

Flora of India  
Series 4

# FLORA OF THE MAHANADI DELTA, ORISSA

L. K. BANERJEE  
&  
T. ANANDA RAO



BOTANICAL SURVEY OF INDIA

Flora of India  
Series 4

# FLORA OF THE MAHANADI DELTA, ORISSA

L. K. BANERJEE  
&  
T. ANANDA RAO



BOTANICAL SURVEY OF INDIA

© Government of India

Date of Publication : January, 2001.

No part of this publication can be reproduced, stored in a retrieval system, or transmitted, in any form or means by electronic, mechanical, photocopying, recording or otherwise, without prior written permission of the Director, Botanical Survey of India.

Cover photo : Components of the Mahanadi Deltaic Eco-system

Published by the Director, Botanical Survey of India, P-8, Brabourne Road, Calcutta-700 001 and Printed at M/s. Imprinta, 243/2B, A. P. C. Road, Calcutta-700 006

## CONTENTS

	<i>Pages</i>
Foreword	... i
Preface	... iii
Acknowledgements	... v
<b>RESOURCES OF THE STUDY AREA</b>	
Introduction	... 1
Climate	... 2
Geomorphological Features	... 7
Soils	... 8
Riverine System	... 9
Estuarine complex	... 11
<b>STRUCTURAL CHARACTERISTICS OF VEGETATION</b>	
Vegetation belts and Sampling	... 14
Analysis of Flora	... 49
Comparison of the Floras of the Mahanadi	
Delta with those of the Sunderbans	... 51
Strand Vegetation	... 58
Estuarine Vegetation	... 60
Discussion and Conclusion	... 67
<b>FLORA</b>	
Systematic Treatment	
Key to Families	... 75
Families	... 86
References	... 292
<b>INDEX</b>	... 301

## FOREWORD

Out of the four major Indian deltas, the Gangetic delta in the Sunderbans, West Bengal, the Mahanadi Delta in Orissa, the Godavari-Krishna Delta in Andhra Pradesh and Cauvery delta in Tamil Nadu, the Mahanadi Deltaic areas between the river Dhamra and the Devi estuarine complex located in Cuttack district, Orissa constitute most interesting floristic composition in India. Haines (1921-25) and Mooney (1950) emphasized the need for further detailed floristic studies of this interesting deltaic complex. Though the mangrove cover in this area is only about 215 sq. km, the presence of a maximum number of mangrove species in this delta due to regular fresh water influence from different rivers and distributaries upon the terrain is no doubt a remarkable feature.

Deltaic plant communities which are the major part of the coastal wet land ecosystem comprising mangroves, salt marshes and various riverine components are our country's treasures. These not only promote the livelihood of the coastal people and pave the way for sustainable socio-economic development but also serve as a static 'Border Security Force' protecting soil erosion, floods and cyclones.

The remarkable mangrove communities within the tidal forests of this delta are unique for floristic, ecological and economic values. Proper understanding regarding the status of floristic composition, vegetation pattern, classification and ongoing changes of the different ecological parameters on which human communities depend for their daily requirements need a very comprehensive study for proper documentation, management and conservation. Such studies have not received adequate attention in the past but now this book by L. K. Banerjee & T. A. Rao from the Ecology Unit, Botanical Survey of India will meet this long felt need.

The present book with valuable account of quantitative vegetation analysis, plant zonation, classification of Mangrove Vegetation, threats and conservation in relation to the impact of various ecological factors would be a valuable document. This is followed by floristic account of the areas with key to genera and species, brief description, world distribution and field notes. It also provides some comparative status on the mangroves of Orissa and that of the Sunderbans in West Bengal. I hope this book will give impetus to conservation of the most important coastal wetland ecosystem of our country and will reach a wide readership of students, foresters, planners and all those who are interested in preservation and protection of our fragile, deltaic ecosystem.

Botanical Survey of India  
P-8, Brabourne Road, Calcutta-700 001.

N. P. Singh  
Director

## PREFACE

To a botanist or an ecologist few ecosystems are as fascinating as the deltaic formations along the coastline. The flora, vegetation and ecological complexities are unique in the deltaic ecosystem. The flora of the Mahanadi delta is not only famous for mangrove but also valuable for different types of riverine scrubs and shrubs. The mangroves along this delta represent the highest number of species composition throughout India. More than 63 number of mangrove species though bounded together in this deltaic areas over a long evolutionary time but majority of them were imperfectly known and understood due to various constrain in the processes of survey, collections, preservation and identification. Along with the mangrove there are some interesting riverine plants restricted only to this deltaic areas. Haines (1921) made one expedition to these littoral part of the delta and he himself admitted that his collection from this region were far from complete. Therefore the present study of the flora and the ecological information would be a valuable data for assessing the natural plant diversity, identity and ecological condition responsible for plant zonation. The book deals with topography, climate, geomorphology alongwith major environmental and ecological factors such as tidal flow, seasonal water salinity ranges and soil characteristic in relation with the changing pattern of plant zonation. The structural characteristic of mangrove vegetation have been studied with the help of Importance Value Index method through the analysis of quantitative ecological data on the field. A new approach to the classification of mangrove vegetation depending upon the interaction of the environmental factors and adaptive characters has been formulated in this book. This is followed by detail floristic study with key to the genera and species, brief ecological, distributional and phenological notes. The main objective is to provide a census of the deltaic plant diversity along the Orissa coast with a means of identifying plants to provide upto date nomenclature, ecological data and conservation strategies.

I hope this book will give impetus to the conservation of the most important coastal wet land ecosystem of our country and will reach a wide Readership of students, foresters, planners and all those who are interested in preservation and protection of this vulnerable ecosystem along our fascinating coast.

Botanical Survey of India.  
Central Botanical Laboratory  
Howrah

L. K. BANERJEE

## ACKNOWLEDGEMENTS

We express our deep sense of gratitude to Late Dr. K. Subramanyam, Ph.D., D.Sc., F.B.S., F.A.Sc, Ex-Director, Botanical Survey of India for his unstinted help and constant encouragement throughout this work ; we would like to express our indebtedness to, the Director, Botanical Survey of India for giving permission to work and for facilities extended.

We also express our gratitude to Mr. A. R. K. Sastry ; Dr. N. C. Majumdar & Dr. A. N. Henry, Botanical Survey of India for help and facilities, to the officers of the Forest Department of Orissa and West Bengal for their ready help and guidance in conducting the field tours.

L. K. Banerjee

Botanical Survey of India  
Howrah-711 103



Mangroves of the Mahanadi delta.



*Sonneratia*, *Rhizophora* and *Avicennia* community of the Bhitarkanika sanctuary-in Mahanadi delta.





*Kandelia candel* (L.) Druce plant showing largest hypocotyles for viviparous germination in the Mahanadi delta.



*Cerbera manghas* L. with fruits in the Bhitari Kanika sanctuary of the M. delta.



*Avicennia affinalis* L. with flowers in the Mahanadi delta.



*Lumnitzera racemosa* willd with white flowers, in the M. delta.



*Ceriops decandra* (Griff.) Ding.  
in the Mahanadi delta.



*Bruguiera gymnorrhiza* (L.) Savieng.  
with hypocotyles in the M. delta.



*Xylocarpus granatum* keen. plant with fruit in the M. delta.



Bhitar Kanika Mangrove forest during low tide.



Stilt roots of *Rhizophora apiculata* BL in the Batighar creek of M. Delta.



*Sonneratia apetala* Buch. Ham. community in the Mahanadi delta.



Large Palmswamp, *Phoenix paludosa* Roxb. pure community near Gupti-in the Orissa coast.



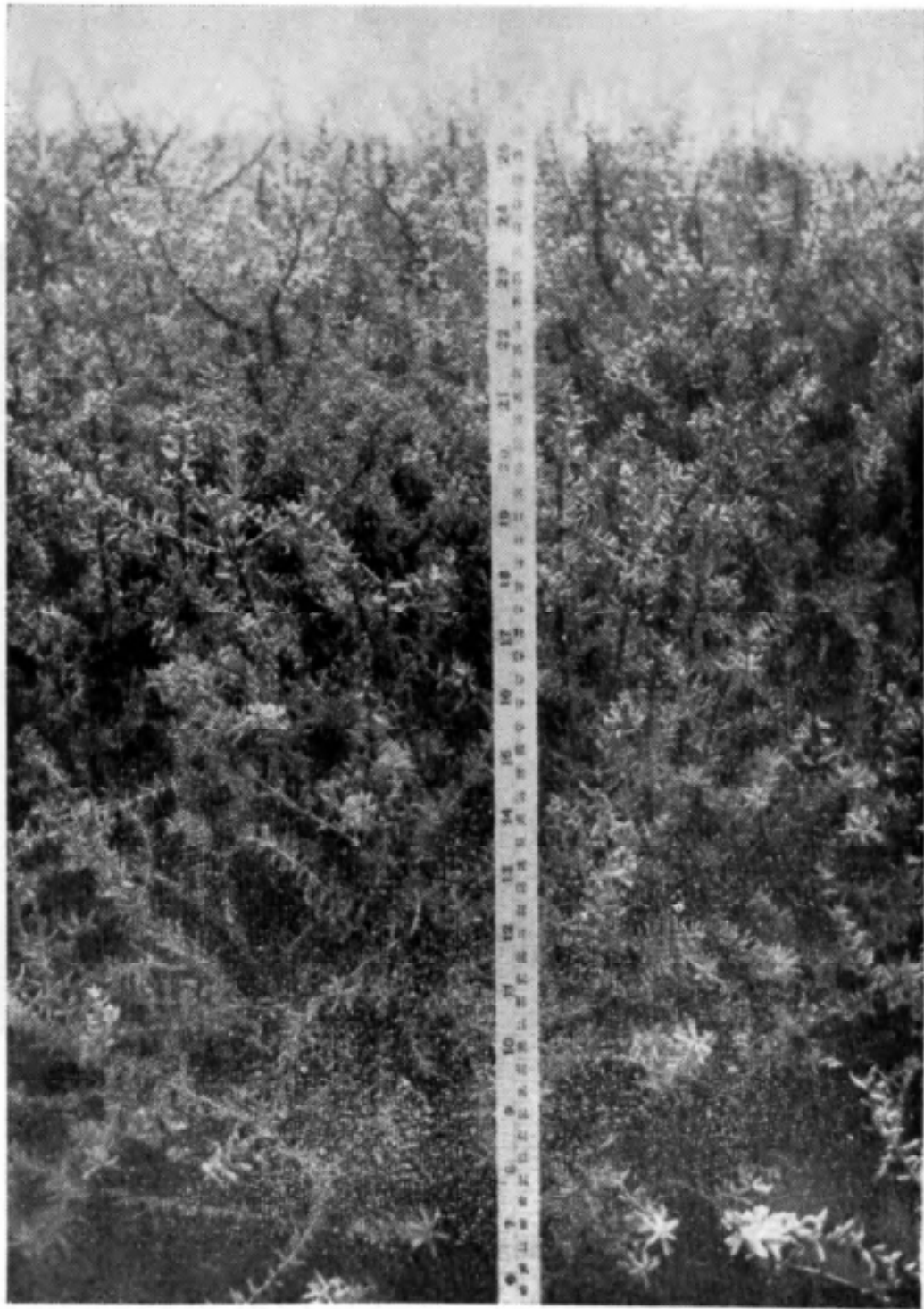
Devastation of coastal plantation due to super cyclone in 1999.



Management of Mangrove swamps in the M. delta by Mangrove Plantation.



Mangrove Fern, *Acrostichum aureum* L. in the M.D.



*Suaeda maritima* (L.) Dum.





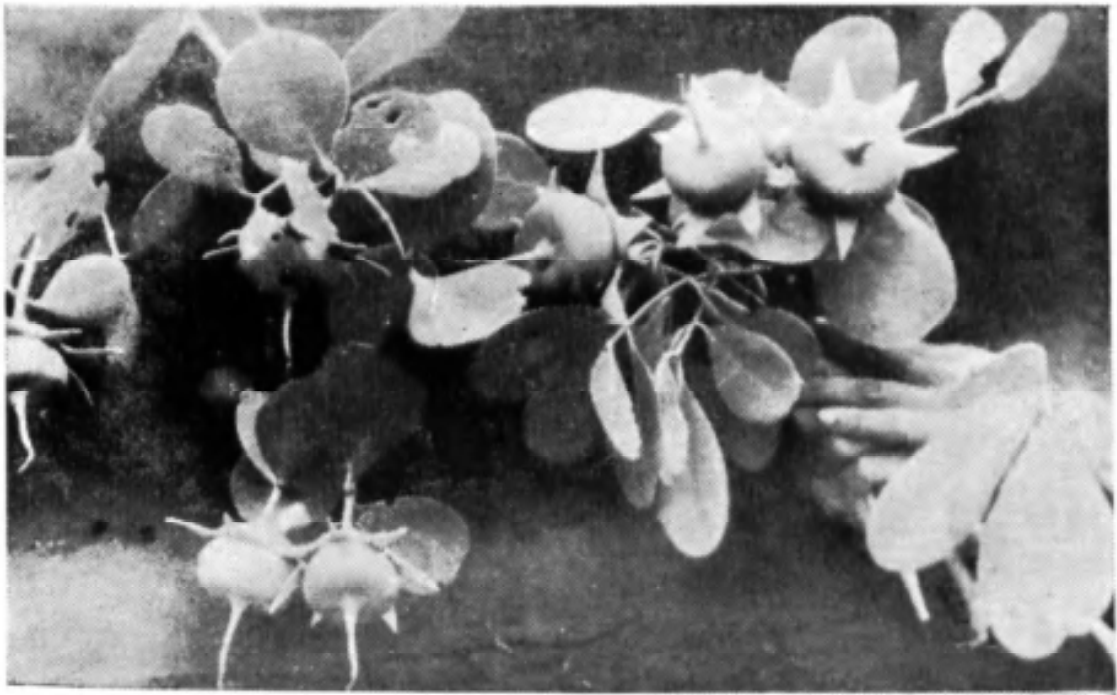
*Suaeda nudiflora* Moqe



*Sonneratia apetala* Buch.-Ham. growing an estuarine mouth  
with numerous peg-like corky pneumatophores.



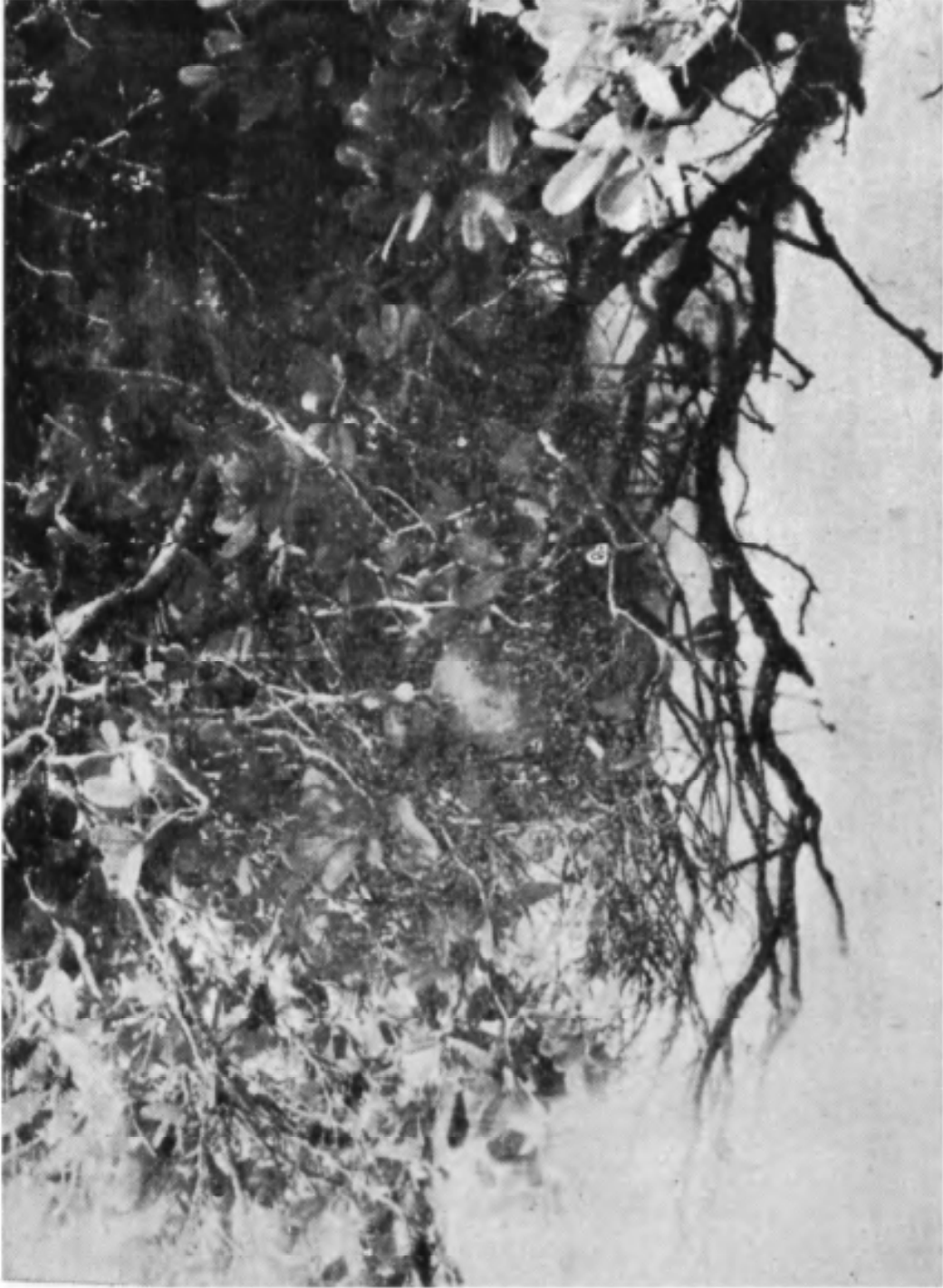
*Bruguiera gymnorrhiza* (L.) Savigny showing hypocotyl.



*Sonneratia caseolaris* (L.) Engl.—fruiting branch.



*Phoenix paludosa* Roxb.—on estuarine banks with aerophores.



*Xylocarpus granatum* Koen showing large fruits.



*Xylocarpus mekongensis* Pierre  
showing peeling of barks, and pneumatophores.

## RESOURCES OF THE STUDY AREA

### INTRODUCTION

The natural vegetation of humid tropical deltas especially in the vicinity of coastal areas of India, has not been studied in its proper perspective although frequent references to the occurrence of mangroves or their associates find place in several Floras and papers. Of the main coastal areas of the deltaic regions, namely the Gangetic Sunderbans delta, the Mahanadi delta, the Godavari and Krishna deltas and the Cauvery delta, the tidal forests in their regional setting in the Gangetic delta have received purely descriptive consideration based on one or more sets of general features (Prain, 1903).

Hooker (1906) stated "Estuarine flora of India are notable, in as much as that, considering the limited areas they occupy, they contain more local species than do any other botanical regions in India". Of the four chief estuarial floras, the Flora of Sunderbun by Prain (1903) was the only source upon which he had made the above remarks.

Haines (1925), while describing the general characters of the flora of coastal tracts of Orissa, mentioned "I was only able to give three days to this tour, most of which was on board steamer, and a more extended inspection would add a very large number of species."

Mooney (1950), while providing some guidance for future workers, stated "another very distinct area which calls for more detailed study is the coastal belt, more specially the Mangroves in the delta of the Mahanadi and the Dhamra river ; Haines made one expedition to these littoral tracts but his collections from this interesting regions were, he admitted, far from complete". Thus, it is very clear that no detailed study on the natural vegetation of the Mahanadi delta in its regional setting has been made apart from Haines's (1925) meagre information on the coastal flora of Orissa and Mooney's (1950) emphasis for detailed study in the vicinity of the Mahanadi estuarine complex. In recent years, however, considerable amount of data has been gathered for the study of coastal areas adjacent to the Mahanadi delta of the Orissa State (Rao and Mukherjee, 1972, 1974 ; Rao and Sastry, 1972 ; Rao and Banerjee 1982 ; Banerjee and Rao, 1985). The work done so far emphasizes the need for detailed floristic and vegetational surveys of the



coastal areas in the Mahanadi delta between the Damara and the Devi riverine complex, often known as 'Little Sunderbans', since the vegetation is disappearing or changing with distressing rapidity. It appeared, therefore, of value to study the tidal forests of the Mahanadi delta between the Dhamra and the Devi estuarine complex.

Coastal plains of Orissa, being generally formed by the alluvial fillings of the littoral zone comprising some of the deltas, sand-bars, riverine complex and active sand-dunes. There are in general, two types of shore-line : the sandy shore-line along the coast, and alluvial deltaic coastal shore at the mouth and banks of several rivers joining the sea.

Of the four main deltaic areas, namely the Ganges delta, the Mahanadi delta, the Godavari delta, the Krishna delta and the Cauvery delta, which, cover 11,10,480 acres approximately, the Orissa deltaic region is the second largest of the four and covers 250 sq. km. This is mostly built by the Mahanadi, the Dhamra, the Maipura, and the Devi rivers situated within the Cuttack district, Orissa State, India. This whole area is located between longitudes from 86° 40' E to 87° E and latitudes from 20°15' N to 20°75' N. The Mahanadi in combination with the Brahmani and Baitarini forms extensive alluvial tract straching from the Lake Chilka in the south to Bhadrak in the north. 172 km long and over 80 km wide. The area under study within the Cuttack district is bounded on the north by the Baitarini river and the Dhamra estuary which separate it from Balasore district : on the east by the Bay of Bengal ; on the south by Puri and on the west by the tributary villages of the Cuttack district (Map Fig. 1).

The whole landscape consists of three distinct Geo-botanical features : Deltaic tidal forest mixed with sand-stand covered strips along the coast : internal arable tract of rice land in the older part of the Mahanadi delta and broken hilly regions along the western boundary. Of the three features, deltaic tidal forest areas resemble the 'Sunderabans' of Bengal and are often known as 'Little Sunderbans'. They are notably associated with innumerable meandering creeks, channels, distributaries, riverine streams, recent fluviated deposits in the lower reaches and older alluvium. Further-more, sluggish water deposits, their silt and sand forming muddy-flats, sand-bars and sand-dunes of varied sizes bounded together into a unique tidal forests eco-system.

### CLIMATE

Under this topic the following data are retrieved. This includes rainfall, temperature, humidity, soils, salinity and tidal inundation. The

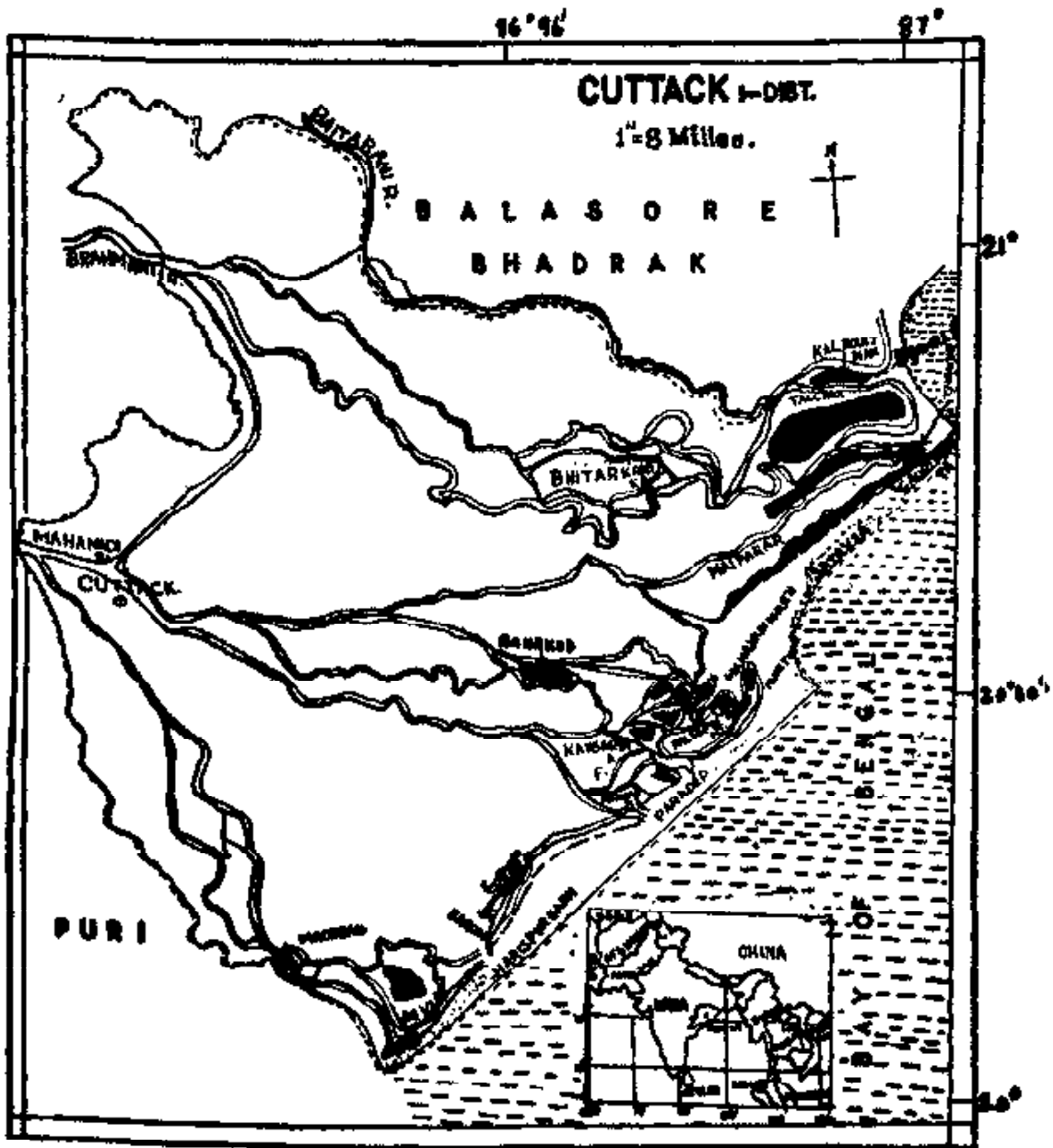


Fig. 1 : Map showing Mahanadi estuarine complex in Cuttack district.

area of study is characterised by oppressive summer, low daily range of temperature, high humidity and moderate annual rainfall. Meandering rivers and the sea-board are the main areas chiefly influenced by the marine climate of this area. April is the hottest month and the temperature at that time goes up to 37°C. The minimum temperature in this month seldom goes below 23°C. May is also a very warm month but there is no appreciable fall in the temperature till October. Humidity in this area is over 60% from April to November. A minimum value is obtained during March and maximum values are found from July-August of over 80%. September and October recorded slightly lower than this. Rainfall of this area shows that mean annual rainfall is 1,585 mm and most of which is received from May to October; the maximum is recorded during July-August over 300 mm, lowest or often zero rainfall records are obtained during December and March. Total average number of rainy days during 1970-1971 is 82, of which 15 and 17 are respectively in July-August. Normally, December and March record no rainy days. The velocity of wind becomes stronger in monsoon, about 12 miles per hour. From April to July, wind velocity remains, 6-12 miles per hour. During October-February, it comes down to 3-6 miles per hour. Sometimes, during the post-monsoon months, it intensifies into severe storms with more than 80 miles per hour, resulting in heavy rainfall and cyclones along this part of the coast.

According to Walter (1971) data filled tables of climate are difficult to comprehend and are not very useful for rapid comparison. He has developed, therefore, a new method for ecological purposes, namely the diagrammatic representation of climate or climatic diagram which permits recognition at first sight of important similarities and differences between climate of different places. The important feature of this diagram is the 1 : 2 relationship between temperature and rainfall. Further, he has suggested that the temperature curve could be used as a measure of the variation in evapo-transpiration. A significant drought period is indicated whenever the rainfall curve undercuts the temperature curve. A dry period is indicated by a mean monthly rainfall of less than 100 mm and the rainfall curve remains above the temperature curve. A humid period is indicated when rainfall reached or exceeded 100 mm since 100 mm rainfall is equal to the average storage capacity of the soil and excess of which disappears as run-off. The climatic (table I) as well as climatic diagram (Fig. 2) show high rainfall and mean minimum temperature. It is, therefore, evident that the area exhibits a warm tropical climate and the flora has an abundance of species characteristic of the warm tropical climatic type, many of

**Table 1**  
**Climatic Table—1970-71**

Elevation : 4.5 m.

Location : Falsepoint—Mahanadi river

Months	Mean Temperature	Average Maximum Temperature—°C	Minimum Temperature °C	Rainfall in mm	Number of rainy days	Relative Humidity %	Wind velocity miles per hour
1	2	3	4	5	6	7	8
January	29.3	25.5	12.4	15	2	62	2.3
February	22.2	28.3	13.0	30	3	63	3.6
March	26.1	32.7	20.1	14	1	43	5.2
April	30.0	33.5	23.8	34	2	64	8.6
May	30.1	34.8	25.0	170	6	63	12.0
June	29.8	34.1	25.3	269	14	71	8.2
July	29.0	32.0	23.0	333	16	82	6.2
August	28.7	31.7	25.4	362	17	82	5.6
September	28.9	31.4	25.5	225	12	76	4.3
October	27.6	31.6	23.6	114	8	70	2.1
November	23.0	29.2	17.2	21	2	60	2.9
December	19.4	26.0	12.4	0	0	60	2.8

(Contd. Table I)

Elevation 5.0 m.

Location : Dhamra and Maipara river Chandball

Months	Mean Temperature	Average Maximum Temperature— °C	Minimum Temperature °C	Rainfall in mm	Number of rainy day	Relative Humidity %	Wind velocity miles per hour
1	2	3	4	5	6	7	8
January	29.8	27.0	12.5	43.2	3	63	3.0
February	23.1	29.3	15.4	33.7	2	63	4.5
March	27.4	34.3	20.0	0	0	48	5.9
April	31.1	37.0	23.1	12.8	1	64	9.1
May	30.8	36.0	25.3	49.3	4	66	12.3
June	29.5	35.1	25.0	186.8	3	71	8.4
July	29.0	32.2	25.2	24.26	13	82	6.6
August	28.4	31.5	25.3	325.2	17	80	6.0
September	28.1	31.0	25.1	211.5	13	62	4.7
October	27.2	30.9	22.8	152.0	8	76	2.5
November	23.6	29.0	17.0	106.0	6	70	2.2
December	19.4	26.1	12.2	0	0	60	3.1

them common to Sunderbans, Chittagong, Burma, Malesia, Java, Indonesia, and other warmer places.

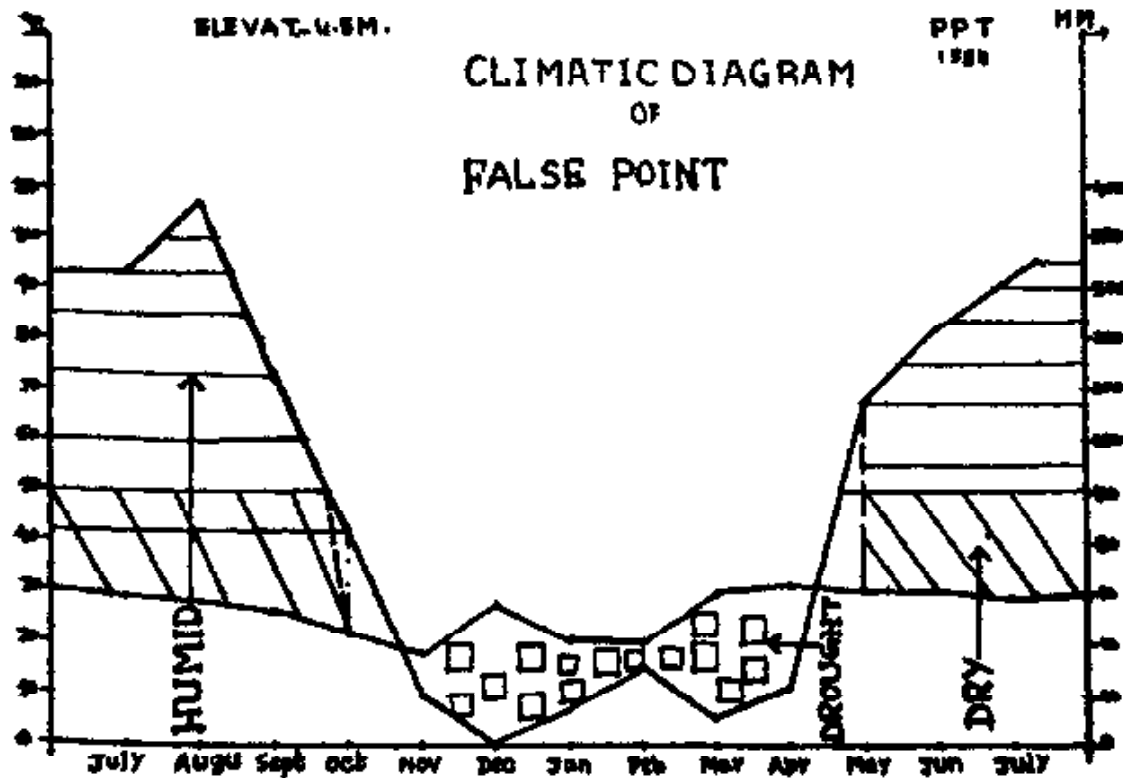


Fig. 2: Climatic diagram of False Point, Mahanadi estuarine complex.

### GEOMORPHOLOGICAL FEATURES

All wastes borne by the streams which function in the fluvial cycle are deposited in the sea except that of the river Devi. The waves and currents in the Mahanadi, the Dhamra and the Maipura are active, so the sediments brought by them are distributed as rapidly as they are furnished. But the discharge of the Devi river is more or less at a sheltered bay-head and is in a relatively quiet site with shallow water at the mouth, where the river current is more or less extinguished and sediments brought by it settle down to the bottom. Before approaching the sea, the other rivers clear their sediment-load by depositing it in the adjacent creeks and distributories and then by lateral erosion excavate all the fill and accumulate the deposits at their mouth, forming thereby a delta. The gradual deposition of beds in a particular order and place causes the delta to extend forwards into the sea and

to expand horizontally. Places like Hookitola, Gahurimata, Thakurdian, Jambu, Kalivonjdian may be the effect of forward extension and False, Point, Kansardia, Khanasi, Bhitarkanika, and Musadia of horizontal expansion.

The creeks and channels shift from side to side, first from one side, then from the other in the alluvial fan and due to which current silts up from a braided course over the delta top and consequently discharges finally at the front and side of the delta through the distributaries.

The Mahanadi delta builds into the heads of an estuarine bay, elongated in outline and is commonly terminated at the seaward end by a straight line at right angles to the longitudinal axis of the bay, where a large number of low-gradient rivers carrying a great bulk of suspended fine sediments are observed. The outer border of the delta exhibits the pattern of a base of a triangle with consequent curved banks. The long narrow projections that are found near Maipura, Hookitola and Kalivonjdian are nothing but natural levees, part of deltaic deposits projected above the water-surface, where the waste-borne stream is halted in the journey to seawards and its accumulation gives rise to a particular relief form. Each of these has an appropriate place in a sequential series which terminates with the building of deltaic deposits on the sea-floor.

## SOILS

The coastal plains of Balasore and Cuttack are covered with deltaic sediments of the Mahanadi, the Brahmani, the Baitarini, the Dhamra and the Maipura rivers. The extensive plain in this area is separated geomorphologically from Peninsula and extra-Peninsula. The plain is wholly composed of the alluvium formed in recent times, brought down by these rivers and known as Indo-Gangetic alluvium. The alluvium consists of sand, silt, and clay with lenticular intercalation of gravel and also contains some impure beds of peat, the product of drifted vegetation. The deltaic alluvium deposition in the recent times is known as 'Khadar' which, as a rule, is confined to the vicinity of the present channels; the present delta is merely a seaward prolongation and lateral expansion of this 'Khadar' deposits from the respective river-valleys. It consists of repeated alternation of clays, sands and minerals with peat, lignite and some forest-beds. Raised beaches containing shells of molluscs may be of pleistocene or of recent origin. Soils in the coastal line are of two types: coastal alluvium and riverine alluvium.

Coastal alluvium occurs from Balasore towards the south, covering the littoral tracts varying in width mostly from 10-20 km whereas riverine alluvium is found in the lower valleys and deltaic regions. Deltaic deposits, though not possessing any important minerals, have the highest economic value for agriculture and forest due to their extreme fertility status.

### RIVERINE SYSTEM

The river system constitutes the conspicuous feature of the Cuttack district. It has three magnificent streams through the mountainous frontier on the west. From the extreme north, the river Baitarini emerges from Keonjhar State in which it takes its rise, and forms a boundary between Cuttack and Balasore. In the south, the great river Mahanadi pours down upon the delta from two hills at Naraj, about 10 km west of Cuttack city. About half-way between the Baitarini and the Mahanadi, the river Brahmani enters the district. The river Baitarini and Brahmani meet near Dungmal before they reach the sea, and thus the combined large river flows into the Bay of Bengal at Palmyras Point under the name Dhamra river or Dhamra estuary. The river Mahanadi, after many interlacings forms two great estuaries: The Devi-estuary near Machagaon, which enters the bay at the south-eastern corner of the Cuttack district, and the other, the Mahanadi-estuary proper which enters the sea at Falsepoint near the recently built Paradeep port, about half-way down the Orissa coast. Each of these great rivers branches off on its way through the district forming a number of distributaries, those of the Mahanadi bearing most numerous and important ones. Main distributaries from the Mahanadi river are Jambu, Kharnasi and Batighar-galia. The Jambu river emerges about 10 km away from Chumahani near Kujang and after sending several creeks and channels enters the sea just below the river Kandra-para. It forms an extensive muddy-flat near its mouth and many swamps due to the intersection of numerous creeks and channels. The Bahar Kharnasi emerges from the Mahanadi at Bahakud, and after producing many creeks and channels enters the sea just below the Jambu river. It also forms many tidal swamps of which Bhitari-Kharnasi and Babar-Kharnasi are the two important tidal reserve forests. The river Batighar-galia is an important distributory, emerging from the Mahanadi at Jagidhankud where it forms two small islands, Jagidhankud and Saralikud. This river after forming several creeks and channels enters the sea under the name Khola river at Hookitola, 20 km away from Falsepoint. In between the Kharnasi and Batighar (Falsepoint), there are many tidal forest and muddy flats of which Kansardia, Batighar,



Hetamundia and Hookitola are the notable reserves. At the meeting point of all these distributaries and the parent-river, Mahanadi, a land-mass projects inside the sea like a hook from the main land is known as Hookitola, which was a small port under the control of the Government of undivided Bengal. Now it is a small island or a point, surrounded by muddy flats, several distributaries and the Bay of Bengal in the front. All these distributaries, creeks and the channels are responsible for making a large deltaic flat towards the north of Paradeep. Besides these, there are two or three large distributaries raised out from the right-end side of the Mahanadi river and after forming numerous creeks and channels at Baitrakud, Musadia and Athrabnokia, they enter the sea at about 20 km south of the Paradeep port. They cover entire Paradeep back-shore and intermix with several creeks and channels. One of these distributaries produce 18 creeks and 18 bends near Atharabankia. All these interconnected network of the channels, provide a good drainage system along the back-shore of Paradeep and due to which the entire back-shore near the Paradeep has given rise to an ideal tidal swamp dominated mostly, by *Phoenix paludosa*. Recently, this dense forest-cover is disappearing due to biotic disturbances in connection with the formation of a major port.

The river Brahmani receives Baitarini in the north-east part of the Cuttack district at about 35 km away from Chandbali (Bhadrak district). The combined stream after some distance branches and forms a small strip of island known as Kalivonjdain between the river-fork. This forking stream again combines near Talchua under the name Dhamra river at Palmyar point. The river Dhamra does not form notable distributaries like the Mahanadi, except some channels here and there. Tidal forests found near the Dhamra river are Sonabadahuguri, Kalivonjdian and Kantiakhai, in the Cuttack district and Banipai in the Balasore district.

The river Patshala, a tributary of the Brahmani after producing two main distributaries, such as Kanika river and Banasagar river, enters the sea under the name of Maipura river at Thakurdian near the Satavya sea coast. There are more than 20 tidal forest blocks within the surroundings of Dhamra. Brahmani and Banasagar rivers towards the north-east part of Cuttack district. All the forest areas were under the control of Raiakanika since ancient time. Recently it has become possible to include these regions within the State forest boundaries. Within the 20 forest blocks Bhitarkanika Thakurdian and Gourhimata are the most worthy areas to study. The forest Bhitarkanika with an area of about 400 acres is being maintained as reserved forest

since the time of Rajkanika. It forms more or less a small island, isolated a little away from the sea within the surrounding of the river Bhitarkanika, the river Bhitarkanika after emerging out from the Bansagar river produces two main branches, one flows towards the south in the name of the Kanika river which after producing several creeks and channels ends blindly within the forest, and other streams towards the north in the name of Kholra river which also after producing creeks and channels enters the Brahmani river, the source of fresh water. Thus the forest Bhitarkanika gets regularly two types of water supply, less brackish water from the Brahmani and high-saline water from the Bansagar river. Since this forest is supported by an ideal physiographic situation, the tidal and other associated taxa are very rich and well developed. The tidal forests Gaurhimata and Thakurdian are situated near the mouth of Maipura river adjacent to the sea.

### ESTUARINE COMPLEX

Coast lines, like other land forms, experience a cyclic development with waves and currents functioning as dominant agencies. The circumstances of their processing are the direct observation of the underwater changes like those taking place under ice. The mechanism of action of waves and current is complex. A coast line is the general configuration of the land where it fronts the sea, and a shore-line is the zone of intimate and direct contact between water and land. The shore-line zone may be a beach or strand at one side and sea cliff at another. The coast line has an epeirogenic (land formation) or an orogenic (mountain formation) background. Shallow landform and emergent coast are the characteristic features in Orissa. Sands are thrown up by the waves to form beach-ridges which may be smoothed out at once to an even slope by wind and wash to form a sandy beach. By such deposition the shore-line is progressively moved seaward and a strand plain developed at the land edge. The erosional and depositional processes of the large waves operate together to produce a steeper bottom profile in a narrowly compressed zone and the result is the formation of a barrier beach by wind into Dunes or drifted into the lagoon behind the bar. The lagoons behind the Bay and off shore bars gradually filled with sands from the sea and sediment from the land. As they become shallow, plants establish themselves and by their growth, both contribute to and facilitate the filling by checking movements of the water. Eventually, tidal taxa supersede the erstwhile upon water. Tidal taxa are in part covered by flood tide only by the greater range of spring tides, in part are completely dry. The

ingress and egress of the tidal water is by mud-walled channels which extend in irregular courses through the swamps.

An estuary is a confined arm of the sea situated at the mouth of a river which serves as an inlet where sea-water comes in contact with the river-current. In a tidal estuary there is an influx of fresh water at the lower level. The amount of fresh water at the upstream changes, seasonally. In the Mahanadi, the Dhamra and the Maipura estuaries, the amount of fresh water is greater during the monsoon than in winter. This large volume of fresh-water floods during the monsoon produces increased turbulence and less salinity condition in the estuaries. In an estuary, the salinity condition varies vertically, horizontally, or even from one shore to other; this is perhaps due to tidal currents moving rapidly in the centre estuarine zone which alter salinity to a great extent. This is the main reason for the low salinity at the surface and increases at different depths of the tidal river. Table II represents yearly salinity and tidal level of outer and inner estuarine regions and table III represents soil particle size in the outer and inner estuarine areas.

Table II

Areas	River Water							
	Salinity EC mmhos/cm Depth — 30 cm				Tide level from tide datum in m			
	J-M	A-J	J-S	O-D	J-M	A-J	J-S	O-D
I. <i>Outer estuaries</i>	33	29	18	26	3.5	4.5	6.0	3.5
II. <i>Inner estuaries</i>								
1. Creeks at lower elevation	25	21	11	22	3.0	3.5	5.5	2.5
2. Creeks at higher elevation	20	16	6	17	2.0	3.0	3.5	2.0
3. Transitional areas	18	14	5	15	1.0	2.0	2.5	1.0

Table III

Areas	Soil Particle size distribution Depth 20 cm.				pH	Organic matter %	EC mmhos/cm ranges
	Clay %	Silt %	Fine sand %	Course sand %			
I. <i>Outer estuaries</i>	31	44	19	7	6.8	2.5	30—12
II. <i>Inner estuaries</i>							
1. Creeks at lower elevation	42	30	22	3	6.9	3.0	24—9
2. Creeks higher elevation	50	29	17	2	7.1	3.5	15—6
3. Transitional areas	25	3	40	24	6.3	4.8	5—1

Analysis of Soil, Water salinity and Tide levels from Mangrove communities—  
Data represents average value of 10 samples from each type.

### STRUCTURAL CHARACTERISTICS OF VEGETATION

Studies on vegetation usually include two major aspects, namely the plant communities as a unit of the vegetation over an area, their structure and classification, and the flora with an inventory of plants growing in an area with its characteristic exomorphic features. Our knowledge of the Indian coastal plant communities is mainly based on systematics in various Floras and articles since the time of the publication of Hooker's Flora of the British India (Roxburgh 1814, Clarke 1896, Prain 1903, Griffith 1836, 1851, Heinig 1893, Nairne 1894. Hooker *et al.* 1875-97; Cooke 1901-1908, Blatter 1905. Gamble 1915-35). The few recent publications pertaining to the Indian coastal vegetation are from Kutch and Saurashtra and South Gujarat (Jain *et al.* 1960a. b: 1968; Rao *et al.* 1962a. b: 1964, 1965, 1966, 1967, 1969, 1970 Toor 1958; Shaw 1967); Konkan area of Maharashtra State and Goa (Bharucha 1950, Satyanarayan 1958. Shah 1962, Navalkar 1910, 1951, 1956, 1959, 1961, Navalkar & Bharucha 1965, Untwale *et al.* 1972); Karnataka coastal areas (Arora and Agarwal 1965, Santapau 1961);

Malabar coast of the Kerala State (Erlanson 1936, Mudaliar & Kamath 1952, Thomas 1962, Rao *et al.* 1977); Tamil Nadu coastal area (Mr Iange and Meher-Homji 1965, 1973, Nayar 1969, Lawrence 1973, Caratini 1973, 1961, Rao *et al.* 1973, Danieal 1967, Blasco and Caratini 1973, Caratini 1973, Caratini *et al.* 1973, Rao *et al.* 1975); Andhra Pradesh (Venkateshwaralu 1944, Venkateshwaralu *et al.* 1973, Rao 1957, Rao *et al.* 1970, 1971, 1972, Siddhu 1963, Sastry and Rao 1976); Utkal coast (Haines 1924, Rao *et al.* 1968, 1970, 1971, 1972, 1975, Mooney 1950, Raizada 1949, Sanyal 1957) and Bengal coast (Curtis 1933).

The vegetation in the study area has been treated under the collective title 'tidal forests' (Champion 1936) or 'tidal swamp forests' (Champion and Seth 1968) or by the general term 'Mangroves' for this unique estuarine soil-vegetation complex; whatever may be the designation, it is evident that the mosaic vegetation in this estuarine complex can be differentiated into distinct units, namely Strand vegetation, Estuarine vegetation and Blanks or scrubland. This differentiation is invariably associated with the general nature of the substratum chiefly governed by salinity of the area. This vegetation complex falls into a system of gradients and gives a distinct physiognomically defined vegetation sub-units representing an eco-system which is generally regarded as primarily expressing the co-existence of soil-vegetation complex. This is not, however, independent of the tidal and fresh water flow. The density, fidelity, frequency and other attributes of the tidal taxa are mainly influenced by local climatic influences. How far the factors are reasonable in moulding the spread and distribution of the vegetation would be a very interesting long-range research programme and the expected data from such a study would be highly rewarding.

### VEGETATION BELTS & SAMPLING

The vegetation of the area of study with its distinct topography is classified into the following belts :

The Estuarine belt at the margins of the tidal riverine banks is one of the most unstable topographic units under great physical stress. Often its formation and stability depend on the nature of the tides duration and season. The meandering riverine banks often show erosional and depositional banks at regular intervals and the tidal action on them is a regular feature of interest. It is obvious to observe the characteristic features of a few taxa which grow in that region. In this area, *Porteresia coarctata* is a pioneer taxon which comes up, and shows

considerable density on silt-laden areas which are limited to newly exposed marginal areas of estuaries. This taxon forms pure associates, and helps considerably to protect the underlying slushy or sandy soil from erosion. The other taxa which generally make their appearance under the aforesaid situations are *Avicennia manna*, *A. alba*, *Sonneratia griffithii* and *S. caseolatis*. *Nypa fruticans* under such a situation, is observed as a pioneer species in the Gangetic Sunderbans. In the present areas of study, however its presence was not noticed anywhere except for a few floating fruits. Further, along exposed marginal areas in the downstream, one could see good coverage of *Myriostachya wightiana*, followed by *Crinum asiaticum* and *Acrostichum aureum* (as indicator of secondary conditions).

The next best grouping of taxa is seen in the Pro-estuarine or intertidal belt, varying in length, breadth and tidal levels. Accordingly, one could see three distinct sub-belts designated as 'Tidal mangroves,' 'Prohaline' and 'Eubaline'.

The members of Tidal mangroves include true mangroves and semi-mangroves showing considerable diversity in tolerating the tidal depth, surface conditions and showing botanical peculiarities. The zonal belt pattern is distinct and dominated by a group of distinct taxa. Under the situation where estuarine belt is absent, the area is occupied by *Rhizophora* with its characteristic stilt roots and viviparous habit. Facing the tides directly, they are found scattered, but under protective conditions their frequency and abundance increase considerably. A few striking visual observations are the abundance of stilt roots and the viviparous habit in such plants which are constantly under tidal water ranging from 3m to 2m but less in plants anchored in shallow areas.

Closely following the species of *Rhizophora* are *Ceriops decandra* and *Kandelia condal* zones. Their maximum density is in the 2 to 1 m depth producing innumerable stilt roots, viviparous habit and a good spreading crown of lush green leaves. The crown spread and the floating litters on the underlying slushy soil are significant. The next zone is that of *Bruguieras*. This species attains a good girth, and crown cover under saline water up to 1 m depth and needs a lower salinity than the *Rhizophora*. Absence of stilt roots seems to be compensated by the possession of slightly compressed or fluted trunks and innumerable geniculate pneumatophores. Further, some of its associates exhibit incipient viviparous habit as a contrast to that of *Rhizophora* and *Ceriops*. The next zone is that of *Avicennia officinalis*, *Excoecaria* and *Xylocarpus* in varying proportions. This zone is characterised by

innumerable peg-like pneumatophores and stunted trees of good girth and crown cover lying under slushy lowlying topography. It is not uncommon to see the peculiar buttress of *Xylocarpus* almost one-sided to support the massive bole. The preceding zone and the subsequent zones are found to be under the influence of tides and fresh-water from the adjacent distributaries of the main stream. Under brackish conditions there is an extensive spread of *Heritiera fomes*, often mixed up with *Sonneratia*. The innumerable blind root-suckers of *Heritiera fomes* mixed with pneumatophores of *Sonneratia apetala* give a distinct stamp to the overlaying topography. Similarly the shrub, *Aegiceras corniculatum* extends considerably, and in such places where it has to face the tidal force, it develops broom-like stilt roots. This is certainly an adaptive feature in a community in which such roots are rarely produced.

