).

Dorsal : relating to the back.

Divaricate : extremely divergent.

Drupe : a fleshy fruit with 1-many-celled stony seeds.

Elliptic : broader in the middle with narrowed ends.

Ellipsoid : an elliptical solid body.

Emarginate : deeply notched at the apex.

Embryo : the incipient new plant within the seed.

Endocarp : the inner layer of the wall of a fruit.

Ensiform : sword-shaped.

Epipetalous : situated on the petals or corolla.

Episepalous : situated on the sepals or opposite to the sepals.

Exerted : protruding above, usually of stamens in the corolla-tube.

Exfoliate : devoid of leaves, usually of branches.

Filament : the stalk of an anther ; any thread-like body.

Fimbriate : fringed.

Floccose : clothed with soft hairs.

Follicle : a fruit of one carpel opening by a ventral suture to which the seeds are attached.

Fragal : a suffix indicating breaking or splitting.

Frond : the leaf of a fern.

Funicle : the stalk of a ovule or seed.

Glabrous : without any hairs.

Glaucous : of sea-green or blue-green colour.

Glandular : beset with glands.

Glume : the bracts and bracteoles on the spikelets of gras sedges.

Gonus : angled, eg. 3-gonus, hexa-gonus, etc.

Hilum : the scar on a seed at which it is attached to the hilum.

Hypanthium : a tubular or flask-like part of the floral axi grows up above the level of the ovary and bears on its or at other levels the floral envelops and all stamens.

Hypocotyle : the axis of an embryo below the cotyledons.

Imbricate : overlapping ; usually of arrangement of sepa petals.

Imparipinnate : a condition in a compound leaf with an od nal leaf-let.

Induplicate : with edges folded inwards.

Indusiate : with a protective membrane on the sori in ferns

Inferior ; position of a floral part at a lower level (usually of

Inflorescence : a cluster of flowers as a whole.

Involucre : a ring of bracts surrounding a single flower or an scence.

Involute : rolled inwards along both margins.

-Jugate : in paired condition.

Keeled : ridged.

Lanceolate : shaped like a lance-head.

Legume : fruit of pea-family members.

Lenticelled : with pores on the bark.

Ligule : a membranous strap-shaped organ, usually in grasses a base of the leaf inside.

Lodicule : small thickened scaly structures in the flowers of gr

Lomentum : a legume with constructions between the seeds dehi along the constrictions and falling apart on maturity.

Membranous : thin.

Monoecious : bearing male and female flowers separately on same plant.

—Merous : a suffix used in combination to indicate the number o parts.

Monopodial : a stem of a single and continuous axis.

Mucronate : tipped with a short hard blunt point.

Node : the part of an axis from where a secondary member whorl arises.

Obconic : inversely conical.

Oblanceolate : inversely lance-shaped.

Oblique : a shape with half more large than the other ; usuall leaf-bases.

Oblong : longer than broad with sides nearly parallel.

Obovate : reversed ovate shape.

Obtuse : blunt ended.

Orbicular : circular in outline.

Ovary : the swollen or flask-shaped part of the pistil enclosin ovules.

Ovate : egg-shaped.

Palea : chaffy or transparent scale on the inflorescence.

Palmate : like a palm with widely divergent fingers ; usually compound leaf with leaf-lets.

Panicle : a repeatedly branched inflorescence.

Papillose : with soft superficial protuberances or glands.

Paripinnate : pinnate with an equal number of members on each side of the axis and without an odd terminal one.

Pedicel : stalk of a flower.

Peduncle : the common stalk of more than two flowers.

Pericarp : the outer wall of a fertised ovary or fruit.

Petal : a single member of the corolla.

Petaloid : like petals.

Petiole : leaf-stalk.

Petiolate : leaves with stalks.

Pinnae : the lobes of a bipinnate leaf.

Pinnate : leaflets arranged on each side of a common axis.