The upland areas free from tides and under sub-humid environment give rise to thick evergreen forests ; such areas under storm tides or of saline alkaline influence develop a few succulent halophytes like *Suaeda*, *Salicornia*, *Sesuvium* in extensive patches often intercepted by *Acanthus ilicifolius*, *Clerodendrum inerme*, *Excoecaria agallocha* and saline grasses and sedges.

#### OBSERVATIONS

Natural vegetation in the areas between the Dhamra and the Devi rivers consists of several taxa belonging to tidal forest communities distributed on estuarine banks and deltaic low-lying topography. They constitute a mosaic of varied shining foliage with an apparently impenetrable tangle of arched aerial roots, pneumatophores and other adaptive features. Their growth and dominance are mainly related to low-lying topography or to its extended relief, which is invariably under the influence of tides twice or at least once a day. The resulting tidal flora is a very interesting soil-vegetation complex, and constitutes a system of gradients.

#### METHODOLOGY

The field work was conducted with a thorough foot and boat traverses, followed by repeated observations on the characteristic features of the vegetation particularly under varied conditions of the study area in different seasons of the years 1968-1973.

In sand strand samples were established at places where there was uniform distribution of species on uniform habitat. In the tidal forests random sample-plots were taken only at accessible areas as much community-variation as possible. In total 30 plots were established and used in this study.

Line-transects were extended across the several strands with a measuring tape to record the plants touching along the tape and also the length of the tape intercepted by the individual plant cover. The length of the tape intercepted by the bare ground was also recorded. The size or length of the measuring tape was determined in accordance with a near-complete representation of the species of the community. By using the criteria of near-complete species representation it was found that along the coastal strand minimal length was only 8-10 m in the study areas, where an increase of 2 m in the sample length yields only 1% more species. The use of 15 m long line-transect was, therefore, greater than the minimal length required. In the tidal forests this length varied from 12-65 m long, with the extent of area of different stands of tidal community.

A similar line was drawn in a large centimeter graph sheet, plants touching along the tape and the intercepted length by the individual plant cover were marked along the line on the graph sheet and bare-ground-portions were not marked. Thus, in the centimeter work sheets each marking represents 1/2 of the basal cover of each individual.

From this data various analytical characters are computed to obtain the relative frequency, relative density and percentage cover for the herbaceous plants, and the Important Value Index (IVI) for tidal plants.

Since this method was found to be more convenient and rapid than the conventional quadrat method, it was adopted here in this study in order to indicate data for density, frequency, basal area, and IVI for the tree species, (IVI Bar-Diagram).

Although the data gathered are preliminary, in particular as regards the vegetation, it may nevertheless serve its purpose in indicating the importance of species within the tidal forests, which has hitherto received little attention in the ecological study especially from this area.

#### QUANTITATIVE ANALYSIS OF VEGETATION STRUCTURE

With the help of the line transect method the structure of the plant community has been studied by taking into consideration of certain



Table I(A)

Location : Baroparia ~ Paradeep.  
Harishpur Gara--Barua River-mouth.

Names of Taxa	No. of species						
	1	2	3	4	5	6	7
1	2						
1. <i>Cyperus arenarius</i>	13	15	13	0	2	0	0
2. <i>Spinifex littorius</i>	46	23	23	30	23	24	26
3. <i>Launaea sarmentosa</i>	36	5	11	2	5	0	0
4. <i>Hydrophylax maritima</i>	0	15	0	0	5	0	5
5. <i>Euphorbia rosea</i>	4	0	0	12	0	0	0
6. <i>Rothia trifoliata</i>	3	2	0	0	0	0	0
7. <i>Portulaca tuberosa</i>	1	3	0	0	0	0	0
8. <i>Eugenia brachiata</i>	2	0	0	0	0	0	0
9. <i>Indigofera pentaphylla</i>	1	0	0	0	0	0	0
10. <i>Hemidesmus indicus</i>	2	0	0	0	0	0	0
11. <i>Ipomoea pes-caprae</i>	0	0	0	0	0	8	17
12. <i>Zoysia matrella</i>	0	0	0	0	0	0	15
13. <i>Aristolochia bracteata</i>	0	0	0	0	0	0	0
14. <i>Sasuvium portulacastrum</i>	0	0	0	0	0	17	19
15. <i>Brachiaria sp.</i>	0	0	0	0	0	0	0

$$R. F. = \frac{\text{No. of occurrence of}}{\text{No. of occurrence of}}$$

Frequency

Length of Line-transect : 15 m.

Dates : 15.6.73 & 29.7.73

in each segment

			Total No. of segments of occurrence	R. F.	% of Fre- quency studied	Total No. of segments studied
8	9	10	3	4	5	6
0	0	14	5	11.3	50	10
10	26	0	9	20.4	90	10
0	8	0	6	13.6	60	10
0	4	0	4	9.0	40	10
0	0	0	2	4.5	20	10
0	0	0	2	4.5	20	10
0	0	2	3	6.8	30	10
0	0	0	1	2.2	10	10
0	0	0	1	2.2	10	10
0	0	0	1	2.2	10	10
0	0	26	3	6.8	30	10
0	0	0	1	2.2	10	10
0	0	5	1	2.2	10	10
20	4	0	4	9.0	40	10
9	0	0	1	2.2	10	10
			44			

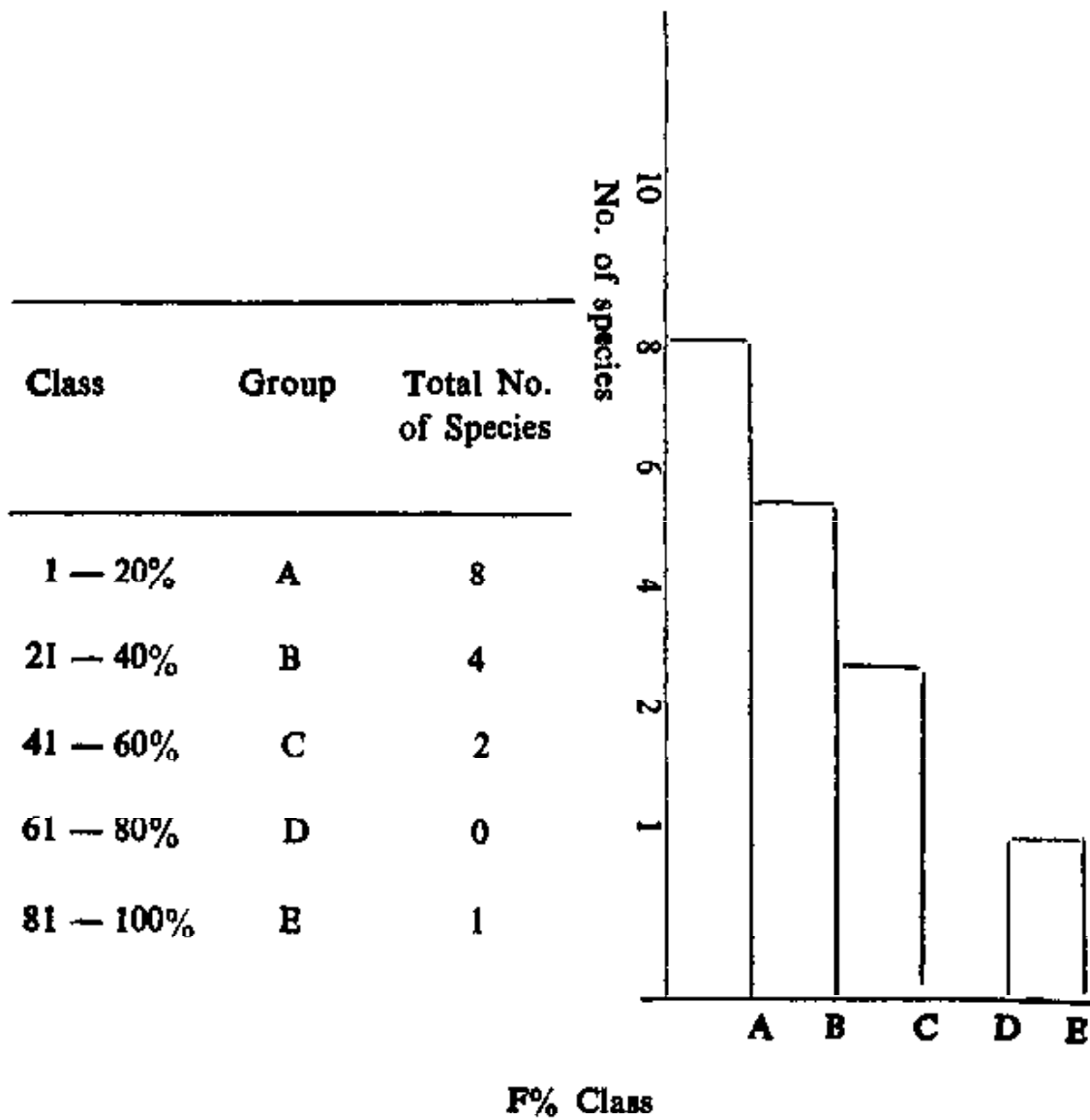
$$\frac{\text{species}}{\text{all species}} \times 100$$

analytical characters, namely frequency, density, abundance, percentage cover of herbaceous species and IVI of tree species in the field.

Experimental data for all the analytical characters from several stands are presented here in different Tables. A total of 9 Tables are constructed, further which are sub-divided into IA, IB, IC, ID and IE with the experimental data of frequency, density, percentage frequency and percentage cover of species along the sand strand/dune vegetation and IIA, IIB, IIC and IID with the experimental data of frequency, density, relative frequency, density, average diameter of species in each segment, average basal area as sq. cm. per sq. m. total basal area of species and relative value index of individual species along the Mangroves.

Table I(B)

Frequency Class



A, B and C, and again E, are in accordance with Raunkiaer's Normal Frequency Diagram but D is not represented ; so the stand is heterogeneous.

Table I(C)

Names of Taxa	Total No. of individual	No. of transect of occurrence
1	2	3
1. <i>Cyperus arenarius</i>	57	5
2. <i>Spinifex littorius</i>	231	9
3. <i>Launaea sarmentosa</i>	67	6
4. <i>Hydrophylax maritima</i>	29	4
5. <i>Euphorbia rosea</i>	15	2
6. <i>Rothia trifollata</i>	5	2
7. <i>Portulaca tuberosa</i>	6	3
8. <i>Eugenia bractata</i>	2	1
9. <i>Indigofera pentaphylla</i>	1	1
10. <i>Hemidesmus indicus</i>	2	1
11. <i>Ipomoea pes-caprae</i>	51	3
12. <i>Zoysia matrella</i>	15	1
13. <i>Aristolochia bracteata</i>	5	1
14. <i>Sesuvium portulacastrum</i>	60	4
15. <i>Brachiaria sp.</i>	9	1

$$R. D. = \frac{\text{No. of individual of sp.}}{\text{No. of individual of all sp.}} \times 100$$

**Density**

Total No. of transects studied	Abundance	R.D.
4	5	6
10	11.4	10.2
10	25.6	41.6
10	11.1	12.0
10	7.2	5.2
10	7.5	2.7
10	2.5	0.99
10	2.0	1.0
10	2.0	0.36
10	1.0	0.18
10	2.0	0.36
10	17.0	9.1
10	15.0	2.7
10	5.0	0.99
10	15.0	10.8
10	9.0	1.6

$$\text{Abundance} = \frac{\text{Col. 2}}{\text{Col. 3}}$$

Table I(D)

Percentage cover of species within 10-line transect, each having 15 m long

Names of Taxa	Total length covered by different species	Total cover in cm within the length (150 m)	% Coverage	Total length of transect
1	2	3	4	5
1. <i>Cyperus arenarius</i>		102	0.68	
2. <i>Spinifex littoralis</i>		680	4.5	
3. <i>Lamaea sarmentosa</i>		160	1.1	
4. <i>Hydrophylax maritima</i>		87	0.5	
5. <i>Euphorbia rosea</i>		40	0.2	
6. <i>Rothla trifoliata</i>		20	0.1	
7. <i>Portulaca tuberosa</i>	1558 cm	24	0.1	15000 cm
8. <i>Eugenia bracteata</i>		8	0.001	
9. <i>Indigofera pentaphylla</i>		3	Less than 0.1	
10. <i>Hemidesmus indicus</i>		6	Less than 0.1	
11. <i>Ipomoea pes-caprae</i>		204	1.5	
12. <i>Zoysia matrella</i>		15	Less than 0.1	
13. <i>Aristolochia bracteata</i>		20	0.1	
14. <i>Sesuvium portulacastrum</i>		180	1.2	
15. <i>Brachiaria</i> sp.		9	Less than 0.1	

**Table I(E)**  
**Percentage cover of a single segment of *Spinifex* stand from a length of 15 m long-line transect at Baraporia-Paradeep, Orissa**

Names of Taxa	Total length covered within 15 m in cm	Percentage cover	Total length covered by different species	Total length of transect
1	2	3	4	5
1. <i>Spinifex littorlus</i>	280	18.6		
2. <i>Cyperus arenarius</i>	26	1.7		
3. <i>Lamnaea sermentosa</i>	69	4.6		
4. <i>Euphorbia rosea</i>	10	0.6	419 cm	1500 cm
5. <i>Rostia trifoliata</i>	12	0.8		
6. <i>Portulaca tuberosa</i>	5	0.33		
7. <i>Eugenia bractiata</i>	7	0.46		
8. <i>Hemidesmus indicus</i>	7	0.46		
9. <i>Indigofera pentaphylla</i>	3	0.2		
	419 cm			



**Table II(A)**  
**Compound Data**

Line-Intercept Method.

Dates : 7th, 20th, 28th & 30th July, 1973.

Total length of transect : 175 m.

Names of Taxa	No. of species in segments					Average diameter of species in segments									
	65m. 25m. 38m. 18m. 27m.					65m. 25m. 38m. 18m. 27m.									
	1	2	3	4	5	1	2	3	4	5					
	1					2					3				
1. <i>Rhizophora apiculata</i>	3	3	5	2	20	10	13	20	21	10					
2. <i>Bruguiera gymnorrhiza</i>	-	3	4	-	2	-	8	5	-	23					
3. <i>Ceriops decandra</i>	15	10	38	4	27	3	3	2.4	5	4.8					
4. <i>Bruguiera parviflora</i>	-	12	60	23	-	-	4	4.5	4	-					
5. <i>Dalbergia spinosa</i>	5	5	-	13	2	3	2	-	6	4.5					
6. <i>Excoecaria agallocha</i>	27	5	7	4	27	10	5	4	6	10					
7. <i>Aegiceras corniculatum</i>	-	-	4	-	-	-	-	-	6.7	-					
8. <i>Aegialitis rotundifolia</i>	85	11	27	3	-	4	4	2.4	2	-					
9. <i>Sonneratia apetala</i>	1	-	1	1	-	10	-	21	25	-					
10. <i>Avicennia officinalis</i>	22	1	-	2	2	12	30	-	21	34					
11. <i>Avicennia alba</i>	-	-	-	2	4	-	-	-	5	5.5					

Location : Batighar-Falsepoint  
Kansardia.  
Bahar-Khanshi &  
Hookitola.

Average basal area sq. cm. $\pi r^2$					Average basal area sq. cm. per sq. m.				
Segments					Segments				
1	2	3	4	5	1	2	3	4	5
		4					5		
78.5	107	314	346	78.5	13	136.3	1705	1681	3364
-	50.2	19.6	-	4152	-	36	4	-	961
7	7	4.5	19	6.18	3	8	25	16	324
-	12.5	13	12.5	-	-	36	400	256	-
7	3.1	-	7	15.8	0.25	2	-	25	1
78.5	19.6	12.5	28.2	78.5	1024	16	5	36	6084
-	-	29.3	-	-	-	-	-	9	-
12.5	12.5	4.5	3.1	-	289	25	16	3	-
78.5	-	346	490	-	1	-	81	729	-
103	706	-	346	907	1225	576	-	1396	4489
-	-	-	19.6	23.4	-	-	4	4	13

Table II(A) (Contd.)

	1	2	3	4	5	1	2	3	4	5	
	2		3								
	1	2		3							
12. <i>Lumnitzora racemosa</i>	-	-	-	-	4	-	-	-	-	8.5	
13. <i>Xylocarpus granatum</i>	6	-	3	-	-	8	-	13	-	-	
14. <i>Xylocarpus moluccensis</i>	-	-	-	-	3	-	-	-	-	19	
15. <i>Phoenix paludosa</i>	106	-	-	-	-	6	-	-	-	-	
16. <i>Kandelia candel</i>	-	-	-	1	-	-	-	-	10	-	
17. <i>Heritiera fomes</i>	8	-	-	15	-	10	-	-	8	-	
18. <i>Finlaysonia obovata</i>	2	-	-	-	-	2	-	-	-	-	
19. <i>Tamarix gallica</i>	7	-	-	-	-	5	-	-	-	-	
20. <i>Brownlowia tersa</i>	12	-	-	7	-	1.5	-	-	2.4	-	
21. <i>Rhizophora mucronata</i>	7	9	10	7	3	22	9	17	11	10	
22. <i>Sonneratia caseolaris</i>	-	-	-	-	6	-	-	-	-	19.6	
23. <i>Derris trifoliata</i>	-	-	4	13	-	-	-	17	3	-	
24. <i>Merope angulata</i>	-	-	-	14	-	-	-	-	3	-	
25. <i>Clerodendrum inerme</i>	-	-	-	-	3	-	-	-	-	2.5	

1	2	3	4	5	1	2	3	4	5
		4				5			
-	-	-	-	51	-	-	-	-	49
50.2	-	132	50.2	-	16	-	100	9	-
-	-	-	-	283	-	-	-	-	961
28.8	-	-	-	-	2116	-	-	-	-
-	-	-	78.5	-	-	-	-	16	-
78.5	-	-	50.2	-	18	-	-	1681	-
3.14	-	-	-	-	0.4	-	-	-	-
19.6	-	-	-	-	4	-	-	-	-
1.7	-	-	4.5	-	0.16	-	-	2	-
380.9	63.3	706	94.9	78.5	25	484	3481	1369	68.8
-	-	-	284	-	-	-	-	-	3936
-	-	2.5	7	-	-	-	0.9	4	-
-	-	-	7	-	-	-	-	25	-
-	-	-	-	4.9	-	-	-	-	0.25

Line-Intercept Method.

Dates : 7th, 20th, 28th &amp; 30th July, 1973.

Total length of transect : 175 m.

Names of Taxa	Total No. of transect of occurrence	Total No. of individual
1	2	3
1. <i>Rhizophora apiculata</i>	5	33
2. <i>Bruguiera gymnorrhiza</i>	3	9
3. <i>Ceriops decandra</i>	5	94
4. <i>Bruguiera parviflora</i>	3	95
5. <i>Dalbergia spinosa</i>	4	25
6. <i>Excoecaria agallocha</i>	5	70
7. <i>Aegiceras corniculatum</i>	1	4
8. <i>Sonneratia apetala</i>	3	3
9. <i>Avicennia officinalis</i>	4	27
10. <i>Avicennia alba</i>	2	6
11. <i>Lumnitzera racemosa</i>	1	4
12. <i>Xylocarpus granatum</i>	2	9
13. <i>Xylocarpus moluccensis</i>	1	3
14. <i>Phoenix paludosa</i>	1	106
15. <i>Kandelia candel</i>	1	1
16. <i>Heritiera fomes</i>	2	23
17. <i>Finlaysonia obovata</i>	1	2
18. <i>Tamarix troupii</i>	1	7
19. <i>Brownlowia tersa</i>	2	19
20. <i>Rhizophora mucronata</i>	5	36
21. <i>Sonneratia caseolaris</i>	1	6
22. <i>Derris trifoliata</i>	2	17
23. <i>Merope angulata</i>	1	14
24. <i>Clerodendrum inerme</i>	1	3
25. <i>Aegialitis rotundifolia</i>	4	126
	61	742

$$R.D. = \frac{\text{No. of individual of sp.}}{\text{No. of individual of all sp.}} \times 100$$

$$R.A. = \frac{\text{Total basal area of sp.}}{\text{Total basal area of all sp.}} \times 100$$

**Compound Data**

Location : Batighar-Falsepoint  
Kansardia.  
Bahar-khanshi and  
Hookitola.

Total basal area of sp.	R.D.	R.F.	R.A.	I.V.I.
4	5	6	7	8
6899.3	4.4	8.1	19.4	31.9
1001	1.22	5	2.8	9.02
376	12.7	8.3	1.06	22.06
692	12.9	5	1.9	19.1
28.25	3.5	6.6	0.08	9.98
7165	9.5	8.3	20.2	38.0
9	0.54	1.6	0.02	2.16
811	0.40	5	2.2	7.6
7686	3.6	6.6	21.7	31.6
17	0.8	3.3	0.04	4.14
49	0.54	1.6	0.13	2.27
116	1.2	3.2	0.36	4.76
961	0.4	1.6	2.7	4.70
2116	14.3	1.6	5.9	21.80
16	0.13	1.6	0.04	1.77
1699	3.1	3.3	4.9	11.30
0.4	0.27	1.6	0.001	4.30
4	0.95	1.6	0.01	2.56
2.16	2.5	3.3	0.006	5.80
5427	4.8	8.1	15.3	28.2
3969	0.88	1.6	11.2	13.68
4.9	2.3	3.3	0.01	5.61
25	1.9	1.6	0.07	3.51
0.25	0.4	1.6	0.0007	2.00
333	17.0	6.6	0.90	24.50

$$R.F. = \frac{\text{No. of occurrence of sp.}}{\text{No. of occurrence of all sp.}} \times 100$$

$$I.V.I. = R.F. + R.D. + R.A.$$

Table II(C)

Dates : 8th, 10th, 7th &amp; 9th August, 1976.

Total length of transect : 76 m.

Names of Taxa	Average diameter of species = 2r 25m. 21m. 18m. 12m.					
	Segments					
	1	2	3	4	1	2
1. <i>Heritiera fomes</i>	9	6	7	6	63.3	58.26
2. <i>Cynometra ramiflora</i>	9	—	8	—	63.5	—
3. <i>Excoecaria agallocha</i>	6	7	—	5	28.26	38.30
4. <i>Amoora cucullata</i>	4.3	8	—	—	14.3	50.24
5. <i>Brownlowia tersa</i>	2.6	3	—	—	5.02	6.90
6. <i>Brownlowia gymnorhiza</i>	23.02	—	—	—	132.05	—
7. <i>Intsia bijugu</i>	22.67	—	—	—	121.04	—
8. <i>Phoenix paludosa</i>	—	—	—	3.02	—	—
9. <i>Ceriops decandra</i>	—	—	—	3.05	—	—
10. <i>Aegiceras corniculatum</i>	—	6	—	3.00	—	28.26
11. <i>Tamarix troupilii</i>	—	—	—	3.08	—	—
12. <i>Kandelia candel</i>	—	7	—	—	—	38.30
13. <i>Hibiscus tiliaceus</i>	—	3	—	—	—	69.08
14. <i>Rhizophora apiculata</i>	—	17	—	—	—	226.8
15. <i>Heritiera littoralis</i>	—	—	9	—	—	—
16. <i>Manilkara hexandra</i>	—	—	12	—	—	—
17. <i>Pongamia pinnata</i>	—	—	14	—	—	—
18. <i>Eugenia brachiata</i>	—	—	3	—	—	—
19. <i>Olax scandens</i>	—	—	6	—	—	—
20. <i>Cerbera manghus</i>	—	—	4	—	—	—
21. <i>Dalbergia spinosa</i>	—	—	—	2.5	—	—

Compound Data

Location : Bhitarkanika,  
Soajore &  
Dangmal

Average basal area in sq.cm. = $\pi r^2$			Average basal area as sq. cm. per sq. m.		
Segments			Segments		
3	4	1	2	3	4
38.30	28.26	5041	354.9	18.26	22.1841
30.24	-	693.40	-	280.45	-
-	23.98	2704.40	5329.26	-	216.64
-	-	70.5	91.5	-	-
-	-	1.03	1.34	-	-
-	-	110.15	-	-	-
-	-	31.21	-	-	-
-	6.908	-	-	-	1375.76
-	-6.908	-	-	-	377.47
-	6.908	-	14.66	-	16.9
-	6.908	-	-	-	3.119
-	-	-	271.7	-	-
-	-	-	19.1	-	-
-	-	-	9447.8	-	-
63.5	-	-	-	1087.02	-
113.04	-	-	-	3943.8	-
153.86	-	-	-	657.5	-
6.90	-	-	-	0.61	-
28.29	-	-	-	22.18	-
12.50	-	-	-	7.79	-
-	4.89	-	-	-	1878.03



Table II(D)

Dates : 8th, 10th, 7th &amp; 9th August 1976.

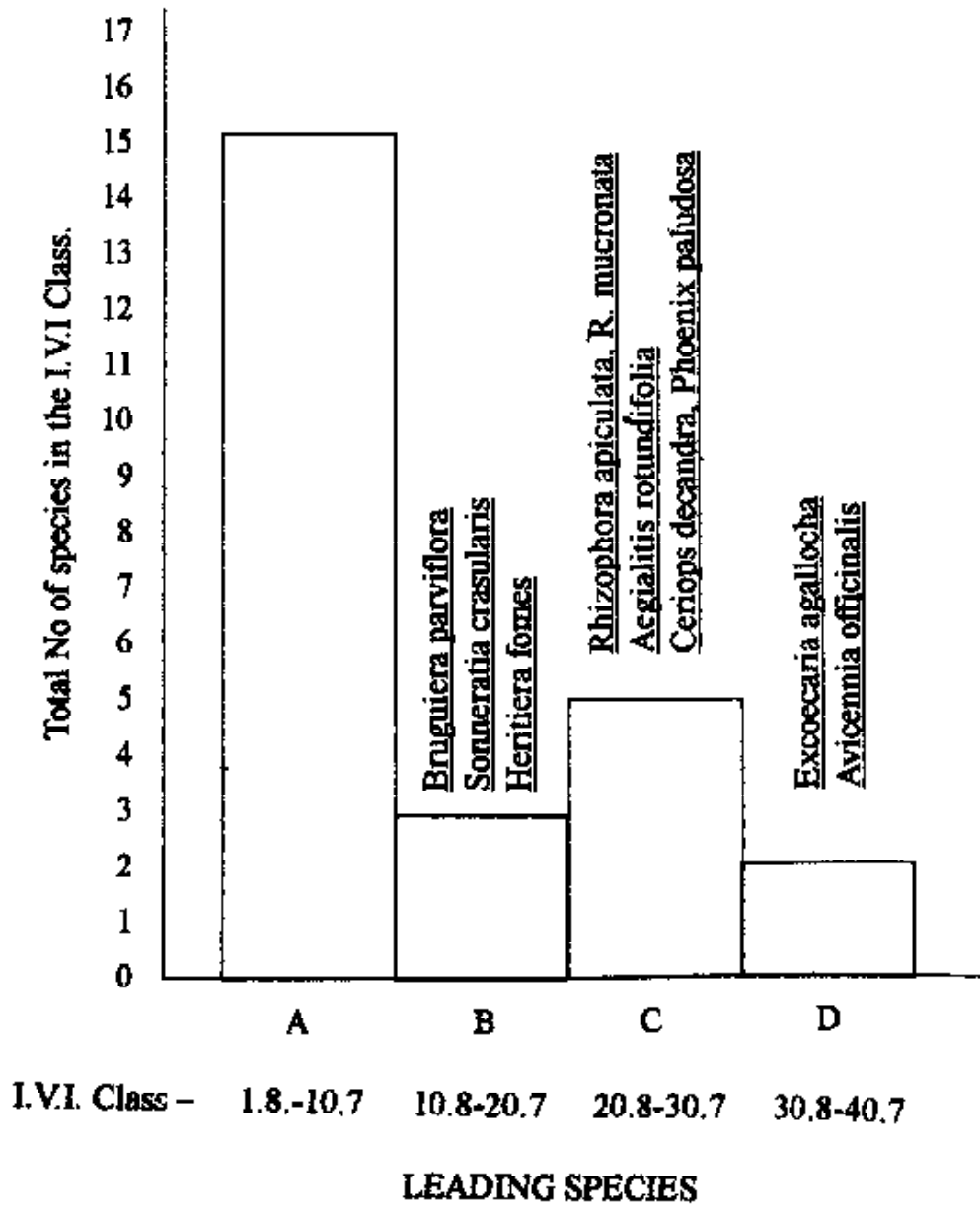
Total length of transect : 76 m.

Names of Taxa in 96 m transect	Occurrence of species in segments					
	Segments					
	1	2	3	4	F.	D.
1	2					
1. <i>Heritiera fomes</i>	29	13	2	2	4	50
2. <i>Cynometra ramiflora</i>	32	—	6	—	2	38
3. <i>Excoecaria agallocha</i>	46	10	—	9	3	65
4. <i>Amoora cucullata</i>	15	4	—	—	2	19
5. <i>Brownlowia tersa</i>	5	2	—	—	2	7
6. <i>Bruguiera gymnorrhiza</i>	2	—	—	—	1	2
7. <i>Intsia bijugu</i>	2	—	—	—	1	2
8. <i>Phoenix paludosa</i>	—	—	—	63	1	63
9. <i>Ceriops decandra</i>	—	—	—	33	1	33
10. <i>Aegiceras corniculata</i>	—	9	—	7	2	16
11. <i>Tamarix troupii</i>	—	—	—	3	1	3
12. <i>Kandelia candel</i>	—	9	—	—	1	9
13. <i>Hibiscus tiliaceus</i>	—	13	—	—	1	13
14. <i>Rhizophora apiculata</i>	—	9	—	—	1	9
15. <i>Heritiera littoralis</i>	—	—	21	—	1	21
16. <i>Manilkara hexandra</i>	—	—	10	—	1	10
17. <i>Pongamia pinnatu</i>	—	—	3	—	1	3
18. <i>Eugenia brachiata</i>	—	—	2	—	1	2
19. <i>Olax scandens</i>	—	—	3	—	1	2
20. <i>Cerbera manghus</i>	—	—	4	—	1	4
21. <i>Dalbergia spinosa</i>	—	—	—	10	1	10
					30	382

## Compound Data

Location : Bhitarkanika,  
Soajore & Dangmal.

Total basal area of individual sp. sq. cm. per sq. m.	R.F.	R.D.	R.A.	I.V.I.
3	4	5	6	7
5436.3	13.3	13	11	37.3
6873	6.6	9.9	16.8	3.33
8294	10	17	20.6	47.6
162	6.6	4.9	0.4	11.9
2	6.6	1.8	0.004	8.4
110	3.3	0.5	0.2	4.0
31	3.3	0.5	0.07	3.87
1375	3.3	16.4	3.4	23.1
377	3.3	8.6	0.9	12.8
162	6.6	4.1	0.4	11.1
3	3.3	0.7	0.007	4.0
271	3.3	2.3	0.4	6.0
19	3.3	3.4	0.03	6.73
9447.8	3.3	2.3	2.0	7.6
1086	3.3	5.4	2.6	11.3
3943	3.3	2.6	9.8	15.7
657	3.3	0.7	1.3	5.3
1	3.3	0.5	0.002	3.80
22	3.3	0.7	0.05	4.0
7	3.3	1	0.01	4.3
1878	3.3	2.6	4.5	10.4
<b>39157.1</b>				



### DETAILS OF THE SYNTHETIC TABLES

The segments were divided into two groups according to their occurrence in the deltaic regions. The two regions are separated by means of physiographic and edaphic conditions. The sea-shore strand or dune region and muddy or selty tidal flats region. In each group, the segments are arranged in a tabular manner. All the species are listed on the left of the table. Segment numbers are arranged on the top. Thus, vertically each column represents one vegetation segment. The species that are listed in the tables are used for distinguishing vegetational units.

Tables represent the quantitative study of frequency, density, percentage of frequency and percentage cover of the species along sand strand/dune vegetation. In Table I(A), the vertical column represents the presence or absence of species in each segment of the transect. The horizontal column under each species represents the number of sampling segments or transects in which the particular species occurs, i.e. frequency, and also the percentage of frequency, which can be arranged by multiplying values of frequency with 100, and dividing by the total number of segments or transect studied. In Table I(B), all species in the Table I(A) are divided into 5 classes based on percentage frequency data from table I(A). Percentage frequency classes are named as Group A, B, C, D & E. The last column represents the total number of species that occurred under each percentage frequency class. Frequency classes are placed on the X axis against the percentage of total number of species coming into each class on the Y axis. Thus, the frequency diagram is prepared for the study area and it is found that the strand is heterogeneous since A, B, C & again E are in accordance with Raunkiaer's normal frequency diagram but D is not represented. In Table I(C), column 2 represents the total number of each species that occurred in all the segments which can be arranged counting from the Table I(A). Column 3 represents the frequency of each species as in Table I(A). Column 4 represents the total number of transects. Column 5 represents the abundance of each species, which can be arranged by dividing the total number of each species in all segments with the number of transects of occurrence. Column 6 represents relative density of each species obtained as follows :

$$\frac{\text{No. of plants of species}}{\text{No. of plants of all the species}} \times 100$$

Table I(D) represents the percentage cover of the species within 10 line-transects, each transect being 15m long. In this Table, column 1 represents the names of taxa that occurred in 10 segments or transects. Column 2 represents the total length of the type intercepted by each species in 10 line-transects, that is total cover. Column 3 represents the total length covered by different species within all segments. Column 4 represents the percentage cover of each species, which can be obtained by calculating percentage of the total length of transect covered by each species. Column 5 represents the total length of transect in cm. Thus, the percentage cover of each species within 15000 cm is shown in a histogram. Table I(E) is the percentage cover of a single strand of *Spinifex littoreus* within 15m line-transect.

#### SUMMARY

**Tables :** The foreshore is physiographically unstable and devoid of vegetation. The backshore, if elevated, forms a repository for sand accumulation through the impact of onshore winds. Thus, an elevated strand/dune topographic facet, on stabilisation supports a good strand flora. The details of this aspect are illustrated in Tables I(A), I(B), I(C), I(D) & I(E).

Relative frequency, relative density and percentage cover in the Table I(E) show that a dioecious spinescent grass *Spinifex littoreus*, is dominant on the sand strand/dune in this area. This psammopyte endures sand burial and sends vertical upright shoots and spreading horizontal branches over sand humps. Mostly the population has a good spread along the area of study. Closely following this grass, is the strand runner, *Ipomoea pes-caprae*, rooting at the nodes and covering larger areas. *Sesuvium portulacastrum* found to take next position, but this may be due to the varied habitat adaptation of this plant, mostly caused by salinity factor. This following taxa are found to maintain usually the order of R.F., R.D. & percentage cover in the strand sand/dune in the study area : *Spinifex littoreus*, *Ipomoea pes-caprae*, *Launaea sarmentosa*, *Cyperus arenarius*, *Hydrophyllax maritima*, *Euphorbia rosea*, and many others which are shown in a histogram, constructed with the values of percentage cover for each species that occurred in sand strand/dune vegetation.

**Tables for compound data :** It represents the quantitative study of frequency density, relative frequency, relative density, average diameter of species in each segment, average basal area as sq. cm. per sq. m., total basal area of species and relative value index of individual species in the Mangrove strand.

**Table II(A) :** Column 1, represents the names of taxa that occurred in 5 line-transects. Column 2, represents the presence or absence of species in

each segment of transect and the length of each transect in méters. Column 3, represents the average diameter of species in each transect. This can be obtained by measuring the length of the tape intercepted by individual species at breast height (2r) and summing up all the values of the individual species in the particular length of transect and then dividing it by the total number of the individual species that occurred within the length of transect (Sum of 2r by the total number of individual species). Column 4, represents the values of the average basal area in sq. cm. of the individual species in each transect, which can be obtained by calculating  $\pi r^2$  value, from the value of 3r, as given in the column 3 which is as follows :

$$2r = x, r = \frac{x}{2}, \pi r^2 = 3.14 \times \left(\frac{x}{2}\right)^2 \text{ Sq. cm.}$$

Column 5 represents the values of the average basal area as sq. cm. per sq. m. of the individual species in each transect. This is obtained by multiplying the value of  $\pi r^2$  with the number of species in each transect, i.e. density of species in each segment and dividing this value with the total length of the line in each transect. Thus, the value obtained is made whole square, to express the result as sq. cm. per sq. m. =

$$\left(\frac{\pi r^2 \times D}{\text{T.L.T.}}\right)^2$$

D = Density of individual in each line.

T.L.T. = Total length of the line in each transect.

In Table II(B) Column 6 represents the total length of the transect in m and name of taxa Columns 7 & 8 represent the F. & D. values of the individual species, which are discussed above. Column 9 represents the total basal area which is the summed-up value of all the basal area for the individual species in 5 line-transects. At the bottom of this column, the total basal area of all the species is obtained by summing up the values respectively. Column 10 represents the values of R.D. and Column 11 represent values of R.F. of the individual species which are also discussed above. Column 12 represents the relative abundance values of individuals, which can be arranged by dividing total basal area of the individual in all transects with the total basal area of all the individuals and multiplying by 1000. The final Column 13 represents Important Value Index of the individual species which is obtained by summing up the value of R.D. R.F., and R.A. I.V.I = R.F. + R.D. + R.A.

**Table II(C) & Table II(D)** : They represent the quantitative study of frequency, density, average basal area, relative frequency, relative density, relative abundance and Important Value Index of species that occurred in the semi-mangrove stand. Analysis of data is followed as described for Tables II(A) & II(B).

#### ANALYTICAL CONCEPT AND RESULTS

**Frequency Diagram**—From the line-intercept data in Table II(B), a frequency diagram may be prepared as follows :

Species are divided into 5 sizes classes based on percentage frequency (determined as Frequency Value 1 = 20%, 2 = 40%, 3 = 60%, 4 = 80% & 5 = 100% since there were 5 line-transects).

Class	Serial Number of species included in Table II(B)	Total no. of species
1-20% A,	7, 11, 13, 14, 15, 17, 18, 21, 23, 24	10
21-40% B	10, 16, 12, 19, 22	5
41-60% C	2, 4, 8	3
61-80% D	5, 9, 25	3
81-100% E	1, 3, 6, 20	4

It is observed that Class A is normally very high due to sporadic occurrence of many species with low frequency in the stand. Classes B & C have equal number of species with moderately high number due to preferential occurrence of species in the stand. Class D is relatively high due to occurrence of dominant species. Class F is comparatively low, perhaps, due to exclusive occurrence of species with high frequency in the strand.

From the frequency diagram, it is found the relation between the Classes A & E. Since the Class E is not high therefore, the strand is not homogenous. Most frequent species in this strand are : *Excoecaria agallocha*, *Ceriops decandra* followed by *Rhizophora apiculata*, *R. mucronata*, *Avicennia officinalis* & *Agialitis rotundifolia*.

*Relative frequency* : From the data in Table II(B), the species with smallest R.F. is 1.6, and the largest R.F. value is 8.3. These R.F. values are divided into 4 size classes as follows :

Classes	Total number of species occurred
1.6-3.5 A	15
3.6-5.5 B	3
5.6-7.5 C	5
7.6-9.5 D	4

After arranging the data in a skewed curve on a graph sheet, it is observed that the curve skewed more towards right where the proportion of individual species is largest that is 14, within the smallest size class. On the other hand, the curve skewed less towards the left where the proportion of individual species is smallest that is 2 within the largest size class.

Ecologically, this indicates higher juvenile condition in the strand which means that individuals have taken advantage of the more available ecological conditions and have entered a period of reproductive activity thereby re-establishing aggregation in the area.

Here, the species *Excoecaria agallocha* & *Cerlops decandra* with R.F. 8.3 come under Class D, where the curve is less skewed which indicates proportionally less juvenile but more mature condition in the strand with a lag of reproductive activity and aggregation. *Rhizophora apiculata*, *R. mucronata*, *Avicennia alba* & *Agialitis rotundifolia* are comparatively in more juvenile stage.

*Relative abundance* : Relative abundance of the species in the Table II(B) are divided into 5 size classes with the smallest no. starting from 0.0007 to highest no. 21.7 to show the dominance of species in the strand :

Classes	Dominance	No. of species
0.0007-5.0	Do1	19
5.0007-10.0	Do2	1
10.0007-15.0	Do3	1
15.0007-20.0	Do4	2
20.0007-25.0	Do5	2



This result indicates that out of 25 species, 19 species come under low dominant class which is in Do1, rare class. One species in the occasional class, Do2. One is under Frequent class, Do3, Two are in dominant class, Do4, And two are in very dominant class, Do5.

Here, *Phoenix paludosa* with high density comes under occasional class. *Sonneratia caseolaris* with moderate density comes under frequent class. *Rhizophora apiculata* & *R. mucronata* come under dominant class and *Avicennia officinalis* & *Excoecaria agallocha* unde very dominant class.

It may be concluded, therefore, that due to dominance of *Rhizophora sp*, the stand is characteristically known as a mangrove stand and the species *Avicennia officinalis* & *Excoecaria agallocha* are ecologically tolerant in various habitat conditions.

#### Important Value Index :

Arrangement of species in decreasing order of I.V.I.-  
values to bottom from Table II(B).

	Names of species	IVI index Nos.
1.	<i>Excoecaria agallocha</i>	38.01
2.	<i>Avicennia officinalis</i>	31.60
3.	<i>Rhizophora apiculata</i>	31.07
4.	<i>R. mucronata</i>	28.20
5.	<i>Aegialitis rotundifolia</i>	24.50
6.	<i>Ceriops decandra</i>	22.06
7.	<i>Phoenix paludosa</i>	21.80
8.	<i>Bruguiera parviflora</i>	19.80
9.	<i>Sonneratia caseolaris</i>	13.68
10.	<i>Heritiera fomes</i>	11.30
11.	<i>Dalbergia spinosa</i>	9.98
12.	<i>Bruguiera gymnorrhiza</i>	9.02
13.	<i>Sonneratia apetala</i>	7.60
14.	<i>Xylocarpus granatum</i>	6.68
15.	<i>Brownlowia tersa</i>	5.80

16.	<i>Derris trifoliata</i>	4.70
17.	<i>Xylocarpus moluccensis</i>	4.30
18.	<i>Finlaysonia obovata</i>	4.14
19.	<i>Avicennia alba</i>	3.15
20.	<i>Merope angulata</i>	2.56
21.	<i>Tamarix troupii</i>	2.27
22.	<i>Lumnitzera racemosa</i>	2.16
23.	<i>Aegiceras corniculatum</i>	2.00
24.	<i>Clerodendrum inerme</i>	2.01
25.	<i>Kandelia candel</i>	1.77

---

Total Value = 300.96

---

These I.V.I. values are divided into 4 size classes as follows :

Classes	Total No. of species occurred
1.8-10.7 A	15
10.8-20.7 B	3
20.8-30.7 C	5
30.8-40.7 D	2

It is observed from class values that there are at least 10 leading species from Class B-D which are dominating in the stand as an ecological success with the concept of single value importance (I.V.I.) These 10 leading species have a combined value of 161 out of total index value of 300. The average index value of these 10 species is 16. On the other hand, 15 species in Class A have a combined value of 139 out of the total 300 and the average value of these 15 species is 9. Therefore, it is obviously cleared that the 10 leading species in Class B-D have a maximum importance in the characteristic of the strand and permit the alignment of species in the flora with the desirable ecological success and produce a clear picture of the plant community. Serial No. of species from 1-10 in the I.V.I. list cited above represent the leading species in the strand.

*Regular & contiguous distribution* : The ratio of abundance and frequency of the species enlisted in Table II(B) clearly shows that all the species have high value of abundance and low value of frequency.

$$\text{Abundance} = \frac{\text{Density of species in Column 7}}{\text{Frequency of species in Column 8}}$$

Only one species, that is *Sonneratia apetala* shows  $A/F = 1/3$  where the abundance is low & frequency is high. Therefore, except for the above species all other species in the strand have contiguous distribution. It may be stated from the above that over-dispersion is a common phenomenon in this strand.

*Fidelity* : On the basis of presence of species in different transects shown in Table II(A), fidelity classes and further association in each class may be constructed as follows :

Name of species		Fidelity class	
1.	<i>Ceriops decandra</i>	}	5 (EXCLUSIVE)
2.	<i>Excoecaria agallocha</i>		
3.	<i>Rhizophora apiculata</i>	}	4 (SELECTIVE)
4.	<i>R. mucronata</i>		
5.	<i>Avicennia officinalis</i>		
6.	<i>Bruguiera gymnorrhiza</i>	}	3 (PREFERENTIAL)
7.	<i>B. parviflora</i>		
8.	<i>Dalbergia spinosa</i>		
9.	<i>Aegialitis rotundifolia</i>		
10.	<i>Xylocarpus granatum</i>		
All other species		2 or 1 (INDIFFERENT & STRANGERS)	

It is observed that 2 species out of 25 are in the fidelity class 5. 3 species out of 25 are in the class 4, 5 species out of 25 are in the class 3 and rest 15 species are either in class 2 or in class 1. Thus, it is found that 10 species out of 25 from the characteristic association in the strand. It may indicate that these species are closely adapted to this particular situation and cannot range far from it.

**Table II(D)—Result & Discussion**

*Frequency Diagram* : From the line intercept data in Table II(D), the frequency diagram of species represented in the field under study may be prepared as follows:

Species are divided into 4 size classes based on % of frequency determined from the frequency value as 1 = 25%, 2 = 50%, 3 = 75% & 4 = 100%. There are only 4 transects.

Classes	Total number of species
1-25 A	15
26-50 B	4
51-75 C	1
76-100 D	1

Here Class A is very high with many species in the low frequency Class. Class B is moderately high with 4 species. Classes C and D have equal number of species and are comparatively very low due to the presence of dominant species with a high frequency class. Class E is Nil. This diagram indicates that the stand is not homogeneous. Most frequent species in this stand are : *Heritiera fomes*, *Excoecaria agallocha*, followed by *Cynometra ramiflora*, *Amoora cuculata*, *Brownlowia tersa* and *Aegiceras corniculatum*.

**Arrangement of species with decreasing order of L.V.I  
to the bottom in Table II(D)**

1.	<i>Excoecaria agallocha</i>	47.6
2.	<i>Heritiera fomes</i>	37.3
3.	<i>Cynometra ramiflora</i>	33.3
4.	<i>Phoenix paludosa</i>	23.1
5.	<i>Manilkara hexandra</i>	15.7
6.	<i>Ceriops decandra</i>	12.8
7.	<i>Amoora cuculata</i>	11.9
8.	<i>Heritiera littoralis</i>	11.3
9.	<i>Aegiceras corniculatum</i>	11.1
10.	<i>Dalbergia spinosa</i>	10.4
11.	<i>Brownlowia tersa</i>	8.4

12.	<i>Rhizophora apiculata</i>	7.6
13.	<i>Hibiscus tiliaceus</i>	6.73
14.	<i>Kandelia candel</i>	6.0
15.	<i>Pongamia pinnata</i>	5.3
16.	<i>Cerbera manghus</i>	4.3
17.	<i>Bruguiera gymnorrhiza</i>	4.0
18.	<i>Olax scandens</i>	4.0
19.	<i>Tamarix traupii</i>	4.0
20.	<i>Intsia bijuga</i>	3.87
21.	<i>Eugenia bractiata</i>	3.8

---

Total Value : 272.4

---

#### I.V.I. Class

	Class	No. of Species
3.80-13.79	A	16
13.80-23.79	B	2
23.80-33.79	C	1
33.80-43.79	D	1
43.80-53.79	E	1

It is observed that there are only 5 leading species from classes B-E. These 5 species have a combined value 155 out of 272 and the average value is 31. The other 16 species have 117 out of 272 within an average value of 7. Therefore, it is clear that these 5 species (listed in the 1-5) have a maximum importance in the characteristic of the stand.

*Comparison of Stands* ; Data represent in Table II(A), II(B), II(C), & II(D) are from different stands. This differential status of the stand can be compared with the help of community co-efficient values as follows :

Table III

## Comparison of Plants of two areas

Species	Frequency by area				
	Stand I	Common			Stand II
	Table-II(A), II(B)	I	+	II	Table-II(C), II(D)
<i>Rhizophora apiculata</i>	-	4		1	-
<i>Bruguiera gymnorrhiza</i>	-	3		1	-
<i>Ceriops decandra</i>	-	5		1	-
<i>Excoecaria agallocha</i>	-	5		4	-
<i>Aegiceras corniculatum</i>	-	1		1	-
<i>Phoenix paludosa</i>	-	1		1	-
<i>Kandelia candel</i>	-	1		1	-
<i>Heritiera fomes</i>	-	2		4	-
<i>Brownlowia tersa</i>	-	2		2	-
<i>Tamarix traupii</i>	-	1		1	-
<i>Bruguiera parviflora</i>	3	-		-	-
<i>Dalbergia spinosa</i>	-	4		1	-
<i>Sonneratia apetala</i>	3	-		-	-
<i>Avicennia officinalis</i>	4	-		-	-
<i>A. alba</i>	2	-		-	-
<i>Lumnitzera racemosa</i>	1	-		-	-
<i>Xylocarpus granatum</i>	3	-		-	-
<i>X. moluccensis</i>	1	-		-	-
<i>Finlaysonia obovata</i>	2	-		-	-
<i>Rhizophora mucronata</i>	4	-		-	-
<i>Sonneratia caseolaris</i>	1	-		-	-
<i>Derris trifoliata</i>	1	-		-	-
<i>Merope angulata</i>	1	-		-	-
<i>Clerodendrum inerme</i>	4	-		-	-
<i>Aegialitis rotundifolia</i>	-	-		-	2
<i>Cynometra mimosoides</i>	-	-		-	2
<i>Amoora cuculata</i>	-	-		-	1
<i>Intsia bijuga</i>	-	-		-	1

**Table III (contd.)**

<i>Hibiscus tiliaceous</i>	-	-	-	1
<i>Heritiera littoralis</i>	-	-	-	1
<i>Cerbera manghus</i>	-	-	-	1
<i>Pongamia pinnata</i>	-	-	-	1
<i>Olax scandens</i>	-	-	-	1
<i>Eugenia bracteata</i>	-	-	-	1
<i>Manilkara hexandra</i>	-	-	-	1
	30	47	13	
		(Common I+II)		

$\frac{1}{2}$  of Common = 23.5

$\frac{1}{2}$  of Common + Stand I+Stand II = 66.5

FICC (Frequency Index of Community Coefficient)

$$= \frac{23.5}{66.5} \times 100 = 35 \text{ (approx.)}$$

As shown in Table III, the Community Coefficient Index is 35 (approx.). This is a clear indication that the coefficient value is lower than 50. Therefore, the area in the Tables II(A) & II(B) and the area in the Tables II(C) & II(D) are dissimilar stands, i.e. two different associations. Thus, the stand for Table II(A) & Table II(B) is named as mangrove stand and for Table II(C) & Table II(D) the stand is named as semi-mangrove stand.

#### Comparison of Density & Frequency by Bar-graph :

To establish and to estimate the numerical and distributional aspect of species occurring in two stands, common species may be presented with the bar-graph view. Density of plant may be placed in the Y axis and % of frequency in the X axis. The height of each bar-graph will indicate the measure of frequency % and width of bar-graph will indicate the density view.

Here, 10 common species within the two stands are compared in the graph as follows :

#### iii) Analysis of Major Factors & Relationship :

Analysis of major factors include the analysis of river-water, soils, salinity and tide-level-soils and water samples were analysed in the laboratory and data are presented in the Tables IIIA, IIIB & IIIC. Tide-level data of the study areas are collected from Indian Tide Table (Survey of India, 1996).

### 3. Analysis of Flora :

In the deltaic areas estuarine plants are dominant except in such areas where the biotic influence in the form of urbanisation or agricultural practices are prevalent. The commonest trees of this area belong to the mangrove families, namely Rhizophoraceae, Sonneratiaceae, Avicenniaceae, Sterculiaceae, Meliaceae and Euphorbiaceae ; a few shrubby taxa along with the mangroves belong to the families like Plumbaginaceae, Tamaricaceae, Rutaceae, Tiliaceae, Combretaceae, Verbenaceae, Palmae and Leguminosae ; herbaceous taxa in this region mostly belong to the families, Gramineae, Cyperaceae, Leguminosae, Euphorbiaceae, Amaranthaceae, Chenopodiaceae and Acanthaceae. Most common associates in this regions are represented by Convolvulaceae, Compositae, Boraginaceae, Myrtaceae, Sapotaceae, Apocynaceae, Rubiaceae and Ebenaceae : annuals are mostly represented by Cyperaceae and Poaceae.

Epiphytes, Parasites and Undergrowth - Almost absence of epiphytes, general scarcity of parasites and under growth, and absence of lianes are the characteristic aspect of this estuarine area. Although Orchids are well reported in the Sunderbans, they are not yet recorded in the Mahanadi delta. The only epiphyte collected from this region is *Hoya parasitica*, growing along the intertidal regions of creeks on the host plant, *Avicennia officinalis*. Some parasites are found towards the outer mangroves, such as *Viscum orientale* on *Excoecaria agallocha* and *Scurrula philippensis* on *Hebiscus tiliaceus*. *Cuscuta reflexa* and *Cassytha filiformis* are found more pronounced towards the coastal thickets and the riverine scrubs. Undergrowths consist of a few sedges like *Fimbristylis ferruginea*, *Cyperus malaccensis*, some Amaryllidaceous plants like *Crinum asiaticum*, *Crinum defixum* and a sub-merged water plant along the banks of creeks like *Cryptocornye ciliata*. Among the lianes and climbers *Derris trifoliata*, *D. scandens*, *Finlaysonia obovata*, *Tyolphora tenuis*, *Mucuna gigantia*, *Sarcolobus globosus* and *Flagellaria indica* are found more or less common towards the inner mangroves and *Rourea minor*, *Hugonia mistax* and *Polyalthia korinti* are found towards the riverine scrubs. Low shrubs appear sometimes in open places within the inner mangroves like *Acanthus ilicifolius* and *Clerodendrum inermc*.

A total of 443 species have been collected representing 300 genera belonging to 102 families from this area and the ratio of family, genera and species are 1 : 2.9 : 4.3. Indigenous plants of the area are represented by 386 species belonging to 261 genera.

An analysis of the Flora gives the following conclusion :



1. Vegetation formula of the area is — 80 T + 85 S + 278 H.  
(T = Trees, S = Shrubs and H = Herbs).
2. Ratio of Monocotyledons to Dicotyledons is — 1 : 3.2.
3. Ratio of genera and species is — 1 : 1.49.

Out of the 102 families only 10 are having more than 10 number of species in each. The ten dominant families of the areas are as follows :

1. Leguminosae. 2. Poaceae. 3. Cyperaceae. 4. Euphorbiaceae.
5. Rubiaceae. 6. Asclepiadaceae. 7. Compositae. 8. Verbenaceae.
9. Rhizophoraceae. 10. Malvaceae.

Prain (1903) recorded 305 taxa from the Sunderbans and Chittagong areas. Out of these 305 taxa, 63 taxa were found to be not recorded from the Mahanadi delta. However, out of these 63 taxa Haines (1925) reported only 18 species common to Sunderbans and Chittagong as new for Orissa. Mooney (1950) reported 153 taxa new for Bihar and Orissa of which 10 species were reported as new for Orissa which occur also in Sunderbans and Chittagong. Thus, out of 63 taxa, 28 species have been reported to occur both in Sunderbans and in the Mahanadi delta by Haines and Mooney. Therefore, 35 of the total number of taxa which occur in the Sunderbans and Chittagong were found to be unreported from the Mahanadi delta. Present study of this area indicates a total number of 50 taxa as new record for Orissa of which 25 taxa occur in the Sunderbans and Chittagong and the rest 25 taxa occur in other adjoining regions. Thus the distribution of 53 taxa (Haines-18 Mooney-10, and present collection-25) out of the 63, are being reported from the Mahanadi delta and only ten species which occur in the Sunderbans and Chittagong are not found in the Mahanadi delta. These ten species are as follows :

1. *Aldrovanda vesiculosa*. 2. *Psilotrichum ferrugineum*. 3. *Nypa fruticans*.
4. *Barringtonia racemosa*. 5. *Stephegyne parvifolia*. 6. *Scyphiphora hydrophyllacea*.
7. *Kleinhovia hospita*. 8. *Putranjiva roxburghii*. 9. *Stictocardia tillaefolia*.
10. *Clerodendrum neriifolium*—(Prain, 1903).

List of 25 species which occur in the Sunderbans and Chittagong and now collected from the Mahanadi delta is as follows :

- |                                  |                                  |
|----------------------------------|----------------------------------|
| 1. <i>Thespesia populneoides</i> | 2. <i>Pavonia procumbens</i>     |
| 3. <i>Amoora cucullata</i>       | 4. <i>Xylocarpus moluccensis</i> |
| 5. <i>Mucuna gigantia</i>        | 6. <i>Intsia bijuga</i>          |
| 7. <i>Cynometra ramiflora</i>    | 8. <i>Ludwigia hyssoifolia</i>   |

- |                                      |                                   |
|--------------------------------------|-----------------------------------|
| 9. <i>Passiflora suberosa</i>        | 10. <i>Morinda citrifolia</i>     |
| 11. <i>Synedrella nodiflora</i>      | 12. <i>Eupatorium odoratum</i>    |
| 13. <i>Sphaeranthus africanus</i>    | 14. <i>Cerbera manghas</i>        |
| 15. <i>Sarcolobus globosus</i>       | 16. <i>Finlaysonia obovata</i>    |
| 17. <i>Heliotropium curassavicum</i> | 18. <i>Ipomoea mauritiana</i>     |
| 19. <i>Hoya parasitica</i>           | 20. <i>Tylophora tenuis</i>       |
| 21. <i>Cryptocoryne ciliata</i>      | 22. <i>Cyperus alopecuroides</i>  |
| 23. <i>Cyperus pachyrhizus</i>       | 24. <i>Myriostachya wightiana</i> |
|                                      | 25. <i>Porteresia coarctata</i>   |

List of 25 species recorded as new for Orissa and not reported from the Sunderbans and Chittagong is given below :

- |                                     |                                      |
|-------------------------------------|--------------------------------------|
| 1. <i>Polyalthia korinti</i>        | 2. <i>Tamarix dioica</i>             |
| 3. <i>Colubrina asiatica</i>        | 4. <i>Rourea minor</i>               |
| 5. <i>Crotalaria laevigata</i>      | 6. <i>Indigofera aspalathoides</i>   |
| 7. <i>Taverniera cuniefolia</i>     | 8. <i>Rothia Indica</i>              |
| 9. <i>Canavalia cathartica</i>      | 10. <i>Cynometra iripa</i>           |
| 11. <i>Bruguiera sexangula</i>      | 12. <i>Ceriops iagal</i>             |
| 13. <i>Rhizophora stylosa</i>       | 14. <i>Lumnitzera littorea</i>       |
| 15. <i>Sonneratia griffithii</i>    | 16. <i>Oldenlandia stricta</i>       |
| 17. <i>Manilkara littoralis</i>     | 18. <i>Ipomoea tuba</i>              |
| 19. <i>Solanum incanum</i>          | 20. <i>Utricularia stricticaulis</i> |
| 21. <i>Utricularia graminifolia</i> | 22. <i>Litsea nitida</i>             |
| 23. <i>Cyperus laevigata</i>        | 24. <i>Sporobolus marginatus</i>     |
|                                     | 25. <i>Dinebra retroflexa</i>        |

#### 4. Comparison of the Floras of the Mahanadi delta with those of the Sunderbans

Both the deltas are surrounded by the Sea, the Bay of Bengal, both are near the Tropic of cancer whereas the Mahanadi delta is more towards the south than that of the Sunderbans. Both are formed by large number of rivers, several creeks, channels and distributaries. Both show the same topographic features. The floras of the two areas are subjected to more or less similar ecological and physiological influences. Both are open to the immigration of species from vast areas.

In order to get a more accurate picture of the two floras, the list of distribution of families, genera and species of the two deltas and a separate list of mangroves are present here for the convenience of those who feel inclined to tackle many botanical problems of the two deltas in future.

**Distribution of Families, Genera and Species in the Mahanadi Delta  
and the Sunderbans**

Region	Families	Genera	Species	Ratio
Sunderbans	72	230	304	1 : 3.1 : 4.2
Mahanadi delta	102	300	443	1 : 2.9 : 4.3

Families	Mahanadi Deltas		Sunderbans	
	Species	Genera	Species	Genera
Annonaceae	3	2	—	—
Menispermaceae	1	1	1	1
Nymphaeaceae	2	1	2	2
Capparidaceae	2	2	4	4
Violaceae	1	1	—	—
Flacourtiaceae	1	1	1	1
Polygalaceae	2	2	—	—
Caryophyllaceae	2	2	—	—
Portulacaceae	3	3	1	1
Tamaricaceae	1	1	1	1
Clusiaceae	1	1	—	—
Malvacene	8	6	6	4
Sterculiaceae	6	5	2	2
Tiliaceae	4	4	2	2
Linaceae	1	1	—	—
Zygophyllaceae	1	1	—	—
Oxalidaceae	2	2	1	1
Rutaceae	4	4	4	4
Ochnaceae	1	1	—	—
Meliaceae	6	4	3	2
Olacaceae	1	1	1	1
Opiliaceae	1	1	—	—
Celastraceae	1	1	1	1
Rhamnaceae	3	2	2	1
Vitaceae	1	1	4	2
Sapindaceae	4	4	3	3
Anacardiaceae	3	3	2	2
Hippocrateaceae	1	1	—	—
Connaraceae	1	1	—	—

<i>Families</i>	<i>Mahanadi Delta</i>		<i>Sunderbans</i>	
	<i>Species</i>	<i>Genera</i>	<i>Species</i>	<i>Genera</i>
Papilionaceae	38	19	37	25
Mimosaceae	3	3	—	—
Caesalpinaceae	9	5	—	—
Vahliaceae	1	1	—	—
Droseraceae	2	2	1	1
Rhizophoraceae	10	4	6	4
Combretaceae	3	2	1	1
Myrtaceae	2	2	4	3
Melastomataceae	1	1	—	—
Lythraceae	4	3	1	1
Sonneratiaceae	4	1	2	1
Onagraceae	3	1	1	1
Passifloraceae	2	2	1	1
Cucurbitaceae	4	4	7	4
Cactaceae	1	1	—	—
Aizoaceae	6	4	2	2
Molluginaceae	3	1	—	—
Rubiaceae	18	11	6	5
Compositae	14	13	12	11
Sphenocleaceae	1	1	—	—
Plumbaginaceae	1	1	1	1
Myrsinaceae	2	2	1	1
Sapotaceae	2	1	—	—
Ebenaceae	3	2	2	1
Oleaceae	1	1	—	—
Salvadoraceae	2	2	1	1
Apocynaceae	4	3	2	2
Asclepiadaceae	10	8	12	11
Periplocaceae	3	3	—	—
Loganiaceae	1	1	—	—
Gentianaceae	1	1	2	2
Boraginaceae	9	5	3	3
Convolvulaceae	8	3	9	4
Solanaceae	6	3	4	1
Scrophulariaceae	6	5	5	5
Lentibulariaceae	8	1	2	1
Pedaliaceae	2	2	—	—
Acanthaceae	4	4	6	3
Verbenaceae	7	5	10	5

<i>Families</i>	<i>Mahanadi Delta</i>		<i>Sunderbans</i>	
	<i>Species</i>	<i>Genera</i>	<i>Species</i>	<i>Genera</i>
<i>Avicenniaceae</i>	3	1	2	1
<i>Lamiaceae</i>	6	5	4	3
<i>Nyctaginaceae</i>	1	1	—	—
<i>Amaranthaceae</i>	9	8	5	3
<i>Chenopodiaceae</i>	5	3	3	3
<i>Basellaceae</i>	1	1	1	1
<i>Polygonaceae</i>	1	1	—	—
<i>Aristolochiaceae</i>	1	1	1	1
<i>Lauraceae</i>	2	1	1	1
<i>Loranthaceae</i>	3	3	4	2
<i>Euphorbiaceae</i>	22	14	16	14
<i>Moraceae</i>	2	2	6	3
<i>Salicaceae</i>	1	1	—	—
<i>Ceratophyllaceae</i>	1	1	1	1
<i>Hydrocharitaceae</i>	1	1	4	4
<i>Amaryllidaceae</i>	2	1	1	1
<i>Dioscoreaceae</i>	3	1	1	1
<i>Smilacaceae</i>	1	1	1	1
<i>Liliaceae</i>	3	3	1	1
<i>Xyridaceae</i>	1	1	—	—
<i>Commelinaceae</i>	3	3	2	2
<i>Flagellariaceae</i>	1	1	1	1
<i>Arecaceae</i>	1	1	5	5
<i>Pandanaceae</i>	1	1	2	2
<i>Typhaceae</i>	1	1	2	1
<i>Araccae</i>	1	1	2	2
<i>Alismataceae</i>	1	1	1	1
<i>Aponogetonaceae</i>	2	1	1	1
<i>Eriocaulaceae</i>	1	1	—	—
<i>Haloragaceae</i>	1	1	—	—
<i>Cyperaceae</i>	36	7	19	9
<i>Poaceae</i>	40	33	27	22
<i>Polypodiaceae</i>	2	2	5	4

**Distribution of 12 dominant families in order of the number of species of both the deltas**

Families	Mahanadi Delta	Sunderbans
1. Leguminosae	50	37
2. Poaceae	41	27
3. Cyperaceae	38	21
4. Euphorbiaceae	22	16
5. Rubiaceae	18	6
6. Compositae	14	12
7. Asclepiadaceae	13	12
8. Verbenaceae	11	12
9. Rhizophoraceae	10	6
10. Convolvulaceae	9	9
11. Malvaceae	8	6
12. Cucurbitaceae	4	7

**Distribution of Herbs, Shrubs and Trees of both the deltas**

Deltas	Herbs	Shrubs	Trees
Sunderbans	178	60	66
Mahanadi Delta	278	85	80

Among the 102 families in the Mahanadi delta only 5 families are not found in the Sunderbans and among the 72 families in the Sunderbans only 3 families are not found in the Mahanadi delta.

Families not found in the Mahanadi delta but recorded in Sunderbans :

1. Ranunculaceae      2. Turnaceae      3. Orchidaceae

Families not found in the Sunderbans but recorded in the Mahanadi delta :

1. Linaceae      2. Opiliaceae      3. Saxifragaceae  
4. Loganiaceae      5. Connaraceae

**Distribution of Mangroves and other species in the Mahanadi Delta and Sunderbans ( other species are indicated by\* )**

Name of the species	Sunderbans	Mahanadi Delta
<i>Acanthus ilicifolius</i> L.	+	+
<i>A. volubilis</i> Wall.	+	-
<i>Acrostichum aureum</i> L.	+	+

Name of the species	Sunderbans	Mahanadi Delta
<i>Aegialitis rotundifolia</i> Roxb.	+	+
<i>Aegiceras corniculatum</i> (L.) Blanco	+	+
<i>Aglala cucullata</i> (Roxb.) Pellegrin	-(+)	+
<i>Avicennia officinalis</i> L.	+	+
<i>A. alba</i> Blume	+	+
<i>A. marina</i> (Forsk.) Vierh.	+	+
<i>A. marina</i> var. <i>acutissima</i> Stapf & Mold.	+	+
<i>Brownlowia tersa</i> (L.) Koster.	+	+
<i>Brugulera cylindrica</i> (L.) Bl.	+	+
<i>B. gymnorhiza</i> (L.) Savigny	+	+
<i>B. parviflora</i> (Roxb.) W. & A. ex Griff.	+	+
<i>B. sexangula</i> (Lour.) Poir.	+	+
<i>Caesalpinia banduc</i> (L.) Roxb.	+	+
<i>C. cristata</i> L.	+	+
<i>Cerbera manghas</i> Linn.	-(+)	+
<i>Ceriops decandra</i> (Griff.) Ding Hou	+	+
<i>C. tagal</i> (Perr.) Robin.		
<i>Clerodendrum inerme</i> Gaertn.	+	+
<i>Cynometra iripa</i> Kostel.	+	+
<i>Dalbergia spinosa</i> Roxb.	+	+
<i>Derris scandens</i> (Roxb.) Benth.		
<i>D. heterophylla</i> (Willd.) Back & Bakh.	+	+
<i>Dolichandrone spathacea</i> Sch.	-(+)	+
<i>Excoecaria agallocha</i> L.	+	+
<i>Fimbristylis ferruginea</i> (L.) Vahl	+	+
<i>Finlaysonia obovata</i> Wall.	+	+
<i>Heritiera fomes</i> Buch.-Ham.	+	+
<i>H. littoralis</i> Dryand.	-	+
<i>H. Kanikensis</i> Majumdar et Bauerjee	-	+
<i>Heliotropium curassavicum</i> L.	+	+
<i>Hibiscus tiliaceus</i> L.	+	+
<i>Intsia bijuga</i> (Colb.) Kunt.	-(+)	+
<i>Ipomoea tuba</i> (Schl.) G. Don	-(+)	+
<i>Kandelia candel</i> (L.) Druce	+	+
<i>Lumnitzera racemosa</i> Willd.	+	+
<i>Merope angulata</i> (Willd.) Swingle	+	+
<i>Mucuna gigantea</i> (Willd.) DC.	+	+
<i>Myriostachya wightiana</i> (Nees ex Steud) Hook. f.	+	+
<i>Nypa fruticans</i> Wurm.	+	-

Name of the species	Sunderbans	Mahanadi Delta
<i>Pandanus tectorius</i> Soland ex Park.	+	+
<i>Phoenix paludosa</i> Roxb.	+	+
<i>Pluchea indica</i> Linn.	+	+
<i>Porteresia coarctata</i> (Roxb.) Tateoka	+	+
<i>Rhizophora apiculata</i> Bl.	+	+
<i>R. mucronata</i> Poir.	+	+
<i>R. stylosa</i> Griff.	-	+
<i>Salacia prinoides</i> (Willd.) DC.	+	+
<i>Salvadora persica</i> Linn.	-	+
<i>Sarcolobous carinatus</i> Wall.	+	+
<i>S. globosus</i> Wall.	+	+
<i>Salicornia brachiata</i> Roxb.*	+	+
<i>Scirpus littorea</i> Schrad.*	+	+
<i>Sesuvium portulacastrum</i> L.*	+	+
<i>Suaeda maritima</i> Dumort.*	+	+
<i>S. nudiflora</i> Moq.*	+	+
<i>S. monoecia</i> (Forsk.) ex Cmel.*	+	+
<i>Sonneratia apetala</i> Buch.-Ham.	+	+
<i>S. caseolaris</i> (L.) Engl.	+	+
<i>S. alba</i> J. Smith	-	+
<i>S. griffithii</i> Kurz.	-	+
<i>Stenochlaena palustre</i> (Burm.) Bedd.	+	+
<i>Stictocardia tiliaefolia</i> Hallier. f.	+	-
<i>Tamarix troupii</i> Hole.*	+	+
<i>T. ericoides</i> Rottl.	-	+
<i>T. dioica</i> Roxb.	+	+
<i>Thespesia populnea</i> (L.) Sol. ex Correa	+	+
<i>T. populneoides</i> (Roxb.) Kostel.	-	+
<i>Tylophora tenuis</i> Bl.	-(+)	+
<i>Xylocarpus granatum</i> Koen.	+	+
<i>X. mekongensis</i> Pierre.	+	+
<i>X. moluccensis</i> (L.) Roem.	-	+

\* Indicate salt marshes.

-(+) Indicate these species are not found in the divided Sunderbans of Indian territory.



From the foregoing account, it is evident that there is a great similarity in the fidelity of taxa in both the deltas. This is significant in view of the similar ecological niches and wider tolerance of a few taxa of both the regions. Further, it is evident that similarity of the adaphic factors perhaps plays an important part in the distribution of plants within the area. Climatic conditions of both the deltas are more or less similar and their impact on the vegetation is not perceptible. On the other hand, changes in the percentage of river water salinity and tidal level bring about perceptible changes in the distribution of the vegetation. The salinity factor is of obvious importance in determining the community structure and floristic patterns. This is very well illustrated along the estuarine banks, starting from the river-mouth up to the upland areas where exists a distinct salinity gradient.

### STRAND VEGETATION

Except the large river-inlets all unsheltered sea-shores of the Orissa State are composed of broad sandy raised beaches with sand-dunes. They are covered by characteristic plants which show an equally characteristic zonation over the shore. According to the zonation patterns, strand vegetation can be classified as follows :

1. Unstabilised sand strand.
2. Semi-stabilised sand strand.
3. Stabilised sand strand.
4. Dune sand strand.
5. Slacks and Lee-side sand-flats.
6. Wood land back-sand strand.

1. *Unstabilised sand strand* : This area is the inner part of the intertidal zone where the accumulated marine sands are shifted back and forth due to wave and wind actions. Due to instability of the sandy relief, this area is practically devoid of vegetation. Such unvegetated areas often extend at certain places from 100 m. to 300 m. along the study area.

2. *Semi stabilised sand strand* : It is the pioneer vegetation zone. Consistent vegetation in this area is chiefly represented by a few strand-binders like *Cyperus arenarius* or succulents like *Sesuvium portulacastrum*. These sand binders grow well despite the hostile environment. In fact, they are the indicators of the semi-stabilised sandy situations. In Paradeep shores, *Sesuvium* is often found along this zone, whereas in other sandy shores of this area, one could see *Cyperus arenarius* in abundance.

3. *Stabilised sand strand* : The demarcation line between the semi-stabilised and stabilised sand strand areas is not absolute and often it is variable due to varied causes. Relatively, this zone is more or less stabilised and gives rise to a dense population of *Hydrophylax maritima*, *Canavalia maritima*, *Ipomoea pes-caprae*, *Launaea sarmentosa*, *Euphorbia rosea*, *Phyllanthus rotundifolius*, *Genosporum tenuiflorum* and others. The totality of the population could be considered as an indicator of the stability of the area for plant growth.

4. *Dune sand strand* : Stabilised sand strand follows immediately the dune-strand, where sand-dunes are of various types, small or large, soils are of coarse sands, pH is neutral, NaCl is very low, calcium carbonate ranges from 0.11-0.25%, organic matter increases according to depth. Vegetation form in this zone are more or less of the bushy type, and the most common constituent is *Spinifex littoræus* a stout, perennial spiny shrub with long horizontal runner which acts as a sand-binder. The other associated species are *Borreria articularis*, *Aristolochia indica*, *Perotis Indica*, *Rothia trifoliata*, *Portulaca tuberosa* and others. In Harispur Ghar these dunes are covered by a pure community of *Calotropis procera*.

5. *Slacks and Lee-side sand-flats* : Formation of slacks and sand-flats are very characteristic along the lee-side of the coastal dunes in Orissa. Near the river-mouth, lee-side of the coast land is generally inter-connected with several channels from the adjacent rivers, and consequently, sediments from inland and sands from the Bay accumulate there in such a manner that the land becomes comparatively elevated and forms a shallow depression. Want of regular tidal ebb and flow makes the overall situation either brackish, slightly brackish or even fresh during the rainy season. It forms a more or less semi-lagoon type mud-flat with pure formation of *Phoenix paludosa* forming extensive patches almost to the exclusion of other species. This palm serves as a soil-binder due to its peculiar root system and is found spreading along the Paradeep coast, Harishpur Ghar, Devi river-Mouth, Barua river-mouth and Satavya coast.

Where the lee-side is not interconnected with any river inlet, the areas are found to be covered with drifted sands from the sea behind the dunes and form a sort of extended sand-flat. The vegetation in this zone is formed by herbaceous cover, more or less similar to the inland weeds. Mainly, they are *Polycarpaea corymbosa*, *Oldenlandia stricta*, *Sida cordata*, *Zornia diphylla*, *Tephrosia villosa*, *Bulbostylis barbata* and others.

#### 6. *Woodland back-sand strand :*

This is the last or outer-most zone of the strand vegetation. Vegetation in this zone is formed by the characteristic *Boarassus flabellifer*, *Cocos nucifera*, *Calophyllum inophyllum*, *Thespesia populnea*, *Pandanus* sp. and others. This zone gradually gets intermixed with the inland vegetation.

### ESTUARINE VEGETATION

Estuarine vegetation is used here in a broad sense which includes mostly vegetation along the banks of the proper river-mouth, tidal forests, and mangrove-associated scrubs.

Estuaries show a series of easily recognisable successive stages of vegetation, as the delta creeps sea-wards, the soil level is raised and water becomes fresher from the newly established fringes and vegetation approaches the local climatic climax. Various genera and species demonstrate a graded sequence along estuaries dictated by varying tolerance to salinity and tide-level condition.

Estuarine vegetation may be classified into the following four main types and subtypes :

1. Marino-estuarine type :
2. Estuarine type :
  - (a) Strictly estuarine, (b) Essentially estuarine
3. Pro-estuarine type or tidal forest type :
  - (a) Eumangrove. (b) Semi-mangrove.
  - (c) Transitional mangrove.
  - (d) Riverine scrubs and mangrove-associated mixed subtype.
4. Euhaline type.

#### 1. *Marino-estuarine type :*

This is the inner limit of estuary or front head of down stream, where the salinity approaches that of the open sea. Influence of flood tidal is maximum in height since the elevation is minimum. There are certain species that occur only in the limited zone and sometimes they also extend along the coast-line under similar eco-physiological condition. In Orissa along the Mahanadi, Dhamra and Maipura estuaries, the vegetation of this type is a pure community of *Avicennia marina*.

#### 2. *Estuarine type :*

It is broadest region of the river-mouth before the emergence of creeks and channels where the formation of eddy and nutrient-trap are a regular event. This type may be divided into two sub-types :

(a) Strictly estuarine type – This is the zone immediate behind the marino-estuarine type where turbidity and silt contents are still too high to make more or less adverse condition to the flora since penetration of light is more or less low due to the high turbidity and silt content. Vegetation dominates in this zone mostly by *Sonneratia griffithii* and *S. alba* with common associates *Aegialitis rotundifolia* and *Bruguiera cylindrica*.

(b) Essentially estuarine type – This zone follows the strictly estuarine type, starting from broadest river-mouth to the upper reaches of the estuary. Here, salinity conditions are much reduced due to inter-mixing of fresh water with the sea-water. Fresh water comes into contact with the underlying salt-water causing considerable amount of turbulence due to shearing of forces. This turbulence results in the formation of eddy which is the source of maximum nutrients, that finally deposit around the boundary of this zone. The vegetation in this zone is a mixed evergreen forest type with common constituents as follows: *Bruguiera parviflora*, *B. gymnorrhiza*, *B. cylindrica*, *Avicennia alba*, *Excoecaria agallocha*, *Sonneratia caseolaris*, and sometimes, *Merope angulata*, *Lumintzera racemosa* and *Aegialitis rotundifolia*.

### 3. Pro-estuarine-type :

This zone is delimited from the upper reaches of estuaries towards the sheltered places where lands are encroached on by several creeks, channels and distributaries away from the river-mouth. Here the periodical changes of the tide levels in relation to the different elevation of terrain play an important factor for the zonation of vegetation. The vigour of the sea-surf is broken as a result of several outlying creeks, channels and distributaries. Strong wind action and continuous salt-spray are not so prominent in this region since it is away from the sea. In this area, the degree of admixture of fresh water with sea-water, and the concentration of brackish water in different seasons are correlated with the vegetation patterns. Here the vegetation is a closed evergreen type with the competitive ability of the individual species to withstand various environmental changes. Pro-estuarine type may be further divided into three sub-types under the major head of Mangroves or tidal forest type in accordance with consistency of soil, frequency and duration of tide, and concentration of brackish water. The velocity of the tidal current is related to many factors such as type of substrate, nature of bottom, amount of fresh water entering, rate of speed and so on ; the waves are more powerful when tidal current is confined to a narrow inlet such as creeks, channels or distributaries. During ebb tide water usually leaves the surface area forcibly, creating a powerful tidal current that sweeps

seawards. This flooding and ebbing of the tidal current is responsible for providing oxygen and food to the fringes along the creeks, channels and distributaries as well as to carry wastes away.

Plants in order to survive in this region must have some structural adaptations such as modification in their root system to withstand the force of the tidal current, physiological adaptations to resist varying periods of submergence under water and development of viviparous habit. This type is divided into three subtypes as follows :

(a) *Eumangrove* -- This zone is found localised along the banks of creeks, channels and distributaries and to some extent along the estuarine islands. Further, in this zone soils are usually of deep soft mud, influence of brackish water is more than fresh water and it must face variable tidal inundation. Vegetation dominated in this zone are *Rhizophora apiculata*, *R. mucronata*, *Avicennia officinalis*, *Excoecaria agallocha*, *Aegiceras corniculatum*, *Xylocarpus obovatus*, *Finlaysonia obovata*, *Kandelia candel*, *Ceriops decandra*, *C. tagal*, and *Bruguiera gymnorrhiza*. Both *Rhizophora* and *Kandelia* establish in the pioneer zones along the intertidal regions to withstand the force of tidal current with their vigorous stilt root system. Occurrence of these species along the intertidal zone is also necessary for their regeneration since they have a special characteristic feature of vivipary. *Avicennia officinalis*, *Xylocarpus obovata* and *Ceriops* do not have such a type of stilt root system, so they usually occupy the back side of the pioneer zone. *Aegiceras* with broom-like stilt root system is sometimes found in the pioneer zone but otherwise they are mostly found at the back side of *Rhizophora* community. *B. gymnorrhiza* is not found to prefer any particular zone of its own but it is found mixed with other species.

(b) *Semi-mangrove* -- This zone follows immediately after the true mangrove type and is also limited along the banks of creeks, channels and distributaries but at higher elevation than the foregoing type. Sometimes, it is found limited towards the inner islands situated between the large rivers. Here, soils are of stiff clay, inundation is not below the normal high tide, and the influence of brackish water is less due to its distance from the sea and greater amount of fresh water supply during monsoon. In this zone, many species may thrive under this condition but none will have the characteristic of vivipary and stilt root system-like that of the Eumangrove type. Vegetation in this zone is a densely closed forest type with most of the trees, 15 to 40 m tall and impenetrable along the ground due to various types of pneumatophores and knee roots. Main constituents in this type are as follows : *Brownlowia tersa*, *Heritiera fomes*, *Cynometra minosoides*, *Aglaiacucullata*, *Sonneratia apetala*, *Xylocarpus molluccensis*, *Intsia bijuga*,

*Cerbera manghas*, *Avicennia officinalis*, *Bruguiera gymnorrhiza* and occasionally *Phoenix paludosa*, *Dalbergia spinosa*, and *Derris trifoliata*. *Brownlowia*, a bushy shrub is found to occupy the pioneer zone with its characteristic hard, woody stems, entangled with one other to form a natural fencing for withstanding the force of tidal current along the intertidal region. *Sonneratia apetala*, the largest species with its long pneumatophores is also found to occupy the pioneer zone along the intertidal banks but with a preference for more fresh water regions. *Heritiera fomes* with its characteristic blind pneumatophores is a dominant in this forest type, in association with *Aglaia cynometra*, and *Xylocarpus*. *Avicennia officinalis*, *Excoecaria agallocha*, and *B. gymnorrhiza* are found distributed without any specific zonation preference.

(c) *Transitional Mangrove* – This zone is confined along the inner most part of the tidal forests, usually devoid of regular tidal influence. Here the creeks and channels are suddenly shut off due to the formation of natural sand-bars. One way flow of tidal current, mostly during monsoon and during abnormal spring tide, keeps the condition transient. The plants in this type possess no features like vivipary, stilt root system or pneumatophores. They can tolerate both fresh and brackish water conditions. Vegetation in this zone is mostly *Acanthus illicifolius*, *Hibiscus tiliaceus*, *Excoecaria agallocha*, *Thespesia populnea*, *Dalbergia spinosa*, *Derris trifoliata* and frequently *Phoenix peludosa*.

Further change in this habitat due to deposition of sands makes the region so elevated that it reaches beyond all but high tide levels. It is flooded only twice a year for a few days. Subsequently, the salt concentration due to increased evaporation, and accumulation of organic matter change the habitat from alkaline to moderately acidic condition which does not favour the growth of any type of vegetation. The common fresh water salt tolerant fern, *Acrostichum aureum* in association with *Tamarix troupii*, *Salvadora persica* and *Bruguiera sexangula* is usually found to dominate in this zone.

This is the end of the seral type after which vegetation passes over to the climax type.

(d) *Riverine scrubs and mangrove associated mixed subtype* – This type is found mainly along the sandy banks of the rivers relatively away from the pro-estuarine zone. Sometimes a similar type is observed along the sand-bars situated in-between the creeks and channels. The influence of brackish water is less, and the habitat is changed in such a way that it appears to be a condition of physical dryness. The vegetation in this zone represents a local climax in the form of tropical or sub-tropical rain forest type. The main

floristic components in this type are *Heritiera littoralis*, found mostly along the sand-bars between creeks and channels associated with *Manilkara hexandra*, *Xylocarpus molluccensis*, *Manilkara littoralis*, *Carissa spinarum*, *Alphanso lutea* and others. *Excoecaria agallocha* when established in the outer part of the mangrove forests is often found in association with *Diospyros peregrina*, *Ficus retusa*, *Antidesma ghesseambilla*, *Syzygium cumini*, *Litsea* sp. *Eugenia bracheata* and *Memecylon grande* in sandy riverine scrubs are found in association with *Maba buxifolia*. *Pterospermum xylocarpum*, *Pongamia glabra*, *Ochna obtusata*, *Polyalthia korinti*, *Hugonia mystax*, *Rourea minor*, *Cansjera rheedii*, *Canthium dicoccum*, *Randia malabarica*, *Carissa spinarum*, *Clausena pentaphylla*, *Zizyphus oenoplia* and many others.

#### 4. Euhaline type :

This zone is limited to the shallow muddy-flats or salt-marshes mostly confined to or near the estuaries. Drainage system by means of creeks and channels is always lacking here. The upper surface is usually covered by a stiff-mud carried in by the swifter current from the estuaries, but ingress and egress of tidal water is by a mud-walled channel which extends irregularly through the areas. The area in part is covered by flood tide only during greater range of spring tide and in part is dry. This tidal water once accumulated becomes stagnant for a certain period resulting in accumulation of readily soluble salts due to evaporation of surface water by temperature. The vegetation in this zone is mainly halophytes with the common occurrence of *Suaeda maritima*, *S. nudiflora* and sometimes *Salicornia brachiata* towards drier parts.

### Comparison of Previous Classification

Haines (1925)	Champion & Seth (1968)	Rao & Sastry (1972-73)
LITTORAL TRACTS	LITTORAL AND TIDAL SWAMP FORESTS	ESTUARINE VEGETATION
A. Tree-cover :		
1. Deltaic swamps	Salt water mixed forest Brackish water forest	Euhaline Prohaline
2. Littoral scrubs	Mangrove scrubs	Tidal Mangrove
B. Open forest :	Littoral	Strand vegetation
3. Sands		Strand sand
4. Rocky faces near the seas		Strand Rock
5. Saline marshes	Palm swamp	Strand coral Euestuarine

Haines (1925) has described the vegetation of coastal Orissa primarily on a botanical basis with topographic sub-divisions. The grouping of two sub-divisions, namely Deltaic Swamps and Littoral scrubs under tree-cover needs clarification to distinguish the subtle differences between them. The words 'Deltaic' and 'Littoral' are broad-based geomorphological terms and their usage without explicit definition cannot convey the characteristic flora or substrata. Further, the term 'littoral' is dubious in the botanical sense and needs clarification when used as an area of plant-growth.

Similarly under the division 'Open forests' the inclusion of saline marsh is not appropriate as they form distinct floras on characteristic substrata. Thus one could see in Haines's classification the need for the introduction of explicit nomenclature indicating the role of topography on the distribution of tidal vegetation.

In the present work, the term 'Tidal Lands' is used in place of Littoral tracts *sensu* Haines, because it is appropriate in view of the fact that the resulting flora is mainly influenced by tidal ebb and flow. Further, the classification as formulated by Rao and Sastry (1975) is adopted with modifications in respect of Tidal mangroves. In view of the difficulties in recognising what constitute a mangrove from authors to authors, various sub-divisions have come into existence without mentioning the subtle differences between them. Champion and Seth's treatment under growth forms is not explicit due to their variability under different environmental stress. The usage of a collective sub-type, 'Tidal Mangroves' under pro-estuarine *sensu* Rao and Sastry (1973) is one of the grouping where a set of taxa prevail under the constant influence of tides. A detailed study of the adaptive modifications of the taxa grouped under 'Tidal Mangroves' has revealed very interesting key points which are very helpful in sub-dividing into three parts : Eumangrove, Semi-Mangrove and Transitional Mangrove, including such taxa which produce stilt roots and viviparous habit and spread over a tidal relief of considerable depth. On the contrary, Semi Mangroves include a few taxa which possess pneumatophores and buttresses or fluted axis with incipient viviparous habit, and spread over a tidal relief of shallow depth. These botanical subtle differences are very constant for each taxon under a definite depth situation. The only exception being that of *Bruguiera gymnorrhiza* and *Aegiceras corniculatum*. In the former the plant possess vivipary and pneumatophores. The pneumatophores are of geniculate type unlike the peg-shaped pneumatophores of 'Mangroves'. Similarly *Aegiceras* shows stilt roots of Eumangrove type. The stilt roots are of the broom stick type unlike the arched stilt roots of Eumangrove group. Apart from the above two taxa, the other members show a great deal of fidelity to the area, attain a good sociability and gradually disappear in the vicinity of the changed relief. Lastly, transitional mangrove includes such taxa which do not produce any feature like pneumatophores or viviparous habit and spread over a



relatively higher relief, where only monsoonal and abnormal spring tides keep the condition transient. After this, the vegetation passes over to the climax type.

**Concordance Table**

Haines (1925) (Major group)	Champion and Seth (1968) (Moist Tropical Forest)	Rao & Sastry (1972-73) (Humid Tropical vegetation)	Present study
1	2	3	4
LITTORAL TRACTS	LITTORAL & SWAMP FOREST	COASTAL VEGETATION	COASTAL VEGETATION
A. Open Coast	Littoral forests	Strand vegetation	Strand vegetation
1. Sand	-do-	Strand sand	Strand sand
2. Rocky face near sea	-do-	Strand rock	Nil
3. Saline Marshes	-do-	Strand coral	Nil
B. Tree-cover	Tidal Swamp Forest	Slacks	Sand flat and Slacks
i. Deltaic swamps	-do-	Tidal land	Tidal land
	Sub-Types-5 Mangrove scrub	Estuarine vegetation Types	Estuarine vegetation Types
	Mangrove forest	1. Estuarine type	1. Marino- estuarine type.
	Salt water mixed forest	2. Proestuarine type Sub-types	2. Estuarine type. sub-types a. Strictly estuarine b. Essentially estuarine
	Brackish water mixed forest	1. Tidal mangrove	3. Proestuarine type Sub-types a. True mangrove b. Semi-mangrove c. Transitional mangrove d. Riverine scrubs and mangrove associated mixed forest
	Palm Swap	2. Prohaline 3. Euhaline	Nil 4. Euhaline type
2. Littoral scrubs			

## DISCUSSION AND CONCLUSIONS

In the light of the data collected so far the estuarine landscape is discussed under the following categories : Topographic diversity, Zonal patterning and Vegetational characteristics.

### TOPOGRAPHIC DIVERSITY

The deltaic coast under the estuarine influence shows distinct topographical situations with its own flora and fauna. This diversity is all the more of interest to ecologist who are interested in understanding the innate reasons for the occurrence of adaptive flora and its physical and biological environment. Of the diverse situations the following areas of study are discussed as follows :

Near the funnel-shaped estuarine mouths, it is not uncommon to observe the existence of sea-fronted sandy beaches of considerable length. These areas are under the spell of the physical forces of the ocean in the form of salt spray, salt laden winds, shifting sands and storm waters. Depending on the operational range of the physical factors, this area is divisible into two zones : Foreshore and Backshore. A sandy Foreshore is inhospitable and cannot support any higher plant life. The backshore, however, under stabilised conditions receiving salt laden winds supports adapted flora of interest. The frequency and density of this flora depends on the stability of the backshore. If the area possesses moving sand-dunes, then they invariably affect the plant life and nearby areas. However, consistent vegetation is seen all along the backshore, or on the leeward side of the fairly stabilised sand-dunes. The operational aspects of the physical forces are very well illustrated by Dolan et al. (per. com.)

According to their view-point, there are two distinct interfaces, namely primary and secondary at which marine energies are dissipated or extended depending on the prevailing situation. Under normal weather, the primary interface receives only salt spray and the secondary interface salt laden winds respectively. Any disturbance in the positional relationship between the primary and secondary interfaces will affect the flora growing under stabilised conditions. The vegetation belt includes index species, localised and typical taxa of limited distribution and indifferent species from the interior.

The estuarine banks of low level as well as elevated erosional or depositional areas are commonly noticed along the estuarine complex.

They are under the influence of tidal and fresh water which creates a situation for the development of a unique type of adaptive flora. They are visible into three zones in response to tidal levels. The first zone is the marginal area of the aquatic moorings. This region has the highest percentage of salinity with few restricted estuarine species and saline grasses. The next zone is the intertidal zone with the assemblance of true tidal mangroves and its associates. The third zone consists a supra-tidal zone holding highly salt-tolerant shrubby plants. This is followed by an ecotone consisting of salt-tolerant localised adapted flora.

Another common topographical situation is the occurrence of Mangrove depressions, limited as well as extensive shallow flats connected by tidal canals and flooded periodically with tidal water. They are shallow, depressed or protected spots from open sea currents. Depending on the degree of salinity varied taxa of the mangrove category make their appearance. Their frequency and abundance are relatively dependent on the uniformity of the habitat. Any permanent change in the brackish to fresh water situation either during the monsoon or by floods leads into a change in the assemblage of plants of different categories.

As a contrast to mangrove depressions there are in the vicinity of strand/dune belts a few widely extended depressions sometimes interdunal called 'slacks'. They can be classified under three categories : Salt water, Brackish and fresh water. Salt water slacks are connected with the sea by narrow canals and occupy extensive areas behind the strand/dune backshores. This area is found occupied by *Phoenix paludosa* community along Bengal and Orissa shores, Brackish slacks are formed where there is intermingling of fresh water from rivers and tidal water from sea. Under this situation the flora is of mixed type and the recorded growth differences of the same tax are perhaps due to environmental variations. Fresh water slacks are cut off from the sea but often flooded by fresh waters. They have fresh water aquatic plants. Thus, one could see, depending on the nature of the slacks, diverse types of plant groupings.

### ZONAL PATTERNING

The distribution and zonation of organisms on the seashore as a basis for classification of terrestrial inshore ecosystems are widely recognised. Some important work along these lines are those of Stephenson and Stephenson (1949), Womersley and Edmonds (1952), Chapman and Trevarthen (1953), Lewis (1955) and Hedgepath (1957). In India, the zonal

approach has a basis of classification on Saurashtra coast has been made by Rao and Shanware (1967). In the present study, varied bounded ecosystems and the zonal distribution of their floristics have been utilised to build up a satisfactory regional classification not differing much from the general scheme of classification as outlined in respect of marine terrestrial coastal areas of India (Rao and Sastry 1973-74). The estuarine complex of the Orissa coast was studied in respect of distinct topographic units as explained elsewhere in the text.

The zonal distribution of taxa on the strand/dune belt is very characteristic and a common feature in all sandy shores under the Tropics. Consistent vegetation is present in the backshore region beyond the tidal level but constantly under salt spray. The vary factors show a graded sequence and the resulting flora also responds and shows a graded sequence. The pioneers are replaced by a mixed group of taxa in the middle which in turn is replaced towards the upland by a mixed population of strand and local plants. Recently it has been shown by Rao and Mukherjee (1975) that in such a situation in each zone there is a gradation in the substratum which is reflected in the variations of its floristic composition.

The estuarine border land forms a discrete belt under the influence of normal and storm tides and also under fresh water floods during the monsoon months. Despite a few recent works on the subject (Rao and Mukherjee, 1973, Rao *et al* 1973) there is need for more intensive and extensive studied for complete understanding of soil-vegetation relationship. Under tidal influence three belts are recognised in the present study. The newly exposed area covered with *Porteresia coarctata* followed by Mangrove taxa and the third belt under Supratidal influence showing highly salt tolerant bushes. Recently treating estuarine borderland as a whole has been classified into distinct belts. Under each one of them a group of plants has been identified. Further their distributional pattern is zonal and reflects the changes in the substratum. The pioneers are replaced by true mangroves which in turn are replaced by salt bushes or woodland depending on the nature of the terrain and the climate.

### VEGETATIONAL CHARACTERISTICS

The floristic components of the strand/dune belt constitute a psammosere with typical carpet forming or upright plants with adaptation to withstand temporarily sand burial and producing vertical branches after some time, or covered with a few taxa with perennial storage organs to hibernate during such periods when there is extreme drought. Of the few creepers *Hydrophyllax*

*maritima* is the best dune stabiliser. It forms extensive vegetal cover over a consolidated dune and thereby protects the dune from wind erosion. The role of *Spinifex littoreus* is dubious. It is more a dune former than a dune stabiliser. When it is dense undoubtedly it protects the underlying soils from erosion but it helps to build small baby dunes by their vertical shoots. The other plants of consequence in protecting the sandy soil are *Launaea sarmentosa*, *Cyperus arenarius*, species of *Borreria* and *Ipomoea pes-caprae*. Unlike the sandy shore the estuarine bank affords an excellent example of the influence of tide and salinity. It is more or less same to that of the open sea, with maximum influence of tidal floods. Often, it is found to be covered with single species dominant usually represented by a pure *Avicennia marina* formation.

With the increase of elevation and consequent admixture of fresh water and sea-water, there establish the formation of a maximum nutrient trap and gradually a single species community is found to be replaced by several species, such as *Sonneratia griffithii*, *S. alba*, *S. caseolaris*, *Avicennia alba*, *Bruguiera cylindrica*, *B. parviflora*, *Meropae angulata* *Aegialitis rotundifolia*, *Excoecaria agallocha*.

The next stage is the appearance of tidal forests where lands are encroached by several creeks and channels. Periodical changes of tidal level in relation to the different terrain and seasonal influence over the concentration of brackish water play an important role on the vegetation. This zone is found to be covered with true mangrove type. Further inland with relatively more fresh water influence and lesser tidal level make for the appearance of semi-mangroves and transitional mangrove types. Thus the successive appearance of plants in a zonal pattern strongly support the contention that the presence or absence of these plants is chiefly governed by the degree of tolerance to salinity, elevation of terrain and changes of tidal level.

Unlike the intertidal region, plants in the supra-tidal region are under the surge of storm water. In this area there is a rich assemblage of halophytes which can tolerate extreme saline condition. They constitute a halosere growing on degraded saline-alkaline soils. If on the other hand, the areas, happens to be a low-lying relief, then it is usually found to be covered by *Avicennia* and *Bruguiera* sp.

### MANGAL EXPLOITATION ACTIVITIES IN THIS DELTA

Recent survey regarding the status of Orissa mangal formation has revealed that besides the natural calamities, vast mangrove areas in the south

eastern littoral zone of the Cuttack district namely the Kujang forest division is under a process of severe destruction either intentionally or as a secondary result of other activities. Short term exploitation with a policy decision by the Government and private sectors for immediate economic benefits has taken precedence over the long term generation of economic and natural values of the mangrove ecosystem. Intentional destructive activities are : over exploitation by the traditional users for fuels, charcoal, house and boat building materials, timbers, poles, and road construction work. Exploitation due to secondary result of other activities appears that the decision makers either ignored the value of mangroves or evaluated significantly higher value for alternate use of mangrove lands without encountering the total impact of the surrounding environment. Some of the dominant reasons for exploitation of the mangrove ecosystem as a result of secondary activities along the Kujang forest division may be highlighted as follows :

#### ESTABLISHMENT OF A PORT IN PARADIP FOR COASTAL DEVELOPMENT

Since 1968, there has been an increase in industrial harbour in Paradip near the mouth of the river Mahanadi for transshipment of iron ores and other raw materials. A vast coastal area and southern estuarine bank of the river Mahanadi were sought for this purpose as a preferred location which was dominated by a pure formation of commercially important palm, *Phoenix paludosa* and other mangrove flora. The impact of construction of the port has a serious alteration on the change of local hydrology and increased human population along these regions. Local hydrological changes particularly with respect to mean water levels, admixture of fresh water with the sea water and changes in salinity conditions on the intertidal environment affected eventually the species composition and dominance. Construction of breakwaters and wharves in the port has resulted a change in the reflection pattern of the sea waves and has led to the serious erosion on sheltered mangrove areas. Human population have increased 6-8 times and demand of fire woods, fuels and charcoal has increased rapidly. The annual extraction of wood has far exceeded the annual regrowth. This was the main reason for rapid destruction of nearby mangroves and palm swamp. The garbage and the solid waste generated by the industrial population have also increased many times than before. Since the mangrove areas have been traditionally regarded as waste land, the dumping of these extra garbage and solid waste has further aggravated the pollution of the mangrove ecosystem. Blocking of natural channels and Diversion of fresh water :

Blocking of 18 natural channels in Atahrabanki areas near the Paradip for construction of some industries has resulted diversion and a check on seawards discharge of fresh water flow. As a result the surviving mangroves of the adjoining areas become very sparse and stunted.

### RESETTLEMENT ACTIVITIES

Land-need pressure has led to the serious exploitation of mangroves along Batighar, Kajalpata, Hookitola, Kansardian, Khanashi and Jambu forest blocks in the Kujang forest division by displaced persons. It is estimated that about 80% of mangroves in these areas have been cleared up during 15 to 20 years. This damage has caused a constrain for management of high water flow, wind speed and cyclonic floods. As these areas are subjected to large tidal range and cyclonic tidal surges, sudden flooding and loss of life have become almost a seasonal event in this part of Orissa.