Pinnatifid : deeply lobed to about half-way down or more with the lobes pinnately arranged.

Pinnatisect : Pinnatifid down to the mid-rib.

Plicate : plaited.

Plumule : primary leaf-bud in an embryo.

Pneumatophore : vertical outgrowths of roots which facilitate breathing in some swamp plants.

Pollinia : pollen masses, as in orchids.

Pubescent : clothed with short soft hairs.

Pyriform : pear-shaped.

Raceme : a type of inflorescence with a continuously growing main axis and the oldest flowers at the base opening first.

Radicle : the rudimentary root in an embryo.

Retuse : a shallow notch in a rounded apex.

Rhizome : a modified horizontally running underground stem.

Scaberulous : covered with small hard rough hairs.

Scandent : climbing.

Scutellum : a second and anterior cotyledon in grasses, as in wheat.

Sepal : a single member (lobe) of the calyx.

Sessile : without stalk.

Setaceous : with long, stiff needle-like hairs.

Sinus : a recess or re-entering angle.

Soriferous : bearing sori, i.e. the reproductive organs in ferns.

Spadix : a flower spike with a fleshy axis.

Spathe : a more or less modified bract enclosing an inflorescence.

Spiciform : a spike-like inflorescence.

Spike : an inflorescence with sessile flowers on a usually elongate axis.

Spikelet : an ultimate part of a spike with 1 or more sessile flowers.

Stamen : the floral organ bearing the anther and pollen.

Staminode : an abortive stamen without anther and pollen.

Standard : referred to the prominent flag-like petal in the pea-family (Papilionaceae).

Stellate : star-like, usually referred to hairs on plant parts.

Stigma : the terminal part of pistil which receives the pollen.

Stipitate : stalked.

Stipule : a lateral appendage at the base of the petiole.

Strobilate : an inflorescence largely made up of overlapping bracts, like a pine-cone.

Sulcate : grooved or furrowed.

Superior : situated above other parts ; usually referred to the position of a ovary in a flower.

Sympodial : a stem with a series of superposed branches appearing to be a simple axis.

Syncarpous : composed of two or more united carpels.

Terete : cylindrical.

Testa : the outer seed-coat.

Thyrse : a compact panicle, usually egg or spindle-shaped.

Tomentellous : minutely tomentose.

Tomentose : densely matted with woolly hairs.

Trichotomous : an axis successively 3-forked.

Umbel : an inflorescence in which a cluster of pedicels arise from the same point.

Uncinate : hooked.

Ventral : relating to the front side.

Villose : clothed with long, shaggy weak hairs.

Vivipary : the process of germination of seed while still attached to the parent plant.

LITERATURE CONSULTED

Anonymous (1959). *Proceedings of the Mangrove Symposium, Calcutta*. Manager, Govt. of India Press, Faridabad. pp. 1-136.

Anonymous (1979). *State-of-the-Art-Report on Mangrove Ecosystems*. Govt. of India, DST., New Delhi. pp. 1-42.

Anonymous (1983). *Global Status of Mangrove Ecosystems* (Commission on Ecology Papers 3). IUCN., Switzerland. pp. 1-85.

Anonymous (1987). *Mangroves in India—Status Report*. Ministry of Environment & Forests, New Delhi. pp. i-viii, 1-150, illustr.

Anonymous (1989). *Conservation of Mangroves in India*. Ministry of Environment & Forests, New Delhi. pp. 1-72.

Banerjee, L. K. (1984). Vegetation of the Bhitarkanika Sanctuary, Orissa State. *J. Econ. Tax. Bot.* 5 : 1065-1079.

Banerjee, L. K. (1987). Ecological studies on the mangals of Mahanadi estuarine delta, Orissa. *Trop. Ecol.* 82 : 117-125.

Blasco, F. (1975). *Mangroves of India*. Inst. Francais, Pondicherry. Trav. Sect. Sci. Tech. 14 : 1-175.