### CONVERSION OF MANGROVE LANDS TO AGRICULTURE

Many "Kandhwalas" after disposing their lands to the port authority have impounded mangrove lands for Agriculture. They have prevented saline water intrusion with the help of suitable embankments. It is found that after 2-3 years these agricultural scheme are becoming failure due to very low production rate. In most of the cases the problems are not due to salinity conditions but formation of sulphuric acid from pyrite sulphate soil.

### AQUACULTURE ACTIVITIES

A large portion of Batighar mangrove forest block has recently been impounded for aquaculture practice. A large shallow land with a small dykes and sluice gate to retain water at all stages of the tide through a drainage system have been constructed after clearfelling the valuable mangroves of the regions. It is found that production of Prawns are not up to the estimated cost in this areas due to increase acidity along the regions.

### PARADIP PHOSPHATE FACTORY

Phosphate chemical factory produces varying quantities of basic organic materials as unwanted waste and discharges it in contrast to the solid waste as suspended or dissolved matter into the nearby rivers or coastal water. These may upset the equilibrium of the aquatic system.

As a result of these exploitation and use of mangrove lands for other activities the following number of taxa collected from these regions and reported new for Orissa (Banerjee, 1975 & 1985.) are at risk and some of these species have become extinct along these regions.

Name of Species	Collected from	Status
<i>Polyalthia korinti</i> (Dunal) Thw.	Hetamundia	Vulnerable
<i>Colubrina asiatica</i> (L.) Brong.	Hookitola	Threatened
<i>Rourea minor</i> (Gaertn.) Leenh.	Bahakud	Vulnerable
<i>Taverniera cunifolia</i> Arn.	Paradip	Extinct
<i>Ipomoea macrantha</i> Roem & Schult.	Baitra kud	Threatened
<i>Litsea nitida</i> (Roxb.) Hook.	Bahakud	Vulnerable
<i>Cyperus pachyrrhizus</i> (Nees.) Kukenth.	Hookitola	Extinct
<i>Merope angulata</i> (Willd.) Swingle.	Batighar	Endangered
<i>Sonneratia alba</i> J. Sm.	Hookitola	Extinct.
<i>Sarcolobus carinatus</i> Wall.	Atahrabanki	Vulnerable
<i>Flagelaria indica</i> L.	Atahrabanki	Threatened

## MANAGEMENT PRACTICES

Mangrove ecosystem is well known for fisheries, coastal stabilization, protection of critical habitat for many life forms, international nesting ground and hatching ground of migratory birds and turtles, sustainable natural resources for local industries and rural development. Realising these factors following management practices and some recommendations should be urgently undertaken by developing a national mangrove plan to save the pristine mangrove areas which are very rapidly disappearing along the South eastern part of this delta.

Sustained yield management for forestry may be developed by leaving the areas intact for 10-20 years cycle operation and planting selected tree species with respect to the ecological background. Choice of tree species must be based on local research using local conditions and available materials.

Estuarine deltas serve as a nurseries of millions of fishes and edible crabs depending on the mangrove detrital materials. Therefore sustained yield management for estuarine fisheries may be developed with the better development of mangrove ecosystem.

Present aquaculture practices in these regions are found not operated scientifically. The best mangrove habitats have been impounded instead of



degraded areas and the projects are found self-defeating due to increased acidity conditions. Scientifically controlled small-pond aquaculture practices may be developed for better production.

Much work has been done on mangrove ecology, species composition, distribution and classification of vegetation from these areas yet no result has been obtained to stop the consequences of rapid exploitation. An extensive awareness programme related to the value of mangroves, conservation and utilization among the decision makers and local mangrove users should be urgently instituted. This would be possible by organising a Mangrove Development Camp in the field with the help of local School and College students and teachers to improve the values of this vulnerable mangrove ecosystem among the local users for proper protection and conservation.

To maintain ecological balance of these cyclone prone areas, 10 km. stretch of mangroves, coastal thickets and riverine scrubs on both sides of the deltaic rivers should in no case be disturbed.

Silvicultural attention for plantation of firewood species along the interdunal slacks and in the ecotonic buffer zones, use of slack water for crop cultivation and management of palm in the scientific line will be very much useful.

### RECOMMENDATION

Management practice along the North-Eastern part of this delta has met with success by establishing the Bhitarkanika Sanctuary in the year 1975. Natural population of *Heritiera*, *Excoecaria* and *Avicennia* has been steadily extended. Population of Open billed storks (from 1000 to 30,000), Olive Ridley turtles (from 1 to 2 lakhs) and Crocodiles (from 100 to 350) have been increased (Raju & Dev. 1982). Therefore the best national plan for management of the South-Eastern part, the Kujang forest division should be to merge the areas with the Bhitarkanika Sanctuary and to be declared as Mahanadi Estuarine-Biosphere Reserve for extending huge bird breeding colony, turtles hatching ground. Crocodiles and satisfactory development of mangrove species in the Orissa mangrove system which seems to be a zone of largest number of mangrove species concentration in India (Banerjee 1987).

## FLORA

*Key to Families*

This key applies to the plants described from the Mahanadi delta, Cuttack dist. Orissa.

- 1a. Ovules enclosed in the carpels.  
Styles and stigma, present. ... ANGIOSPERMAE
- 2a. Flowers 4-5 merous ; stem woody  
with central pith ; Cotyledon 2. ... DICOTYLEDONEAE
- 3a. Calyx and corolla present :
- 4a. Petals usually free ;  
stamens often numerous :
- 5a. Sepals imbricate in bud :
- 6a. Sepals usually free :
- 7a. Stamens more than 12 :
- 8a. Sepals 2 ; petals 4-5 ;  
leaves sometimes terete ... PORTULACACEAE
- 8b. Sepals 4 or more ; petals  
many in several whorls.  
Leaves never terete ;  
plants aquatic ... NYMPHAEACEAE
- 9a. Sepals deciduous ; fruit  
borne on a gynophore ... CAPPARIDACEAE
- 9b. Sepals persistent ;  
fruit not on gynophore :
- 10a. Leaves alternate, not  
coriaceous ; flowers  
bisexual ; carpels  
united into a deeply  
3-10 lobed ovary ... OCHNACEAE
- 10b. Leaves opposite,  
coriaceous ; flowers  
1-sexual or polygamous ;  
carpels not as above ... CLUSIACEAE
- 7b. Stamens 10, or fewer :
- 11a. Flowers 3-merous ; dioecious,  
scandent herbs or shrubs ;  
seeds reniform ... MENISPERMACEAE
- 11b. Flowers 4-5 merous ;  
bisexual, erect herbs or  
shrubs ; seeds not reniform :

- 12a. Plants with sinuous branchlets and minute scale like leaves ... TAMARICACEAE
- 12b. Plants not of such branchlets and leaves never scale like :
- 13a. Corolla irregular in herbs ; stamens as many as the sepals ; placentas parietal ... VIOLACEAE
- 13b. Corolla regular in herbs ; stamens twice as many as the sepals ; placentas free ... CARYOPHYLLACEAE
- 14a. Filaments of anthers free :
- 15a. Leaves compound, stipulate ; flowers bisexual ; stamens always 10, not inside the disc ... ZYGOPHYLLACEAE
- 15b. Leaves simple or compound ; exstipulate, flowers polygamous ; stamens 5-10, inserted inside the disc ... SAPINDACEAE
- 14b. Filaments of anthers more or less united :
- 16a. Flowers irregular ; ovary 1-3 celled ; style single ... POLYGALACEAE
- 16b. Flowers regular ; ovary 3-5 celled ; style 3-5 ... LINACEAE
- 6a. Sepals more or less united at the base :
- 17a. Leaves pellucid, gland-dotted ; stamens usually free, stigma not capitate or discoid ... RUTACEAE
- 17b. Leaves not gland-dotted ; stamens united into a tube, stigma capitate or discoid ... MELIACEAE
- 18a. Stamens alternate with the petal :
- 19a. Ovary 3-5 celled ; leaves simple :
- 20a. Plants predominantly lianous habit ; stamens 3 ; seeds not arillate ... HIPPOCRATEACEAE
- 20b. Plants herbs or shrubs ; stamens 4-5 ; seeds arillate ... CELASTRACEAE

- 19b. Ovary 1-celled ; leaves simple or compound ... ANACARDIACEAE
- 18b. Stamens opposite the petals :
- 21a. Climbers without tendrils ; bracts patent ; ovary 1-celled ... OPILIAEAE
- 21b. Trees or climbers without tendrils ; bracts absent ; ovary usually 1-5 celled ... OLACACEAE
- 5b. Sepals valvate in bud :
- 22a. Flowers 3-merous ; sepals free ; ripe carpels free : ... ANNONACEAE
- 22b. Flowers 4-6 merous ; sepals united into a lobed or toothed cup ; carpels not free ;
- 23a. Filaments of anthers united into a column or cup :
- 24a. Stamens numerous in a column around the style ; staminodes absent ; anther 1-celled ... MALVACEAE
- 24b. Stamens 15 in a cup around the style ; anther 2-celled ; staminodes present ... STERCULIACEAE
- 23b. Filaments of anthers free : rarely united at the base :
- 25a. Stamens many, borne on a tows ; anther opening by slits ; fruit a capsule ... TILIACEAE
- 25b. Stamens 4-5 ; anthers opening by pores ; fruit a drupe with a single stone ... RHAMNACEAE
- 26a. Carpels solitary excentric ; flowers regular or irregular ; leaves stipulate ; fruits legume or lomentum :
- 27a. Flowers irregular ; stamens 10 or fewer :
- 28a. Corolla papilionaceous ; hamy comate ; ... PAPILIONACEAE

- 28b. Corolla caesalpinaceous, distinctly free ... CAESALPINIACEAE
- 27b. Flowers regular ; stamens numerous ... MIMOSACEAE
- 26b. Carpels many ; flowers regular ; leaves exstipulate ; fruit not a legume or loment :
- 29a. Carpel quite free ; fruit follicular :
- 30a. Ovules 2 in each cell, ascending ; leaves alternate, imparipinnate ; trees or climbing shrubs not fleshy ... CONNARACEAE
- 30b. Ovules many in each cell ; leaves apposite, simple ; fleshy herbs ... CRASSULACEAE
- 29b. Carpels united : fruit a septicidal capsule ... AIZOACEAE
- 31a. Calyx lobes imbricate :
- 32a. Stamens many ; petals imbricate in bud ; leaves gland dotted, not ribbed ... MYRTACEAE
- 32b. Stamens 3-12 ; petals contorted in bud ; leaves not gland dotted, 3-5 ribbed ... MELASTOMATACEAE
- 31b. Calyx lobes valvate.
- 33a. Ovary free or slightly adnate to the calyx tube ; herbs, shrubs, or trees :
- 34a. Flowers axillary ; petals, crinkled ovary 1-6 celled, free ... LYTHRACEAE
- 34b. Flowers terminal ; petals not crinkled ; ovary 10-15 celled, adnate to the calyx tube :

- 33b. Ovary completely adnate to the calyx tube ;  
marshy herbs or undershrubs ... ONAGRACEAE
- 35a. Ovary inferior
- 36a. Flowers 1 sexual
- 37a. Climbing or prostrate herbs with tendrils ... CUCURBITACEAE
- 37b. Aquatic herbs without tendrils ... HALORAGACEAE
- 36b. Flowers bisexual :
- 38a. Ovary 1/2 inferior, 1 celled with 2 ovules ; pollen sacs more than 6 ; fruits not winged ... RHIZOPHORACEAE
- 38b. Ovary inferior, 1 celled with 3 ovules ; pollen sacs 2 ; fruits 2-5 winged ... COMBRETACEAE
- 35b. Ovary superior
- 39a. Leaves covered with glandular hairs, small herbs with insect catching mechanism. Corona not present ... DROSERACEAE
- 39b. Leaves not with glandular hairs ; climbing herbs with distinct corona ... PASSIFLORACEAE

- 4b. Petals almost always united ; stamens fewer than 12 :
- 40a. Ovary inferior
- 41a. Flowers in head ; calyx reduced to pappus ;  
heads surrounded by an involucre of bracts ... ASTERACEAE
- 41b. Flowers not in head calyx not reduced to pappus :
- 42a. Leaves opposite ; stipules conspicuous ;  
ovary 2-10 celled ; ovules 1-many ... RUBIACEAE
- 42b. Leaves alternate ; stipules not conspicuous ;  
ovary 2-celled ; ovules 2 ... GOODENIACEAE
- 40b. Ovary superior :
- 43a. Ovary 1 celled ; placentation free central :
- 44a. Ovules solitary, pendulus ; style 5 fid ;  
calyx with stalk glands ... PLUMBAGINACEAE
- 44b. Ovules more than one, not pendulus ;  
style 2-8 ; calyx without stalk gland :
- 45a. Corolla tube with 4-6 lobes ; stamens  
more than 2 ; anther with  
transverse septs ... MYRSINACEAE
- 45b. Corolla with 2 lipped spurred ;  
with 3 anterior lobes ; stamens 2 ;  
anther not with septs ... LENTIBULARIACEAE
- 43b. Ovary 2-many celled ; placentation  
parietal :
- 46a. Stamens free from corolla ;  
flowers dioecious ; ... EBENACEAE
- 46b. Stamens inserted on the corolla ;  
flowers not dioecious :
- 47a. Ovary 3 or more carpelled ;  
stamens opposite the corolla  
lobes ; trees with milky sap ... SAPOTACEAE
- 47b. Ovary 2 carpelled ; stamens  
alternate with the corolla  
lobes ; trees without milky sap :
- 48a. Stamens 2, ovary  
2 celled ; ovules 8 ... OLEACEAE
- 48b. Stamens 4, ovary  
1-2 celled ; ovules 1-2 ... SALVADORACEAE

- 49a. Flowers regular ;  
corolla distinctly 5 lobed :
- 50a. Carpels free ;  
style united :
- 51a. Pollen granular ;  
not in tetrades :
- 52a. Anthers coherent and  
adpressed to the apex  
of the style ... ASCLEPIADACEAE
- 52b. Anthers free  
from the style ... APOCYNACEAE
- 51b. Pollen grains united in tetrades ... PERIFLOACEAE
- 50b. Carpels and styles always united :
- 53a. Leaves opposite :
- 54a. Stipules present ;  
placentas 2-fid ... LOGANIACEAE
- 54b. Stipules absent ;  
placentas undivided ... GENTIANACEAE
- 53b. Leaves alternate :
- 55a. Corolla lobes plicate ;  
flowers in axillary cymes :
- 56a. Ovary 2-5 celled with  
many ovules ; embryo  
without folded  
cotyledon ... SOLANACEAE
- 56b. Ovary 2-celled with  
2 ovules ; embryo with  
folded cotyledon ... CONVULVACEAE
- 55b. Corolla lobes imbricate ;  
flowers usually in  
scorpioid cymes ... BORAGINACEAE
- 49b. Corolla irregular distinctly  
oblique, lobes over-lapping :
- 57a. Carpels with 2 or  
many ovules :
- 58a. Fruit opens elastically ;  
retinacula supports seeds ... ACANTHACEAE
- 58b. Fruit opens not  
elastically ; retinacula  
absent :



- 59a. Ovules attached singly  
or 1-seriate under  
the leaves of a pro-  
jecting 2 bladed  
parietal placenta ;  
seeds not albuminous ... PEDALIACEAE
- 59b. Ovules many on  
placentas, attached  
to the middle of the  
septum. Seeds  
albuminous ... SCROPHULARIACEAE
- 57b. Carpels 1 ovuled :
- 60a. Plants with aromatic glands ;  
flowers in pairs or fascicled  
in whorls ; ovary deeply  
4 lobed ; fruit with  
4 distinct nutlets ... LAMIACEAE
- 60b. Plants without aromatic  
glands ; flowers in cymose,  
racemose or in spikes ; ovary  
entire or lobed fruit drupaceous  
with bony pyrenes ;
- 61a. Seeds without testa ;  
cotyledon conduplicate ... AVICENNIACEAE
- 61b. Seeds with testa ;  
cotyledon not conduplicate ... VERBENACEAE
- 3b. Corolla rarely present and calyx often absent :
- 62a. Flowers 2 sexual :
- 63a. Ovary inferior :
- 64a. Scandent herbs or shrubs ;  
flower irregular ;  
stamens 6-12 ... ARISTOLOCHIACEAE
- 64b. Epiphytic or parasitic  
herbs or under-shrubs ;  
flowers regular ; stamens 3-8 ... LORANTHACEAE
- 63b. Ovary superior :
- 65a. Seeds with copious  
albumen ; anthers  
not opening by upcurved,  
valvular lids :
- 66a. Stipules absent :
- 67a. Perianth tabular ;  
perianth base adhe-  
ring to the ovary ;  
flowers not with  
scarious bracts ... NYCTAGINACEAE

- 67b. Perianth lobed,  
scarious ; united  
only at base ;  
flowers with scari-  
ous bracts and  
bracteoles ... AMARANTHACEAE
- 66b. Stipules present,  
scarious, connate  
in a tube around  
the node ... POLYGONACEAE
- 65b. Seeds without albumen ;  
anthers opening by  
upcurved, valvular lids ... LAURACEAE
- 62b. Flowers unisexual :
  - 68a. Terrestrial plant ; branches  
not dichotomous ; leaves  
not in whorled :
    - 69a. Filaments inflexed in bud  
with reversed anthers :
      - 70a. Style branched in 2 ;  
plant with milky sap ;  
leaves not with stinging  
hairs ... MORACEAE
      - 70b. Style unbranched ;  
plant with watery sap ;  
leaves with stinging  
hairs ... URTICACEAE
    - 69b. Filaments not inflexed in bud  
with reversed anthers :
      - 71a. Flowers in cyathium ;  
ovary trilocular ; seeds  
not with silky hairs ;  
plant with milky sap. ... EUPHORBIACEAE
      - 71b. Flowers in catkins ;  
ovary bilocular ; seeds  
with silky hairs ; plants  
without milky sap. ... SALICACEAE
  - 68b. Submerged plant ; branches  
dichotomous ; leaves in  
whorled ... CERATOPHYLLACEAE
- 2b. Flowers 4-merous ; stems  
without central pith ; woody  
substances in isolated bundles ;  
cotyledon one ... MONOCOTYLEDONEAE

- 72a. Seeds very small ; albumen absent ; outer perianth segments calycine ; inner corolline ; submerged herbs ... HYDROCHARITACEAE
- 72b. Seeds conspicuous ; albumen present ; perianth segments not as above plants not submerged :
- 73a. Ovary inferior :
- 74a. Leaves radical at the apex of bulb, corn or tuber ; ovules many ; capsule not winged ... AMARYLLIDACEAE
- 74b. Leaves cauline ; ovules 2, superposed ; capsule 3-winged ... DIOSCOREACEAE
- 73b. Ovary superior :
- 75a. Inflorescences in a dense head and supported by rigid bracts ... XYRIDACEAE
- 75b. Inflorescences not in a dense head and not supported by rigid bracts :
- 76a. Both perianth series corolline ; embryo completely enclosed in albumen :
- 77a. Herbs usually with subterranean bulbs, tubers or rhizomes ; leaf-seath not with tendrils ... LILIACEAE
- 77b. Climbing herba with leaf-seath tendrils ... SMILACACEAE
- 76b. Outer perianth series calycine ; inner corolline ; embryo partly enclosed in albumen ... COMMELINACEAE
- 78a. Perianth present in regularly 2-seriate

- 79a. Both perianth-series calycine rigid ; flowers in one or more sheathing spathes ; plants not with milky juice ... ARECACEAE
- 79b. Outer perianth series herbaceous inner corolline ; plants with milky juice ... ALISMACEAE
- 78b. Perianth absent :
- 80a. Inflorescence of many flowered spadices or spikes not in a glumaceous bracts ; plant not a scapigerous herb ;
- 81a. Shrubs or trees with prop roots ; flowers dioecious, crowded in a hard spathe ... PANDANACEAE
- 81b. Herbs or shrubs not with prop roots ; flowers monoecious, crowded in a fleshy spathe ... ARACEAE
- 82a. Flowers not in spikelets and not with imbricating glumes :
- 83a. Flowers in a cylindrical superposed spadix ; fixed herbs with creeping root stock ... TYPHACEAE
- 83b. Flowers in a simple spike ; floating herbs without creeping root stock ... APONOGESTONACEAE
- 80b. Inflorescence of heads composed of solitary flowers in the axil of glumaceous bracts ; a scapigerous herb ... ERIOCAULACEAE
- 82b. Flowers in spikelets with imbricating glumes :

- |   |     |               |
|---|-----|---------------|
| 84a. Stem solid, unbranched ;<br>ligule absent ; placenta<br>free central | ... | CYPERACEAE    |
| 84b. Stem hollow, branched ;<br>ligule present, placenta<br>parietal      | ... | POACEAE       |
| 1b. Seeds and ovules none ; stigma none ;<br>Leaves bearing sporangia     | ... | POLYPODIACEAE |

### ANNONACEAE

- |                                    |     |              |
|------------------------------------|-----|--------------|
| 1a. Ovules 4-8 ; carpels tomentose | ... | ALPHONSEA 1  |
| 1b. Ovules 1-2 ; carpels glabrous  | ... | POLYALTHIA 2 |

#### ALPHONSEA Hook. f. & Thoms.

*Alphonsea ventricosa* (Roxb.) Hook. f. & Thoms. in Fl. Indica 152, 1885 ; Hook. f. Fl. Brit. India 1 : 89. 1872 ; Haines 1 : 15. 1921.  
*Uvaria ventricosa* Roxb. Fl. Ind. Carry Ed. 2 : 656. 1832.

Trees 6-10 m tall ; stems much-branched, smooth ; bark ash-coloured. Leaves 6-8 × 3-4 cm ovate-oblong or ovate-lanceolate, entire, coriaceous, shining above, conspicuously veined beneath, subacute at apex, rounded at base. Flowers 1-2 cm long, pale yellow, fragrant, in leaf-opposed or extra-axillary racemes ; petals thick, coriaceous ; pedicels 2-3 cm long. Ripe carpels 6-8, shortly stalked, tomentose ; each 1.5-2 cm across, ovoid or globose. Seeds 8-10, placed in two series on the ventral suture.

*Fl. & Fr.* : February-March ; July-August.

*Distrib.* : BAHAKUD, BHITARKANIKA : Rare in riverine scrub jungles and back mangroves.

#### 2. POLYALTHIA Bl.

- |                                      |     |                   |
|--------------------------------------|-----|-------------------|
| 1a. Spreading shrubs ; berries green | ... | <i>korinti</i> 1  |
| 1b. Erect shrubs ; berries purple    | ... | <i>suberosa</i> 2 |

1. *Polyalthia korinti* (Dunl.) Thw. Enum. 398. 1864 ; Hook. f. & Thoms. in Fl. Brit. India 1 : 64. 1872. *Guatteria korinti* Dunl. in DC. Prodr. 1 : 94, 1824.

Spreading shrubs; stems striate, young twigs slightly pubescent. Leaves very variable in size and shape, usually 3-12 × 2-5 cm, ovate or elliptic-oblong, coriaceous, acute or acuminate at apex, obtuse at base. Flowers 1-2 cm long, yellow, solitary, axillary; petals coriaceous, inner one largest; peduncles stout, 3.5 cm long. Fruits a ring of 10-12 pea-shaped berries; berries 2-3 cm across, one-seeded.

*Distrib.* : BAHAKUD, BHITARKANIKA : Frequent forming coastal scrubs along the Mahanadi delta, usually in association with *Carissa spinarum* and *Maba buxifolia*.

*Note* : Haines in Bot. Bihar and Orissa (1925) and Mooney in Suppl. Bot. Bihar and Orissa (1950) have not reported this species. It is a new record for Orissa.

2. *Polyalthia suberosa* (Roxb.) Thw. Enum. 398, 1864; Sinclair in Gard. Bull. 14 : 298, 1955; Hook. f. & Thoms. in Fl. Brit. India 1 : 65, 1872; Haines 1 : 13, 1921. *Uvaria suberosa* Roxb. Pl. Cor. 1 : 31, t. 34, 1895. "*Burichamri*."

Erect shrubs or small trees, upto 4m tall; stems much-branched; young branches rusty-pubescent, old ones glabrous with thick corky bark. Leaves 4-10 × 2-4 cm elliptic-oblong or oblanceolate, glabrous, obtuse or rounded at apex, unequal at base. Flowers 8-16 mm across, yellow, solitary, axillary or extra-axillary; peduncles 8-16 cm long, slender. Ripe carpels 5-6 mm across spherical, usually purple-coloured. Seeds one, rarely two.

*Fl. & Fr.* : May-June; September-October.

*Distrib.* : HATAMUNDIA, DALTANGHAR : Common in coastal scrubs along the Mahanadi delta, usually, in association with *Eugenia bracteata*, *Strychnos nuxvomica* and *Maba buxifolia*.

## MENISPERMACEAE

### CISSAMPELOS Linn.

*Cissampelos pareira* Linn. Sp. Pl. 1031, 1753 var. *hirsuta* (Buch.-Ham. ex DC.) Forman in Kew Bull. 22 : 356, 1968. Hook. f. & Thoms. in Fl. Brit. India 1 : 103, 1872; Haines 1 : 17, 1921. "*Pitusinga*".

Dioecious climbers; stems slender, pubescent, much-branched. Leaves 2-7 × 1.5-4 cm, peltate, suborbicular or reniform, glabrous above, silky-

pubescent below, obtuse or emarginate at apex, cordate or subcordate at base. Flowers minute, greenish white; male flowers fascicled on axillary panicles; female flowers in axillary pendulous racemes; bracts foliaceous, orbicular. Drupes 1-2 mm across, scarlet-coloured, hard.

*Fl. & Fr.* : May-August; July-October.

*Distrib.* : BAHAKUD, KUJANG : Rare, in hedges in scrubs along the Mahanadi delta; locally common along the roadsides and gardens.

## NYMPHAEACEAE

NYMPHAEA Linn. emend. J. F. Smith (*nom. cons.*)

- |    |                                       |     |                    |
|----|---------------------------------------|-----|--------------------|
| 1a | Leaves glabrous; flowers bluish-white | ... | <i>nouchali</i> 1  |
| 1b | Leaves pubescent beneath; flowers red | ... | <i>pubescens</i> 2 |

1. *Nymphaea nouchali* Burm. f. *Fl. Indica* 120. 1768; van Royen in *Nova Guinea* 8, 110. 1962. *N. stellata* Willd. *Sp. Pl.* 2: 1153. 1797; Hook. f. & Thoms. in *Fl. Brit. India* 1: 114, 1872; Haines 1: 21. 1921; Subramanyam in *Aqua. Angiosperms* 6. 1962.

Perennial, aquatic herbs with creeping rhizomes. Leaves 10-20 × 6-15 cm, broadly orbicular, floating, glabrous along both surfaces, shallowly undulate, cordate at base; petioles long, slender, arising from subterranean rhizome. Flowers 14-18 cm across, bluish white, fragrant, floating or emersed on long peduncles. Fruits 10-12 cm in diam., globose, spongy berry. Seeds many with saccate aril.

*Fl. & Fr.* : June-December.

*Distrib.* : TALCHUA, DANGMAL : Common in rice fields, shallow ditches and along the blind canals under fresh water condition near the deltas.

2. *Nymphaea pubescens* Willd. *Sp. Pl.* 2: 1154, 1797; van Royen in *Nova Guinea* 8, 107, 1962. *N. lotus auct. non* Linn. Hook. f. & Thoms. in *Hook. f. Fl. Brit. India* 1: 114, 1872; Haines 1: 21. 1921. *N. nouchali auct. (non* Burm. f.) Subramanyam in *Aqua. Angiosperms* 6. 1962. "*Rakta Saluk*".

Perennial aquatic herbs with rhizomes. Leaves 12-40 × 9-30 cm broadly oval-oblong or orbicular, sharply dentate, pubescent beneath. Flowers 9-20 cm across, red, sometimes white, on long peduncles; calyx green with prominent nerves. Fruits 12-16 cm across. Seeds many, red-coloured.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : RHIGAGAR : Mostly found in ponds and pools, often cultivated.

## CAPPARACEAE Juss.

- |                        |     |            |
|------------------------|-----|------------|
| 1a. Leaves simple      | ... | CAPPARIS 1 |
| 1b. Leaves 3-foliolate | ... | CRATEVA 2  |

## 1. CAPPARIS Linn.

**Capparis brevispina** DC. Prodr. 1 : 246. 1824 ; Hook. Ic. Pl. t. 126. *C. zeylanica* (non L.) Hook. f. & Thoms in Hook. f. Fl. Brit. India 1 : 174. 1872 ; Dunn in Kew Bull. 62. 1916 ; Haines 1 : 32. 1921. Jacobs in Blumea 12 : 437. 1965.

Erect shrubs or small trees 4-6 m tall ; stems much-branched, rigid, thorny ; twigs densely clothed with brown papillae. Leaves 5-8 × 2-3 cm elliptic-oblong or ovate-lanceolate, glabrous, strongly reticulate below, mucronate at apex, obtuse or rounded at base. Flowers 3-5 cm across, white, solitary, in terminal axiles ; pedicels 6-7 cm long. Fruits 3-6 cm across, ovoid to fusiform berries, red when ripe.

*Fl. & Fr.* : March-April ; July-September.

*Distrib.* : BAHAKUD, DANGMAL : Common in coastal scrubs along the Mahanadi delta, in association with *Memecylon edule*, *Randia fasciculata* and *Rouria minor*.

## 2. CRATEVA Linn.

**Crateva adansonii** DC. ssp. *odora* (Buch.-Ham.) Jacobs in Blumea 12 : 198. 1964. *C. odora* Buch.-Ham. in Trans. Linn. Soc. 15 : 118. 1827. *C. religiosa* Forst. var. *roxburghii* (R. Br.) Hook. f. & Thoms. in Hook. f. Fl. Brit. India 1 : 172. 1872, *C. religiosa* non Forst. f. : Haines 1 : 30. 1921.

Deciduous trees 4-6 m tall ; stems branched, unarmed. Leaves digitately 3-foliolate, each 5-9 × 2-5 cm elliptic or oblanceolate, membranaceous, cuneate at base, acuminate at apex ; petioles 5-7 cm long, slender. Flowers 2-3 cm across, yellow, arranged in terminal corymbs ; gynophores 2.5-3.5 cm long ; ovary 2-3 mm across, sub-globose, constricted below the stigma. Fruits 3-4 cm across, fleshy berries ; seeds many, embedded in pulp.

*Fl. & Fr.* : April-May ; July-September.

*Distrib.* : BAHAKUD, KUJANG : Frequent along the banks of the Mahanadi river, usually in association with *Eugenia bracteata* and *Litsea nitida*.



## VIOLACEAE

## HYBANTHUS Jacq.

**Hybanthus enneaspermus** (Linn.) F. Muell. *Fragm.* 10 : 81. 1876 ; Tennant in *Kew Bull.* 16 : 430. 1963, *Viola enneasperma* Linn. *Sp.* : Pl. 937. 1753. *Ionidium enneaspermum* (Linn.) Vent. *Jard. Mal. Sub. t.* 27, 1803, *I. suffruticosum* (Linn.) Roem. *Schul. Syst. Veg.* 5 : 394. 1819 ; Hook. f. & Thoms. in Hook. f. *Fl. Brit. India.* 1 : 185. 1872 ; Haines 1 : 34. 1921. "Nunbore"

Suffrutescent perennial herbs 15-40 cm tall ; stems glabrous or pubescent, sparingly branched. Leaves 1-4 × 0.2-2 cm, variable in size and shape, linear lanceolate or oblanceolate, glabrous or pubescent, entire or serrate, acute at apex, sessile or sub-sessile at base ; stipules subulate. Flowers 1-1.5 cm across, purple, solitary axillary. Capsules 0.7-1 cm across, subglobose ; Seeds 1-2 mm across, ovoid, longitudinally striate.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : KUJANG, BAHAKUD, PARADEEP : Common weed spreading from inland to the sea-shore and river-banks.

## FLACOURTIACEAE

## FLACOURTIA L'Heritier

**Flacourtia indica** (Burm. f.) Merr. *Interpr. Rumph. Herb. Amb.* 377. 1917 ; Sleumer in *Fl. Males.* 5 : 76. 1958. *Gmelina indica* Burm. f. in *Fl. Indica* 132, t. 39, f. 5. 1768. *Flacourtia ramontchi* Herit. *Stirp.* Nov. 3 : 59, t. 30, 30B, 1785 ; Hook. f. & Thoms. in Hook. f. *Fl. Brit. India* 1 : 193. 1872 ; Haines 1 : 38. 1921 "Bainchi"

Bushy shrubs or small trees 1-3 m tall, deciduous ; stems and branches set with simple and branched thorns. Leaves variable in shape and size, usually 2-3 × 1-2 cm ovate, ovate-elliptic or heart-shaped, obtuse or rounded at apex, cuneate at base. Flowers 1-3 cm across, white, dioecious 3-4, arranged in axillary or terminal racemes ; male flowers larger than female flowers. Fruits 1-13 cm in diam globose, dull-red or blackish-red when ripe.

*Fl. & Fr.* : March-April ; May-July.

*Distrib.* : BAHAKUD, DALANAGAR : Frequent in scrubs, along the river banks and coastal thickets, in association with *Hugonia mystax* and *Ziziphus oenoplia*.

## POLYGALACEAE

- |                                     |     |             |
|-------------------------------------|-----|-------------|
| 1a. Stamens 8 ; flowers in racemes  | ... | POLYGALA 1  |
| 1b. Stamens 4-5 ; flowers in spikes | ... | SALOMONIA 2 |

## 1. POLYGALA Linn.

**Polygala arvensis** Willd. Sp. Pl. 876, 1802 ; Adem in Blumea 14: 269, f. 15, 1966 ; Benn. in Hook. f. Fl. Brit. India 1 : 204, 1872 ; Haines 1 : 41, 1921. *Polygala chinensis* (auct. Pl. non Linn. 1753). "Caighur"

Erect or semiprostrate annual herbs ; stems much-branched, glabrous or puberulous, spreading from woody rootstock. Leaves 5-25 × 1-6 mm, ovate-elliptic or oblanceolate, glabrous, rounded at apex, cuneate at base. Flowers 4-8 mm long, yellow, in lateral racemes; racemes 3-5 cm long, staminal tube splits half way; bracts persistent. Fruits 1-2 cm in diam., suborbicular with sparsely hairy marginal wings. Seeds ovoid, black, covered with patent hairs; strophiole white, 3-lobed.

*Distrib.* : CATAVYA, KUJANG : Frequent along the sea-shores, sandy river banks and road-sides.

## 2. SALOMONIA Lour.

**Salomonium ciliata** (Linn.) DC. Prodr. 1 : 334, 1824. *Polygala ciliata* Linn. Sp. Pl. 705. *Salomonium oblongifolia* DC. Prodr. 1 : 354, 1824 ; Benn. in Hook. f. Fl. Brit. India 1 : 207, 1874 ; Haines 1 : 44, 1921.

Delicate, erect, annuals, 6-17 cm tall ; stems winged, simple or branched. Leaves 3-9 × 2-4 mm, sessile, elliptic-oblong, or ovate-lanceolate, acute at apex, narrowed at base. Flowers 2-3 mm long, deep purple, in terminal spikes ; stamens usually 4-5. Fruits didymous, laterally compressed, margins muriculate; seeds orbicular, black, glabrous, without caruncles.

*Fl. & Fr.* : March-April : June-July.

*Distrib.* : KONARK, GUPTI : Frequent in moist sandy places along the sea-shores, sometimes in and around the dune slacks.

## CARYOPHYLLACEAE

- 1a. Erect herbs ; sepals not keeled ... POLYCARPAEA 1  
 1b. Spreading herbs ; sepals keeled ... POLYCARPON 2

## 1. POLYCARPAEA Lamark.

**Polycarpaea corymbosa** (Linn.) Lamk. Tabl. Eacyl, 2 : 129. 1797 ; Backer in Acta Botanica Neer. 6 : 51, Fig. 1, 1957. Edgs. & Hook. in Hook. f. Fl. Brit India 1 : 245. 1874 ; Haines 1 : 47. 1921. *Achyranthes corymbosa* Linn. Sp. Pl. 205. 1753. "Janhejom"

Erect annual herbs, 10–40 cm tall ; stems much-branched, pubescent. Leaves opposite or in whorls, 10–20 × 1–2mm, linear, glabrous, acuminate at apex, sessile; stipules 3–4 mm long. Flowers 5–7 mm long, silvery brown, in terminal branched cymes ; bracts 1–2 × 1–1.2mm scarious, clasping the stems. Capsules 1–1.2 mm across, elliptic, brown. Seeds 6, reniform.

*Fl. & Fr.* : August- September ; October-November.

*Distrib.* : PARADEEP, KUJANG, CHANDBALI : Common along sea-shore, lee sides of sanddunes and sandy river-banks.

## POLYCARPON Linn.

**Polycarpon prostratum** (Forsk.) Aschers. & Schweinf. in Oestr. Bot. Zeitschr. 39 : 128. 1889 ; Turrit in Fl. Top. East Africa 4, f. 2, 1956 *Alsine prostrata* Forsk. in Fl. Aegypt. Arab. 207. 1775. *Polycarpon loeflingias* (Wall ex Wt. & Arn.) Benth. in Benth. & Hook. Gen. Pl. 1: 153. 1862 ; Edge. & Hook. in Hook. f. Fl. Brit. India 1 : 243. 1874 ; Haines 1 : 48. 1921.

Spreading annual herbs with profused dichotomous branches. Leaves 1–2 × 0.2–0.5 cm, verticillate, linear or linear-lanceolate, acute at apex, narrowed at base ; stipules scarious. Flowers 2–4 mm across, greenish-white, in axillary and terminal branched cymes ; sepals keeled ; bracts scarious. Capsules 3–4mm across, yellow or green.

*Fl. & Fr.* : May-June ; September-October.

*Distrib.* : SATAVYA, PARADEEP : Frequent along the sea-shores, locally common along the river-banks and waste places.

## PORTULACACEAE

## PORTULACA Linn.

- |  |     |                     |
|--|-----|---------------------|
| 1a. Nodes witha ring of stipular hairs |     |                     |
| 2a. Leaves ovate-elliptic              | ... | <i>quadrifida</i> 1 |
| 2b. Leaves terete                      | ... | <i>pilosa</i> 2     |
| 1b. Nodes without stipular hairs       | ... | <i>oleracea</i> 3   |

1. *Portulaca quadrifida* Linn. Mant. 73. 1767 ; Geesink in Blumea 290. 1969 ; Dyer in Hook. f. Fl. Brit. India 1 : 247. 1874 ; Haines 1 : 48. 1921.

Creeping herbs ; stems filiform, reddish-brown, rooting at nodes. Leaves 6-8 × 2-3 mm, succulent, elliptic-oblong, or ovate, acute at apex, narrowed at base. Flowers 1-2 mm across, yellow, solitary, terminal. Capsules 5-8 mm across, ovoid, dehiscing circumscissily ; seeds many, reniform, tuberculate.

*Fl. & Fr.* : May-June ; July-September.

*Distrib.* : PARADEEP, KUJANG : Frequent along the sea-shores, roadsides and waste places, often cultivated in gardens.

2. *Portulaca pilosa* Linn. ssp. *pilosa* Geesink, in Blumea 17 : 295. 1969. *Portulaca tuberosa* Roxb. Fl. Ind. ed. Carey 2 : 464. 1832 ; Dyer in Hook. f. Fl. Brit. India 1 : 247. 1874 ; Haines 1 : 48, 1921.

Erect, succulent herbs ; stems much-branched from perennial fusiform tuberous roots ; tubers 10-15 cm long. Leaves 1-1.5 cm long, linear, fleshy, terete, sessile. Flowers 5-8 mm across, yellow, solitary or in 2-4 flowered clusters ; clusters surrounded by an involucre of 3-8 cauline leaves. Capsules 5-8 mm across, ovoid, shining at apex, dehiscing circumscissily ; seeds many, orbicular, black.

*Fl. & Fr.* : June- July ; September-December.

*Distrib.* : PARADEEP, SATAVYA, HATAMUNDIA : Frequent along the sea-shore, sand dunes and sandy river-banks.

3. *Portulaca oleracea* Linn. Sp. Pl. 445, 1753 ; Geesink, in Blumea 17 : 292. 1969 ; Dyer in Hook. f. Fl. Brit. India 1 : 246. 1874 ; Haines 1 : 48. 1921.

Erect or decumbent herbs ; stems glabrescent, nodal hairs absent. Leaves 3-4 × 1-1.5 cm, spirally arranged or opposite, obovate or spatulate, obtuse

or retuse at apex, narrowed at base. Flowers 1–1.5 cm across, yellow, in terminal clusters, enveloped an involucre of cauline leaves. Capsules 5–8 mm across, ovoid, dehiscing above base ; seeds many, reniform.

*Fl. & Fr.* : May-June ; July-August.

*Distrib.* : KUJANG, PARADEEP : Common in waste places, sea-shores, open gardens, often cultivated as a vegetable.

## TAMARICAEAE

### TAMARIX Linn.

1a. Stamens 5		
2a. Leaves not sheathing ; flowers bisexual	...	<i>troupii</i> 1
2b. Leaves sheathing ; flowers unisexual	...	<i>diolca</i> 2
1b. Stamens 10	...	<i>ericoides</i> 3

1. *Tamarix troupii* Hole in Ind. For. 45 : 247. 1919. *T. gallica auct non* Linn. Dyer in Hook. f. Fl. Brit. India 1 : 248. 1874. *T. indica* Koen. ex Roxb. in Fl. Ind. Ed. Carey 100, 1832 (*excl. syn.*) ; Haines 1 : 51. 1921. "*Jagura*"

Shrubs or trees 2–4 m tall. Leaves 2–3 mm long, subulate, semiamplexicaule at base, adpressed to the younger twigs, not sheathing. Flowers 3–4 mm across, white or pink, bisexual, in lateral and terminal pendulous racemose panicles. Capsules 4–5 mm across, 3–4 valved, tapering towards the apex. Seeds 8–10, tufted silky hairy at apex.

*Fl. & Fr.* : August-September ; October-December.

*Distrib.* : HOOKITOLA, GHONOGHALIA, SATAVYA : Common along the river-banks of the Mahanadi and Dhamra estuaries ; usually prevalent within the zone of fresh and brackish water mixture, frequent along the sea-shore.

2. *Tamarix diolca* Roxb. Fl. Ind. Ed. Carey 101. 1832 ; Dyer in Hook. f. Fl. Brit. India 1 : 240. 1874 ; Haines 1 : 51. 1921.

Dioecious trees 3–4 m tall. Leaves 2–3 mm long, subulate, sheathing at base. Flowers 3–4 mm across, purple in lateral and terminal racemose panicles; Male flowers : stamens 5 ; female flowers : staminodes 3–4. Capsules 4–5 mm long, conical, 4-valved. Seeds many, silky hairy at apex.

*Fl. & Fr.* : August-September; November-December.

*Distrib.* : BAHAKUD, CHAUMAHANI : Rare along the river-beds and moist sandy areas.

3. *Tamarix ericoides* Rottl. in Gesel. Naturf. Fr. Berlin Neueschr. 4 : 214. 1803 ; Dyer in Hook. f. Fl. Brit. India 1 : 249. 1874 ; Haines 1 : 52. 1921. "*Pani Jhu*"

Shrubs or small trees, 2-3 m tall ; stems smooth, much-branched. Leaves 1-3 mm long, subulate, amplexicaule at base. Flowers 6-8 mm across, deep purple in lateral racemes 15-18 cm long ; stamens 10, alternately long and short. Capsules 5-6 mm long, conical, 3-valved; seeds 2-3 mm long, oblong, silky comose at apex.

*Fl. & Fr.* : October-November ; December-January.

*Distrib.* : KUJANG, JAGATASINGPUR : Frequent along the sandy river-beds of Mahanadi.

## CLAUSIACEAE

### CALLOPHYLLUM Linn.

*Callophyllum inophyllum* Linn. Sp. Pl. 513. 1753 ; Maheshwari in Bull. Bot. Surv. India 2 : 145. 1960; Anders. in Hook. f. Fl. Brit. India 1 : 273. 1874 ; Haines 1 : 56. 1921. "*Punang*"

Trees 12-15 m tall ; trunk 30-70 cm in girth with milky exudate ; bark pale grey, widely fissured. Leaves 8-15 × 6-10 cm, broadly ovate or elliptic-oblong, shining along both surfaces, rounded or emarginate at apex, truncate at base ; nerves numerous, closely parallel. Flowers 1.2-1.5 cm across, white, fragrant, polygamous, in axillary racemes. Drupes 3 × 4 cm in diam., globose, shortly acuminate at apex.

*Fl. & Fr.* : April-May ; September-October.

*Distrib.* : KUJANG, PARADEEP, BAHAKUD : Common along the sea-shore and river banks, often cultivated for timber. Fruits are used for washing purpose and seeds for extraction of oils.

## MALVACEAE

## Key to Genera

- 1a. Trees :
- 2a. Young parts with peltate scales ... THESPESIA 1
- 2b. Young parts without peltate scales :
- 1b. Shrubs, undershrubs or herbs :
- 3a. Flowers capitate ... MALACHRA 2
- 3a. Flowers solitary ... PAVONIA 3
- 4a. Fruits schizocarp :
- 5a. Ovules solitary ... SIDA 4
- 5b. Ovules 2-many ... ABUTILON 5
- 4b. Fruits capsule ... HIBISCUS 6

1. THESPESIA Solnder *ex* Correa

- 1a. Capsules dehiscent ; exocarp separated from endocarp  
by a fibrous spongy mesocarp ... *populneoides* 1
- 1b. Capsules indehiscent ; exocarp not separated from  
endocarp, mesocarp not distinguishable ... *populnea* 2

1. *Thespesia populneoides* (Roxb.) Kostel, Allg. Med. Pharm. Fosberg and Sachet in Smith. Con. Bot. 7. 1972. *Hibiscus populneoides* Roxb. Fl. Ind. Ed. Carey 3 : 181. 1832. "Habl".

Trees 3-6 m tall, young twigs covered with bronze-coloured lepidotes. Leaves 7-10 × 5-8 cm, deltoid to cordate or subcordate with shallow sinus at base, acuminate or caudate at apex ; petioles 5-6 cm long ; stipules early caducous. Flowers 3-5 cm across, yellow, red in centre, axillary, solitary on a stout pedicels ; Pedicels 5-7 cm long, recurved in fruits. Capsules 3-4 cm across, globose, exudes deep yellow latex when young ; mature fruits dehiscent apically into two distinct layers ; exocarp separates into 5 valves from endocarp attached to fibrous spongy mesocarp ; seeds 6-8 mm across, ovoid, angled ; angles covered with rough clavate hairs.

*Fl. & Fr.* : Throughout the year ; separation of exocarp during the month of May-June.

*Distrib.* : HOOKITOLA, GOURIMATA ; Frequent along the muddy sea-shores and outer fringes of the mangroves.

Roxburgh (*l.c.*) reports this species from Samalkot, Andhra Pradesh. Masters in Hook. f. Fl. Brit. India 1 : 345. 1874, states that the characters assigned by Roxburgh to this species are not sufficient. However, he places this species under *T. populnea* (Linn.) Sol. ex Correa, following the distribution from tropical shores of Bengal and both peninsulae. Haines 1 : 70. 1921, did not report this species from the Mahanadi delta since he was unable to verify the characters by Roxburgh. The present collection of the plant represents a new record for Orissa.

2. *Thespesia populnea* (Linn.) Sol. ex Correa in Ann. Mus. Nat. Paris 9 : 290. 1807 ; Mast. in Hook. f. Fl. Brit. India 1 : 345. 1874 ; Haines 1 : 70. 1921. *Hibiscus populneus* Linn. Sp. Pl. 697. 1753.

Trees, 6-9 m tall with yellow latex ; young twigs covered with brown lepidotes. Leaves 6-15 × 4-13 cm, deltoid, orbicular or cordate, acuminate or cuspidate at apex, sinous narrow at base ; petioles 6-8 cm long. Flowers 4-6 cm across, yellow, solitary, axillary ; pedicels 3-15 cm long. Capsules 4-5 cm across, globose, indehiscent. Seeds 1-1.3 cm across, ovoid, angled, with long silky hairs along the angles.

*Fl. & Fr.* : Throughout the year. May-September.

*Distrib.* : FALSE POINT, PARADEEP : Common along the sea-shore, river-banks and outer fringes of mangroves, often planted along the road side for yellow flowers.

## 2. MALACHRA Linn.

*Malachra capitata* (Linn.) Syst. Nat. ed. 12, 2 : 458, 1767 ; Borss. in Blumea 14 : 146. 1966 ; Mast in Hook f. Fl. Brit. India 1 : 329. 1874 ; Haines 1 : 64. 1925. *Sida capitata* Linn. Sp. Pl. 685, 1753.

Undershrubs or herbs 50-100 cm tall, stellately hairs. Leaves 1.5-10 × 1-9 cm, ovate or suborbicular, crenate or dentate, obtuse at apex, cordate at base. Flowers 1-1.6 cm across, yellow, 2-4 together in involucrate heads. Fruits schizocarps ; mericarps 5, indehiscent rounded at apex ; seeds triangular, pointed.

*Fl. & Fr.* : May-June ; August-September.

*Distrib.* : KUJANG, GOPTI : Occasional along the river-banks and back shores, locally common along road-sides and near waste places.

*Notes* : Haines (*l.c.*) remarks that since it is widespread in India, it will probably be found in Bihar and Orissa.



## 3. PAVONIA Cav.

**Pavonia procumbens** (W. & A.) Walp. Rep. Bot. Syst. 1: 301. 1842; Borss. in *Blumea* 14 : 135. 1966. *Pavonia glechomifolia* (A. Rich.) Garcke ex Schweinfur, Beitr. Fl. Abyss. 1 : 54. 1847; Mast. in Hook. f. Fl. Brit. India 1 : 330. 1875.

Glandular, pubescent herbs or undershrubs. Leaves 4-8 × 3-7 cm ovate or suborbicular, 2-3 lobed with wedge-shaped margins, acute at apex, cordate at base. Flowers 1-2 cm across, white or yellow, solitary, axillary; bracteoles many, exceeding calyx lobes. Ripe carpels ovoid or rounded, winged, separating from axis.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : KUJANG & GUPTI : Frequent along the sea-shore and river-banks, locally common along roadsides.

*Notes* : Haines in Bot. Bihar and Orissa and Mooney in Suppl. (1921 & 1950) did not record this species; hence it is a new record for Orissa.

## 4. SIDA Linn.

*Key to species*

- |   |     |                   |   |
|---|-----|-------------------|---|
| 1a. Carpels 5, if awned not exceeding calyx lobes | ... | <i>cordata</i>    | 1 |
| 1b. Carpels 10, awns always exceeding calyx lobes | ... | <i>cordifolia</i> | 2 |

1. **Sida cordata** (Burm. f.) Borss. in *Blumea* 14 ; 182. 1966. *Melochia cordata* Burm. f. Fl. Ind. 143. 1768. *Sida veronicifolia* Lamk. Encyl. 1 : 5. 1783; Haines 1 : 61. 1921. *Sida humilis* Cav. Diss. 5 : 277. t. 134, f. 2. 1788; Mast in Hook. f. Fl. Brit. India 1 : 322. 1874.

Erect or trailing herbs with woody rootstock; stems much-branched, covered with minute scattered hairs. Leaves 1-4 × 1-3.5 cm broadly ovate, sub-orbicular or deltoid, crenate or serrate, obtuse or acute at apex, cordate at base. Flowers 3-4 mm across, yellow, solitary; pedicels 3-4 cm long, articulated. Fruits of 5 mericarps, tetrahedral; awns absent, if present short, glabrous.

*Fl. & Fr.* : March-April; May-June.

*Distrib.* : PARADEEP, CHANDBALI : Frequent along sea-shore, river-banks and roadsides.

2. *Sida cordifolia* Linn. Sp. Pl. 684. 1753 ; Borss. in Blumea 14 : 183. 1966 ; Mast. in Hook. f. Fl. Brit. India 1 : 324. 1874 ; Haines 1 : 61. 1921.

Erect herbs, 50-70 cm tall ; stems much-branched, tomentose. Leaves 1-6 × 0.5-1.5 cm, ovate crenate, obtuse or acute at apex, truncate at base ; petioles 1-3 cm long. Flowers 1-2 cm across, yellow, axillary, corymbose or solitary. Carpels 10 ; awns two, exceeding calyx lobes, retroscely hispid.

*Fl. & Fr.* : March-May ; July-August.

*Distrib.* : BAHAKUD, KUIANG : Common along the river-banks, sandy sea-shore and road-sides.

### 5. ABUTILON Gaert.

1. *Abutilon indicum* (Linn.) Sweet, Hort. Brit. 1 : 54. 1826 ; Borss. in Blumea 14 : 171. 1966 ; Mast. in Hook. f. Fl. Brit. India 1 : 326, 1874 ; Haines 1 : 64. 1921. *Sida indica* Linn. Sp. Pl. 2 : 26. 1756.

Erect, annual or perennial herbs or undershrubs ; stems velutinous. Leaves 2-7 × 2-5 cm ovate or suborbicular, crenate or dentate, acute at apex, cordate at base. Flowers 2-3 cm across, yellow, solitary, axillary. Fruits 15-18 mm across, globose, separating into 20-25 mericarps.

*Fl. & Fr.* : March-June ; August-September.

*Distrib.* : FALSE POINT, BHITARKANIKA : Rare along the sea-shore, locally common along road-sides and waste places.

### 6. HIBISCUS Medic.

*Hibiscus tiliaceus* Linn. Sp. Pl. 694. 1753 ; Borss in Blumea 14 ; 30. 1966 ; Mast. in Hook. f. Fl. Brit. India 1 : 343. 1875 ; Haines 1 : 69. 1921. "Habali".

Trees 3-6 m tall or lianas ; stems much-branched, glabrous, closed to ground level. Leaves 5-16 × 4-18 cm, orbicular, crenulate, stellate beneath, acute or acuminate at apex, cordate at base ; stipules 2-3 cm long, subulate. Flowers 7-10 cm across, campanulate, bright yellow with crimson eye in the centre, turning bright purple when old, solitary or rarely two, in terminal

peduncles ; bracteoles 5-6, lanceolate. Capsules 3-5 cm across, ovoid, closely tomentose, splitting into 5 mericarps, Seeds black with pale dots.

*Fl. & Fr.* : February-April ; August-September.

*Distrib.* : FALSE POINT, HOOKITOLA : Common along the islands near the estuaries, banks of creeks and channels and occasional in the back mangroves.

### 13. STERCULIACEAE

#### *Key to Genera*

- |                              |     |                |
|------------------------------|-----|----------------|
| 1a. Trees :                  |     |                |
| 2a. Flowers unisexual        | ... | HERITIERA 1    |
| 2b. Flowers bisexual :       |     |                |
| 3a. Capsules glabrous        | ... | QUAZUMA 2      |
| 3b. Capsules rusty tomentose | ... | PTEROSPERMUM 3 |
| 1a. Herbs or undershrubs :   |     |                |
| 4a. Ovary 1-loculed          | ... | WALTHERIA 4    |
| 4b. Ovary 5-loculed          | ... | MELUCHIA 5     |

#### 1. HERITIERA Aiton

##### *Key to Species*

- |  |     |                     |
|--|-----|---------------------|
| 1a. Fruits 3-4 cm across with a transverse, circular ridge | ... | <i>fomes</i> 1      |
| 1b. Fruits 8-12 cm across with a longitudinal ridge        | ... | <i>littoralis</i> 2 |

1. *Heritiera fomes* Buch.-Ham. in Symes *Avic. Emb.* t. 28. 1800 ; Lamk. *Poir. Encycl. Suppl.* 5 ; 30. 1817 ; Kosterman in Reinwardt 4 ; 400. 1959 ; Mast. in Hook. f. *Fl. Brit. India* 1 : 363. 1874. *H. minor* Roxb. *Fl. Ind.* ed. Carey 3 : 142. 1832 ; Haines 1 : 81. 1921. (*non* Lam). "*Sundari*"

Trees, 6-30 m tall, 30-80 cm in girth ; stems with well-developed buttressed and innumerable blind rootsuckers or pneumatophores beneath the trees ; rootsuckers 15-30 × 4-8 cm, strong, erect, peg-like ; barks reddish-brown ; wood dark-red ; young branches golden brown, covered with non-fimbriate scales. Leaves 5-14 × 3-6 cm, elliptic or elliptic-lanceolate, upper surface glabrous, lower surface covered with golden fimbriate scales, tapering at both ends. Flowers unisexual, campanulate, golden yellow with reddish tinge inside, densely pubescent, in axillary panicles ; peduncles 3-6 cm long ; pedicels 6-9 mm long, articulate ; male flowers 1-3 mm across, mostly in

the lower ramifications ; androgynophore 1 mm long, glabrous ; anther thecae 8, in a regular ring, topped by minute, sterile ovaries ; female flowers 2-5 mm across in the upper ramifications ; ovary 1-2 mm in diam. ; sessile, glabrous, with sterile thecae arranged in two groups at the base ; styles short, glabrous ; stigma recurved. Fruits 3-4 cm in diam., 4-carpelled, subglobose, dorsally flat, ventrally with distinct transverse circular ridges.

*Fl. & Fr.* : April-May ; June-July.

*Distrib.* : FALSE POINT, BHITARKANIKA, KANSARDIAN : Common throughout the reserve tidal forests along the raised banks of creeks and channels around the mangrove swamps. They are well-developed both in height and girth along the inner fringes of the swamps where the soils are usually a mixture of clay-loam or clay. Under this condition they are never found growing just near the estuaries or along the sea-shores but usually found away from the river-mouth in association with *Cynometra mimosoides*, *Amoora cucullata* and *Intsia bijuga*.

2. *Heritiera littoralis* Ait. in Hort. Kew. ed. 1, 3 : 546. 1789 ; Kosterman in Reinward. 4 : 465. 1959 ; Mast. in Hook. f. Fl. Brit. India 1 : 369. 1874. "Bara Sundari"

Trees, 12-20 m tall, 30-90 cm in girth ; buttresses wavy, upto 30 cm in diam., bark pale-brown ; sap wood white merging into reddish-brown heart wood. Leaves 7-24 × 10-22 cm coriaceous, broadly elliptic or ovate-elliptic, obliquely cordate at base, acute or obscurely acuminate at apex, upper surface smooth, glossy, lower surface covered with silvery fimbriate scales. Flowers 3-6 mm across, golden yellow, tinged red within, densely stellate-pubescent, in axillary panicles ; male flowers : 3-4 mm across : androgynophores white, headed by 8-10 anther thecae in a regular female flowers : 4-5 mm with sterile anthers in many groups arranged at the base of ovary ; style short ; stigmas minute. Fruits 8-12 cm across, ellipsoid, light brown, woody, ventral side flat with a prominent midrib which bends towards apex into a dorsal rudder-like crest or wing ; seeds 2-3 cm broad, ellipsoid, divided into two cotyledons by a ventral line ; plumule deep-red.

*Fl. & Fr.* : June-August ; September-February.

*Distrib.* : BHITARKANIKA : Frequent, in sandy elevated regions within the reserve tidal forests and elevated banks of creeks and channels around the mangrove swamps, usually in association with *Hibiscus tiliaceus*, *Xylocarpus granatum* and *Malinkara hexandra*.

*Notes* : Fruits permit on the trees for more than 6 months, till the beginning of the monsoon. Master (*l.c.*) described this taxon from the coast of Bengal, Eastern and Western peninsula and Sri Lanka, Gamble (Fl. Pres. Madr. 1: 74, 1915) from west coast to Cochin, perhaps also along East coast in the southern district ; Prain (Bengal Plan 1 : 188, 1830) states "No one has ever been able to find it in Sunderbans, thought it has over and over again been specially hunted for", Kosterman (*l.c.*) states the distribution of South East Indian-peninsula. Hence it is evident that the plant has been recorded from the East coast without mentioning any specific locality and as such the present finding from the Orissa coast near Bhitarkanika tidal forest is an interesting record.

## 2. GUAZAMA Adans.

**Guazama ulmifolia** Lamk. Encycl. Meth. Bot. 3 : 52. 1789. *Guazama tomentosa* H. B. K. Nov. Gen. Sp. Pl. 5 : 320. 1823 ; Mast. in Hook. f. Fl. Brit. India 1 : 375. 1874 ; Haines 1 : 86, 1921. "*Bastar*".

Trees, 4-16 m tall, young twigs tomentose. Leaves 6-15 × 3-5 cm, ovate-oblong or oblong-lanceolate, inequilateral, upper surface scabridulous, lower pubescent, crenate-serrate, acuminate at apex, oblique at base. Flowers 2-3 mm across, yellow, stellate-pubescent, in axillary or terminal panicles. Capsules 1-2 cm across, glabrous, woody, indehiscent, coarsely tuberculate.

*Fl. & Fr.* : April-July ; August-December.

*Distrib.* : JAGATSINGPUR : Occasional in scrubs and along roadside.

## 3. PTEROSPERMUM Schreb. (*nom. cons.*)

**Pterospermum xylocarpum** (Gaertn.) Sant. and Wagh in Bull. Bot. Surv. India 5 : 108. 1963. *Velaga xylocarpa* Gaertn. Fruct. 2 : 245, t.133, 1791. *Pterosperm heyneanum* Wall. ex Wt. & Arn. Prodr. 69. 1834 ; Mast. in Hook. f. Fl. Brit. India 1 : 369. 1874 ; Haines 1 : 83. 1921. "*Giringa*"

Trees, 6-12 m tall ; twigs rusty-tomentose. Leaves 6-20 × 4-12 cm, ovate-oblong or elliptic-oblong, variously lobed, stellate-pubescent, acuminate at apex, subcordate at base. Flowers 6-8 cm across, white fragrant in terminal

panicles, solitary or few-flowered cymes. Capsules 5-6 cm across, oblong, woody, brown rusty-tomentose, loculicidally 5-valved ; seeds many, glabrous, bearing a long wing along one side of apex.

*Fl. & Fr.* : October-December ; April-May.

*Distrib.* : BAHAKUD : Frequent in riverine scrubs, secondary forests and roadsides.

#### 4. WALTHERIA Linn.

**Waltheria americana** Linn. Sp. Pl. 673. 1753 ; Back. and Bakh. in Fl. Java 1 : 406. 1963. *W. indica* Linn. Sp. Pl. 673. 1753 ; Mast. in Hook. f. Fl. Brit India. 1 : 374. 1874 ; Haines 1 : 86. 1921. "*Biringa*"

Erect, stellate-pubescent herbs or undershrubs. Leaves 3-5 × 2-2.5 cm, broadly ovate-oblong, soft-pubescent along both sides ; serrate, obtuse or rounded at apex, shallowly cordate at base. Flowers 4-5 cm across, purple, sessile, in axillary or terminal clusters, subtended by many pilose bracts. Capsules 2-3 cm in diam. ovoid, 2-valved ; seeds mostly one.

*Fl. & Fr.* : April-May ; June-July.

*Distrib.* : KUIANG : A polymorphous weed, frequent on sand-dunes, river-banks and dams. Locally common.

#### 5. MELOCHIA Linn.

**Melochia corchorifolia** Linn. Sp. Pl. 675. 1753 ; Johnston, in Sargentia 8 : 203. 1949 ; Mast. in Hook. f. Fl. Brit. India 1 : 374. 1874 ; Haines 1 : 86. 1921. "*Thieka*"

Herbs, 0.5-1 m tall ; young twigs covered with stellate hairs. Leaves 2-3 × 0.5-1 cm ovate, membranous, serrate, acute at apex, cuneate at base ; stipules linear, filiform. Flowers 4-5 mm across, purple, in terminal, head-like clusters, involucred by 4 stipules. Capsules 3-4 mm across, globose, septically dehiscent into 5 cocci.

*Fl. & Fr.* : June-July ; August-September.

*Distrib.* : PARADEEP, KUIANG : Frequent in moist places, river-banks, and sandy sea-shores.

## 14. TILIACEAE

*Key to Genera*

- 1a. Small trees or shrubs :
- 2a. Sepals connate below ; staminodes present ... BROWNLOWIA 1
- 2a. Sepals free ; staminodes absent ... GREWIA 2
- 1a. Herbs or undershrubs :
- 3a. Capsules echinate ... TRIUMFETTA 3
- 3a. Capsules not echinate ... CORCHOROUS 4

## 1. BROWNLOWIA Roxb.

**Brownlowia tersa** (Linn.) Kosterm. in Reinward. 4 : 536. 1959. *Glabraria tersa* Linn. Mant. 2 : 276. 1771. *Brownlowia lanceolata* Benth. in Jour. Linn. Soc. Bot. 5, Suppl. 57. 1861 ; Mast. in Hook. f. Fl. Brit. India 1 : 381. 1874 ; Haines 1 : 84. 1921. "*Pani sundari* or *Nata sundari*"

Trees, 1-2 m tall ; young twigs covered with brown lepidotes. Leaves 13-18 × 3-5 cm. lanceolate, glabrous, closely lepidote beneath, acuminate at apex, rounded at base. Flowers 3-4 mm across, flesh-coloured in axillary or terminal cymes ; peduncles 5-7 cm long ; sepals 4 or 5 connate below ; petals free, isomerous to sepals. Fruits 1-1.5 cm across, pyriform, or obliquely ovoid, woody, brown with distinct line of two valved carpels ; seed 1, obovoid, glossy.

*Fl. & Fr.* : May-June ; September-December.

*Distrib.* : FALSE POINT, BHITARKANIKA : Common along the inter tidal regions of several creeks and channels in mangrove forests. It usually occupies the first stratum of mangrove forests in groups where more than half the length of plants remain under salt water during high tides ; roots are found to interlock with each other for a synchronising mechanism against tidal forces.

## 2. GREWIA Linn.

**Grewia rhamnifolia** Heyne ex Roth. Nov. Pl. Sp. 244. 1821 ; Narayanswami and Rao in Indian Bot. Soc. 29 : 187. 1950 ; Haines 1 : 92. 1921. *G. orientalis* (non Linn.) Mast. p. p. in Hook. f. Fl. Brit. India 1 : 384. 1874. "*Ghorgur*"

Straggling shrubs or lianas; stems covered with stellate hairs. Leaves 6-12 × 3-6 cm, ovate, lanceolate or oblong, serrulate, acuminate at apex, rounded at base, 3-nerved; nerves with adpressed stellate hairs. Flowers 1-1.3 cm long, yellow or white, arranged in axillary, extra-axillary, or leaf-opposed cymes collected into panicles. Fruits 1.3-1.5 cm across, 4-lobed pyrenes; pyrenes matted with golden yellow tomentum and septate between seeds; seeds 4, with elevated ridges.

*Fl. & Fr.* : May-July; September-December.

*Distrib.* : BAHAKUD, DALATNAGAR : Frequent in scrubs along sandy river banks in association with *Roripa minor*, *Hugonia mystax* and *Carissa spinarum*.

### 3. TRIUMFETTA Linn.

*Triumfetta rhomboidea* Jacq. Enum. Pl. Craib. 22, 1760; Sant. in Bull. Bot. Surv. India 3 : 21. 1962; Mast. in Hook. f. Fl. Brit. India 1 : 395, 1874; Haines 1 : 89. 1921. "*Chikta*".

Stellate, pubescent undershrubs, 30-60 m tall. Leaves variable, 2-10 × 0.5-9 cm ovate-lanceolate, rhomboid or cordate covered with simple or stellate hairs along both surfaces, serrate or irregularly lobed. Flowers 4-6 mm across, dull red or yellow, in terminal or axillary fasciculate cymes. Capsules subglobose, densely covered with hooked bristles.

*Fl. & Fr.* : October-November; January-February.

*Distrib.* : KUJANG : Frequent along the river-banks and sea-shores, locally common on moist places.

### 4. CORCHORUS Linn

*Corchorus aestuans* Linn. Syst. Nat. ed. 10, 1079. 1759; Sant. in Rec. Bot. Surv. India ed. 3. 16 (1) : 27. 1967. *C. acutangulus* Lamk, Encycl. 2 : 104, 1786; Mast. in Hook. f. Fl. Brit. India 1 : 398. 1874; Haines 1 : 90. 1921.

Erect annual herbs or undershrubs, 1-1.5 m tall. Leaves 2-7 × 1-4 cm, ovate-lanceolate or elliptic-oblong, serrate, glabrous or pubescent, acute at apex, rounded at base; petioles 1-15 cm long, hispid; stipules 0.3-0.5 cm, linear-acuminate. Flowers 2-4 mm across, yellow, in subaxillary cymes. Capsules 2.5-3 cm long, 6-angled; alternate angles, winged; horns 3, bifid at apex.



*Fl. & Fr.* : June-July ; September-October.

*Distrib.* : KUJANG, FALSE POINT : Frequent along the river-banks and moist places, locally common on pastures and cultivated lands.

## LINACEAE

### HUGONIA Linn.

*Hugonia mystax* Linn. Sp. Pl. 675. 1753 ; Hook. in Hook. f. Fl. Brit. India 1 : 413. 1874 ; Haines 1 : 151. 1921. "*Chulijtnka*".

Scandent shrubs : branches yellowish, tomentose, with alternate horizontal branchlets. Leaves 3-6×1.5-3 cm, alternate or crowded at apex of the horizontal branchlets, mostly elliptic or pandurate, entire, glabrous, subacute at apex, tapering at base ; stipules 0.4-0.6 cm long, subulate, tomentose. Flowers 1-1.5 cm across, yellow, in terminal or upper axils of branchlets ; peduncles 2-4 cm long, lower peduncles of each branchlet modified into a spiral hook. Drupes 1-1.2 cm in diam., globose, yellow or orange-red with scanty pulp and persistent calyx.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : BAHAKUD, HARISHPUR : Common in riverine scrubs and coastal thickets, in association with *Rouria minor* and *Clausena heptaphylla*.

## ZYGOPHYLLACEAE

### TRIBULUS Linn.

*Tribulus terrestris* Linn. Sp. Pl. 387, 1753 ; Hook. in Hook. f. Fl. Brit. India 1 : 423. 1874 ; Haines 1 : 159. 1921. "*Gokhur*".

Prostrate annual herbs ; stems much-branched, pubescent. Leaves 2-4 cm long, opposite, anisophyllous, peripinnate ; leaflets 3-6 pairs, each 4-10×2-9 mm, sessile, ovate or elliptic-oblong, entire, silvery-pubescent below, obtuse at apex, oblique at base. Flowers 1 cm across, yellow, solitary, axillary. Fruits 1-1.5 cm in diam., globose, at maturity dividing into 5 mericarps without the central axis ; mericarps triangular, tuberculate, dorsally crested, bearing two dorsal and two basal spines.

*Fl. & Fr.* : Mostly throughout the season.

*Distrib.* : PARADEEP, FALSE POINT : Frequent in scrubs, roadsides and sandy uplands ; rare, along the sea-shores amidst *Spinifex littoreus* and others.

## OXALIDACEAE

### Key to Genera

- |                                   |     |             |
|-----------------------------------|-----|-------------|
| 1a. Leaves palmately trifoliolate | ... | OXALIS 1    |
| 1a. Leaves pinnate                | ... | BIOPHYTUM 2 |

### 1. OXALIS

*Oxalis corniculata* Linn. Sp. Pl. 435, 1753 ; Eiten in Taxon 4 : 99-105. 1955 ; Ingram in Bailey 6 : 28, f. 7A, 1958 ; Hook. in Hook. f. Fl. Brit. India 1 : 436. 1874 ; Haines 1 : 162. 1921. "*Amboti*".

Creeping, perennial herbs with slender branches ; rooting at nodes. Leaves palmately trifoliolate ; petioles 0.6-6 cm long, slender ; leaflets subsessile, obcordate, cuneate at base. Flowers yellow, one to many, in axillary umbellate clusters. Capsules 6-15 mm long, linear, shortly beaked, tomentose.

*Fl. & Fr.* : During the rainy season.

*Distrib.* : PARADEEP : Frequent along the edges of sandy ditches near the sea-shore ; usually gregarious in moist places and cultivated land.

### 2. BIOPHYTUM DC.

*Biophytum sensitivum* (Linn.) DC. Prodr. 1 : 690. 1824 ; Steenis in Bull. Bot. Gard. Buitenz. 3, 18 : 452. 1950 ; Hook. in Hook. f. Fl. Brit. India 1 : 436. 1874 ; Haines 1 : 161. 1921. *Oxalis sensitiva* Linn. Sp. Pl. 434. 1753.

Erect annual herbs crowned with a rosette of paripinnate leaves ; stems 3-16 cm long, sensitive ; rachella slender, ending in minute projections ; leaflets 8-14 pairs, decreasing in size basipetally, each 0.5-1 × 0.3-0.6 cm, oblong to obliquely obovate, apiculate at apex, obliquely rounded at base. Flowers yellow, in pedunculate umbels ; peduncles 3-15 cm long, slightly pubescent. Capsules 4-6 mm long splitting into 5 spreading valves ; seeds ellipsoid with prominent transverse ridges.

*Fl. & Fr.* : May-June ; October-November.

*Distrib.* : ALIPINGAL : Common along sandy river-banks, in open places and cultivated field.

## RUTACEAE

### Key to Genera

- 1a. Plants armed with spines or prickles :
- 2a. Plants with axillary spines ; leaves simple ... MEROPE 1
- 2b. Plants with prickles ; leaves trifoliolate ... TODDALIA 2
- 1a. Plants unarmed :
- 3a. Leaflets not more than 7 ... GLYCOSMIS 3
- 3b. Leaflets more than 7, usually 11 ... CLAUSENA 4

### 1. MEROPE Roem.

*Merope angulata* (Willd.) Swingle in Journ. Washington Acad. Sci. 5 : 423. 1915 ; Back. & Bakh. in Fl. Java 2 : 106. 1965. *Citrus angulata* Willd. Sp. Pl. 3 : 1426. 1826. *Paramignya angulata* (Willd.) Kurz in Jour. Asiat. Soc. Beng. 44 (2) : 135. 1875 ; Mooney in Suppl. Bot. Bihar and Orissa 249. 1950. "*Bon-limbu*".

Spiny shrubs, 2-4 m tall ; stems glabrous with paired axillary spines ; spines 2-5 cm long, straight, prominent in young branches. Leaves 3-14 × 1.5-3.5 cm simple, oblong or elliptic-oblong ; entire, thick, coriaceous, obtuse or acute at apex, obtuse at base ; petioles 0.5-0.7 cm long, slightly winged. Flowers 1-1.3 cm across, white, fragrant, axillary, solitary or in pairs or in few-flowered clusters ; pedicels 1-15 cm long ; calyx 5-lobed, each 3-4 × 2-3 mm, cupulate, toothed ; petals 5, ovate, obtuse, imbricate, 6-8 × 2-3 mm, stamens 10, free ; anthers apiculate, longer than filaments ; ovary glabrous, stipitate ; style cylindric ; stigma capitate. Fruits 3-4 × 1.5-2 cm, ovoid, triquetrous, beaked, coriaceous berry, filled with mucilaginous fluid. Seeds 4, one in each locule, 1.5-2 cm long, ovoid-oblong, compressed with a narrow beak at apex, attached to the apiculus of fruit.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : JAMBU, FALSE POINT : Common in estuarine islands along the intertidal as well as supratidal regions of several creeks and channels, in association with *Cerriops decandra* and *Aegiolites rotundifolia*.

*Notes* : Dry berries are said to be very effective for bronchial asthma and children's whooping cough.

## 2. TODDALIA Juss.

*Toddalia asiatica* (Linn.) Lamk. 111 : 2. 1792. *Paullinia asiatica* Linn. Sp. Pl. 524, 1753. *Toddalia aculeata* Pers. Syn. Pl. 1 : 249. 1806 ; Hook. in Hook. f. Fl. Brit. India 1 : 497. 1874 ; Haines 1 : 116, 1921. "*Tundapora*".

Erect, bushy or rambling shrubs ; branches puberulous, armed with prickles. Leaves trifoliolate ; leaflets subsessile, each 3-7 × 1-1.5 cm, lanceolate, crenulate, upper surface coriaceous, lower surface slightly puberulous with prickles along midrib, subacute at apex, obtuse at base. Flowers white, unisexual ; male flowers : 2-3 mm across, in axillary cymes or panicles ; female flowers ; 3-5 mm across, in axillary simple racemes. Fruits 5-7 mm across, subglobose, 3-5-loculed, orange-red when ripe : seeds 1 in each locule, angled, reniform ; testa coriaceous.

*Fl. & Fr.* : August-October ; November-December.

*Distrib.* : BAHAKUD, BHITARKANIKA : Frequent in riverine scrubs and coastal thickets.

## 3. CLAUSENA Burm. f.

*Clausena heptaphylla* Wt. & Arn. Prodr. 95, 1834 ; Tanaka in Jour. Indian Bot. Soc. 16 : 230. 1937 ; Hook. in Hook. f. Fl. Brit. India 1 : 504. 1874 ; Mooney in Suppl. Bot. Bihar & Orissa, 38, 1950.

Strongly aromatic, glabrous shrubs or small trees. Leaves imparipinnate, 8-11 foliolate ; leaflets 6-8 × 2-4 cm, elliptic or ovate-lanceolate, coriaceous, entire, shining, acute at apex, obliquely obtuse at base. Flowers 3-4 mm across, whitish, in short-branched, axillary or terminal thyrses. Fruits 0.5-0.7 cm in diam., globose berry, orange-red when ripe.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : BAHAKUD, BHITARKANIKA : Common in riverine scrubs, sand-bars within the tidal forests, in association with *Rouria minor*, *Hugonia mystax* and *Carissa spinarum*.

## 4. GLYCOSMIS Correa

*Glycosmis pentaphylla* (Retz.) DC. Prodr. 1 : 538. 1824, quoad basio ; Tanaka in Jour. Indian Bot. Soc. 16 : 229. 1937 ; Mitra & Subramanyam in Jour. Arn. Arb. 50 : 155. 1969 ; Hook. in Hook. f. Fl. Brit. India 1 : 500. 1875 ; Haines 1 : 169. 1921. *Limonia pentaphylla* Retz. Obs. Bot. 5 : 24, 1789.

Undershrubs or shrubs upto 3 m tall. Leaves pinnate, 3-5, or 7 foliolate; leaflets 4-13×1-4 cm, elliptic or ovate-lanceolate, entire or slightly serrate, glabrous, acute or acuminate at apex, tapering towards base. Flowers 2-3 mm across, brownish-white, in axillary panicles. Berries 0.5 cm in diam., globose, juicy, apiculate. '*Homonicho*'.

*Fl. & Fr.* : May-July ; August-September.

*Distrib.* : BAHAKUD : Common along the roadsides, river-banks ; frequent on sand bars within the tidal swamps.

## OCHNACEAE

### OCHNA Linn.

*Ochna obtusata* DC. Ann. Mus. Paris 17 : 4111, Pl. 11. 1811 ; Kanis in Blumea 16 (1) : 29. 1968. *Discladitum obtusatum* (DC.) v. Tiegh. in Morot. Jour. Bot. 16 : 125. 1902. *Ochna squarrosa* (auct non Linn.) Rottb. Dansk. Vidensk. Selsk. Skrift. N.S. 2 : 545, t. 6. 1783 ; Benn. in Hook. f. Fl. Brit. India 1 : 523. 1875 (excl. syn.) ; Haines 2 : 169. 1921. "*Bara-Charapa*".

Trees or shrubs 2-3 m tall ; branches glabrous, with annular scars ; stipules simple, caducous. Leaves alternate, distichous, 4-14×2-8 cm, elliptic or ovate-lanceolate, subcoriaceous, denticulate, acute at apex, attenuate at base. Flowers 1-4 cm across, yellow, with red torus, in shortly-branched, axillary or terminal thyrses ; peduncles 1-1.5 cm long, with annular scars ; pedicels 2-4 cm long, slender ; sepals 3-5 ; petals 8-10 ; stamens many. Fruits 3-5, attached to an elongated torus.

*Fl. & Fr.* : June-July ; October-December.

*Distrib.* : HETAMUNDIA : Frequent along the river-banks and sand bars situated in between the tidal swamps.

## MELIACEAE

### Key to Genera

- |                            |                   |
|----------------------------|-------------------|
| 1a. Fruits capsules :      |                   |
| 2a. Seeds with fleshy aril | ... AGLAIA 1      |
| 2b. Seeds without aril     | ... XYLOCARPUS 2  |
| 1b. Fruits drupes :        |                   |
| 3a. Drupes 1-celled        | ... CIPADESSA 3   |
| 3b. Drupes 5-celled        | ... AZADIRACHTA 4 |

1. *AGLAIA* LOWR. (*nom. cons.*)

*Aglaia cucullata* (Roxb.) Pellegrin in Lecomte, Fl. Gen. Indochine 1 : 771. 1911 ; Pennington & Styles in Blumea 22 (3) : 481. 1975. *Amoora cucullata* Roxb. Pl. Coromandel, 3 : 54, t. 258. 1819 ; Hiern in Hook. f. Fl. Brit. India 1 : 560, 1875 ; Harms in Engl. & Prantl, Pfam. ed. 2. 19b. 1 : 128. 1940. "*Angara*" (Fig. 3).

Dioecious trees or treelets, 3-8 m tall with numerous blind rootsuckers beneath ; stems few-branched ; barks soft, lenticellate. Leaves 34-40 cm long, imparipinnate, glabrous ; leaflets 7-11, each 9-18 × 4.6 cm, elliptic-oblong or oblong-lanceolate, glabrous, inequalateral, obtuse at apex, terminal leaflets mostly forming a distinct cup at base. Flowers unisexual, 3-4 mm across, yellow, in axillary panicles ; male inflorescence : 20-30 cm long, many-flowered ; female inflorescence : 8-20 cm long, few-flowered ; calyx 3-lobed, each 1-2 mm, lepidote, minutely ciliate, petals 3, broadly elliptic, concave ; staminal tube 2-3 mm long, petaliferous, obovoid, campanulate ; anthers 6, attached at top of each filament ; connective hood-like. Fruits trilocular capsules 8-12 cm across, globose, depressed, yellow when ripe ; seeds 3, completely covered by a fleshy, orange arils.

*Fl. & Fr.* : Male flowers throughout the season, female flowers during April-July ; fruits during August-November.

*Distrib.* : BHITARKANIKA : Common in tidal forests along intertidal regions usually in association with *Heritiera fomes*, *Cynometra mimosoides* and *Xylocarpus moluccensis*.

*Notes* : Haines in Bot. Bihar & Orissa (1921) and Mooney in Suppl. Bot. Bihar & Orissa (1950) did not record this plant from Orissa ; hence, it is a new record for Orissa. The formation of basal cup in the terminal leaflets and presence of strong rootsuckers help in the identification of this taxon in sterile condition.

The generic status of *Amoora* has been discarded here because of the recent generic monograph of the Meliaceae by Pennington and Styles (*l.c.*).

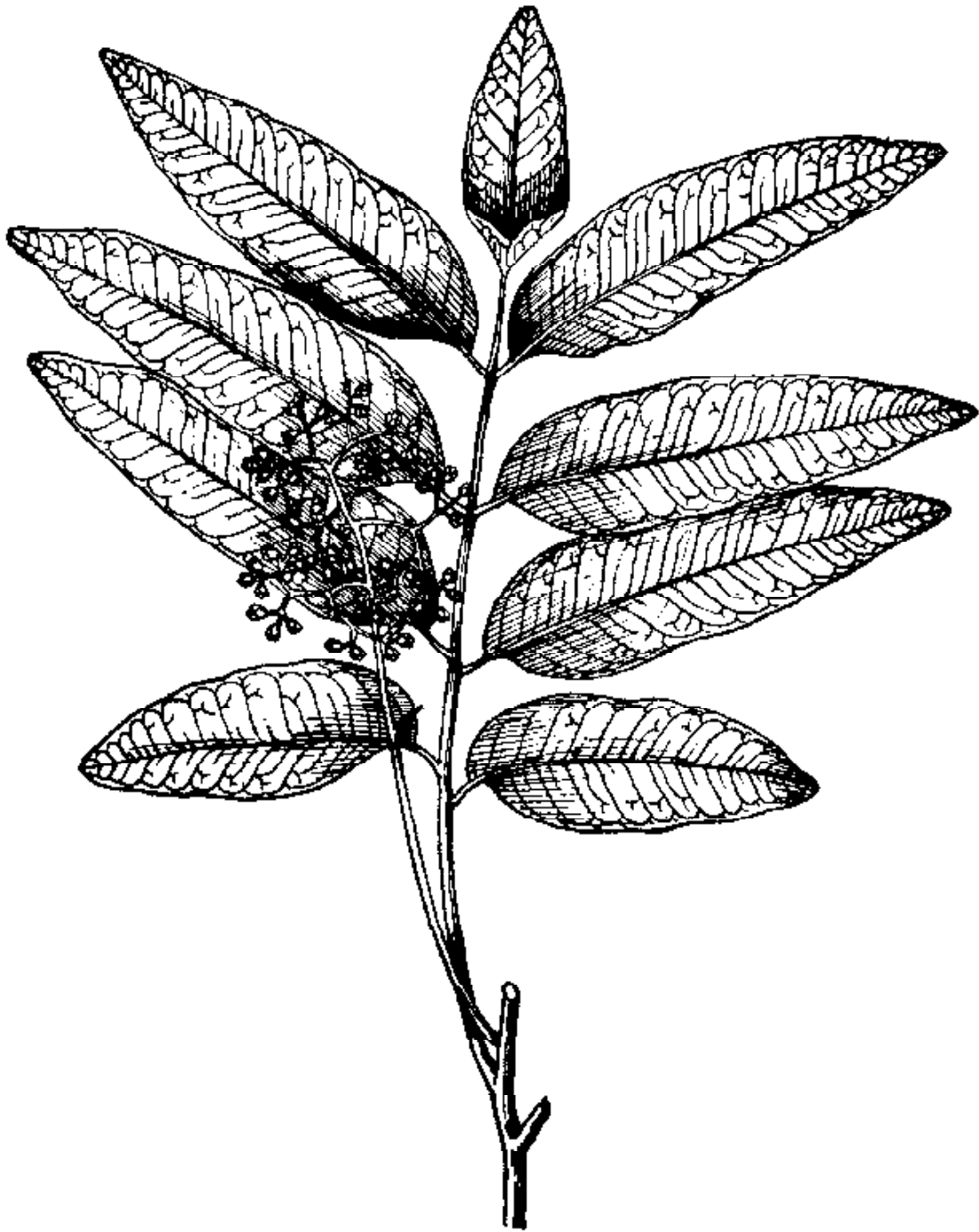


Fig. 3. *Aglaia cucullata* (Roxb.) Pellegrin.

## 2. XYLOCARPUS Koen.

*Key to species*  
(Based on vegetative characters)

- 1a. Buttresses present ; rootsuckers absent ; bark yellowish  
-white with papery flakes ; leaflets obovate ; fruits  
20 - 35 cm across

... *granatum* 1

- 1a. Buttresses absent ; rootsuckers present ; bark dark-red with thick flakes ; leaflets not obovate ; fruits less than 20 cm across :
- 2a. Leaflets elliptic-oblong ; fruits 8 - 15 cm across ... *mekongensis* 2
- 2b. Leaflets ovate ; fruits 5 - 7 cm across ... *moluccensis* 3

*Key to species*

( Based on floral characters )

- 1a. Anthers exceeding the obscure staminal teeth ... *moluccensis*
- 1a. Anthers not exceeding the prominent staminal teeth :
- 2a. Staminal teeth 1.5 - 2 mm long ; stigma discoid ... *mekongensis*
- 2b. Staminal teeth 0.5 - 1 mm long ; stigma cupular ... *granatum*

1. *Xylocarpus granatum* Koen. Naturforscher 20 : 2, 1784 ; Harms in Engl. & Prant. Pfam. ed. 2, 19bI 81, 1940 ; Parkinson in Indian For. 60 : 138. 1934 ; Mooney in Suppl. Bot. Bihar & Orissa 249. 1950. *Carapa obovata* Blume Bijdr. 179. 1825 ; Haines 1 : 187. 1921. "Susumaro".

Trees, 10-15 m tall, 60-80 cm in girth ; stems buttressed ; bark smooth, yellowish-white with papery flakes. Leaves unijugate or bijugate, lower pairs subopposite ; leaflets 6-10×3-5 cm, obovate, entire, coriaceous, rounded at apex, tapering at base. Flowers 5-7 mm across, white, red glandular within, on short sparingly-branched, axillary thyrses ; calyx 4-lobed ; petals 4, free ; staminal teeth 0.5-1 mm long, exceeding anther lobes ; ovary 4-locular ; style short ; stigmas cupular. Fruits 30-40 cm across, spherical, pendulous, septifragal capsules, splitting tardily into 4 valves ; seeds more than 15 ; each 4-7×3-4 cm pyramidal or triangular ; testa corky.

*Fl. & Fr.* : Throughout the season, fruits split during July-August.

*Distrib.* : FALSE POINT, JAMBU : Common along the intertidal regions in the tidal forests, usually in association with *Rhizophora apiculata*, *Kandelia candel* and *Sonneratia apetala*.

2. *Xylocarpus mekongensis* Pierre, Fl. Cochin, t. 359B. 1897. *X. gangeticus* (Prain) Parkinson in Indian For. 60 : 140, 1934 ; Mooney 249, 1950. *Carapa moluccensis* Lamk. var. *gangeticus* Prain in Rec. bot. Surv. India 2 : 292. 1903 ; Harms in Engl. & Prant. Pfam. ed. 2. 19bI 85, 1940. "Pitamari".

Trees, 10-15 m tall, 40-60 cm in girth with many blind rootsuckers bark reddish-brown with thick flakes. Leaves paripinnate, mostly bijugate ; leaflets 2-4 pairs, each 9-18×4-7 cm, elliptic or oblong,



coriaceous, obtuse at both ends. Flowers 3-4 cm across, white in short-branched, axillary thyrses; staminal teeth 1.5-2 mm long, linear anthers not exceeding the staminal teeth; ovary 4-locular, each locale with 4-ovules; stigmas discoid. Fruits 8-12 cm across, capsular, brown, leathery, globose; seeds 1-2 cm across, flat, compressed, tetrahedral; testa corky.

*Fl. & Fr.* : March-April; June-July.

*Distrib.* : HOOKITOLA, JAMBU, BHITARKANIKA : Frequent in tidal forests along the intertidal as well as supra tidal regions in association with *Heritiera fomes* and *Bruguiera gymnorrhiza*.

3. *Xylocarpus moluccensis* (Lamk.) M. Roem. Syn. Hesper. 124, 1846; Harms in Engl. Prant. Pfam. ed. 2, 19b1 84, 1940; Adelbert in Blumea 6 (1) : 314, 1947-48. *Carapa moluccensis* Lamk. Encycl. 1 : 621, 1785; Hiern in Hook. f. Fl. Brit. India 1 : 567, 1875. "*Pitakura*".

Trees, 10-50 m tall, 20-50 cm in girth with numerous blind rootsuckers; bark red with thick flakes; constantly peeling off; wood dark red. Leaves paripinnate, 2-3 jugate; leaflets 7-12 × 3-6 cm, ovate, coriaceous, acute at apex, oblique at base. Flowers 2-3 cm across, red glandular within, on sparingly-branched, axillary thyrses; staminal teeth obscure; anthers exceeding the staminal teeth; stigma cupular. Fruits 10-18 cm across, globose, woody; seeds 2-4 cm in diam., tetrahedral, angular margined due to compression; testa smooth, corky.

*Fl. & Fr.* : June-July (with the appearance of new leaves); September-December.

*Distrib.* : BHITARKANIKA : Sporadic in the intertidal or supra tidal regions, usually favouring sandy uplands within the tidal swamps in association with *Heritiera littoralis*, *Aglata cucullata* and *Intsia bijuga*.

Red wood is used for making furniture.

*Notes* : Haines (1921) and Mooney (1950) did not record this plant from Orissa; the constant peeling of bark in the form of flakes is a remarkable feature of this species.

#### 4. CIPADESSA Blume

*Cipadessa baccifera* (Roth) Miq. in Ann. Mus. Lugd. Bot. 4 : 6, 1868; DC. Mon. Phan. 1 : 426, t. 16, f. 1a-c, Harms in Engl. & Prant. Pfam. ed.

2, 19bI 93, 1940. *Melia baccifera* Roth, Nov. Pl. Sp. 215. 1821. *Cipadessa fruticosa* Blume Bijdr. 162, 1825 ; Hiern in Hook. f. Fl. Brit. India 1 : 545, 1875 ; Haines 1 : 183. 1921. "Nalballi".

Trees, 3-6 m tall with more or less soft lenticellate bark. Leaves 13-20 cm long, imparipinnate ; leaflets 7-11, each 4-9 × 2-4 cm, ovate or ovate-elliptic, glabrous or thinly pubescent, crenate or entire, oblique at base. Flowers 3-5 mm across, polygamous, white, in axillary panicles ; peduncles 5-7 cm long. Fruits 3-5 mm across, globular drupes with 2 pyrenes ; seeds 1 in each pyrene, elongated ; testa thin, membranous.

*Fl. & Fr.* : May-June ; August-September.

*Distrib.* : DALTANAGAR : Frequent in scrubs along the river-banks.

#### 5. AZADIRACHTA A. Juss.

*Azadirachta indica* A. Juss. Mem. Mus. Hist. Nat. Par. 19 : 220, 5. 2, f. 5, 1830 ; Harms in Engl. & Prant. Pfam. ed. 2, 19bI 102, f. 26. 1940 ; Haines 1 : 182. 1921. *Melia azadirachta* Linn. Sp. Pl. 385. 1753 ; Hiern in Hook. f. Fl. Brit. India 1 : 544, 1875.

Trees, 10-30 m tall. Leaves 8-20 cm long, imparipinnate, leaflets 7-11, each 2-6 × 1-3 cm, ovate-lanceolate, obliquely falcate, serrate, acuminate at apex, oblique or lobulate at base. Flowers 3-5 mm across, white, polygamous, in axillary many-flowered panicles. Fruits 10-15 mm long, ovoid, one-seeded, drupes ; endocarp cartilaginous, yellow when ripe ; seed one, pointed at apex ; testa membranous.

*Fl. & Fr.* March-April, May-June.

*Distrib.* : KUJANG, GOPALPUR : Frequent along the lee side of the coastal dunes, and along road-sides and gardens.

### OLACACEAE

#### OLAX Linn.

*Olax scandens* Roxb. Pl. Cor. 2 : 2, t. 102. 1799 ; Sleumer in Engl. & Prant. Pfam. ed. 2, 16b : 27. 1935 ; Mast. in Hook. f. Fl. Brit. India 1 : 575. 1875 ; Haines 1 : 189, 1921. "Bdurli".

Woody, scandent shrubs ; stems much-branched, cylindric, striate ; branchlets armed with curved prickles. Leaves 3-9 × 2-5 cm elliptic-oblong or ovate-lanceolate, glabrous above, puberulous beneath, entire, acute or obtuse at apex, subcordate at base. Flowers 5-6 mm long, white, fragrant, in axillary racemes ; peduncles 1.5-1.7 cm long, pubescent. Fruits 1-2 cm across, ellipsoid drupes, yellow when ripe, enclosed by accrescent calyx.

*Fl. & Fr.* : June-July ; August-September.

*Distrib.* : BAHAKUD, BHITARKANIKA : Frequent along the river-banks, sandy uplands sand bars in between the creeks and channels.

## OPILIACEAE

### CANSIERA JUSS.

*Cansiera rheedii* Gmelin, Syst. 2 : 280. 1791 ; Mast. in Hook. f. Fl. Brit. India 1 : 582. 1875 ; Haines 1 : 191, 1921. "*Jhantika*".

Large, scandent shrubs ; twigs ferruginous, pubescent, old stems lenticellate, spiny at base. Leaves 4-10 × 1-4 cm, lanceolate or ovate, glabrous, wrinkled with translucent markings, acuminate at apex, rounded at base. Flowers 1-2 mm across, white, pubescent, in axillary spikes. Fruits not seen.

*Fl. & Fr.* : July-August ; fruit not seen.

*Distrib.* : HETAMUNDIA : A root parasite, frequent in scrubs and coastal thickets.

## CELASTRACEAE

### MAYTENUS Molina

*Maytenus emarginata* (Willd.) Ding Hou in Fl. Males. 6 (2) : 2411, 1962. *Celastrus emarginatus* Willd. Sp. Pl. 1, 2 : 1128, 1798. ex descr. : Lawson in Hook. f. Fl. Brit. India 1 : 621, 1875 ; Haines 1 : 194, 1921. "*Bali-boincha*".

Shrubs, 1-3 m tall or scandent ; stems much-branched, glabrous, armed with long spines. Leaves variable in size and shape, usually 2.5-8.5 × 1.5-3 cm, obovate or ovate-elliptic, coriaceous, entire, attenuate

at base, obtuse, rounded or mostly emarginate at apex. Flowers 3-4 mm across, polygamous, white, densely clustered cymes on branchlets or on the spines; pedicels 3-11 mm long, slender, reddish brown. Fruits 8-14 × 6-8 mm, obovoid, pyriform, 3-loculed, 6-chambered by partition, splitting into 3-valved. Seeds 1-2, in each chamber; shining brown; aril cupular at base.

*Fl. & Fr.* : November-January; February-March.

*Distrib.* ; BAHAKUD : Common in riverine scrubs, coastal thickets and sand bars within the mangrove swamps.

## RHAMNACEAE

### Key to Genera

- |   |     |             |
|---|-----|-------------|
| 1a. Under surface of leaves tomentose; stipules spinulose,<br>fruit one-seeded drupe    | ... | ZIZIPHUS 1  |
| 1a. Under surface of leaves glabrous; stipules not spinulose,<br>fruit 3-seeded capsule | ... | COLUBRINA 2 |

### 1. ZIZIPHUS Miller

#### Key to species

- |                                   |     |                     |
|-----------------------------------|-----|---------------------|
| 1a. Erect shrubs or trees         | ... | <i>mauritiana</i> 1 |
| 1b. Scandent or straggling shrubs | ... | <i>oenoplia</i> 2   |

1. *Ziziphus mauritiana* Lamk. *Encycl. Method. Bot.* 3 : 319. 1789. Engl. & Prant. *Pfam.* ed. 2, 20D : 124, f. 35A-D, 1953. *Ziziphus jujuba* Lamk. *Ibid.* 318, non Miller 1768; Lawson in Hook. f. *Fl. Brit. India* 1 : 632. 1875; Haines 1 : 201. 1921; Santapau J. *Bomb. nat. Hist. Soc.* 51 : 802. 1954.

Trees 4-8 m tall, branchlets drooping, armed with thorns. Leaves 1.5-6.5 × 1-3.5 cm alternate, broadly elliptic or ovate, dark-green, tomentose beneath, connate or serrate rounded at apex oblique at base. Flowers greenish white, 4-5 mm across, arranged in axillary cymes. Fruits 1-2 cm across, an ellipsoid drupe.

*Fl. & Fr.* : August-October; December-March.

*Distrib.* : BAHAKUD : Frequent along scrub jungles and beach forests near the delta.

2. *Ziziphus oenoplia* (Linn.) Miller, Gard. Dict. ed. 8, no. 3, 1768 ; Lawson in Hook. f. Fl. Brit. India 1 : 634, 1875 ; Haines 1 : 203, 1921. *Rhamnus oenoplia* Linn. Sp. Pl. 282, 1753. "Kontakuli".

Straggling, thorny shrubs with many pubescent branches ascending the nearest trees. Leaves 2.5 × 1-2.5 cm ovate-lanceolate, glabrous above, adpressed silky hairy beneath, acuminate at apex, obliquely rounded at base. Flowers greenish white, 1-2 mm across, in axillary cymes, peduncles 2-4 cm long, brownish tomentose. Fruits 4-6 mm across, globose drupes.

*Fl. & Fr.* : June-September ; November-December.

*Distrib.* : BAHAKUD, BHITARKANIKA : Common in scrub jungles and coastal thickets usually in association with *Carisa spinarum*, *Eugenia bracheata* and *Memecylon edula*.

#### COLUBRINA L. Rich. ex Brong. (*nom. cons.*)

*Colubrina asiatica* (Linn.) Brong. in Ann. Sci. Nat. Ser. 1, 10 : 369, 1827 ; Lawson in Hook. f. Fl. Brit. India 1 : 642, 1875. *Ceanothus asiatica* Linn. Sp. Pl. 196, 1753.

Unarmed, glabrous shrubs with many shining branches. Leaves 4-8 × 3-5 cm, alternate, ovate, dentate, obtusely acuminate at apex, rounded or cordate at base ; petioles 1.5 cm long ; stipules caducous. Flowers, 2-3 mm across, white or cream-coloured, arranged in axillary thyrses or cymes. Fruits 7-9 mm across, subglobose, tardily dehiscent capsules ; seeds 3, obovate, brown, one in each locule.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : HOOKITOLA : Frequent in sandy beach forests and along sand bars within the mangrove swamps usually found in association with *Lumnitzera racemosa*, *Excoecaria agallocha*, and others.

*Notes* : Lawson in Hook. f. Fl. Brit. India (*l.c.*) has reported its distribution from Eastern and Western peninsulas without any precise locality. Gamble in Fl. Pres. Madras 1 : 161. rep. ed. 1957 reported from Coimbatore dist. Cooke in Fl. Pres. Bombay 1 : 261. rep. ed. 1958 reported from Ratangiri hills and Laccadive Island. Haines in Bot. Bihar and Orissa, 1921 and Mooney in Supp. Bot. Bihar & Orissa 1950 have not reported this species ; hence the present distribution of this species from Hookitola Island is a new record for Orissa.

## VITACEAE

CAYRATIA Juss. ( *nom. cons.* )

*Cayratia trifolia* (Linn.) Domin in *Biblioth. Bot.* 89 : 37. 1972 ; Back & Bakh. in *Fl. Java* 2 : 93. 1965. *Vitis trifolia* Linn. *Sp. Pl.* 203. 1753 ; Haines 1 : 213. 1921. *V. carnosa* (Lamk.) Wall. ex Wt. & Arn. *Prodr.* 127, 1834 ; Laws. in Hook. f. *Fl. Brit. India* 1 : 654. 1875. *Cissus carnosa* Lamk. *Encyl.* 1 : 31. 1783. *Cayratia carnosa* (Lamk.) Gagnep. in *Nat. Syst.* 1 : 347. 1911. 'Amarlathi'.