Blatter, E. (1905). The mangroves of Bombay Presidency and its biology. *J. Bombay Nat. Hist. Soc.* 16 : 644-656.

Chapman, V. J. (1976). Mangrove biogeography. *In : Wet Coastal Ecosystems*. Ed. V. J. Chapman. Elsevier Sci. Pub. Co., Amsterdam. pp. 1-29.

Clarke, C. B. (1896). Presidential address to the Linnean Society on the Sunderbans of Bengal. *Proc. Linn. Soc. London*, 14-29.

Dwivedi, S. N., A. H. Parulekar & S. C. Goswami (1974). Ecology of mangrove swamps of the Mandovi estuary, Goa, India. *Proc. Inter. Symp. Manag. Mangroves, Hawaii*. 1 : 115-194.

Haines, H. H. (1921). *The Botany of Bihar and Orissa*.

Mukherjee, B. B. & J. Mukherjee (1978). Mangroves of Sunderbans, India. *Phytomorphology* 28 (2) : 217-229.

Naskar, K. & D. N. Guha Bakshi (1987). *Mangrove Swamps of the Sunderbans*. Naya Prakash, Calcutta.

Navalkar, B. S. (1951). Succession of mangrove vegetation in Bombay & Salsette Islands. *J. Bombay Nat. Hist. Soc.* 50 : 157-160.

Prain, D. (1903). Flora of the Sunderbans. *Rec. Bot. Surv. India* 2 : 231-370.

Rao, A. N. (1986). Mangrove ecosystems of Asia and the Pacific. *In: Mangroves of Asia and the Pacific-- Status and Management*. UNDP/UNESCO Technical Report. pp. 1-33.

Rao, T. A. & A. R. K. Sastry (1972). An ecological approach towards classification of Coastal Vegetation of India-I. Strand Vegetation. *Ind. For.* 98 : 597-607.

Rao, T. A. & A. R. K. Sastry (1974). An ecological approach towards classification of coastal vegetation of India-II. Estuarine vegetation. *Ibid.* 100 : 438-452.

Rao, T. A. & A. R. K. Sastry (1977). An outline of the coastal vegetation of India. *Bull. Bot. Surv. India* 16 : 101-115.

Rao, T. A., A. R. K. Sastry & P. G. Shanware (1972). Analysis of basic patterns of an estuarine shore in the vicinity of Coringa Bay, Andhra Pradesh. *Proc Ind. Acad. Sci.* 75(B) : 40-50.

Rao, T. A. & A. K. Mukherjee (1971). Ecological aspects along shores of Burabalanga tidal estuary. Orissa State. *Ibid.* 76(B) : 201-206.

Sanyal, P., L. K. Banerjee & M. K. Chowdhury (1984). Dancing mangals of Indian Sunderbans. *J. Ind. Soc. Coastal Agri. Res.* 2(1) : 10-16.

Sidhu, S. S. (1960). Studies on mangroves. National Acad. Sci., Allahabad, India. pp. 111-112.

Thothathri, K. (1981). Studies on the mangroves of peninsular India vs. the Andaman and Nicobar Islands. *Bull. Bot. Surv. India* 23: 151-154.

Untawale, A. G. (1980). Present status of the mangroves along the west coast of India. *Asian Symp. Mangrove Env. Res. Management*, Kaula Lampur. pp. 1-26.

Untawale, A. G., *et al.* (1982). Application of remote sensing techniques to study the distribution of mangroves along the estuaries of Goa. *In : Wetlands : Ecol. & Management. Proc. 1st Inter. Wetlands Conference, New Delhi*. pp. 51-57.

Waheed Khan, M. A. (1959). Ecological studies of the mangrove forests in India. *In : Proc. Mangs. Symposium*. Faridabad. pp. 97-113.

Watson, J. G. (1928). Mangrove forests of the Malay peninsula. *Malayan For. Rec.* 6 : 1-275, illustr.