Herbaceous climbers with leaf-opposed bifid tendrils. Leaves trifoliolate ; leaflets 3-7 x 1-5 cm ovate, elliptic or rhomboid, lower surface patently hairy, crenate, acute at apex, rounded or obtuse at base. Flowers 3-4 mm across, greenish white, in axillary cymes ; peduncles slender, 10-20 cm long. Fruits 1-15 cm across, depressed, globose berries, reddish black when ripe ; seeds 3-4, with a chalaza on the back.

*Fl. & Fr.* : June-September, November-December.

*Distrib.* : BAITRAKUD : Frequent along the outer fringes of mangroves, river-banks and road-sides.

## SAPINDACEAE

*Key to Genera*

1a. Tendrillar herbs	...	CARDIOSPERMUM 1
1b. Erect shrubs		
2a. Fruits drupaceous, not winged		
3a. Leaves 3-foliolate	...	ALLOPHYLUS 2
3b. Leaves paripinnate	...	LEPISANTHES 3
2b. Fruits capsules, winged	...	DODONEA 4

## 1. CARDIOSPERMUM Linn.

*Cardiospermum hallicacabum* Linn. *Sp. Pl.* 366, 1753 ; Engler. *Pflanzenr.* 4 : 165, 370, 1931 ; Hiern. in Hook. f. *Fl. Brit. India* 1 : 670. 1875 ; Haines 1 : 218. 1921. 'Sibjhula'.

Climbing herbs with angular, puberulous branches. Leaves alternate, biternate; petioles 2-5 cm long, sulcate; leaflets or ultimate segments 3-6 × 1.5-3 cm, pinnately cleft, lobed or incised along margins, puberulous along both surfaces. Flowers 2-3.5 mm across, white in axillary cymes subtended by a pair of tendrils. Fruits 1.5-2 cm across, depressed, inflated capsules; seeds 3, with a conspicuous hilum at base.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : KIJUNG : Frequent in waste places and along the riverside hedges.

*Notes* : Local people use roots for intestinal disease.

#### 4. DODONAEA Linn.

*Dodonaea viscosa* (Linn.) Jacq. Enum. Pl. Car. 19. 1760; Hiern. in Hook. f. Fl. Brit. India 1 : 697. 1875; Haines 1 : 225. 1922; *Ptelea viscosa* Linn. Sp. Pl. 118, 1753. 'Mohara'.

Evergreen shrubs or small trees 1-2 m tall; stems glabrous, dark brown. Leaves 8-14 × 2-6 cm oblanceolate, viscid, shining, entire, acute or acuminate at apex, attenuate at base. Flowers 1-2 mm across, greenish-white in axillary or terminal branched cymes. Petals absent. Fruits 1.7 cm across, membranous inflated, winged capsules; seeds globose, black.

*Fl. & Fr.* : November-December; February-March.

*Distrib.* : HOOKITOLA, SATAVYA : Common along sandy sea-shores, often cultivated as an ornamental species.

#### 2. ALLOPHYLUS Linn.

*Allophylus cobbe* (Linn.) Raeusch. Nomencl. ed. 3. 108, 1797; Leenhouts in Blumea 15 : 301. 1967. Hiern. in Hook. f. Fl. Brit. India 1 : 673. 1875. *Rhus cobbe* Linn. Sp. Pl. 267. 1753. *Allophylus serratus* (Roxb.) Kurz Journ. As. Soc. Beng. 2 : 74. 1870; Mukherjee in Ind. For. 98 : 1972; Haines 1 : 219. 1921. 'Kandakula or Lapasia'.

Shrubs or trees, 2-3 m tall, sometimes scandent ; branches with plenty of pith, brown lenticels. Leaves trifoliolate, alternate ; leaflets 2-12 × 1.5-5 cm very variable in shape, and size ; margin serrate, crenate or dentate ; surface puberulous or glabrate ; acute to acuminate at apex, cuneate or oblique at base. Flowers 1-2 mm across, white or greenish yellow, in axillary spiciform racemes ; racemes 5-8 cm long, pubescent or glabrous. Fruits 5-7 mm across, globose, shining, red when ripe.

*Fl. & Fr.* : July-September ; November-December.

*Distrib.* : BAHAKUD, BHITARKANIKA : Frequent along the intertidal zones of several creeks, and in scrubs jungles usually found in association with *Eugenia bracteata*, *Hibiscus tiliaceus* and *Dalbergia spinosa*.

*Notes* : The polymorphic nature of this species is due to different ecological conditions ; our field observation indicated the following forms ; pubescent shrubs with serrate, denticulate leaves, common along the coastal thickets and scrub jungles ; glabrous shrubs with crenate or entire leaves, more common along the tidal forests.

Leenhouts (*l.c.*) recognised 255 species of the genus *Allophylus* in a race of only one polymorphus pantropical species of *A. cobbe* (Linn.) Rausch. Mukherjee (*l.c.*) considers that the genus *Allophylus* includes 8 species and 2 varieties and one form from the Indian subcontinent.

### 3. LEPISANTHES BL.

**Lepisanthes tetraphylla** (Vahl) Radlk. Sitz. Ber. K. Bayer. Ak. Wiss. M.ph.Kl. Munch. 8 : 276, 1878; Leenhouts in *Blumea* 17 : 63, 1969 ; Haines 1 : 212 1921. *Sapindus tetraphylla* Vahl. *Symb.* 3 : 54, 1794. *Hemigyrosa canescens* Bl. *Rumph.* 3 : 166, 1849 ; Thw. *En.Pl. Zeyl.* 56, 1858 ; and *H. deficiens* Beddom, *Fl. Sylv.* t. 231, 1872 ; Hiern. in Hook. f. *Fl. Brit. India* 1 : 671, 1875.

Small trees or shrubs 3-8 m tall ; twigs glabrous or pubescent. Leaves 2-5 jugate, leaflets 4-20 × 2.5-6 cm oblong, very variable, chartaceous glabrous, or slightly puberulous, rounded acuminate, or emarginate at apex, narrowly oblique at base. Flowers 0.5-0.7 cm across, greenish white, in terminal branched racemes. Fruits 2-5 cm, subglobose, densely hairy, obtusely 3-angled.

*Fl. & Fr.* : April-May ; June-July.



*Distrib.* : BHITARKANIKA : Frequent along the river-banks and inner fringes of the mangrove swamps, rare along the lee side sand dune.

## HIPPOCRATEACEAE

### SALACIA Linn.

*Salacia prinoides* ( Willd.) DC. Prodr. 5 (1) : 571, 1824 ; Back. & Bakh. in Fl. Java 2 : 58, 1865 ; Lawson in Hook. f. Fl. Brit. India 1 : 626, 1875 ; Haines 1 : 197, 1921. *Tontales prinoides* Willd. in Ges. Naturf. Fr. Neuesch 4 : 184, 1803. 'Batara'

Erect or scandent shrubs ; branches glabrous, divaricate, angular. Leaves 2-8 × 1.5-2.5 cm, opposite or subopposite, elliptic-oblong, coriaceous, crenate, acuminate at apex, obtuse at base. Flowers 3-4 mm across, greenish-yellow, fascicled in leafy axils or extra axillary on short-branchlets ; calyx 5-partite, puberulous, ciliate ; petals 5, imbricate ; stamens 3, recurved, continuous with the disk ; ovary 1-3 locular. Fruits globose, fleshy, usually 1-locular ; seed one.

*Fl. & Fr.* : December-January ; March-April.

*Distrib.* : BATIGHAR, BHITARKANIKA : Common along the inner fringes of tidal swamps, usually scandent, twigs growing spirally on *Excoecaria agallocha*, *Salvadora persica* and *Merope angulata*.

## ANACARDIACEAE

### Key to Genera

- |                          |     |              |
|--------------------------|-----|--------------|
| 1a. Leaves simple        | ... | ANACARDIUM 1 |
| 2a. Fruits pendocarpis   | ... | HOLIGARNA 2  |
| 2b. Fruits drupes        | ... | LANNEA 3     |
| 1b. Leaves imparipinnate | ... | LANNEA 3     |

### 1. ANACARDIUM Linn.

*Anacardium occidentale* Linn. Sp. Pl. 583, 1753 ; Hook. in Hook. f. Fl. Brit. India 2 : 20, 1876 ; Haines 1 : 288, 1922. 'Bajan cashew'

Trees, 6-8 m tall, often branched near the base. Leaves 7-14 × 6-10 cm ovate, oblong or obovate, glabrous, rounded or emarginate at apex, cuneate or obtusely rounded at base. Flowers 5-9mm long, polygamous, greenish-white, turning purple with age, arranged in terminal branched panicles. Fruits including pendocarp 6-12 cm ; reniform ; nuts seated on a fleshy, reddish yellow pendocarp.

*Fl. & Fr.* : January-March ; March-May.

*Distrib.* : BATIGHAR, KUJANG : Common along sand bars and uplands situated in between creeks and canals within the tidal forests ; also found along the lee sides of the sea-shore sandunes, but never found along the windward sea-shore.

*Notes* : Native from Costa Rica to Brazil and Ecuador. Present wild or as introduced throughout the tropics of the New and Old world.

## 2. HOLIGARNA Ham.

**Holigarna longifolia** Roxb. Cor. Pl. 79, t. 282, 1820 ; Fl. Ind. 2 : 80, 1832 ; Hook. in Hook. f. Fl. Brit. India 2 : 37, 1876.

Trees, 10-15 m tall, with whitish grey bark. Leaves 18-25 × 8-12 cm, shining, thinly coriaceous, obovate to broadly oblanceolate, entire, obscurely serrate, glabrous or pubescent when young, cuneate at base, obtuse or rounded at apex ; petioles 5-6 mm long. Flowers and fruits not observed.

*Distrib.* : BHITARKANIKA : Rare along sand bars and uplands in between the tidal creeks within the mangrove swamps.

*Notes* : Haines (1925) and Mooney (1950) did not report this plant from Orissa. However, this taxon has been collected only in the vegetative condition for the first time from Orissa.

## 3. LANNEA Rich.

**Lannea coromandelica** (Houtt.) Merrill in Journ. Arn. Arb. 19 : 353, 1939. *Dialium coromandelicum* Houtt. Nat. Hist. 11(2) : 39, t. 5, f. 2, 1774. *Odina wodier* Roxb. Hort. Beng. 29, 1814. *nom. nud.* Hook. in Hook. f. Fl. Brit. India 2 : 29, 1876 ; Haines 1 : 231, 1922. 'Jail ; Rajimohi'

Trees, 6-10 m tall, deciduous ; bark smooth, soft, thick, chlorophyllous ; wood soft, exudes gum. Leaves 5-9 foliolate ; leaflets 6-12 × 3-6 cm, ovate-oblong, glabrous or pubescent when young, acute or acuminate at apex, oblique at base. Flowers 2-3 mm across, yellowish green, dioecious, fascicled in subterminal racemes. Fruits 9-12 mm long, compressed drupes, yellowish, fleshy when ripe.

*Fl. & Fr.* : February-April ; May-July.

*Distrib.* : DUNGMAL, BHITARKANIKA : Common in low lying areas along

the outer fringes of tidal forest and river-banks. It can tolerate a wide range of ecological niches, from the foot of the hills up to the sea-shore.

## CONNARACEAE

### ROUREA Abul.

**Rourea minor** (Gaertn.) Leenh. in Fl. Mal. 5 : 514, 1958. *Aegiceras minus* Gaertn. Fruct. 1 : 216, t. 46, 1788 excl. Syn. *Rourea acuminata* Hook. f. in Hook. f. Fl. Brit. India 2 : 48, 1876.

Large lianas or shrubs ; branches glabrous, woody. Leaves imparipinnate, 5-9 jugate ; leaflets very variable, usually  $2-20 \times 1-8$  cm, coriaceous, ovate, ovate-lanceolate, obovate or sometimes suborbicular, entire, acuminate or caudate at apex, obliquely obtuse at base ; nerves 4-6 pairs ; petioles 0.4-0.5 cm long. Flowers 2-3 cm long, deep purple, bell-shaped, in axillary panicles ; inflorescences consisting of 2-5 axes of which central one is 6-12 cm long, others are up to 8 cm long ; sepals 5, imbricate, each  $3-4 \times 2-2.3$  mm, broadly ovate, pubescent with hairy margins ; petals 5, each  $5-7 \times 1-1.5$  mm, lanceolate, glabrous ; stamens 10, confluent into a ring, filaments filiform, episepalous and epipetalous ; episepalous one 4-5 mm long, epipetalous one 6-7 mm long, hairy at apex ; anthers introse, semi-dorsifixed ; ovary obliquely ovoid, 2-3 mm in diam. ; stigmas 2-lobed. Fruits  $4-6 \times 1-2$  cm, ovoid, oblique, with persistent calyx ; seeds ellipsoid, enclosed by yellow-coloured fleshy aril.

*Distrib.* : BAHAKUD : More or less common in sandy scrub jungles along the Mahanadi river and coastal thickets in association with *Hugonia mystax*, *Maba buxifolia* and *Ichnocarpus frutescens*.

*Notes* : Haines in Bot. Bihar and Orissa (1921), Mooney in Suppl. Bot. Bihar and Orissa (1950) have not mentioned the occurrence of the family connaraceae in their study of this region ; hence the taxon is a new addition to the flora of Orissa.

PAPILIONACEAE

Key to Genera

- 1a. Plants generally herbs, shrubs or climbers :
    - 2a. Pods dehiscent, not jointed :
      - 3a. Anthers uniform ... ROTHIA 1
      - 3b. Anthers dimorphous :
        - 4a. Stipules basifixed ... CROTALARIA 2
        - 4b. Stipules not basifixed :
          - 5a. Anthers apiculate, hairy  
at the centre ... INDIGOFERA 3
          - 5b. Anthers obtuse, hairy at the base ... TEPHROSIA 4
    - 2b. Pods indehiscent, jointed :
      - 6a. Stamens monadelphous, pods glochidiate ... ZORNIA 5
      - 6b. Stamens diadelphous, pods not glochidiate :
        - 7a. Pods enclosed in the calyx ... SMITHIA 6
        - 7b. Pods exerted from the calyx :
          - 8a. Leaves more than 1 cm long ;  
dry land plants ... TAVERNIERA 7
          - 8b. Leaves 0.4 cm long ; marshy plants ... AESCHYNOMENE 8
  - 9a. Herbs or shrubs, erect or  
climbing ; stamens 9 and 1 :
    - 10a. Joints of pods turgid ... ALYSICARPUS 9
    - 10b. Joints of pods flattened ... DESMODIUM 10
  - 9b. Climbing shrubs ; stamens 9 :
    - 11a. Seeds bright red ... ABRUS 11
    - 11b. Seeds not bright red :
      - 12a. Pods covered with  
irritant bristles ... MUCUNA 12
      - 12b. Pods not with  
irritant bristles :
        - 13a. Pods conspicuously  
hooked at apex ... TERAMNUS 13
        - 13b. Pods not hooked at apex :
          - 14a. Pods thin, flat  
and winged ... DERRIS 14
          - 15a. Upper lip of  
calyx largest ... CANAVALLIA 15
          - 15b. Lower lip of  
calyx largest ... ATYLOSIA 16
- 1b. Plants generally trees :
  - 16a. Stems and branches studded with prickles ... ERYTHRINA 17
  - 16b. Stems and branches not studded with prickles :
    - 17a. Leaflets alternate ; pods linear ... DALBERGIA 18
    - 17b. Leaflets opposite ; pods flattened ... PONGAMIA 19

## 1. ROTHIA Pers

**Rothia indica** (Linn.) Druce in Rep. Bot. Exch. Club Brit. Isles 3 : 423, 1914. *R. trifoliata* Pers. Syn. Pl. 2 : 302 & 659, 1807 ; Baker in Hook. f. Fl. Brit. India 2 : 63, 1876. *Trigonella indica* Linn. Sp. Pl. 778, 1753.

Annual, spreading herbs ; stems much-branched, pubescent. Leaves 1.5-2 cm, digitately 3-foliolate ; leaflets 6-15 × 2-6 mm, ovate-elliptic, or oblanceolate, adpressed silky-hairy, obtuse or acute at apex, cuneate at base ; stipules free. Flowers 3-4 mm long, yellow, arranged in axillary racemes. Pods 3-4 cm long, linear, straight, covered with silky hairs, 8-15 seeded.

*Distrib.* : KUJANG, BATIGHAR : Common along sandy sea-shores, scrub jungles, and sandy river-banks, in association with *Gisekia pharnaceoides*, *Cyperus arenarius* and *Launaea sermentosa*.

*Fl. & Fr.* : August-September ; October-November.

Its occurrence is not recorded by Haines (1921) and Mooney (1950) ; hence it is a new record for Orissa. Rao, *et al.* in J. Bombay nat. Hist. Soc. 64 (3) : 1968.

## 2. CROTALARIA Linn.

*Key to Species*

- |                                      |     |                    |
|--------------------------------------|-----|--------------------|
| 1a. Leaves simple :                  |     |                    |
| 2a. Erect herbs ; stipules present : |     |                    |
| 3a. Stipules foliaceous              | ... | <i>verrucosa</i> 1 |
| 3b. Stipules subulate                | ... | <i>retusa</i> 2    |
| 2b. Diffused herbs ; stipules absent | ... | <i>nana</i> 3      |
| 1a. Leaves trifoliolate :            |     |                    |
| 4a. Leaflets more than 6 cm long     | ... | <i>pallida</i> 4   |
| 4b. Leaflets upto 2 cm long          | ... | <i>levigata</i> 5  |

**Crotalaria verrucosa** Linn. Sp. Pl. 715, 1753 ; Muuk. in Reinward. 6 : 217, 1962 ; Chuang in Taiwana 9 : 90, f. 14, 1963 ; Baker in Hook. f. Fl. Brit. India 2 : 77, 1876 ; Haines 2 : 243, 1922. '*Bon Junka*'

Erect undershrubs 0.5-1 m tall ; branches quadrangular, winged, glabrous or slightly pubescent. Leaves 4-8 × 2-4 cm, alternate, ovate, suborbicular or ovate-rhomboid, entire, acute, obtuse, or rounded at apex, cuneate at base ; stipules semilunate, foliaceous. Flowers 1.5-2 cm, bluish-purple, arranged in lateral racemes. Pods 2-3 cm long, oblong, turgid, secciceous.

*Fl. & Fr.* : March-May ; September-October.

*Distrib.* : BAHAKUD, KUJANG : Common along the dry sandy river-banks, and inlands.

2. *Crotalaria retusa* Linn. Sp. Pl. 715, 1753 ; Muuk in Reinward. 6 : 212, 1962 ; Baker in Hook. f. Fl. Brit. India 2 : 75, 1876 ; Mooney in Suppl. Bot. Bihar and Orissa 46, 1950. '*Boushoma*'

Much-branched undershrubs, 0.5-1 m tall ; branches striate, glabrous or whitish pubescent. Leaves 4-8 × 1-3 cm, oblong-oblancheolate, glabrous, or whitish pubescent beneath, retuse or sometimes 3-4 lobed at apex, cuneate at base. Flowers, 2-3 cm, yellow in terminal racemes. Pods 2.5-4 cm long, turgid, narrowed towards apex. Seeds 15-20.

Frequent along sandy river-banks in waste places and sometimes in the back mangroves.

*Fl. & Fr.* : May-July ; September-October.

3. *Crotalaria nana* Burm. f. Fl. Ind. 156, t. 156, t. 48, fig.2, 1768 ; Reinward. 6 : 210, 1962 ; Baker in Hook. f. Fl. Brit. India 2 : 71, 1876 ; *C. umbellata* Wight ex W. & A. 191, 1834 ; Mooney in Suppl. 46, 1950.

Silky hairy diffused annuals, with slender, terete branches. Leaves 1-2 × 0.2-0.5 cm, linear-oblong, subsessile, acute at apex, obtuse at base. Flowers, 2-3 mm across, yellow, in terminal sub-umbellate racemes ; bracts and bracteoles densely covered with silky hairs. Pods 6-9 mm long, ovoid, hairy or glabrous ; seeds 2-3.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : BAHAKUD, HOOKITOLA : Frequent along sandy sea-shores, scrub jungles, and in coastal thickets.

*Notes* : Mooney (*op. cit.*) collected it from Keonjhar, 3000 ft. altitude. This plant is found to occur in the coastal areas of Kerala and Karnataka (T.A. Rao, Bull. Bot. Surv. India 1972).

4. *Crotalaria pallida* Ait. Hort. Kew. ed. 1, 3 : 20, 1789 ; Polhill, in Kew Bull. 22 : 262, 1968. *C. striata* DC. Prodr. 2 : 131, 1825 ; Baker in Hook. f. Fl. Brit. India 2 : 84, 1867 ; Haines 2 : 244, 1922. '*Junjuika*'.

Erect undershrubs, 0.5-1 m tall ; branches terete, striate, puberulous.

Leaves 12-14 cm long, trifoliolate ; leaflets 5-7.5 × 3-5 cm, obovate, entire, glabrous or faintly puberulous beneath, retuse or obtuse at apex, cuneate at base. Flowers 1.5-2 cm across, yellow, with purple tinged, in terminal racemes ; peduncles 40-45 cm long. Pods upto 4.5 cm long, turgid, glabrous or pubescent, beaked at apex. Seeds 25-35.

*Fl. & Fr.* : July-August ; November-December.

*Distrib.* : PARADEEP, KUJANG : Frequent along the river-banks and roadsides, occasional along the sandy sea-shores.

5. *Crotalaria levigata* Lamk. ex Dc. Prodr. 11 : 131, 1825 ; Baker in Hook. f. Fl. Brit. India 2 : 83, 1876. *C. stipita* Grah. ( in Wall. Cat. 5425, 1832 ) ex W. & A. Prodr. 193, 1834.

Erect undershrubs 20-30 cm tall ; branches slender, smooth. Leaves 3-4.5 cm long, trifoliolate, petioles 1.5-2 cm long ; leaflets 1.5-2 × 0.6-1.3 cm, oblong, obovate, glabrous or slightly downy beneath, emarginate or obtuse at apex, cuneate at base. Flowers 1-1.5 cm across, yellow, in axillary or terminal racemes ; bracts setaceous, deciduous. Pods not seen.

*Fl. & Fr.* : September-October (fruit not seen).

*Distrib.* : BAHAKUD : Rare in coastal thickets and scrub jungles on sandy habitat.

### 3. INDIGOFERA Linn.

#### *Key to Species*

1a. Leaves simple ; Pods 1-seeded	...	<i>linifolia</i> 1
1b. Leaves imparipinnate ; Pods 2-many seeded :		
2a. Pods oblong, 2-seeded	...	<i>linnaei</i> 2
2b. Pods cylindrical, adpressedly hairy, 5-6 seeded	...	<i>aspalathoides</i> 3
3a. Leaflets 7-13 ; racemes more than 12- flowered	...	<i>tinctoria</i> 4
3b. Leaflets 5 ; racemes 2-5 flowered	...	<i>glabra</i> 5

*Indigofera linifolia* (Linn.) Retz. Obs. 4 : 29, 1786 ; Ali in Bot. Notis, iii : 546, 1958 ; Baker in Hook. f. Fl. Brit. India 2 : 92, 1876 ; Haines 2 : 248, 1922. *Hedysarum linifolium* Linn. f. Suppl. 331, 1781.

Spreading annuals ; stems much-branched, adpressed silvery-hairy. Leaves 1.5-2.5 × 0.1-0.2 cm, simple, linear or linear-spathulate, sessile, mucronate at apex, narrowed at base. Flowers 2-3 mm across, red in axillary racemes. Pods 2 mm across, globose, apiculate, shining, with silvery adpressed hairs.

*Fl. & Fr.* : October- November ; December-January.

*Distrib.* : KUJANG, CHANDBALI : Common along the sandy river-banks and lee side of the sand-dunes.

2. *Indigofera linnaei* Ali in Bot. Notis. 111 : 549, 1958. *I. enneaphylla* Linn. Mant. 272, append. 571, 1771, nom. ellegit. ; Baker in Hook. f. Fl. Brit. India 2 : 94, 1876 ; Haines 2 : 249, 1922. *Hedysarum prostratum* Linn. Mant. 102, 1797. *Indigofera prostrata* (Burm. f.) Domin. in Bidl. Bot. Stutt. 187. 1926, non Willd. 1803.

Diffused, perennial herbs with long tap root ; branches as many as 20, terete, covered with adpressed silky hairs, spreading radially from woody rootstock. Leaves 5-7-foliolate ; leaflets 5-9 × 2-3 mm, obovate or spatulate, densely adpressed with silky hairs on both the surfaces, emarginate at apex, cuneate at base. Flowers 2-3 mm across, purple, in axillary, bracteate racemes. Pods 5-8 mm long, oblong, hairy, 2-seeded.

*Fl. & Fr.* : August-September ; December-January.

*Distrib.* : KUIJANG, HOOKITOLA & CHANDBALI : Common along sandy river-banks, dry places, along road-sides and coastal thickets.

*Notes* : *Indigofera enneaphylla* Linn. Mant. 1771. Syn. *Hedysarum prostratum* Linn. Mant. 1967 and Burm. f. 1768. According to Art. 55, the correct name should have been *I. prostrata* (Art. 70) Domin. (*l.c.*) adopted this combination *I. prostrata* (Burm. f.) Domin. but there had been many homonyms, therefore, to avoid the many homonyms Ali (*l.c.*) proposed the new name *I. linnaei* for the same.

3. *Indigofera aspalathoides* Vahl ex DC. Prodr. 2 : 231, 1825 ; Baker in Hook. f. Fl. Brit. India 2 : 94, 1876 ; Wight Ic. 1. 332, 1840. *Aspalathus indicus* Linn. Sp. Pl. 712, 1753.

Stiff, silvery hoary undershrubs, branches divaricate. Leaves 2-3 × 0.5-1 mm, whorled, spatulate, sessile, obtuse at apex, cuneate at base. Flowers 1-2 mm across, red, solitary, axillary. Pods 10-14 mm long, cylindrical, straight, covered with silky hairs, 5-6-seeded.

*Fl. & Fr.* : August-September ; December-January.

*Distrib.* : SATYAVYA, HOOKITOLA : Frequent along the sandy sea-shores, and river-banks.

*Notes* : Haines (1921) and Mooney (1950) did not report this species from Orissa ; hence the present collection of species is a new record for Orissa.



4. **Indigofera tinctoria** Linn. Sp. Pl. 751, 1753 ; Baker in Hook. f. Fl. Brit. India 2 : 99, 1876 ; Haines 2 : 250, 1922. *I. indica* Lamk. Encl. 3 : 245, 1789.

Erect, slender shrubs, 1-1.5 m tall ; branches many, terete, sparsely strigose. Leaves 5-8 cm, 9-13-foliolate ; leaflets 1.5-2 × 0.6-1 cm, ovate-oblong, obovate or oblanceolate, glabrous or thinly strigose, obtuse at apex, narrowly rounded at base. Flowers, 3-6 mm, across, red, in axillary racemes ; peduncles 4-7 cm long, puberulous ; racemes with more than 12 flowers. Pods 3-5 cm long, curved, glabrous, apiculate, 12-16 seeded.

*Fl. & Fr.* : July-October ; October-December.

*Distrib.* : SARLIKUD : Occasional in sandy places near estuaries and back mangroves, cultivated in hills and plains.

**Indigofera glabra** Linn. Sp. Pl. 751, 1753 ; Ali in Bot. Notis. 111 : 572, 1958. *I. pentaphylla* Murr. Syst. Veg. (ed. 13) : 564, 1774 ; Baker Hook. f. Fl. Brit. India 2 : 95, 1876 ; Wt. Ic. t. 385, 1840 ; Haines 2 : 249, 1922.

Diffused annuals with slender, puberulous branches. Leaves 5-foliolate ; leaflets 3-11 × 1-5 mm, obovate or elliptic-ovate, adpressly hairy on both the surfaces, obtuse at base, apiculate at apex. Flowers 3-4 mm across, deep red, in axillary 2-5-flowered racemes ; pods 1.5-2.5 cm, long, turgid, straight, glabrous, 12-14-seeded.

*Fl. & Fr.* : July-September ; October-November.

*Distrib.* : HOOKITOLA, SATYAVIA : Frequent along sandy sea-shores, especially in waste places along with local plants.

#### 4. **TEPHROSIA** Pers. (*nom. cons.*)

##### *Key to Species*

- |                          |     |                   |
|--------------------------|-----|-------------------|
| 1a. Pods glabrous :      |     |                   |
| 2a. Stipules subulate    | ... | <i>purpurea</i> 1 |
| 2b. Stipules lanceolate  | ... | <i>maxima</i> 2   |
| 1b. Pods velvety villose |     | <i>villosa</i> 3  |

1. **Tephrosia purpurea** (Linn.) Pers. Syn. Pl. 2 : 329, 1807 ; Burmitt in Bot. Soc. Brot. 2a, 41 : 242, 1967 ; Baker in Hook. f. Fl. Brit. India 2 : 112, 1876 ; Haines 2 : 255, 1922. '*Bona Nila*'

Erect bushy undershrubs 0.5-1m tall ; branches terete, glabrous or puberulous when young. Leaves 8-12 cm long, 9-17-foliolate ; leaflets 0.5-3 × 0.3-1 cm, opposite, obovate, or oblong-lanceolate, glabrous, rounded, emarginate or mucronulate at apex, cuneate at base. Flowers, 5-7mm across, deep purple, in axillary or terminal racemes. Pods 3-4 cm, oblong, compressed, glabrous ; seeds 6-8.

*Fl. & Fr.* : Throughout the season.

*Distrib.* : KUJUNG, BAHAKUD, PARADEEP : Common along the riverbanks and roadsides, occasional along the sandy sea-shores.

2. *Tephrosia maxima* (Linn.) Pers. Syn. Pl. 2 : 1807 ; Haines 2 : 254. 1922. *T. purpurea* Pers. var. *maxima* Baker in Hook. f. Fl. Brit. India 2 : 113, 1876. *Galega maxima* Linn. Sp. Pl. 1063, 1753.

Erect undershrubs, 0.5-1.5 tall ; branches woody, terete, covered with silvery hairs. Leaves 4-6 cm, long, alternate, 9-13-foliolate ; leaflets 1.2-1.8 × 0.3-0.5 cm opposite, glabrous, thinly puberulous beneath, stipules lanceolate. Flowers 1.5-2 cm across, bright purple, in axillary or terminal racemes. Pods 6-8 cm, straight, glabrous, 15-16-seeded.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : PARADEEP : Rare along sandy sea-shore and frequently seen on open places.

3. *Tephrosia villosa* (Linn.) Pers. Syn. Pl. 2 : 329, 1807 ; Brumitt in Bot. Soc. Brot. 41 (2): 224. 1967 ; Baker in Hook. f. Fl. Brit. India 2 ; 113. 1876. Haines 2 : 256. 1922. *Galega villosa* Linn. Sp. Pl. 1063, 1753.

Erect undershrubs 0.5-1 m tall ; branches terete, adpressedly hairy. Leaves 9-17-foliolate ; leaflets 1-2 × 0.3-0.5 cm, obovate to oblanceolate, prominently reticulo-venose, glabrous or whitish puberulous beneath, rounded at apex, obtuse at base. Flowers 1-1.3 cm across, densely villose, purple, in terminal racemes. Pods 3-3.5 cm long recurved, velvety pilose, 8-9-seeded.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : KUJANG, PARADEEP : Common along sandy river-banks and in sea-shores.

*Notes* : Haines (*l.c.*) stated that no collection of this taxon has been made from Bihar and Orissa. Mooney (1950) made the collection of this taxon from Chilka Lake-Ganjam. Thus the present collection of this taxon from Orissa is a new locality record.

### 5. ZORNIA J. Gmel.

#### *Key to Species*

- |   |     |                 |   |
|---|-----|-----------------|---|
| 1a. Leaves linear-lanceolate ; loment 4-6, bristles<br>in loment retrorsely hairy | ... | <i>gibbosa</i>  | 1 |
| 1b. Leaves ovate ; loment 4, bristles not retrorsely hairy                        | ... | <i>diphylla</i> | 1 |

1. *Zornia gibbosa* Span. in *Linnaea* 15 : 192. 1841 ; *Mohlenbrook* in *Webbia* 16 (1) : 112. 1961. *Z. diphylla* (*auct. non.* Linn.) Pers. Baker in Hook. f. *Fl. Brit. India* 2 : 147. 1878 ; Haines 2 : 263, 1922 ; Sant. in *Rec. Bot. Surv. India* 16 (1) : 53, 1952. *Z. angustifolia* Sm. in Rees. *Cycl.* 34 : 1, 1819 (*nomen illeg.*).

Much-branched, diffused annuals ; with slender, glabrous branches from woody rootstock. Leaves distichous, 2-foliolate, leaflets 1.5-1.7 × 0.2-0.5 cm, lanceolate, rarely ovate-lanceolate when young, glabrous, punctate, acute at apex, obtuse at base ; stipules 5-7 mm long, lanceolate, 3-nerved, midly fixed. Flowers 2-3 mm across, yellow, in terminal or axillary, 2-seriate spikes ; each enclosed by 2 basal bracteoles of the calyx ; bracteoles 8-10 mm long, lanceolate, peltate. Pods 8-10 mm long, with usually 6 loment, each 1.5-1.8 mm across, covered with retrorsely hairy bristles.

*Fl. & Fr.* : July-August ; September-October.

*Distrib.* : HOOKITOLA : Common along sea coast, river-banks, road-sides and dry inland habitats.

*Notes* : Most of the specimens referred to this species previously were either *Z. diphylla* Pers. or *Z. angustifolia* Sm. (*Illeg.*).

2. *Zornia diphylla* (Linn.) Pers. *Syn.* 2 : 318. 1807 ; *Mohlenbrook* (*l.c.*) 67, *Z. diphylla* Pers. var. *zeylonensis* Benth. in *Mart. Fl. Brass* 15 (1) : 82, 1859 ; Baker in Hook. f. *Fl. Brit. India* 2 : 148, 1876. *Z. conjugata* (Willd.) Sm. in Rees. *Cycl.* 39 : 3, 1819 ; Sant. in *Rec. Bot. Surv. India* 16 (1) : 53, 1952. *Hedysarum diphyllum* Linn. *Sp. Pl.* 247. 1753.

Much-branched annual or perennial herbs with long taproot system. Leaves distichous, 2-foliolate : leaflets 1.5-2 × 1-1.3 cm ovate, glabrous, slightly pubescent along margins, apiculate at apex, oblique at base ; petiolules pubescent. Flowers 7-8 mm long, yellow, in terminal and axillary, congested 2-seriate spikes ; each enclosed by paired bracteoles from the calyx ; bracteoles ovate, ciliated along margins. Pods 3-6 cm long with 3-4 loment, each 5-6 mm across, covered with glandular, glabrous bristles.

*Fl. & Fr.* : July-September ; October-December.

*Distrib.* : HOOKITOLA, SATYAVYA : Frequent along the sandy or muddy sea-shores and dry sandy areas near the coast.

*Notes* : H. P. Nooteboom in Reinwardita 5 : 453-456, 1960 treated Malesian *Z. diphylla* Pers. and *Z. gibbosa* Span. as conspecific recognising large variation between this two species. However, we agree with later workers, namely Mohlenb. and Dandy and Milne-Redhad [Kew Bull. 17 (1) : 194, 1963] who have treated this taxon as two different species. Haines (1921) and Mooney (1950) did not report this plant ; hence it is a new record for Orissa.

#### 6. TAVERNIERA DC.

**Taverniera cunefolia** Arn. in Wt. Ic. t. 1055, 1846 ; Gamble in Fl. Pers. Mad. 1 : 231, 1957 (rep. ed.) *T. nummularia* (auct. non. DC.) Baker in Hook. f. Fl. Brit. India 2 : 140, 1876. '*Jhamta*'

Much-branched, spreading herbs, or undershrubs ; branches triangular, hoary. Leaves simple, alternate, 1.5-2 × 1-1.3 cm, obovate or suborbicular, glabrous and canescent beneath, rounded at apex, cuneate at base ; stipules linear, scarious. Flowers 1-1.5 cm across, rose-red, in short axillary racemes. Pods 5-7 cm long, jointed, echinate, with transverse ridges ; seeds, smooth reniform.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : PARADEEP, HETAMUNDIA : Frequent along with the sandy scrup jungles and saline flats. Sometimes found rare along the sandy sea-shore.

*Notes* : Haines (1921) and Mooney (1950) have not reported this taxon ; hence the present collection is a new record for Orissa.

7. *SMITHIA* Ait. (*nom. cons.*)

*Smithia sensitiva* Ait. Hort. Kew. ed. i, 3 : 494. 1789 ; Meenwen in Reinward. 5 : 444, 1961 ; Baker in Hook. f. Fl. Brit. India 2 : 148. 1876 ; Haines 2 : 265. 1922.

Much-branched, perennial herbs, 30-40 cm long ; branches slender, terete, glabrous, often rooting at nodes. Leaves 2-6 jugate, alternate ; rachis strigose ending in a bristle ; leaflets 2-6 × 1-3 mm, oblong, entire, bristly along midribs. Flowers 6-9 mm across, bright yellow, 2-3, in axillary racemes. Lomentum 4-6 cm long, joints 4-5, warty, enclosed by scariaceous calyx.

*Fl. & Fr.* : October-December.

*Distrib.* : PURI, SATYAVALA : Frequent along sandy sea-shores, inward forests.

8. *AESCHYNOMENE* Linn.

*Aeschynomene indica* Linn. Sp. Pl. 713, 1753 ; Baker in Hook. f. Fl. Brit. India 2 : 152. 1876 ; Haines 2 : 265. 1922. '*Kat Shola*'

Erect, suffruticose, spreading undershrubs ; branches slender, terete, striate with small warts or papillae. Leaves 3-12 cm long, imparipinnate ; leaflets 4-6 × 1.5-2 mm linear-oblong, glabrous, acute at apex, oblique at base. Flowers 4-8 mm across, yellowish white, in axillary racemes. Pods 3-5 cm, slightly curved, joints 6-8, tetragonal, compressed.

*Fl. & Fr.* : August-December.

*Distrib.* : BATIGHAR, PARADEEP : Frequent in moist places, mostly under fresh water situation, sometimes along shallow ditches and rice-fields near the sea coast.

9. *ALYSICARPUS* Desv. (*nom. cons.*)*Key to Species*

- |    |  |     |                  |   |
|----|--|-----|------------------|---|
| 1. | Pods moniliform, joints globose, constricted between | ... | <i>monilifer</i> | 1 |
| 1. | Pods straight, not moniliform, joints tetragonus     | ... | <i>vaginalis</i> | 2 |

1. *Alysicarpus monilifer* (Linn.) DC. Prodr. 2 : 353, 1825 ; Baker in Hook. f. Fl. Brit. India 2 : 157. 1876 ; Haines 1 : 270. 1922 ; *Hedysarum moniliferum* Linn. Mant. 1 : 102. 1767.

Diffused annual or perennial herbs ; branches 30-60 cm long, densely covered with spreading hairs. Leaves simple, 1-1.5 × 1-1.2 cm, variable, elliptic-oblong or sub-orbicular, glabrous above, hairy beneath, obtuse or mucronulate at apex, cordate at base. Flowers, 5-7 mm across, bluish, purple, in axillary short racemes. Pods 2.5-3 cm, moniliform, joints globose clothed with hooked hairs.

*Fl. & Fr.* : All through the year.

*Distrib.* : KUJANG : Frequent along sandy river-banks and scrub-jungles.

2. *Alysicarpus vaginalis* (Linn.) DC. Prodr. 2 : 353. 1825 ; Meeuwen in Reinward. 6 : 87. 1961. Baker in Hook. f. Fl. Brit. India 2 : 158. 186 ; Haines 1 : 271. 1922. *Hedysarum vaginale* Linn. Sp. Pl. 746. 1753. Prostrate, glabrous annuals. Leaves 1-2.5 × 0.5-1.5 cm elliptic-oblong, ovate or ovate-lanceolate, obtuse or retuse at apex, obtuse or cordate at base ; stipules lanceolate. Flowers 5-6 mm across, pinkish, in lateral or terminal racemes. Pods 3-4 cm, globose, joints turgid, tetragonous, reticulate-veinose.

*Fl. & Fr.* : March-April ; May-June.

*Distrib.* : KUJANG, PARADEEP : Common along the river-banks, and coastal sands. Locally common along road-sides and grass-lands.

## 10. DESMODIUM Desv. (*nom. cons.*)

### *Key to Species*

- |     |   |     |                      |   |
|-----|---|-----|----------------------|---|
| 1a. | Pods straight ; covered with simple hairs | ... | <i>biarticulatum</i> | 1 |
| 1b. | Pods falcate, covered with hooked hairs : |     |                      |   |
| 2a. | Leaves unifoliate                         | ... | <i>gangeticum</i>    | 2 |
| 2b. | Leaves 3-foliolate                        | ... | <i>triflorum</i>     | 3 |

1. *Desmodium biarticulatum* (Linn.) F.V.M. in Fragm. Phyt. Austr. 2 : 121. 1861 ; Baker in Hook. f. Fl. Brit. India 2 : 163. 1876 ; Haines 2 : 277. 1922 ; Meeuwen in Reinward. 6 : 246. 1962. *Hedysarum biarticulatum* Linn. Sp. Pl. 1054. 1753. *Dicerma biarticulatum* DC. Prodr. 2 : 339. 1825 ; Wt. Ic. t. 419. 1840.

Trailing undershrubs with long taproots ; branches reddish-brown, woody, glabrous. Leaves 3-foliolate ; leaflets 8-11 × 3-5 mm, elliptic oblong, coriaceous, entire, obtuse at both ends ; stipules membranous, striate. Flowers

5-9 mm across, bright red. 2-3. fascicled in terminal or branched racemes ; racemes 10-20 cm long. Pods 1-1.3 cm long, flat, biarticulate with adpressed hairs, seeds broadly ellipsoid, smooth, 1 in each joint.

*Fl. & Fr.* : August-September ; September-October.

*Distrib.* : SATYAVYA, HOOKITOLA, HATAMUNDIA : Common along the sandy sea-shore, scrub-jungles, coastal thickets and outer zones of the mangrove swamps.

2. ***Desmodium gangeticum*** (Linn.) DC. Prodr. 2 : 327. 1825 ; Meeuwen in Reinward, 6 : 249, 1962 ; Baker in Hook. f. Fl. Brit. India 2 : 168. 1876 ; Haines 2 : 276, 1922. *Hedysarum gangeticum* Linn. Sp. Pl. 746. 1753. '*Bhidipani*'.

Erect or diffuse perennial undershrubs 1-1.5 m tall ; branches woody, glabrous or slightly downy. Leaves very variable 1-10 × 0.5-6 cm ovate, glabrous or slightly scabrous beneath, acute at apex, rounded at base ; stipules subulate. Flowers 5-10 mm long, white, in axillary or terminal racemes ; pods 1-2.5 cm long, falcate, 6-8-jointed, covered with few hooked hairs.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : KUJANG, BAHAKUD : Occasional in scrub-jungles, and in waste places. Common towards inland forests.

3. ***Desmodium triflorum*** (Linn.) DC. Prodr. 2 : 334. 1825 ; Meeuwen 261 ; Baker in Hook. f. Fl. Brit. India 2 : 173. 1876 ; Haines 2 : 278. 1922. *Hedysarum triflorum* Linn. Sp. Pl. 749. 1753.

Slender, much-branched, trailing herbs, often rooting at nodes. Leaves 3-foliolate, terminal one largest ; leaflets 2-8 × 1-6 mm obovate, glabrous, often with black dots beneath, emarginate at apex, cuneate at base. Flowers 2-3 mm across, 1-3 fascicled in upper leaf axils of lateral branches, red or purple. Pods 6-10 mm long, joints 3-5, clothed with hooked hairs.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : PARADEEP, KUJANG : Common along sandy river-banks, open grass-lands and roadsides.

## 11. ABRUS Adans

*Abrus precatorius* Linn. Syst. Nat. ed. 12, 472, 1767 ; Breteler in Blumea 10 : 617, f. 5, 1960 ; Verdcourt in Kew Bull. 24 : 240, 1970 ; Baker in Hook. f. Fl. Brit. India 2 : 175, 1876 ; Haines 2 : 259, 1922. '*Runja or Gunja*'.

Slender, twining shrubs ; branches terete, glabrous or young twigs slightly pubescent. Leaves 8-12 cm long, 16-30 jugate ; leaflets 1-2 × 0.5-0.8 cm, oblong, glabrous, apiculate at apex, rounded at base, deciduous. Flowers 8-10 mm across, purple or bluish-purple, clustered in racemes on lateral branches. Pods 3-4.5 cm long, oblong, flat, warty, glabrous rarely adpressed pubescent with a deflexed beak at apex. Seeds 4-6 mm across, ovoid, glossy, scarlet, with black spot around the hilum.

Common on bushes in scrub jungles along the river-banks and coastal thickets.

*Fl. & Fr.* : August-September ; October-March.

Verdcourt (*l. c.*) - Establishes two subspecies as follows :

- |  |                                    |
|--|------------------------------------|
| 1. Plants with short muriculate pods, the valves twisting up     | ... subsp. <i>africanus</i> Verdc. |
| 2. Plants with longer, smooth pods, the valves remaining flatter | ... subsp. <i>precatorius</i>      |

## 12. ERYTHRINA Linn.

*Erythrina variegata* Linn. Herb. Amboin. 10, 1754 ; Bullock in Kew Bull. 20 : 294, 1966. *E. corallodendron* Linn. var. *orientalis* Linn. Sp. Pl. ed. 2 : 993, 1763. *E. indica* Lamk. Encycl. 2 : 391, 1788 ; Baker in Hook. f. Fl. Brit. India 2 : 188, 1876 ; Haines 2 : 297, 1922. *E. variegata* Linn. var. *orientalis* (Linn.) Merr. Intr. Herb. Amboin. 276, 1917 ; Mahesh. in Bull. Bot. Surv. India 3 : 46, 1961. '*Pani Madar*'.

Prickly, deciduous trees 4-10 m tall ; stems and branches soft, with corky barks. Leaves 3-foliolate ; leaflets 4-9 × 2-8 cm, broadly ovate or rhomboid, entire, glabrescent, acute to acuminate at apex, truncate or obtuse at base. Flowers 3-7 cm across, deep red, in terminal or axillary, many flowered racemes. Pods 10-20 cm, long, torulose, glabrous, beaked.

*Fl. & Fr.* : February-March ; August-December.

*Distrib.* : KUJANG, BATIGHAR : Common along the river-banks, mostly under fresh water situation, frequently planted as a hedge plant.



## 13. DALBERGIA Linn. f.

*Key to Species*

- |   |     |                  |
|---|-----|------------------|
| 1. Unarmed trees ; leaflets 6-9 cm long               | ... | <i>sissoo</i> 1  |
| 1. Spiny shrubs or small trees ; leaflets 1-3 cm long | ... | <i>spinosa</i> 2 |

1. *Dalbergia sissoo* Roxb. Fl. Indica, ed. Carey 3 : 223, 1832 ; Baker in Hook. f. Fl. Brit. India 2 : 231, 1876 ; Haines 2 : 307, 1922.

Trees upto 20 m tall, glabrous. Leaves alternate, bifarious, imparipinnate ; rachis zig-zag ; leaflets 6-9 × 3-4 cm, elliptic-ovate, or obovate, rarely orbicular, entire, cuspidate or acuminate at apex, obtuse or rounded at base. Flowers 2-4 mm across, yellow, in axillary panicles. Pods 2-6 cm long, strap-shaped, cuneate, 2-4-seeded.

*Fl. & Fr.* : March-April ; September-December.

*Distrib.* : BHITARKANIKA : Frequent along river-banks and scrubs, planted along the road-sides.

2. *Dalbergia spinosa* Roxb. Fl. Ind. ed. Carey 3 : 233, 1832 ; Baker in Hook. f. Fl. Brit. India 2 : 238, 1876 ; Haines 2 : 310, 1922.

Shrubs or small bushy trees 4-10 m tall ; branchlets many, horizontal, ending in a hard spine. Leaves 6-9 cm long, crowded at the nodes of spinous branchlets ; leaflets 9-11, alternate, each 1-2.5 × 0.5-1 cm, elliptic, obvate or obovate, glabrous, obtuse or emarginate at apex, rounded or cuneate at base. Flowers 2-3 mm across, whitish purple, in axillary lateral racemes. Pods 2.5-3 cm long, thin, glabrous, kidney-shaped, 1-2-seeded.

*Fl. & Fr.* : April-June ; August-December.

*Distrib.* : RIVERINE BANKS : Common in the intertidal zones along the estuarine banks, especially under the condition influenced by fresh and brackish water mixture, usually in association with *Sonneratia apetala*. Frequent along the creeks and channels in the mangrove swamp.

## 14. PONGAMIA Vent.

*Pongamia pinnata* (Linn.) Pierre, Fl. For. Cochinch. Sub. t. 385, 1899 ; Thothathri in Bull. Bot. Surv. India 3 : 418, 1962. *P. glabra* Vent. Jard. Malm. t. 28, 1803 ; Baker in Hook. f. Fl. Brit. India 2 : 240, 1876 ; Haines 2 : 313, 1922. 'Karanja'.

Trees 10-20 m tall, 50-150 cm in diam.; stems smooth; barks greyish-white; woods yellow. Leaves 20-30 cm long, 5-7-foliolate; leaflets 6-10×4-8 cm, ovate-elliptic or oblong, glabrous, acute, or acuminate at apex, obtuse at base. Flowers 7-8 mm across, lilac or purple, in axillary racemes; peduncles 20-35 cm long. Pods 4-8×2-3.5 cm, flat, oblong-ovoid, woody, obscurely ridged along the suture, narrowed at base, mucronate at apex; seed one.

*Fl. & Fr.*: April-July; September-December.

*Distrib.*: HATAMUNDIA, BHITARKANIKA: More or less restricted throughout the coastal regions along sandy beaches, coastal thickets and back mangroves, sometimes planted along the road-sides.

*Note*: Bennet in [ J. Bomb. nat. Hist. Soc. 68 (1): 302, 1971 ] treated the genus *Pongamia* under a section of the genus *Derris* and named accordingly *Derris indica* (L amk.) Bennet.

### 15. TERAMNUS Swartz.

*Teramnus labialis* (Linn. f.) Spreng. Syst. 3: 235, 1826; Verdcourt in Kew Bull. 24: 266, 1970; Baker in Hook. f. FL. Brit. India 2: 184, 1876; Haines 2: 289, 1922. *Glycine labialis* Linn. f. Suppl. 325, 1781.

Deep-rooted, perennial trailers; branches slender, spreading, adpressed pubescent. Leaves 3-foliolate, alternate; leaflets 1-3.5×0.6-2 cm, ovate, or elliptic-ovate, glabrous or slightly puberulous beneath, obtuse or acute at apex, rounded at base. Flowers 4-5 mm across, purple in axillary racemes. Pods 2-5 cm, long, linear, beaked at apex.

*Fl. & Fr.*: April-May; August-September.

*Distrib.*: BAHAKUD, SATYAVIA: Frequent in waste places along the sandy sea-shore-river-banks and road-sides. Common in dry inland places.

### 16. MUCUNA Adans. (nom. cons.)

#### Key to Species

- |  |                         |
|--|-------------------------|
| 1a. Pods without plaited; winged.                                    |                         |
| 2a. Pods straight, covered with hard irritant, golden brown bristles | ... <i>gigantea</i> 1   |
| 2a. Pods S-shaped, covered with velutinous irritant hairs            | ... <i>puritea</i> 2    |
| 1b. Pods plaited on the face, without wings                          | ... <i>manasperma</i> 3 |

1. *Mucuna gigantea* (Willd.) DC. Prodr. 2: 405, 1825; Baker in Hook. f. Fl. Brit. India 2: 186, 1876; Prain 1: 285, 1903. *Dolichos giganteus* Willd. Sp. Pl. 3: 1041, 1799. 'Nona-bai-Donka'.

Large, woody, perennial twiners; stems glabrous, twisted. Leaves 3-foliolate; leaflets 8-10 × 4-7 cm, elliptic or ovate, very inequilateral, coriaceous, rounded base, acute at apex; stipules subulate. Flowers 4-6.5 cm long, yellow, bristly, drooping in axillary umbelliform racemes 15-20 cm long, woody peduncles. Pods 8-15 cm, flattened broadly winged on both the suture, clothed with golden brown, irritant bristles; seeds 2-4, each 4-4.5 cm across, compressed, helium extending more than  $\frac{1}{2}$  of the seed.

*Fl. & Fr.*: July-September; October-March.

*Distrib.*: BHITARKANIKA: Common along the intertidal zones of several creeks and channels in the mangrove forests, often found in the transitional zones between the mangroves and inland.

Haines (1922) and Mooney (1950) did not report the occurrence of this species from Orissa hence it is a new record for Orissa.

2. *Mucuna prurita* Hook. Bot. Misc. 2: 348, 1831; Haines 2: 296, 1922. *M. pruriens* (auct. non. Linn.) DC. prodr. 2: 405, 1856; Baker in Hook. f. Fl. Brit. India 2: 187, 1876.

Large climbers, stems slender, young twigs pubescent, at length glabrescent. Leaves 3-foliolate; petioles 6-20 cm long; leaflets 12-20 × 6-12 cm ovate, rhomboid or triangular-ovate, inequilateral, adpressed bristly on both surface, acute or apiculate at apex, truncate or cuneate at base. Flowers 3-3.5 cm, deep violate, in axillary drooping racemes. Pods 6-9 cm long, S-shaped, densely covered with brown velutinous irritant hairs.

*Fl. & Fr.*: August-September; November-December.

*Distrib.*: BAHAKUD: Frequent on sandy riverbanks, scrubs and inland gardens.

3. *Mucuna monosperma* DC. Prodr. 2: 406, 1825; Baker in Hook. f. Fl. Brit. India 2: 185, 1876; Haines 2: 296, 1922. 'Bat-donka'.

Perennial twiners; stems woody, brown rusty tomentose. Leaves 3-foliolate; leaflets 9-16 × 6-8 cm, ovate, oblong, or elliptic-oblong, inequilateral, subcoriaceous, acuminate at apex, cuneate or rounded at base. Flowers 4-8 cm across, purple, covered with bristles arranged in

axillary racemes. Pods 6-9 cm long, ellipsoid, flat, transversely plaited or plicate on the face, clothed with brown irritant bristles; seeds one, compressed, brown.

*Fl. & Fr.* : August-September; November-December.

*Distrib.* : DALATNAGAR, BAHAKUD : Frequent in sandy scrub jungle, river-sides and inward forests.

### 17. DERRIS Lour.

#### *Key to Species*

- |                               |                           |
|-------------------------------|---------------------------|
| 1. Pods strap-shaped, narrow  | ... <i>scandens</i> 1     |
| 1. Pods rounded, papery, flat | ... <i>heterophylla</i> 2 |

1. *Derris scandens* (Roxb.) Benth. in JLS 4 (Suppl.) : 103, 1860; Baker in Hook. f. Fl. Brit. India 2 : 240, 1876; Haines 2 : 312, 1922. *Dalbergia scandens* Roxb. Pl. Cor. 2 : t. 102, 1798. '*Katla nata*'.

Scandent shrubs; stems brownish, lenticellate. Leaves imparipinnate, 6-12 cm long; leaflets 9-13, opposite, each 4-8 x 1-1.8 cm, narrowly oblong or ovate-oblong, subcoriaceous, acute at apex, obtuse at base. Flowers 4-6 cm across, white or pinkish, clustered in axillary racemes; peduncles 30-35 cm long, rusty pubescent. Pods 6-8 cm long, strap-shaped, narrow, winged along the upper suture; seeds 1-3.

*Fl. & Fr.* : June-July; August-December.

*Distrib.* : BATIGHAR, BHITARKANIKA : Common along the intertidal regions of several creeks in the tidal forests.

2. *Derris heterophylla* (Willd.) Back. & Bakh. Fl. Java 1 : 619, 1963. *D. uliginosa* (Roxb.) Benth. Pl. Jungh. 1 : 252, 1832; Baker in Hook. f. Fl. Brit. India 2 : 241, 1878; Haines 2 : 311, 1922. *Dalbergia heterophylla* Willd. Sp. Pl. 111 : 901, 1802; and *Robinia uliginosa* Willd. (l.c.) 113. *Galedupa uliginosa* Roxb. Fl. Ind. 3 : 243, 1832. '*Bara-Kettinata*'.

Large twining or creeping shrubs; branches woody, glabrous with scattered lenticels. Leaves imparipinnate, 6-15 cm long; leaflets 5-10 x 2-3.5 cm, ovate or ovate-oblong, subcoriaceous, acute to shortly acuminate at apex, obtuse or rounded at base. Flowers 4-6 mm across, pink, lilac, or pale-white, in axillary panicles. Pods 3-4 cm across, roundish, flat, papery, narrowly winged along upper suture, 1-seeded.

*Fl. & Fr.* : April-May; July-September.

*Distrib.* : BATIGHAR, BHITARKANIKA : Common along intertidal regions of the mangrove forests, on the banks of creeks and channels.

18. *CANAVALIA* DC. (*nom. cons.*)*Key to Species*

1. Leaflets broadly obovate ; upper lip of the calyx apiculate ... *maritima* 1  
 1. Leaflets ovate ; upper lip of the calyx not apiculate ... *cathartica* 2

1. *Canavalia maritima* (Aubl.) Thou. in J. Bot. Desv. 1 : 80, 1813 ; Sauer in Britt. 16 : 163, 1964 ; Mooney in Suppl. Bot. Bihar & Orissa 54 : 1950. *Dolichos maritimus* Aub. Hist. Pl. Guian. Fr. 765, 1775. *Canavalia obtusifolia* (Lamk.) DC. Prodr. 2 : 404, 1825 ; Baker in Hook. f. Fl. Brit., India 2 : 196, 1876. *C. lineata* (auct. non. Thunb.) DC. ; Haines 2 : 291, 1922. '*Kansarinata*'.

Perennial trailers ; stems terete, striate, puberulous, entirely or for the greater part decumbent or creeping, often rooting from the nodes. Leaflets 4-7 × 3.5 - 6.5 cm. broadly obovate or suborbicular, usually clothed with soft adpressed hairs when young, rounded or emarginate at apex, cuneate at base. Flowers 2.5 - 3.5 mm long, purple, arranged in axillary racemes on a 20-40 cm long peduncles ; calyx-tube 11-14 mm, long, upper lip apiculate. Pods 6-8 × 2-2.5 cm, compressed, glabrous, slightly curved and beaked at apex. Seeds 11-13 × 7-8 mm, ellipsoid, pale-brown, 2-10, ecarunculate.

*Fl. & Fr.* : May-September ; October-December.

*Distrib.* : SARLIKUD, SATAVYA : Common along the sandy sea-shores, and estuarine sand bars, serve as a sandbinder in association with *Ipomoea pes-caprae*, *Launaea sermentosa* and *Cyperus arenarius*. Occasionally found to form a pure stand over the sandy beach.

2. *Canavalia cathartica* Thou. in J. Bot. Desv. 1 : 81, 1813 ; Sauer in Britt. 16 : 163, 1964. *C. turgida* Grah. ex. A. Gray Bot. U. S. Expl. Exped. 1 : 440, 1854. *C. ensiformis* (Linn.) DC. var. *turgida* Baker in Hook. f. Fl. Brit. India 2 : 196, 1876 ; *C. obtusifolia* (auct. non Lamk.) DC. ; Prain in Beng. Pl. 2 : 281, 1903 ; *C. microcarpa* (DC.) Piper. Proc. Biol. Soc. Wash. 30 : 176, 1917 ; Chatterjee in J. Ind. Bot. Soc. 28 : 29, 1949 ; Back. Fl. Java 1 : 633, 1963. '*Sara-kansarinata*'.

Perennial creepers ; stems more or less twining, glabrous, often rooting at the nodes. Leaflets 4-6.5 × 3-5 cm, ovate, or oval-elliptic, adpressed pubescent when young, obtuse or acute at base. Flowers 3.5-4 cm long, purple, in axillary racemes on 6-15 cm long peduncles ; calyx-tube 16-18 mm long, upper lip not apiculate. Pods 13-17 × 2-2.5 cm, obovoid, inflated ribbed and extra-ribbed along the suture, beaked

at apex. Seeds 17-18 × 1-1.5 cm, dark-brown with hilum 8-12 mm long, ecarunculate.

*Distrib.* : SARLIKUD : Frequent along the estuarine sand-bars, sandy river-banks and lee side sand dunes.

#### 19. ATYLOSIA Wt. & Arn.

*Atylosia scarabaeoides* (Linn.) Benth. in Pl. Jungh. 2 : 243, 1852 ; Baker in Hook. f. Fl. Brit. India 2 : 215, 1876 ; Haines 2 : 286, 1922. *Cantharospermum scarabaeoides* (Linn.) Baill. in Bull. Soc. Linn. Paris 1 : 384, 1883 ; Mooney in suppl. 52, 1950. *Dolichos scarabaeoides* Linn. Sp. Pl. 726, 1753. 'Bon Kulthia'.

Herbaceous twiners, sometimes trailing along sands. Stems terete, brownish-grey, densely covered with scabrid hairs. Leaves 3-foliate; leaflets 1-2.5 × 0.5-1 cm, ovate-oblong, or obovate, softly velutinous on both the surface, strongly reticulovenous beneath, obtuse or retuse at apex, rounded at base. Flowers 5-8 mm across, yellow, 2-3 in axillary racemes. Pods 15-25 × 5-8 mm, inflated, septed between the seed with transverse lines, obtusely beaked, covered with golden-brown, velvety hairs. Seeds 4-5, dark-brown, with white strophioles.

*Fl. & Fr.* : February-June ; September-October.

*Distrib.* : SATYAVIA, PARADEEP : Frequent along sandy sea-shore jungles and inland forests.

*Note* : Wight & Arnott in Prodr. Fl. Pen. Ind. Orient (1834) described the genus *Atylosia* in page 255, and the genus *Cantharospermum* in page 257, Bentham (l.c) united the two genera under *Atylosia*. Under Art. 57 of 1956 code, the name *Atylosia* is a legitimate one for the group including *Atylosia* and *Cantharospermum* of Wt. & Arn. Taubert in Engl. & Prantl, Pfam. 1894 ; and Merrill in 1912 ; chose *Cantharospermum* on the apprehension that the latter name has page priority over *Atylosia* which is not according to code.

### MIMOSACEAE

#### Key to Genera

- |   |     |            |
|---|-----|------------|
| 1. Plants armed with prickles ; anthers not gland-crested | ... | MIMOSA 1   |
| 1. Plants glabrous ; anthers gland-crested                | ... | NEPTUNIA 2 |

## 1. MIMOSA Linn.

*Mimosa pudica* Linn. Sp. Pl. 518, 1753; Brennan in Kew Bull. 184, 1955; Baker in Hook. f. Fl. Brit. India 2: 291, 1876; Haines 2: 336, 1922. 'Lajkuri'.

Perennial undershrubs, erect or rambling; stems woody, armed with prickles, glabrous when young. Leaves bipinnate, sensitive; pinnae 4-6 cm long; rachises clothed with ascending bristles; leaflets 10-25 pairs, each 3-10 × 1-3 mm, linear-oblong, sessile, setose beneath, acute or mucronulate at apex, oblique at base. Flowers pink, densely bristly, in axillary pedunculate heads. Pods 1.5-2 cm long, plano-compressed, joints 4-6, valves 2, separating from persistent margins and divided transversely into numerous spiny bristles. Seeds orbicular, smooth.

*Fl. & Fr.* : May-September.

*Distrib.* : DALTANAGA, KUJANG : Common along the river-banks, and embankments near low land.

*Note* : Brennan (*l.c.*) and Milne-Redhead (Fl. Trop. E. Afr. 46-47, 1956) distinguished three subordinate taxa in *M. pudica*. Our specimens compare well with var. *hispida* Brennan.

## 2. NEPTUNIA Lour.

*Neptunia oleracea* Lour. Fl. Cochinch. 654, 1790; Brennan in Hubbard & Milne-Redhead, Fl. Trop. East Africa 40, f. 12, 1959; Subramanyam in Aqu. Ang. 15, f. 122, 1962; Windler in Asiatic J. Bot. 14: 401, f. 10, 1966; Baker in Hook. f. Fl. Brit. India 2: 285, 1876; Mooney 58, 1950. *Mimosa natans* Linn. f. suppl. 439, 1781, *nomen confusum*. *M. prostrata* Lamk. Encycl. Meth. 1: 10, 1783; *nomen illeg.* 'Panilajkuria'.

Floating herbs; stems fleshy, spongy with fibrous adventitious roots at the nodes. Leaves bipinnate, thigmotropic; pinnae 2-4 pairs; leaflets 3-16 × 1-5 mm, sessile, linear-oblong, glabrous, acute at apex, oblique at base. Flowers 1-2 cm long, deep yellow, in axillary pedunculate heads; peduncles angular fleshy 20-30 cm long. Pods 1-2 × 0.5-1 cm, ovoid flat, deflexed into a short stipe and beaked at apex, suture with membranous wings. Seeds 4-6, compressed, flat.

*Fl. & Fr.* : August-September; October-December.

*Distrib.* : PARADEEP : Common in ditches and low land along sandy river-banks and inland.

Note : There has been much controversy regarding the choice of a proper name for this species. Windler (*l.c.*) has discussed and correctly published the view currently held in most of the botanical works, as follows :

When Loureiro described *Neptunia* in 1790, based on a species to which he gave the name *N. oleracea*, several other names had already been applied to this plant. The earliest name which exists is *Mimosa natans* Linn. f. A curious situation exists with reference to this name. The original description of *M. natans* is for the terrestrial species, *Neptunia triquetra*, but the epithet *natans* and the specimens cited by Linn. f. refer to the floating plant in question. Hence the name *M. natans* Linn. f. was applicable to the two different plants. To resolve this, Mac-Boride (1919) proposed that the binomial *M. natans* be discarded since it is an error. The earliest name which follows *M. natans* is *M. prostrata* Lamk. Since Lamarck cites *M. natans* with description and does not clarify the reason for proposing the name, *M. prostrate* must be considered superfluous and therefore illegitimate at the time of publication. Therefore, the earliest legitimate name which clearly applies to this species, is *N. oleracea*.

**ALBIZIA Durazz.**

*Albizia lebbek* (Linn.) Benth. in Hook. Lond. J. Bot. 3 : 87, 1844 ; Baker in Hook. f. Fl. Brit. India 2 : 298. 1876 ; Haines 2 : 346, 1922. *Mimosa lebbek* Linn. Sp. Pl. 516, 1753. 'Seris'.

Deciduous trees with many spreading branches. Flowers greenish-white. Pods thin, flat.

*Distrib.* : BAHAKUD : Frequently planted along road-sides, occasionally found naturalized near the river-banks and low-lying forests.

Note : Linnaeus originally spelt the specific epithet as *lebbeck*, and not *lebbek*. Little (Amer. Mid. Nat. 33 : 510, 1945) has discussed the reasons for spelling *lebbek*.

**CAESALPINIACEAE**

*Key to Genera*

- 1a. Leaves bipinnate :
  - 2. Main rachis of leaf spiniform ; pods constricted between seeds ... PARKINSONIA 1
  - 2. Main rachis of leaf aculeate ; pods not constricted, flat ... CAESALPINIA 2
- 1b. Leaves paripinnate ... CASSIA 3
  - 3. Petals one ; pods many-seeded ... INTYBIA 4
  - 3. Petals 5 ; pods one-seeded ... CYNOMETRA 5



## 1. PARKINSONIA Linn.

*Parkinsonia aculeata* Linn. Sp. Pl. 375, 1753; Baker in Hook. f. Fl. Brit. India 2 : 260, 1876; Haines 2 : 327, 1922. '*Bilati Kikar*'.

Shrubs or small trees, 2-6 m tall, armed with long spines. Leaves at first pinnate and fasciculate, later bipinnate, spinescent along rachis; pinnae 2-4, 30-45 cm long; rachis of pinnae phyllodial, 1-3 mm across, apparently borne on spine; leaflets numerous, 3-5 mm long, linear-oblong or oblanceolate, caducous. Flowers 8-12 mm long, deep yellow, in axillary racemes. Pods 6-10 cm, linear-oblong, torulose, attenuated along both ends. Seeds 2-4.

*Fl. & Fr.* : October-March; June-July.

*Distrib.* : BAHAKUD, KANKA : Frequent along the river-banks, coastal thickets and back mangroves. Commonly found as hedge plants in low-lying areas.

## 2. CAESALPINIA Linn.

*Key to Species*

- |                     |     |                 |
|---------------------|-----|-----------------|
| 1. Pods prickly     | ... | <i>bonduc</i> 1 |
| 1. Pods not prickly | ... | <i>crista</i> 2 |

1. *Caesalpinia bonduc* (Linn.) Roxb. Fl. Ind. 2 : 362, *quoad basion.*; Roti-Michelozzi in Webbia 13 : 204, 1957. *Gullandina bonduc* Linn. Sp. Pl. 381, 1753. *Caesalpinia bonducella* (Linn.) Flem. in As. Res. 11 : 159, 1810; Baker in Hook. f. Fl. Brit. India 2 ; 254, 1876. *C. crista auct. non* Linn. Haines 2 : 331, 1922. '*Nata*'.

Much-branched, scrambling shrubs armed with prickles. Leaves bipinnate, alternate, pubescent, armed with recurved prickles; pinnae 4-16 jugate; leaflets 1.5-4 x 1-2 cm, ovate to elliptic-oblong, acute or mucronate at apex, oblique at base; stipules foliaceous. Flowers 5-10 mm long, yellow, in supra axillary racemes; lower flowers only fertile. Pods 4-6 cm, elliptic-oblong, turgid, densely prickly. Seeds 2 cm across, 1-3, globose, shining.

*Distrib.* : BAHAKUD, SATAVYA : Common in open hedges; sandy scrubs; coastal thickets, and occasionally along sandy sea-shore and of back mangroves.

*Note* : The nomenclature of this plant is somewhat confusing. Linnaeus included in the protologue of *Caesalpinia crista* elements belonging to two species, the one usually known as *C. nuga* (Linn.) Ait. f. and other as *C. bonducella* (Linn.) Flem. Contrary to Merrill (Int. Rumph. Herb. Amb. 260-262, 1917) Dandy and Exell (J. Bot. 76 : 175-180, 1938) convincingly argues and lectotypified *C. crista* Linn. with the element usually known as *C. nuga* (Linn.) Ait. f., a view followed in most of the recent works. Roxb. (*l.c.*) while effecting the transfer of *Guilandina bonduc* Linn. to *Caesalpinia*, misapplied the name *C. bonduc* to an altogether different plant. Following Merrill (*l.c.*) some authors treat *Caesalpinia bonduc*, as a new name and not as a combination based on *C. bonducella* (Linn.) Flem. for this species. This, however, is inadmissible under ICBN rules, and according to Article 55, of 1972 code, the name *C. bonduc* (Linn.) Roxb. must be treated as a combination based on *Guilandina bonduc* Linn.

2. *Caesalpinia crista* Linn. Sp. Pl. 380, 1753 ; Dandy and Exell. in J. Bot. 76 : 179, 1938 ; Back & Bakh. Fl. Java 1 : 545, 1963. *C. nuga* (Linn.) Ait. f. in Hort. Kew. ed. 2, 3 : 32, 1811 ; Baker in Hook. f. Fl. Brit. India 2 : 255, 1876 ; Haines 2 : 330, 1922. 'Kantakarange.'

Large climbers or lianas, armed with hooked prickles. Leaves 18-30 cm long, decomposed ; pinnae 2-6 pairs ; rachises unarmed or sparingly aculeate, 3-10 cm long ; leaflets ovate or elliptic-oblong, subcoriaceous, pale glaucous beneath, acute at apex, obtuse at base. Flowers 1.5-2 cm long, deep yellow, fragrant, in axillary or supra-axillary branched racemes. Pods 4-5 × 3-3.5 cm, ellipsoid, flat, compressed, beaked. Seeds 1, flat, smooth.

*Fl. & Fr.* : October-January ; December-May.

*Distrib.* : BATIGHAR, MUSADIH, BHITARKANIKA : Common along the intertidal zones of several creeks and canals in the mangrove forests usually restricted to the littoral zones, in association with *Dalbergia spinosa*, *Hibiscus tiliaceus* and *Phoenix paludosa*.

### 3. CASSIA Linn.

#### *Key to Species*

- |  |     |                       |
|--|-----|-----------------------|
| 1a. Petioles glandular, petioles eglandular  |     |                       |
| 2a. Leaves ovate ; pods compressed, flat     | ... | <i>occidentalis</i> 1 |
| 2b. Leaves oblong-lanceolate ; pods inflated | --- | <i>sophora</i> 2      |
| 1b. Petioles eglandular, petioles glandular  | --- | <i>tora</i> 3         |

1. *Cassia occidentalis* Linn. Sp. Pl. 377, 1753 ; Dewit in Webbia 11 : 207, 1956 ; Baker in Hook. f. Fl. Brit. India 2 : 262, 1876 ; Haines 2 : 318, 1922. '*Kalakasouda*'.

Perennial shrubs, 1-2 m tall ; stems glabrous, subquadrangular. Leaves peripinnate, 4-5 jugate, alternate ; leaflets 3-6 × 2-3 cm, ovate, glabrous, acute and mucronate at apex, oblique at base. Flowers 1-1.5 cm across, yellow, in short axillary racemes. Pods 12-15 cm, torulose, compressed, with thick ridges along both the sutures. Seeds many, ribbed.

*Fl. & Fr.* : July-November ; December-January.

*Distrib.* : BAHARUKH : Frequent on sandy sea-shores, scrub jungles and along the road-sides.

2. *Cassia sophora* Linn. Sp. Pl. 379, 1753 ; Dewit 265 ; Baker in Hook. f. Fl. Brit. India 2 : 262, 1876 ; Haines 2 : 318, 1922. '*Kanndi*'.

Erect perennial herbs or undershrubs up to 2 m tall ; stems much-branched, glabrous. Leaves peripinnate, 6-12 jugate, alternate ; rachis 4-20 cm long ; glands clavate or cylindrical, above the petioles ; leaflets 4-6 × 0.8-1 cm, oblong-lanceolate, glabrous, acute at apex, oblique at base. Flowers 1-1.5 cm across, yellow, in upper axillary racemes. Pods 6-11 cm, straight turgid, septate between seeds ; seeds many.

*Fl. & Fr.* : July-November.

*Distrib.* : KUWANG, CHANDIBALI : Mostly common towards inland, frequent along the river-banks and lee side of the sandy sea coast.

Flowers and leaves used as vegetables and leaves are used for recovering skin diseases.

3. *Cassia tora* Linn. Sp. Pl. 376, 1753 ; Dewit 276 ; Baker in Hook. f. Fl. Brit. India 2 : 263, 1876 ; Haines 2 : 318, 1922. '*Chakoara*'.

Erect, perennial herbs or undershrubs 30-70 cm tall ; stems terete, much-branched. Leaves peripinnate, 3-jugate, rachis 1-3 cm, sulcate ; glands subulate above the petiolules in-between leaflets ; leaflets 1-3.5 × 0.5-2 cm, obovate, glabrous, obtuse at apex, cuneate or oblique at base. Flowers 5-6 mm across, yellow, in pairs on short axillary peduncles. Pods up to 20 cm, slender, tetragonous, slightly curved, obliquely septate between seeds ; many-seeded.

*Fl. & Fr.* : June-December.

*Distrib.* : SATYAVIA : Common along road-sides, waste land, river-banks and occasionally along the sandy sea-shores, in places exposed to biotic influence.

## 4. INTSIA THOUARS

*Intsia bijuga* (Colebr.) O. Kuntze, Rev. Gen. Pl. 192, 1891; Dewit in Bull. Jard. Buitz. Ser. 3: 17, 139, 1941. *Macrolobius bijugam* Col. in Trans. Linn. Soc. 12: 359, t. 17, 1817. *Afzelia retusa* Kutz in J. As. Soc. Bengal 42: 73, 1875; Baker in Hook. f. Fl. Brit. India 2: 274, 1876. *A. bijuga* (Col.) A. Gray Bot. Wilks. U. St. Exp. 467, 1873; Baker in Hook. f. Fl. Brit. India 2: 274, 1876. 'Maha sita'.

Trees. 10-20 m tall, 30-60 cm in diam., stems somewhat curved, devoid of branches up to certain height; bark smooth, whitish-grey. Leaves prevailingly bijugate; leaflets 2-6, each 8-13 x 4-9 cm, elliptic, ovate-elliptic, or broadly ovate inequilateral, subcoriaceous, rounded, subacute, or retuse at apex, obliquely rounded at base. Flowers 3-4 cm across, deep purple, white in bud, arranged in terminal corymbs with racimiform branched, each flower in axil of bract; calyx tube 1.5-2 cm, shortly pubescent, 4-fid, imbricate; petal 1-1.5 cm clawed. Pods 15-20 x 4-5 cm, unequal-sided woody, compressed, curved, transversely reticulovenose, 2-valved, septate between the seeds. Seeds 3-8, 3-3.5 x 2-2.8 cm across, transverse, covered with yellow or reddish brown, incomplete aril.

**Fl. & Fr. :** January-March; Fruits present on the plant from March-December.

**Distrib. :** BHITARKANIKA: More or less common towards the inner mangroves, sometimes along the intertidal zones in association with *Heritiera fomes*, *Cynometra ramiflora* and *Brownlowia teresa*.

**Note :** Our observation in the field concur with Dewit (*l.c.*) although we have also observed the leaflets varying in numbers from 2, 4, 5 or 6 in the same branch. Further, Haines (1922) and Mooney (1950) have not reported this taxon from the Orissa State, hence the present finding is a new distributional record for Orissa.

## 5. CYNOMETRA Linn.

*Key to Species*

- |  |     |                    |
|--|-----|--------------------|
| 1a. Pods deeply wrinkled, apical part hooked | ... | <i>tripe</i> 1     |
| 1b. Pods rugose, apical part not hooked      | ... | <i>ramiflora</i> 2 |

1. *Cynometra tripe* Kostel. Allg. Med. Pharm. Fl. 4: 1341, 1835; Meuwens in Blumea 18 (1): 21, 1970. *C. ramiflora* Linn, var. *mimosoides* Baker, in Hook. f. Fl. Brit. India 2: 267, 1878. *C. ramiflora* Linn. ssp.

*bijuga* Prain var. *mimosoides* Prain in J. As. Soc. Bengal 66 (2) : 198, 478, 1897. *C. mimosoides* Prain in Rec. bot. Surv. India 2 : 303 ; Mooney in Suppl. Bot. Bihar & Orissa 251, 1950. 'Singhara'.

Trees 4-12 m tall, 40-50 cm in diam., growing flash-wise uniform crowns. Leaves 2-jugate, rarely 1-jugate ; leaflets smaller in lower pairs, and larger in upper pairs, usually  $2.7 \times 1.3.5$  cm, ovate or ovate-oblong, coriaceous, inequilateral, emarginate at apex, oblique at base. Flowers 4-6 mm long, purple, arranged in densely contracted axillary racemes or borne on trunks and old branches ; while in bud covered with congested, short scales ; bracts ovate ; bracteoles caducous. Pods 3-6 per raceme, each 1.5-2.5 cm, obliquely elliptic, or semi-orbicular fleshy, deeply wrinkled, with pointed apical beak ; seeds 1, flat, smooth or sometimes rugose.

*Fl. & Fr.* : October-November ; December-March.

*Distrib.* : BATIGHAR, JAMBU, BHITARKANIKA : Common along the intertidal zones in the semi-mangrove forest in association with *Heritiera fomes*, *Excoecaria agallocha* and *Bruguiera* sp.

2. *Cyrometra ramiflora* ; Linn. Sp. Pl. 382, 1753 ; Meewen in Blumea 23 ; Baker in Hook. f. Fl. Brit. India 2 : 267, 1878. *C. ramiflora* Linn. ssp. *genuina* Prain, J. As. Soc. Bengal 66 (2) : 198, 478, 1897. 'Singhara'.

Trees 10-16 m tall, 40-70 cm in diam. ; Leaves 2-jugate, or 1- and 2-jugate ; leaflets of lower pairs  $2.4.5 \times 1.2.5$  cm, and of upper pairs  $4.5-10 \times 3.5-5.5$  cm, variable in shape, ovate, ovate-oblong, suborbicular, or lanceolate, emarginate, at apex, conspicuously oblique at base. Flowers 4-6 mm across, purple, arranged in condensed axillary racemes or borne on trunk ; rachis of inflorescence 6-20 mm. Pods 2.5-4 cm across, ovate-elliptic, woody, rugose, apex without a hooked point ; seeds 1, flat, white, fleshy, smooth.

*Fl. & Fr.* : September, November, December-January.

*Distrib.* : BHITARKANIKA : Common along the inner as well as outer fringes of tidal forests, restricted in the islands near estuaries, in association with *Heritiera littoralis*, *Xylocarpus* sp., and *Heritiera fomes*.

It is a very good fuel even when green, timber is heavy and durable. Seeds are edible ; fruits are roasted and the inner cotyledons are eaten by local people like ground nuts.

During monsoon pods are found floating along the river water, the fibrous layer of the pericarp with numerous air pockets helps the pods to be boyant. Germination of seedlings found only under fresh water conditions during May to July.

Our field observation revealed that *C. iripa*, is very common and widely distributed throughout the mangrove forests rather than the *C. ramiflora*, which is more or less restricted to the islands, and found only along the inner zones of the forests. Differences between these two species in the field are seen in the shape and size of leaflets, their number and nature of pods.

However, recently Meeuwen (*J. c.*) differentiated these two species on the basis of some additional characters, such as inside hairiness of the ovarian wall, and nature of style. There are specific differences to consider them as separate taxa. Haines (1922) and Mooney (1950) did not report this taxon from Orissa ; hence it is a new record for Orissa.

## VAHLIACEAE

### VAHLIA Thunb.

*Vahlia dichotoma* (Murray) Kuntze, Rev. Gen. Pl. 227. 1891 ; D.M. Bridson in Kew Bull. 30 (1) : 164, 1975. *Heuchera dichotoma* Murray in Nov. Comm. Soc. Reg. Sci. Gott. 3 : 64, t. 1, 1773. *Vahlia oldenlandioides* Roxb. Fl. Ind., ed. Carey 2 : 89, 1852 ; Clarke in Hook. f. Fl. Brit. India 2 : 399, 1878 ; Haines 2 : 356, 1922.

Erect herbs 10-30 cm tall ; branches diffuse or erect, pubescent. Leaves 2-3.5×0.3-0.5 cm sessile, linear-lanceolate, pubescent, acute at apex, obtuse at base. Flowers 2-3 mm across, white, paired in axillary peduncles ; peduncles 5-10 mm long. Capsules 3-4 mm across, ovoid or subglobose, with adpressed hairs ; seeds many, golden-brown.

*Fl. & Fr.* : January-April.

*Distrib.* : CHANDBALLY : Frequent in moist places along the sandy sea shore.

## CRASSULACEAE

### BRYOPHYLLUM Salisb.

*Bryophyllum pinnatum* (Lamk.) Oken, Allg. Naturgesch 3 (3) : 966, 1841 ; Sant. in Fl. Saur. 1 : 213, 1962. *Cotyledon pennatum* Lamk. Encycl. 2 : 141, 1786. *Bryophyllum calycinum* Salisb. Parad. Lond. t. 3, 1805 ; Clarke in Hook. f. Fl. Brit. India 2 : 413, 1878 ; Haines 2 : 357, 1922.

Succulent glabrous herbs or undershrubs, 0.5-1 m tall ; stems fleshy, pithy, erect or sometimes prostrate, rooting at nodes. Leaves 5-12×3-5 cm, greenish-purple, campanulate, in axillary or terminal panicles ; flowering scape 30-60 cm long. Fruits follicular, included in the persistent perianth.

*Fl. & Fr.* : December-March ; April-May.

*Distrib.* : BAHAKUD, PARADEEP : Frequent in sandy scrubs along river banks ; often in the cultivated gardens.

## DROSERACEAE

### DROSERA Linn.

#### *Key to Species*

- |   |                       |
|---|-----------------------|
| 1a. Leaves obovate, in rosettes at base | ... <i>burmanni</i> 1 |
| 1b. Leaves linear, cauline              | ... <i>indica</i> 2   |

1. *Drosera burmanni* Vahl, *Symb.* 3 : 50, 1794 ; van Steenis in *Fl. Mal.* 4 : 378, 1958 ; Clarke in *Hook. f. Fl. Brit. India* 2 : 424, 1878 ; Haines 2 : 359, 1922. '*Mukta Jali*'.

Perennial, rosulate herbs ; stems with subterranean tubers. Leaves in rosettes, adpressed to the soil, 1-1.5 x 0.5-1 cm, obovate or spatulate, sessile, red or green covered with glandular, irritable, orthigmotropid capitate hairs. Flowers 2-3 mm across, purple or rose-coloured, 6-20, arranged in helicoid cymes on a slender scape ; scapes 2-3, each 9-20 cm long. Capsules ovoid, 1-2 mm long ; seeds many, scrobiculate.

*Fl. & Fr.* : December-April.

*Distrib.* : KONARK, CHANDBALI : More or less common along the lee side, of moist sandy places or along open grasslands near the sea-shore.

2. *Drosera indica* Linn. *Sp. Pl.* 282, 1753 ; van Steenis in *Fl. Mal.* 4 : 379, 1953 ; Clarke in *Hook. f. Fl. Brit. India* 2 : 424, 1878 ; Haines 2 : 359, 1922.

Perennial herbs ; stems without subterranean tubers. Leaves 2-8 cm long, linear, covered with irritable tentacles. Flowers 2-4 mm across, purple arranged in helicoid cymes ; Capsules 4-6 mm across, broadly oblong. Seeds many, apiculate, finely ribbed.

*Fl. & Fr.* : August-October.

*Distrib.* : KONARK : Frequent on moist sandy places and grasslands.

## RHIZOPHORACEAE

#### *Key to Genera*

- |   |                  |
|---|------------------|
| 1a. Flowers ebracteolate ; calyx 8-13-lobed | ... BRUGUIERA 1  |
| 1b. Flowers bracteolate ; calyx 4-6-lobed : |                  |
| 2a. Petals with appendages :                |                  |
| 2b. Petals without appendages               | ... RHIZOPHORA 4 |
| 3a. Calyx ovate, acute ; stamens 10-12      | ... CECIOPS 2    |
| 3b. Calyx linear-oblong ; stamens numerous  | ... KANDelia 3   |

## 1. BRUGUIERA Lamark.

## Key to Species

- 1a. Flowers solitary :
- 2a. Flowers red, petal lobes reflexed ... *gymnorrhiza* 1
- 2b. Flowers yellow, petal lobes not reflexed ... *sexangula* 2
- 1b. Flowers not solitary, 2-5-flowered :
- 3a. Calyx tube semi-cylindrical, ridged ... *parviflora* 3
- 3b. Calyx tube cup-shaped, not ridged ... *cylindrica* 4

1. *Bruguiera gymnorrhiza* (Linn.) Savigny in Lam. Enc. 4 : 696, 1798 ; Ding Hou in Fl. Thailand, 2 : 8, 1970 ; and Fl. Mal. 5 : 461, f. 16, 17n., 1958 ; Henslow in Hook. f. Fl. Brit. India 2 : 437, 1878. *B. conjugata* (non *Rhizophora conjugata* Linn.) Merr. Philipp. J. Sci. 9 : 118, 1914 ; Haines 1 : 349, 1922 ; *Rhizophora gymnorrhiza* Linn. Sp. Pl. 443, 1753. 'Kekra'.

Tree 6-20 m tall, 30-60 cm in diam. ; bark rough, fissured, corky lenticellate ; stem base shortly buttressed with many geniculate pneumatophores. Leaves 12.5-20.5 × 5.5-7.5 cm elliptic-oblong or ovate-elliptic, thick, coriaceous, dark-green, entire, acute at apex, obtuse at base ; petioles reddish green in colour. Flowers, scarlet, up to 3.5-4 cm, solitary, axillary ; calyx tubes ribbed, 10-14-lobed, petals as many as calyx lobes, 13-17 mm long, two lobed, caducous, embracing a pair of stamens, each lobe reflexed at the tip ; tip of petal lobe acute, with 2-4 cillias ; sinus of petal with one straight bristle ; margin of petal glabrous or hairy ; sinus bristles, apical cillias and marginal hairs, very variable in numbers and sizes with many intergrading forms ; stamens 9-12 mm long ; anthers linear ; style 12-17 mm long, 3-fld. Hypocotyl, angular, cigar-shaped, 15-17 × 1.5-2.5 cm narrowed at apex.

*Fl. & Fr.* : Throughout the year. Shedding of hypocotyle : at the onset of monsoon (March to June), several hypocotyles are found floating during this period with plumules upwards and radicles submerged.

*Distrib.* : DHAMARA, MAIPARA : Frequent along the intertidal regions of several creeks and channels usually preferring inundated wet soils in association with *Rhizophora apiculata* and *Kandelia candel*. It is often common along the interior island in association with *Heritiera fomes*, *Cynometra mimosoides*, *Aglala cucullata* and *Excoecaria agallocha*.

2. *Bruguiera sexangula* (Lour.) Poir. in Lamk. Enc. Suppl. 4 : 262, 1816 ; Ding Hou in Fl. Thailand 2 : 8, 1970 ; and Fl. Mal. 5 : 23, 463f. 6b. 17m, 1958 ; Back. & bakh. f. in Fl. Java 1 : 381, 1963. *Rhizophora*



*sexangula* Lour. Fl. Cochinchina 297, 1790. *Bruguiera eriopetala* W. & A. ex Arn. Ann. Mag. nat. Hist. 1 : 368, 1838 ; Henslow in Hook. f. Fl. Brit. India 2 : 438, 1878.

Trees 6-16 m tall, 20-40 cm diam. ; stems shortly buttressed, with many still roots from the base ; bark reddish brown, fissured, lenticellate. Leaves 10-15 × 4-5.5 cm elliptic-oblong, or oblanceolate, coriaceous, acute at apex, obtuse or truncate at base ; midribs and petioles yellow in colour. Flowers yellow, 3-3.5 cm long, solitary, axillary ; calyx tube 1.2-1.7 cm long, ribbed, 10-12-lobed, each 1.8-2 cm long, petals yellow, as many as calyx lobes, coriaceous ; each 13-14 mm long, bilobed, caducous, embracing a pair of stamen ; lobes obtuse at apex, not reflexed at tip ; tip of petal lobes with 0-1 or 2 cillias ; sinus of petal with one straight bristle ; margin of petal glabrous to densely hairy ; sinus bristles, apical cillias and marginal hairs very variable in number and size ; stamens 8-9 mm long ; hypocotyle 10-15 cm long.

*Fl. & Fr.* : Same as *B. gymnorrhiza*.

*Distrib.* : BAHAKUD, DUNGMAL, BHITARKANIKA : Common in the outward mangrove fringes, the beginning of the transition areas to ordinary inland plants ; as a rule on dry sandy soils where the places are infrequently flooded with salt water. Contrary to Ding Hou (Fl. Mal. l. c.) it is often found in association with *Acrostichum*, *Tamarix* Sp., *Salvadora persica* and never in association with *B. cylindrica* or *B. parviflora*.

*Note* : Like *B. gymnorrhiza*, sinus bristles, apical cillias of the petal lobes and marginal hairs of the petals are very variable ; extreme as well as intergrading forms are also found here. Haines (1922) and Mooney (1950) have not recorded this species from Orissa. The presence of this taxon is a new record for entire E. coast.

3. *Bruguiera parviflora* (Roxb.) W. & A. ex Griff. Trans. med. phys. Soc. Calcutta 8 : 10, 1836 ; Ding Hou in Fl. Thailand 2 : 9, 1970 ; and Fl. Mal. 5 : 564f. 6a, 20, 21, 1958 ; Henslow in Hook. f. Fl. Brit. India 2 : 438, 1878 ; Mooney 252, 1950. *Rhizophora parviflora* Roxb. Fl. Ind. ed. Carey 2 : 461, 1832.

Trees, 10-16 m tall, 15-20 cm in diam. ; bark greyish-white, lenticellate, smooth ; twigs yellowish with many stipular scars : stem base usually buttressed, with numerous flesh-coloured, knee-bent pneumatophores. Leaves 6.5-10.5 × 2.5-4 cm, elliptic, coriaceous, dark-green with yellow mid-ribs, acute at apex, cuneate at base ; petioles yellow 2-2.5 cm long. Flowers, greenish-yellow, 1.3-1.5 cm long, sub-cylindrical,

3 in axillary pedunculate cymes; peduncles 0.8 cm long; pedicels 0.8-1 cm long, articulated; calyx tubes 9-11 mm long, ribbed; lobes 8, each 2 mm long, thick, coriaceous; petals as many as calyx lobes, caducous; each 2 mm long, bilobed, rounded at apex, tip of the petal lobes with 3 long cillias; sinus with one longer bristle; margin of petals mediumly hairy throughout. Hypocotyle 15-25 cm long, cylindrical, smooth, slightly curved towards middle.

*Fl. & Fr.* : Usually March-July.

*Distrib.* : **BATIGHAR** : Common along the intertidal zones near estuaries just after *Avicennia marina*. Usually much more tolerant of submergence, salinity and soft silty clay soil. It often establishes itself as a pure stand on the inner side of the mangrove, or frequently in association with *B. cylindrica*, *Aegialitis rotundifolia* and *Lumnitzera racemosa*.

4. *Bruguiera cylindrica* (Linn.) Bl. En. Pl. Java 1 : 93, 1827, *quoad basionym*; Ding Hou Fl. Thailand 2 ; 9, 1970; and in Fl. Mal. 5 : 467, 1958. *Rhizophora cylindrica* Linn. Sp. Pl. 443, 1753. *Bruguiera caryophylloides* (Burm. f.) Bl. En. 01. Jav. 1 : 93, 1827; Henslow in Hook. f. Fl. Brit. India 2 : 438, 1878; Haines 1 : 349, 1925. 'Champa'.

Trees 10-12 m tall, stems smooth, lenticellate; stem base buttressed, with many still roots; twigs bronze-coloured with stipular scars. Leaves 8-16.5 × 5.5-6.5 cm oblanceolate, or rarely elliptic, thick coriaceous, bronze-green, acute at apex, cuneate at base; petioles 3-3.5 cm long. Flowers, white, 1-1.3 cm across, 3 in axillary pedunculate cymes; peduncles 7-8 mm long; pedicels very short, not articulated; calyx tubes smooth, cup-shaped, not ribbed, lobes variable in numbers usually 8-9, or 10, reflexed, each 8-10 mm long; petals white, as many as the calyx lobes, each 8-10 mm long, bilobed, tip of petal lobes rounded, with 3 cillias in each; sinus of petal lobes with one long bristle; margins of petals mediumly hairy throughout. Hypocotyle 10-14 cm long, 5 mm in diam., more or less cylindric, straight or slightly curved towards apex.

*Fl. & Fr.* : March-August or rarely throughout the season.

*Distrib.* : **MAHANADI, MAIPARA** : More or less same as *B. parviflora*, gregarious on newly formed soils along the estuaries behind *Avicennia marina* communities; tolerant of prolonged submersion, high salinity and prefers immature soils. Sometimes found along the intertidal zones up to the inner fringes of mangrove swamps; frequently in association with *Sonneratia griffithii* and *Aegialitis rotundifolia*.

Throughout estuaries of Mahanadi and Maipara. Batighar, Jambu, Kansardia, Tharkurdian and Hookitola, Cuttack Dt., Orissa.

*Notes* : Number of calyx lobes vary from 8-10. Even in a cyme of three flowers, this condition is observed clearly.

## 2. CERIOPS Arn.

### *Key to Species*

- |   |     |     |                   |
|---|-----|-----|-------------------|
| 1a. Petals with 3 clavate appendages ; anthers shorter than the filaments           | ... | ... | <i>tagal</i> 1    |
| 1b. Petals fringed, not with clavate appendages ; anthers longer than the filaments | ... | ... | <i>decandra</i> 2 |

1. *Ceriops tagal* (Perr.) C. B. Rob. in Phillip. J. Sc. 3 (Bot.) : 306, 1903 ; Ding Hou in Fl. Thailand 2 : 11, 1970 ; V. Steenis in Fl. Mal. 5 : 469, 1958. *Rhizophora tagal* Perr. Mem. Soc. Linn. Paris 3 : 138, 1824. *Ceriops candoliana* Arn. Ann. Mag. nat Hist. 1 : 364, 1838, *nom. illeg.* ; Henslow in HK. f. Fl. Brit. India 2 : 346, 1878. '*Math garan*'.

Trees 3-5 m tall, 10-20 cm in diam. ; bark light red, lenticellate, peeling in thin flakes ; stem base pyramidal in outline, with fluted buttresses and stilt roots. Leaves 6-12 × 3-6 cm, obovate, or obovate-oblong, coriaceous, entire, emarginate or rounded at apex, cuneate at base ; petioles 2.5-3.5 cm long, stipules 2-2.5 cm long lanceolate. Flowers 5-7 mm, across, white, resinous, 6-10, arranged in condensed cymes from the upper axils ; calyx 5 cleft, lobes linear, reflexed in fruit ; petals 5, oblong, coherent at the base with uncinata hairs, each 3-3.5 mm long with 3 clavate appendages at the tip ; anthers shorter than the filaments. Fruits ovoid, 1.5-2 cm long, with persistent reflexed, calyx lobes ; hypocotyle 20-25 cm long, club-shaped, pointed towards the radical end.

*Fl. & Fr.* : February-August ; September-December.

*Distrib.* : THAKURDIAN : Frequent along the intertidal zone, inner and outer fringes of the mangrove swamps. Usually found in association with *Ceriops decandra*, *Bruguiera cylindrica* and *Xylocarpus mekongensis*.

*Note* : Most useful taxa ; Barks yield maximum quantity of tannin ; trunks and branches used for house building accessory, parts of country boats and good charcoal.

Prain in Rec. Bot. Surv., India 2(4) : 306, 1903, stated that "There is no obvious reason why *C. candolena*, should not occur, and the circumstances it deserve to be carefully looked for".

However, we have collected this plant from Sunderbans near Shajinali R. F. and also from Mahanadi delta near Thakurdian Reserve tidal forest, in Maipara river mouth, Cuttack District, Orissa. Haines (1922) and Mooney (1950) did not report this taxon from Orissa; hence the present record of its collection is a new record for the East coast of India.

2. *Ceriops decandra* (Griff.) Ding Hou in Fl. Thailand 2 : 11, 1970 ; and v. Steenis Fl. Mal. 5 : 471, 1958. *C. roxburghiana* Arn. Ann. Mag. nat. Hist. 1 : 364, 1838 ; Hensl. in Hk. f. Fl. Brit. India 2 : 436, 1878 ; Haines 2 : 363, 1922. *Brugulera decandra* Griff. Trans. med. Phys. Soc. Calcutta 8 : 10, 1836. 'Gharn or Charta'.

Trees, about 4-10 m tall and 10-30 cm in diam. ; stems reddish-brown, much-branched ; bark light-gray, lenticular fissures, peeling in thin flakes ; stem base pyramidal in outline, with many stilt roots. Leaves 5-14 × 4-10 cm, obovate or elliptic-oblong, coriaceous, rounded or emarginate at apex, cuneate at base ; petioles 1.5-2 cm long. Flowers white, 3-4 mm across, resinous, 8-14-flowered, condensed cymes arranged in the axils of several nodes or from upper axils of branchlets ; Calyx lobes not reflexed ; petals not cohering, fringed at apex ; stamens 1 mm long, anthers much longer than filaments. Fruits ovoid, conical, hypocotyle 12-14 cm long, angular, sulcate.

*Fl. & Fr.* : February-November ; almost throughout the year.

*Distrib.* : BATIGHAR, BHITARKANIKA : Common along the edges of mangrove swamps, intertidal zones of several creeks and canals and sometimes towards the outer mangrove zones on sandy habitat, usually in association with *Excoecaria agallocha*, *Rhizophora apiculata* and *Brugulera gymnorrhiza*.

*Uses* : Same as *C. tagal*.

*Note* : The local people recognise this taxon under 3 forms, namely 'Mat garan', 'Jelegaran', and 'Jhamti garan'. The field observations showed that 'Mat garan' is common along the intertidal zones of mangrove swamps. This form corresponds to *C. tagal*, a tree 4-10m tall, 10-30 cm in diam., not much-branched ; leaves dark-green, thickly coriaceous. As a contrast to this form the locally known 'Jelegaran' and 'Jhimti garan' are one and same taxon and belong to *C. decandra*, a bushy tree 0.5-3 m tall, 3-10 cm diam., profusely branched ; leaves light-green, thinly coriaceous. Common along the outer fringes of mangroves mainly associated with *Tamarix* and *Achrosticum* sp.

## 3. KANDELIA W &amp; A.

*Kandelia candel* (Linn.) Druce, Rep. bot. Exch. Club Br. Isl. 3 : 420, 1914; Ding Hou Fl. Mal. 5 : 475, fig. 26, 1958; Fl. Thailand 2 : 12, 1970. *Kandelia rheedei* W. & A. Prod. 311, 1834; *nom. illeg.*; Hensl. in Hook. f. Fl. Brit. India 2 : 437, 1878; Haines 1 : 348, 1922. *Rhizophora candel* Linn. Sp. Pl. 443, 1753. 'Rasunia'.

Trees or shrubs 5-9 m tall, 20-40 cm in diam. With many soft, upright branches; stem base flesh-coloured, suddenly inclined to form a direct line with buttresses; tap roots abortive, stilt roots present from the under-surface of the inclined stem base. Entire stem base with its stilt roots resemble a horse-tail. Leaves 10-14 x 3-5.5 cm, oblong or elliptic-oblong, coriaceous, deep green above, pale beneath, entire, rounded at apex, obtuse or cuneate at base; petioles 1.6-2 cm long; stipules 2.5-3 cm long. Flowers, 1-1.5 cm long, white, arranged in axillary, dichotomously branched cymes; bracteoles cup-shaped, at the base of each dichotomy and adnate to the base of the calyx. Calyx 5-lobed, reflexed, each lobe 12-15 mm long; petals 5, each 8-10 mm long, multifid with long setas. Fruits 2.5-3.5 cm long, ovoid, conical, solid; hypocotyle spindle-shaped, 30-80 cm long, terete, narrowly pointed towards the radical ends.

*Distrib.*: BATIGHAR, BHITARKANIKA: More or less common as a pioneer, along the intertidal zones of several creeks and canals; sporadic along the banks of estuarine islands; usually in association with *Porteresia coarctata* and *Rhizophora apiculata*.

*Fl. & Fr.*: Throughout the year.

Germination and seedlings: Same as in *Rhizophora*.

*Uses*: Mainly for firewoods.

During the ebb tide the area presents a picture as if an outside agency has planted innumerable hypocotyles into the soft mud in regular order.

## 4. RHIZOPHORA Linn.

*Key to Species*

- |  |     |                    |
|--|-----|--------------------|
| 1a. Inflorescences 2-flowered; petals glabrous         | ... | <i>apiculata</i> 1 |
| 1b. Inflorescences more than 2-flowered; petals hairy: |     |                    |
| 2a. Style obscure, 0.5-1 mm long                       | ... | <i>mucronata</i> 2 |
| 2b. Style conspicuous, 3-5 mm long                     | ... | <i>stylosa</i> 3   |

1. *Rhizophora apiculata* Bl. En. Pl. Jav. 1 : 91, 1827 ; Ding Hou in Fl. Thailand 1970 ; v. Steenis Fl. Mal. 5 : 452, 1958. *R. conjugata* auct. non. Linn. Hensal. in Hk. f. Fl. Brit. India 2 : 436, 1878. *R. candelaria* DC. Prod. 3 : 32, 1828 ; Haines 1 : 362, 1922. 'Rai'.

Trees 15-20 m tall, 30-100 cm in diam. ; stem base without tap root system from beginning ; supporting stilt roots aerial, many branched ; branched sympodial. Leaves 10-20×5-9 cm, elliptic oblong, sublanceolate or ovate-lanceolate, decussate, entire, coriaceous, acute, apiculate at apex, cuneate at base. Flowers, 10-12 mm long, yellow, sessile, paired in upper axils from cupular involucre, peduncles short, 4-6 mm long. Fruits 2.5-3 cm across, obpyriform, solid, brown ; hypocotyle 40-80 cm long, smooth, cylindrical, pointed towards the radical end.

*Fl. & Fr.* : Mostly throughout the season.

*Distrib.* : FALSE POINT, JAMBU, HOOKITOLA : Common along the intertidal zones of several creeks and canals in the mangrove swamps, in deep soft mud and subjected to regular normal high tides ; usually in association with *R. mucronata* and *Xylocarpus obovata* or sometimes as pure stands. Four to six metres of the total height of these plants remain submerged in saline water during high tides thus showing a remarkable adaptation to the surrounding conditions.

Germination of seedlings from the hypocotyle :—v. Steenis in Fl. Mal. 5 : 431, 1958, states "To our knowledge there have been made no pertinent observation in nature to the effect that one has actually seen fruits falling, sticking in the mud, remaining in a vertical position and growing up."

We were fortunate, however, to observe the following facts in the field. We have collected mature hypocotyles which were more than 70 cm long. Since the lower part of the hypocotyle is always heavier than the upper part, at maturity, after detachment from the attached fruit it penetrates directly vertically in the soft mud underneath during the ebbtide, and further development takes in the same place by developing roots and leaves. This phenomenon is observed even during the beginning and at the end of high tide while the places remain under low water current with low water level. But during the high tide the force of water current is so strong that it does not allow the hypocotyle to come into the contact with soft mud, and naturally it floats vertically along the water current. The hypocotyle drifts freely in water with plumule upwards and radical submerged and along water current it is

dispersed or wafted into the adjacent forests. In the forest floors if they are obstructed by other roots and forest debris during ebb tide, it remains there acquiring a horizontal position and develops roots from the pointed end. As the roots establish themselves the seedling soon assumes a vertical position. It was also observed that the detachment of hypocotyles from mother plants occur during the monsoon when there is a fresh supply of water during May-July, thus offering a usually suitable period for the hypocotyles to develop roots and leaves.

We have observed at Falsepoint, Cuttack, Mahanadi Delta, from a boat that a hypocotyle of 70 cm long, detached from a fruit from a height of about 15 m, and stuck into the soft mud during the ebb tide with about 30-35 cm of its length embedded in the mud.

*Uses* : Firewood, charcoal, and bark for tannin.

*Note* : As *R. conjugata* Linn. is based on a drawing of flowers and fruits of two different species of different genera, the species identification shall remain uncertain because of the inadequacy of the drawing, which, in turn, has led in the past to confusion and error. Hence Ding Hou (*l. c.*) has rejected rightly it in accordance with the Article 65 of the ICBN (1956).

2. *Rhizophora mucronata* : Poir. in Lamk. Tab. Encycl (Text) 2 : 517, 1794 ; Lam. Tab. Encycl. 1 : t. 396, f. 2, 1797 ; Poir in Lamk. Encycl. 6 : 189, 1804 ; Hensal. in Hook. f. Fl. Brit. India 2 : 435, 1878 ; Haines 1 : 346, 1922 ; Ding Hou (*l. c.*). 'Bara Rai'.

Trees 10-20 m tall, 60-150 cm in diam., much-branched ; branches marked with closed leaf scars ; stem base with numerous still roots ; still roots branched, lenticellate ; aerial roots present ; tap root abortive. Leaves decassate, 10-18 × 4-9 cm broadly elliptic, oblong or broadly ovate, deep green, coriaceous, acute, blunt or with a fine mucro at apex, obtuse or cuneate at base. Flowers 1.5-2 cm long creamy white, fleshy, fragrant, arranged in axillary cymes ; peduncles 2-5 cm long, 2-3 times forked ; pedicels 5-10 mm long. Calyx 12-15 mm long, deeply lobed ; petals 7-8 mm long, hairy along margins. Fruits 3-4 cm across, ovoid, conical, solid brown ; hypocotyle 30-70 cm long, cylindric, warty.

*Fl. & Fr.* : Same as *R. apiculata*.

*Distrib.* : MAHANADI DELTA : Gregarious along the intertidal zones of several creeks and canals in the mangrove swamps, more common than *R. apiculata* in similar localities in association with *R. apiculata*, *Xylocarpus mekongensis*, and *Avicennia officinalis* Haines

(*l. c.*) mentioned the occurrence of pneumatophores in this species. The pneumatophores of *A. officinalis* frequently get intermixed with the stilt roots of this plant, thus they appear as pneumatophores of *R. mucronata*.

3. *Rhizophora stylosa* Griff. Not. Pl. As. 4 : 665, 1854; and Ic. 4, t. 640, 1854; Ding Hou in v. Steenis Fl. Males. 5 : 456, 1958. *R. mucronata* var. *stylosa* Schimp. Bot. M. H. Trop. 3 : 92, 1981.

Trees 8-12 m tall, with numerous stilt roots; branches sympodial, leafscars closely arranged. Leaves 6-16 × 5-7.5 cm, elliptic or broadly elliptic-oblong, coriaceous, obtuse or blunt at apex, cuneate at base. Flowers 1-1.2 cm across, yellow with purple tinged at apex, arranged in axillary dichotomously branched cymes; peduncles 3-5 cm long, 4 times forked; calyx lobes 7-9 × 2-3 mm long; petals 6-7 × 1-2 mm long, purple tinged at apex; margins densely hairy; stamens 8, 4 epipetalous and 4 episepalous; filaments short; styles 3-5 mm long, slightly forked; hypocotyle cylindric warty 40-50 cm long or more at maturity.

*Fl. & Fr.* : Same as in other species.

*Distrib.* : THAKURDIAN : Rare along shallow muddy sea-shores and along sandy sea beach facing the sea. It usually favours a separate ecological nich than the other two species of the genus and usually found in association with *Avicennia marina* and *Aegialitis rotundifolia*.

*Note* : Occurrence of this species along the sea-shore near Satyavia, and Thakurdain Reserve tidal forest towards the outer fringes of mangrove in Orissa is a new record for the Indian Flora.

## COMBRETACEAE

### Key to Genera

Receptacles with two adnate bracteoles	...	LUMNITZERA 1
Receptacles without bracteoles	...	COMBRETUM 2

### 1. LUMNITZERA Willd.

#### Key to species

Flowers white; knee-like pneumatophores absent	...	<i>racemosa</i> 1
Flowers red; knee-like pneumatophores present	...	<i>litorea</i> 2

1. *Lumnitzera racemosa* Willd. in Neue Schr. Ges. naturf. Fr. Berl. 4 : 187, 1803; Excell in Fl. Mal. 4 : 588, 1954; Clarke in Hook. f. Fl. Brit. India 2 : 452, 1878; Haines 2 : 363, 1922. '*Kiripa*'.



Trees, 3-8 m tall, without pneumatophores; bark reddish-brown, lenticellate. Leaves 4-8.5 × 1.5-3.5 cm, obovate, thick, coriaceous, entire, emarginate at apex, cuneate at base; petioles very short. Flowers 9-11 mm long, white, sessile, in axillary spikes; receptacles 3-5 mm long, tubular, with two adnate, persistent bracteoles. Ovary oblong, elongated, 4-5 carpellary, unilocular, ovules pendulous from the top of placenta. Fruits 8-10 × 4-6 mm, compressed, woody, ellipsoid, 1-seeded, drupes; seeds elongated, pointed towards apex.

*Fl. & Fr.* : March-May; June-July.

*Distrib.* : HUKITOLA, BATIGHAR, THAKURDIN : Common along sandy and muddy sea shores, back mangroves and inner fringes of estuarine islands. Found in pure stands or in association with species of *Excoecaria* and *Avicennia*. If the mangrove swamps become unsuitable, gradually for further regeneration of *Rhizophora* sp. this species establishes in such regions.

2. *Lumnitzera littorea* (Jack.) Voigt. Hort. Suburb. Calc. 39, 1845; Exell in Fl. Mal. 4 : 586, 1954. *Pyrrhanthus littoreus* Jack. Mal. Misc. 2 (7) : 57, 1822. *Lumnitzera coccinea* W. & A. Prodr. 316, 1834; Clarke in Hook. f. Fl. Brit. India 2 : 452, 1878. 'Kiripa'.

Trees 8-15 m tall, 30-60 cm in diam., with knee-like pneumatophores; bark dark-brown, fissured. Leaves 1.5-4.5 × 0.8-1.5 cm, ovate or ovate-elliptic, coriaceous, rounded, emarginate at apex, cuneate at base. Flowers 10-12 mm long, red, shortly pedicelled in terminal racemes. Fruits 9-12 mm long, compressed, corky, longitudinally-ribbed. Seed one.

*Fl. & Fr.* : May-June; July.

*Distrib.* : THAKURDIAN : Rare, mostly restricted towards the middle zone of estuarine islands, sometimes found forming pure stands along the back-mangroves.

*Note* : Haines (1922) and Mooney (1950) have not reported this species from Orissa; hence it is a new record for Orissa.

## MYRTACEAE

### SYZYGIUM Gaertn.

#### Key to Species

Flowers in paniculate cymes	...	<i>cumini</i> 1
Flowers solitary or fascicled	...	<i>ruscifolium</i> 2

1. *Syzygium cumini* (Linn.) Skeels in U. S. Dept. Agric. Bur. Pl. Bull. 2 : 248, 1912 ; *Myrtus cumini* Linn. Sp. Pl. 471, 1753 ; *Eugenia jambolana* Lamk. Encl. 3 : 198, 1789 ; Duthie in Hook. f. Fl. Brit. India 2 : 499, 1879 ; Haines 2 : 376, 1922. 'Jamkuli'.

Evergreen trees, 10-20 m tall ; bark smooth, greyish-white. Leaves 4-16 × 3-6 cm, elliptic-oblong, coriaceous, acuminate at apex, cuneate at base. Flowers 5-10 mm across, white fragrant, in paniculate cymes. Fruits 2-3 cm, ellipsoid, dark-purple berries.

*Fl. & Fr.* : March-April ; May-June.

*Distrib.* : BAHAKUD, BHITARKANIKA : Frequent in scrubs, river banks and back mangroves ; commonly cultivated in gardens as fruit trees.

2. *Syzygium ruscifolium* (Willd.) Sant. & Wagh. in Bull. Bot. Surv. India 5 : 109, 1963. *Myrtus ruscifolius* Willd. Sp. Pl. 2 : 970, 1801. *Eugenia bracteata* Roxb. ex DC. Prodr. 3 : 264, 1828 ; Duthie in Hook. f. Fl. Brit. India 2 : 502, 1879 ; Haines 2 : 379, 1922. 'Unchan'.

Shrubs or small trees, 0.5-2 m tall ; branches rusty-pubescent when young. Leaves 3-6 × 2-3.5 cm, ovate or elliptic-ovate, subcoriaceous, acute at apex, obtuse at base. Flowers 3-8 mm across, white, fragrant, in axillary, solitary or 2-4 flowered fascicles ; peduncles 1-2 cm long, rust-pubescent. Fruits 1 cm in diam., globose berries, red when ripe.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : BAHAKUD, BHITARKANIKA : Common along the riverine scrubs, coastal thickets and sandy sea shores, usually in association with *Carissa spinarum* and *Clausena heptaphylla*.

## MELASTOMATACEAE

### MEMECYLON Linn.

*Memecylon edule* Roxb. var. *ovatum* (J. E. Smith) Clarke in Hook. f. Fl. Brit. India 2 : 558, 1879 ; Bakh. & Bakh. in Fl. Java 1 : 374, 1963. *Memecylon edule* (Roxb.) var. *ovata* Clarke (l.c.), 564 ; Haines 2 : 389, 1922.

Shrubs or small trees, 0.5-2 m tall ; branches many, glabrous. Leaves 5-14 × 2-7 cm, ovate-elliptic or broadly ovate, coriaceous, shining, acute at apex, rounded at base. Flowers 4-5 mm across, blue, arranged in panicles ; panicles 2-4, clustered together in the axils of leaves or

fallen leaves ; peduncles 1.5-2.5 cm long, quadrangular ; hypanthium campanulate. Fruits 4-8 mm across, globose ; berries, dark blue when ripe.

*Fl. & Fr.* : April-June ; July-August.

*Distrib.* : BAHAKUD, BHITARKANIKA : Common in sandy scrubs and coastal thickets, usually in association with *Carissa spinarium* and *Eugenia ruschifolia*.

## LYTHRACEAE

### *Key to Genera*

- |   |     |                 |
|---|-----|-----------------|
| 1a. Herbs with glabrous leaves :                                      |     |                 |
| 2a. Bracts leaf-like ; capsules septicidal                            | ... | ROOTALA 1       |
| 2b. Bracts scale-like ; capsules indehiscent, or bursting irregularly | ... | AMMANIA 2       |
| 1b. Shrubs or trees with pubescent leaves                             | ... | LAGERSTROEMIA 3 |

### 1. ROTALA Linn.

*Rotala verticillaris* Linn. Mant. 157, 1771 ; Koehne in Engl. Pflanzg. 17 : 30, 1903 ; Wt. Ic. t. 60A, 1840. *Ammania rotala* F. Muell. Fragm. 3 : 108, 1863 ; Clarke in Hook. f. Fl. Brit. India 2 : 567, 1879.

Erect or ascending, glabrous herbs, 10-20 cm tall ; stems sometimes creeping with erect branches, rooting at nodes. Leaves 8-13 mm long, linear, sessile, glabrous, mostly arranged in whorls of 4-8. Flowers 1-1.4 mm long, purple, verticillate with leafy bracts. Fruits ellipsoid, 3-valved capsules ; walls finely transversely striated.

*Fl. & Fr.* : September ; October-November.

*Distrib.* : SATAVYA : Frequent along moist sandy places near the coast, low lying areas and rice fields.

*Note* : Haines ( 1922 ) and Mooney ( 1950 ) have not reported this species ; hence it is a new record for Orissa.

### 2. AMMANIA Linn.

#### *Key to Species*

- |  |     |                     |
|--|-----|---------------------|
| Cymes distinctly-peduncled ; petals present    | ... | <i>multiflora</i> 1 |
| Cymes not distinctly-peduncled ; petals absent | ... | <i>baccifera</i> 1  |

1. *Ammania multiflora* Roxb. Fl. Ind. ed. Carey 447, 1832; Koehne in Engl. Pfreich 17: 48, f. 5A. 1903; Clarke in Hook. f. Fl. Brit. India 2: 570, 1879; Haines 2: 396, 1922.

Much-branched, erect or decumbent herbs; stems quadrangular, often rooting at nodes. Leaves upto 2 cm long, sessile, decussate, elliptic-oblong or lanceolate; bracts scale-like, linear. Flowers 1 mm long, red, axillary, pedunculate, 3-5-flowered in thyrses or in simple dichasia; petals present. Capsules 1-1.3 mm across, globose, reddish-brown, partially exserting from calyx.

*Fl. & Fr.* : August-September; November-December.

*Distrib.* : FALSE POINT, KUJANG : Common along moist sandy places and paddy fields.

2. *Ammania baccifera* Linn. Sp. Pl. 120, 1753; Koehne (*l. c.*) 54; Clarke in Hook. f. Fl. Brit. India 2: 569, 1879; Haines 2: 396, 1922.

Erect herbs, upto 50 cm tall; stems much-branched, rigid, quadrangular. Leaves 2-4 × 0.5-0.8 cm, sessile, decussate, elliptic-oblong or linear-lanceolate, acute at apex, narrowed at base. Flowers 2-3 mm long, greenish-brown, axillary, 3-many-flowered cymes; petals absent. Capsules 1-2 mm across, depressed globose; seeds many.

*Fl. & Fr.* : October-November; December.

*Distrib.* : CHAUMAHANI, FALSE POINT : Common in Paddy fields, inundated low lying areas and river banks.

### 3. LAGERSTROEMIA Linn.

*Lagerstroemia speciosa* (Linn.) Pers. Synops. 2: 72, 1806; Koehne in Engl. Pfreich 17: 261, 1903. *Muncheausia speciosa* Linn. Mant. 2: 243, 1771. *Lagerstroemia flos-reginae* Retz. Obs. 5: 25, 1788; Clarke in Hook. f. Fl. Brit. India 2: 577, 1879; Haines 2: 391, 1922.

Deciduous trees or shrubs, 3-8 m tall. Leaves 8-25 × 3-10 cm, elliptic-oblong, dark-green above, pubescent below, obtuse or acuminate at apex, acute or rounded at base. Flowers 4-8 mm long, deep purple, arranged in terminal paniculate cymes. Capsules 0.8-1 cm long, ellipsoid, woody, 3-6-valved; seeds many, apically winged.

*Fl. & Fr.* : September-October; December.

*Distrib.* : FALSE POINT, BAHAKUD : Rarely wild in sandy scrubs along river banks. Planted as an ornamental trees in gardens and parks.

## SONNERATIACEAE

SONNERATIA Linn. f. *nom. cons.**Key to Species*

- 1a. Petals absent :
- 2a. Calyx 4-merous ; leaves narrowly elliptic ... *apetala* 1
- 2b. Calyx 7-8-merous ; leaves obovate to suborbicular ... *griffithii* 2
- 1b. Petals present :
- 3a. Flowers red with expanded calyx tube ; leaves usually mucronate (Hydathode) ... *caseolaris* 3
- 3b. Flowers red with cup-shaped calyx tube ; leaves emucronate (Hydathode nil) ... *alba* 4

1. *Sonneratia apetala* Buch.-Ham. in Symes, Embassy Ava 3 : 477, 1800 ; Back. & v. Steenis in Fl. Males. 4 : 286, 1951 ; Clarke in Hook. f. Fl. Brit. India 2 : 579, 1879 ; Haines 2 : 392, 1922. 'Kerua'.

Trees 10-40 m tall, 50-200 cm in diam., with dense crowns ; stems with many pale-green, soft drooping branches ; bark thin, light-brown, irregularly fissured ; stem base not buttressed, provided with 15-150 cm long, peg-like, corky pneumatophores ; pneumatophores sometimes forked twice or thrice. Leaves 5-14 × 2-3.5 cm, narrowly elliptic-oblong or oblanceolate coriaceous, attenuate at base, tapering towards apex. Flowers 1.5-2 cm across, apetalous, green or yellowish-white, in axillary solitary, or terminal 3-flowered dichasia or 7-flowered cymes from the branch-axils. Fruits 2-2.5 cm across, smooth globose, many-seeded berries, shortly pointed at apex, supported on flat, expanded calyx tubes with persistent, reflexed calyx lobes at base.

*Fl. & Fr.* : February-May ; June-July.

*Distrib.* : BATIGHAR, JAMBU, BHITARKANIKA : Common along the border of islands near estuaries ; intertidal zones of several creeks and channels towards upstream swamps ; invariably found in places, affected with fresh brackish water mixture ; in association with *Tamarix troupii*, *Excoecaria agallocha*, and *Ceriops decandra*.

2. *Sonneratia griffithii* Kurz., in J. As. Soc. Bengal 40(2) : 56, 1871 ; Back. & v. Steenis (l. c.), 286 ; Clarke in Hook. f. Fl. Brit. India 2 : 580, 1879 ; *S. acida* Linn. f. var. *griffithii* King, J. As. Soc. Bengal 67(2) ; 11, 1898. 'Oro'.

Trees 8-15 m tall, 30-60 cm in diam. ; branches pale-green, glabrous, drooping ; bark slightly fissured when old. Leaves 6-12 × 3-7 cm, obovate, or suborbicular, thick, coriaceous, cuneate at base, rounded

or emarginate at apex. Flowers greenish-white, 4-8 cm across, apetalous, solitary at apices of terminal branchlets. Fruits 5-9 cm across, ovoid-globose, with pointed tips at apex, broad, inflated, calyx tube with reflexed calyx lobes at base; seeds many.

*Fl. & Fr.* : February-May; June-July.

*Distrib.* : THAKURDIAN : Common along the intertidal zones just near the estuaries, and often restricted towards the islands; in association with *Avicennia alba* and *A. marina*.

The present report of this species from Orissa tidal forest is a new record for the flora of Indian mainland.

3. *Sonneratia caseolaris* (Linn.) Engl. in E. & P. Nachtr. 261, 1897; Back. & v. Steenis (*l.c.*) 283. *Rhizophora caseolaris* Linn. in Stickman, Herb. Amb. 13, 1754. *Sonneratia acida* Linn. f. Suppl. 252, 1781; Clarke in Hook. f. Fl. Brit. India 2 : 579, 1879; Haines 2 : 393, 1922. 'Ora'.

Trees 6-15 m tall, 30-70 cm in diam., with many drooping branches and numerous, breathing roots from the horizontal roots buried in the mud; stem with short boles; main branches sometimes running prostrate along the ground in a zig-zag way covering a large area. Leaves 4-13 x 3-5.5 cm, elliptic-oblong or obovate, coriaceous, cuneate at base, mucronate at apex. Flowers reddish-purple, 4-8 cm across, solitary, at summit of branchlets. Fruits 4-6 cm across, globose-circular, concave-depressed, pointed-tipped at apex, calyx-tube flattened; calyx-lobes 6, straight, persistent.

*Fl. & Fr.* : March-July; July-September.

*Distrib.* : BATIGHAR, JAMBU, BHITARKANIKA : Less common than *S. apetala*; in the intertidal zones under more saline conditions than *S. apetala*; in association with *Avicennia alba* and *Bruguiera cylindrica*.

4. *Sonneratia alba* J. Smith in Recs. Cycl. 33 (2), 1819; Back. & v. Steenis (*l.c.*) 85; Clarke in Hook. f. Fl. Brit. India 2 : 580, 1879. Mooney in Suppl. Bot. Bihar & Orissa 251, 1950. 'Ora'.

Trees 5-10 m tall, 20-60 cm in diam., with pneumatophores. Leaves 5-10 x 3-5.5 cm, obovate, coriaceous, cuneate at base rounded at apex. Flowers 4-6 cm across, white, solitary or in dichasia or terminal branchlets. Fruits 4-5 cm across, ovoid-globose, apex concave-depressed; with tip pointed; base resting on cup-shaped calyx-tube; calyx lobes 6-7, reflexed; seeds many.

*Fl. & Fr.* : February-October.

*Distrib* : HUKITOLA : Rare, along the outer zones of muddy sea shores ; on sandy or hard calcareous substratum. Covered with oyster shells.

*Note* : Mooney (*l.c.*) reported this species from falsepoint, Mahanadi delta, Orissa, but the description of this species in his supplement where he admitted is after Watson in *Mal. For. Rec.* 1 : 6, 1928.

## ONAGRACEAE

### LUDWIGIA Linn.

#### *Key to Species*

- |  |     |                       |
|--|-----|-----------------------|
| 1a. Aquatic, floating herbs ; flowers usually white          | ... | <i>adscendens</i> 1   |
| 1b. Non aquatic, erect or ascending herbs ; flowers yellow : |     |                       |
| 2a. Seeds in fruit pluriseriate above and uniseriate below   | ... | <i>hyssopifolia</i> 2 |
| 2b. Seeds in fruit pluriseriate throughout                   | ... | <i>perennis</i> 3     |

1. *Ludwigia adscendens* (Linn.) Hara in *J. Jap. Bot.* 28 : 291, 1953 ; Raven in *Reinwar.* 6 : 387, 1963 ; Sreemad. in *Bull. bot. Surv. India* 8 : 79, 1966. *Jussia adscendens* Linn. *Mant.* 69, 1767. *J. repens* Linn. *Sp. Pl.* 388, 1753 ; non *Ludwigia repens* Forst. (1771) ; Clarke in *Hook. f. Fl. Brit. India* 2 : 587, 1879 ; Haines 2 : 398. 1922. 'Kesardam'.

Marshy herbs ; stems glabrous, light brown, white hairy at nodes. Leaves 1-5 × 0.5-2 cm, obovate or oblanceolate, glabrous above, pale beneath, acute or subacute at apex, cuneate at base. Flowers 1.5-2 cm long, white or yellowish-white, solitary, mostly arranged along upper axils. Capsules 1.5-1.8 cm long, terete ; seeds uniseriate in each loculus. 'Kesardam'.

Frequent along sandy ditches and moist places along the leeward side of coastal sandunes ; locally common.

*Fl. & Fr.* : September-October ; November-December.

2. *Ludwigia hyssopifolia* (G. Don) Excell in *Carica de orta* 5 : 471, 1957 ; Raven in *Reinward.* 385 ; Sreemad. 79 ; Bennet in *Ind. For.* 92 : 227, 1966. *Jussia hyssopifolia* G. Don *Gen. Syst.* 2 : 693, 1832. *J. llinifolia* Vahl, *Ecolg. Am.* 2 : 32, 1798, non *Ludwigia llinifolia* Poir. (1813). *J. fissendocarpa* Haines in *J. As. Soc. Beng. n. s.* 15 : 313, 1920. *Fissendocarpa llinifolia* (Vahl) Bennet in *J. Bomb. nat. Hist. Soc.* 67 : 125, 1970.

Undershrubs, 30-80 cm tall, with pointed horizontal roots from submerged vertical root system; stems much-branched, tinged red. Leaves 5-13 × 0.5-5 cm, lanceolate, membranous, subacute at apex, tapering towards base. Flowers 2-4 cm long, sessile, yellow, axillary, solitary. Capsules 2-3 cm long, slender terete, 4-loculed; seeds dimorphic, pluriseriate above and uniseriate below in each locule.

*Fl. & Fr.* : August-September; November-December.

*Distrib.* : JAGATSINGPUR, MACHOGON : Frequent along the edges of ponds and ditches; often in rice fields.

*Notes* : Bennet (*l. c.*) raised *Fissendocarpa* (Haines) to a generic status to solve its anomalous position, and to make the genus *Ludwigia* homogenous one.

Haines (*l. c.*) in Bot. Bihar and Orissa 1 : 382, 1922 recorded this species only from Purana, Bihar. It is thus a new record for Orissa.

3. *Ludwigia perennis* Linn. Sp. Pl. 119, 1753 (Excl. '*foliis oppositis*'); Raven 367; Sreemad. 80, *L. parviflora* Roxb. Fl. Ind. ed. Carey: 440, 1832; Clarke in Hook. f. Fl. Brit. India 2 : 588, 1879; Haines 2 : 399, 1922.

Annual herbs, 10-40 cm tall; stems glabrous with raised decurrent lines from leaf-base. Leaves 1-8 × 0.5-2 cm, elliptic-oblong, sub-acute at apex, narrowed at base. Flowers 2-3 cm long, yellow, solitary, axillary. Capsules 3-15 mm long, terete, slender, 4-celled; seeds pluriseriate, free in each loculus.

*Fl. & Fr.* : August-September; November-December.

*Distrib.* : KUJANG : Common weed in fresh water swamps and moist sandy places.

## PASSIFLORACEAE

### PASSIFLORA Linn.

#### *Key to Species*

- |   |                   |
|---|-------------------|
| 1a. Stipules semiauriculate; petals present | <i>foetida</i> 1  |
| 1b. Stipules linear-subulate; petals absent | <i>suberosa</i> 2 |

1. *Passiflora foetida* Linn. Sp. Pl. 959, 1753; Green in Kew Bull. 26 (3) : 555, 1972; Master in Hook. f. Fl. Brit. India 2 : 599, 1879; Haines 2 : 402, 1922.



Tendrils-climbers; stems hispid hairy. Leaves 5-10 × 2.5-8 cm, ovate, 3-lobed, ciliate with gland-tipped golden hairs, acuminate at apex, cordate at base; petioles 3-4 cm long, covered with gland-tipped hairs. Flowers 2-6 cm across, white, with bluish-purple corona, axillary, solitary; bracts pinnatisect. Berries 2-3 cm across, subglobose, surrounded by persistent bracts.

*Fl. & Fr.* : May-July; September-December.

*Distrib* : DALTANGAR, JAGATINGPUR : Frequent on bushes and hedges along river-side and in scrub jungles; common as an inland weed in waste places.

2. *Passiflora suberosa* Linn. Sp. Pl. 958, 1753; Chakravarty in Bull. bot. Soc. Bengal 3 : 54, 1951; Green in Kew Bull. 557, Back & Bakh. Fl. Java 1 : 291, 1963; Master in Hook. f. Fl. Brit. India 2 : 599, 1879.

Slender, tendril-climbers; stems terete, glabrous. Leaves 3-8 × 3-5 cm, variable, broadly ovate-orbicular to ovate-lanceolate, sometimes 3-lobed, membranous, acuminate at apex, obtuse or subpeltate at base. Flowers 3-4 mm across, apetalous, green or greenish-yellow, axillary solitary or paired. Berries 4-10 mm across, globose, purple when ripe.

*Fl. & Fr.* February-March; May-June.

*Distrib* : DALTANGAR, KUJANG : Rare along hedges in scrub jungles and coastal thickets.

*Notes* : Haines (1922) and Mooney (1950) have not reported this plant from Orissa, hence it is a new record for Orissa.

## CUCURBITACEAE

### Key to Genera

- |  |     |                 |
|--|-----|-----------------|
| 1a. Seeds compressed; margins raised :                 |     |                 |
| 2a. Petals entire; stylar disc cup-shaped              | ... | MUKIA 1         |
| 2b. Petals fimbriate; stylar disc absent               | ... | TRICHOSANTHES 2 |
| 1b. Seeds not compressed, margins not raised :         |     |                 |
| 3a. Tendrils simple; anther connectives prolonged      | ... | CUCUMIS 3       |
| 3b. Tendrils 2-3-fid; anther connectives not prolonged | ... | CITRULLUS 4     |

### 1. MUKIA Arn.

*Mukia maderaspatana* (Linn.) M. J. Roem. Syn. Monogr. 2 : 47, 1846; Jeffrey in Fl. Trop. E. Africa : 115, 1967. *Cucumis maderaspatana*

Linn. Sp. Pl. 1012, 1753; *Melothria maderaspatana* (Linn.) Cong. DC. Chakrav. in Monogr. Ind. Cucurbitaceae : 141, 1959; *M. scabrella* (Linn.) Arn. in Hook. J. Bot. 3 : 267, 1841; Clarke in Hook. f. Fl. Brit. India 2 : 623, 1879; Haines 2 : 408, 1922. '*Bilaria*'.

Annual, scabrous, herbs; branches slender, hispid. Leaves 4-8 × 5-7 cm, ovate, hastate, irregularly 3-5-lobed, sinuate-toothed, acute at apex, sub-cordate on narrowed at base. Male flowers: 3-4 mm across, yellow, subsessile, hairy; female flowers 3-5, in separate clusters on 1 mm long pedicels, bristly. Fruits 8-15 mm across, subsessile, in axillary clusters of 1-5; globose, scarlet-coloured, smooth; seeds 4-5 mm across, compressed, with raised margins.

*Fl. & Fr.* : February-March; June-July.

*Distrib* : BAHAKUD : Frequent on bushes, along the river-banks, scrubs and sandy places.

## 2. TRICHOSANTHES Linn.

*Trichosanthes cucumerina* Linn. Sp. Pl. 1008, 1753; Chakrav. (*i.c.*) 31; Clarke in Hook. f. Fl. Brit. India 2 : 609, 1879; Haines 2 : 405, 1922. '*Bonpotol*'.

Annual or perennial herbs; stems tendrillar climbing, or twining, scabrid, pubescent. Leaves 7-9 × 9-12 cm, orbicular or reniform, deeply 5-6-lobed, cordate at base. Tendrils 2-5-fid. Flowers 4-7 mm across, white, in axillary racemes; male flowers: solitary, shortly pedicelled; female flowers: sometimes 2-3-clustered on 2-4 cm long pedicels. Fruits 4-8 cm long, ovoid, conical with white stripes; seeds flat, compressed, tuberculate along margins.

*Fl. & Fr.* : August-September; November-December.

*Distrib* : PARADEEP, KUJANG : Frequent on hedges and bushes in scrub jungles, river-banks and inland cultivated fields.

## 3. CUCUMIS Linn.

*Cucumis callosus* (Rottl.) Cog. in Engl. Pfeilrch. iv. 275, ii. 129, 1924; Chakrav. (*i.c.*) 100; *Bryonia callosa* Rottl. Neue. Schrif. Ges. Nat. Fr. Ber. 4 : 201, 1803. *Cucumis trigonus* Roxb. Fl. Ind. ed. Carey, 722, 1832; Clarke in Hook. f. Fl. Brit. India 2 : 619, 1879; Haines 2 : 409, 1922. '*Bonkhurmaja*'.

Annual or perennial herbaceous climbers or trailers; branches rigid, angular; tendrils simple. Leaves 3-5 × 4-6 cm, palmately lobed, sinuate-dentate, rounded at apex, narrowed at base; petioles 3-4 cm long. Flowers 8-12 cm across, yellow; male flowers: fascicled in axillary racemes; female flowers: solitary, axillary. Fruits 1.5-3 cm across, rounded or trigonous, smooth, many-seeded; seeds ovoid or ellipsoid, smooth.

*Fl. & Fr.* : February-March; June-July.

*Distrib* : SATAVYA : Frequent along dry sandy places near the coast, backshore mangroves and inwards along sandy places.

#### 4. CITRULLUS Neck.

*Citrullus colocynthis* (Linn.) Schr. in *Linnæa* 12 : 414, 1838; Jeffrey (*l. c.*) 46; Oza in *Taxon* 11 (8); 179, 1962; Clarke in *Hook. f. Fl. Brit. India* 2 : 620, 1879; Haines 2 : 411, 1922. *Cucumis colocynthis* Linn. *Sp. Pl.* 1011, 1753; *C. vulgaris* Schr. 1833; Chakrav. (*l. c.*) 113. 'Bontormuj'.

Perennial, trailing herbs with woody rootstock; stems angled, scabrid; tendrils simple or bifid. Leaves 4-9 cm long, deeply pinnatifid, 3-5-lobed, scabrid below. Flowers 1-2 cm across, yellow, villose, unisexual, axillary, solitary; male flowers; borne on 8-10 mm long pedicels; female flowers: borne on 10-45 mm long pedicels. Fruits 3-6 cm across, subglobose, longitudinally striped or marked yellow; seeds ovoid, smooth.

*Fl. & Fr.* : September-October; November-December.

*Distrib.* : HOOKITOLA, KUJANG : Rare, in waste places near the coast, sandunes and river-banks.

### CACTACEAE

#### OPUNTIA Mill.

*Opuntia dillenii* Haw. *Suppl. Pl. Succ.* 79, 1919; Burkill in *Rec. bot. Surv. India* 4 : 314, 1911; Clarke in *Hook. f. Fl. Brit. India* 2 : 675, 1879; Haines 2 : 4211, 1922. 'Nagphani'.

Erect, spiny straggling shrubs; stems widely branched, articulated, articulations surrounded by ring of spines; internodes flat; areoles on stems in the axils of scale-like caducous leaves, and with 4-6 yellow spines. Flowers 4-6 cm across, bright yellow with red flush, solitary, axillary, mostly along the upper half of internodes. Fruits pear-shaped, tubercled berries.

*Fl. & Fr.* : April-July ; August-September.

*Distrib.* : PARADEEP : Frequent along sandy sea shores and sand bears near river mouth ; locally cultivated as hedge plants.

AIZOACEAE

*Key to Genera*

1a. Carpels free	...	...	GISEKIA 1
1b. Carpels united	...	...	GLINUS 2
2a. Flowers sessile ; styles 1-2	...	...	TRIANTHEMA 3
2b. Flowers pedicellate ; styles 3-4	...	...	SESUVIUM 4

1. GISEKIA Linn.

*Gisekia pharnaceoides* Linn. Mant. 2 : 562, 1771 ; Jeff. in Hubb. & Milne-Redh. Fl. Trop. E. Afr. 31, 1961 ; 31, 1961 ; Clarke in Hook. f. Fl. Brit. India 2 : 664, 1879 ; Mooney Suppl. Bot. B & O. 26, 1950.

Diffuse, succulent herbs with long tap roots ; stems glabrous, terete, often pink-tinged. Leaves opposite or in whorls each 5-30 × 3-12 mm, spatulate, subsessile, fleshy with numerous raphides, rounded at apex, obtuse at base. Flowers 2-3 mm across, white, in axillary umbelliform fascicles or in short cymes. Fruits of 5, free membranous, indehiscent carpels ; seeds reniform, finely tuberculate ; funicles semicircular.

*Fl. & Fr.* : Throughout the season.

*Distrib.* : PARADEEP : Common along sandy sea-shores, river-banks, and sand bars in-between tidal forests.

2. GLINUS Linn.

*Key to Species*

1a. Flowers stellate-pubescent, subsessile	...	...	<i>lotoides</i> 1
1b. Flowers glabrous, pedicellate	...	...	<i>oppositifolius</i> 2

1. *Glinus lotoides* Linn. Sp. Pl. 463, 1753 ; Back. Fl. Mal. 4 : 269, 1951. *Mollugo hitra* Thunb. Prodr. Fl. Cap. 24, 1794 ; Clarke in Hook. f. Fl. Brit. India 2 : 662, 1879. *M. lotoides* W. & A. ex Clarke (*l.c.*) 2 : 776 ; Haines 1 : 50, 1921.

Prostrate, stellate-pubescent, annual herbs with long tap roots. Leaves variable in size and shape, 5-30 × 4-20 mm, opposite, 3-nate, or apparently verticillate, glabrous to densely villose, elliptic-ovate, obovate, ovate or sub-orbicular, obtuse or rounded at apex, cuneate at base. Flowers 3-5 mm across, sessile, greenish-white, 3-4, in axillary clusters. Capsules 4-11 mm long, ovoid, 5-valved, many-seeded ; seeds reniform, granulated with white strophioles.

*Fl. & Fr.* : February-April ; September-October.

*Distrib.* : KUJANG, BAHAKUD, PARADEEP : Common along the sea-shore, river-banks, road-sides and waste places ; usually prefers dry reclaimed soils.

The following ecological variants were observed in the field.

- (1) Robust, villose with suborbicular leaves and larger calyx lobes, found restricted to dry sandy habitats.
- (2) Slender, glabrous with ovate-elliptic leaves, and smaller calyx lobes found confined to mostly moist inland regions.

2. *Glinus oppositifolius* (Linn.) A. DC. in Bull. Herb. Boiss. 2, 1 : 559, 1901 ; Back. Fl. Mal. 270. *Mollugo oppositifolia* Linn. Sp. Pl. 89, 1753. *M. spergula* Linn. Syst. Nat. ed. 10, 881, 1759 ; Clarke in Hook. f. Fl. Brit. India 2 : 662, 1879 ; Haines 1 : 50, 1921.

Diffused, glabrous, annual herbs ; branches terete, up to 70 cm long. Leaves 1-2 × 0.3-0.6 cm, verticillate, variable, linear-lanceolate, or ovate-oblongate, obtuse at apex, narrowed towards base. Flowers 3-4 mm long, greenish-white, 4-10, in axillary fascicles ; pedicels 8-15 mm long. Capsules 2-3 mm across, ellipsoid, many-seeded ; seeds reniform, dark-brown strophiolate.

*Fl. & Fr.* : March-April ; June-July.

*Distrib.* : PARADEEP, SATAVYA : Frequent along sea-shores, river-banks and road-sides ; locally common in waste places, and cultivated in fields.

### 3. TRIANTHEMA Linn.

#### *Key to Species*

- |                      |     |                  |
|----------------------|-----|------------------|
| a. Flowers solitary  | ... | portulacastrum 1 |
| b. Flowers clustered | ... | triquetra 2      |

1. *Trianthema portulacastrum* Linn. Sp. Pl. 223, 1753 ; Back. Fl. Mal. 74, 1951 ; Jeffrey in Fl. Trop. E. Africa ; 23, 1961. *T. monogyna* Linn. Mant. 1 : 69, 1767 ; Clarke in Hook. f. Fl. Brit. India 2 : 660, 1879 ; Haines 1 : 51, 1921.

Much-branched, prostrate annuals with long tap roots ; stems flattened on the nodes, thick, finely puberulose. Leaves 2-4 × 1-3 cm, ovate, ovate or sub-orbicular, fleshy, rounded at apex, obtuse at base. Flowers partially hidden within the petiolar pouch, pink-coloured, axillary, solitary. Capsules flat, bilobed, with more or less fleshy cretulum ; seeds reniform, black.

*Fl. & Fr.* : Mostly May-August.

*Distrib.* : CHANDBALI, KUJANG : Frequent along sandy coast, in waste places. Common locally as a vegetable weed.

2. *Trianthema triquetra* Rottl. ex Willd. Neue Schr., Naturfr. Berlin 4 : 181, 1803 ; Back. Fl. Mal. 273, 1951. *T. crystallina* (auct. div. non Vahl) Roxb. Fl. Ind. ed. Carey 2 : 444, 1832 ; Clarke in Hook. f. Fl. Brit. India 2 : 660, 1879 ; Mooney 246, 1950.

Succulent, much-branched, papillose, prostrate herbs. Leaves 4-6 mm, linear, often oblanceolate, papillate, obtuse at apex, narrowed at base. Flowers up to 1 mm across, 2-3, in axillary clusters, or 1 in the axil of short lateral branches. Capsules enclosed within cup-shaped calyx tubes ; seeds 2, superposed, often 1, reticulate with papillose along margins.

*Fl. & Fr.* : March-April ; June-July.

*Distrib.* : PARADEEP : More or less common in dry waste places along the sea-coast, river-banks, road-sides and embankments. Sometimes found in saline habitats specially on reclaimed soils.

#### 4. SESUVIUM Linn.

*Sesuvium portulacastrum* (Linn.) Linn. Syst. ed. 10 : 1058, 1759 ; Back. Fl. Mal. 272, 1951 ; Clarke in Hook. f. Fl. Brit. India 2 : 659, 1879 ; Mooney 246, 1950. *Portulaca portulacastrum* Linn. Sp. Pl. 446, 1753.

Succulent, perennial herbs with long taproots : stems creeping, much-branched, greenish or red, rooting from nodes. Leaves 2-6 × 0.5-1.5 cm, lanceolate, oblanceolate or spatulate, very thick, glabrous, rounded at apex, narrowed towards base. Flowers 5-8 mm long, deep purple or pinkish-violate, axillary, solitary. Capsules 5-7 mm across, included within the perianth, many-seeded ; seeds black, reniform, smooth, with long funicles.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : PARADEEP, BHITARKANIKA : Common salt-loving plants occurring along the pioneer zones of sandy or muddy sea-beaches and growing in such places unsuitable for any other plant due to high salinity ; sometimes found along saline bunds and embankments in-between the mangroves. It serves as a sandbinder just behind the intertidal region of the sea-shore.

## MOLLUGINACEAE

## MOLLUGO Linn.

*Key to Species*

- |   |     |                      |
|---|-----|----------------------|
| 1a. Seeds reniform :                    |     |                      |
| 2a. Seeds dark-brown, granulated        | ... | <i>pentaphylla</i> 1 |
| 2b. Seeds golden-yellow, not granulated | ... | <i>disticha</i> 2    |
| 1b. Seeds orbicular                     | ... | <i>cerviana</i> 3    |

1. *Mollugo pentaphylla* Linn. Sp. Pl. 89, 1753 ; Backer in Fl. Mal. 4 : 268, 1951. *M. stricta* Linn. Sp. Pl. ed. 2, 131, 1762 ; Clarke in Hook. f. Fl. Brit. India 2 : 663, 1879 ; Haines 1 : 49, 1921.

Prostrate, glabrous herbs ; stems angular. Leaves 1-2.5 × 0.3-0.7 cm, obovate-spathulate in false whorls of 4-5, subsessile, acute at apex, narrowed at base. Flowers 2-2.5 mm across, greenish-white, in terminal uniparous scorpioid cymes on compound dichasial branches. Capsules 3-4 mm long, ellipsoid, or sub-globose ; seeds reniform, dark-brown, granulated.

*Fl. & Fr.* : Mostly throughout the season.

*Distrib* : BATIGHAR, KUJANG : Common along sea-shore, river-banks and sand bars, sometimes found along the road-sides.

2. *Mollugo disticha* (Linn.) Seringe in DC. Prodr. 1 : 392, 1824 ; Clarke in Hook. f. Fl. Brit. India 2 : 663, 1879 ; Mooney 25, 1950 ; Wt. l.c. t. 3, 1840. *Pharnaceum distichum* Linn. Mant. 221, 1771.

Much-branched, diffuse, puberulo-glandular herbs ; stems up to 50 cm tall, angular. Leaves 2-3.5 × 0.2-0.4 cm, whorls of 3-8 linear or lanceolate, acute at apex, tapering at base ; petioles obscure. Flowers 5-6 mm long, white, in axillary, scorpioid dichasial cymes ; rachises developing into elongated pseudoracemes. Capsules 4-6 mm across, ellipsoid ; seeds reniform, golden-yellow, not granulated along margins.

*Fl. & Fr.* : Mostly throughout the year.

*Distrib.* : PARADEEP, HOOKITOLA : Frequent along sea-shores, sandy-banks and sand bars in-between the creeks and channels.

*Note* : Mooney (l.c.) doubtfully recorded this plant from kodinga Mali (800 m), Orissa. He has remarked that though his collection closely tallied with *Mollugo pentaphylla* Linn. It was however, identified at the Forest Research Institute, Dehra Dun, as *M. disticha* Ser.

3. *Mollugo cerviana* (Linn.), Seringe, in DC. Prodr. 1 : 392, 1824 ; Backer in Fl. Mal. 4 : 268, 1951 ; Clarke in Hook. f. Fl. Brit. India 2 : 663, 1879 ; Mooney 25, 1950. *Pharnaceum cerviana* Linn. Sp. Pl. 272, 1753.

Annual, pluricauline, glabrous, slender herbs ; stems 4-16 cm long, with many radiating branches from a woody rootstock. Leaves radical, rosulate, 4-6 mm long, subspathulate ; cauline leaves 10-20 mm long, linear or narrowly lanceolate, 4-8, in false whorls. Flowers 2-3 mm across, greenish-white, in terminal or axillary sub-umbellate cymes, or trichotomously branched cymes. Capsules globose ; seeds orbicular or semi-orbicular, not granulated.

*Fl. & Fr.* : Mostly throughout the year.

*Distrib.* : BAHAKUD : Frequent along sandy river-banks, sea shores and waste places.

## RUBIACEAE

### *Key to Genera*

- 1a. Trees or shrubs :
- 2a. Plants armed ... RANDIA 1
  - 2b. Plants unarmed :
    - 3a. Flowers corymbose :
      - 4a. Corolla lobes shorter than the tube ... TARENNA 2
      - 4b. Corolla lobes longer than the tube :
        - 5a. Styles much longer than corolla lobes ... PAVETTA 3
        - 5b. Styles shorter than corolla lobes ... IXORA 4    - 3b. Flowers in umbels or in globose heads :
      - 6a. Fruit a syncarp ... MORINDA 5
      - 6b. Fruit a 1-seeded drupe ... CANTHIUM 6
- 1b. Herbs or undershrubs :
- 7a. Ovules many in each locule :
    - 8a. Fruits densely hairy ... DENTELLA 7
    - 8b. Fruits glabrous ... OLDENLANDIA 8  - 7b. Ovules solitary in each locule :
    - 9a. Fruits winged ... HYDROPHYLAX 9
    - 9b. Fruits not winged :
      - 10a. Calyx tube densely pubescent ... KNOXIA 10
      - 10b. Calyx tube glabrous ... BORRERIA 11



1. *RANDIA* Linn.

***Randia malabarica*** Lamk. Encyl. Method. 3 : 25, 1789 ; Wt. Ic. t. 310 ; Hook. in Hook. f. Fl. Brit. India 3 : 111, 1880 ; Haines 2 : 454, 1922.

Thorny shrubs, 1-1.5 m tall ; stems much-branched with divaricate branchlets. Leaves 4-7 × 2-3.5 cm, whorled on short branchlets, obovate, or elliptic-oblong, sub-coriaceous, obtuse at apex, narrowed into a short petiole ; stipules triangular. Flowers 1-1.5 cm long, white, fragrant, in axillary or terminal fasciculate cymes. Fruits 4-6 mm across, globose, scarlet berries. Seeds 6-8, closely packed.

*Fl. & Fr.* : May-July ; October-December.

*Distrib.* : KUIJANG, HARISPUR : Common in scrubs, coastal thickets and sand bars in-between the mangroves and cultivated hedge plants.

## TARENNA Gaertn.

***Tarenna asiatica*** (Linn.) Alst. in Trim. Handb. Fl. Ceylon (ed. 2) 6 : 150, 1931 ; Henry in Bull. bot. Surv. India 9 : 290, 1967. *Randia asiatica* Linn. Sp. Pl. 172, 1753. *Webera corymbosa* Willd. Sp. Pl. 1 : 1224, 1798 ; Hook. in Hook. f. Fl. Brit. India 3 : 102, 1880 ; Haines 2 : 448, 1922.

Shrubs 2-6 m tall ; stems glabrous, much-branched. Leaves 6-20 × 3-8 cm, oblong-lanceolate or elliptic-oblong, penninerved, acute at apex, obtuse at base. Flowers 1-2 mm across, white, fragrant, in terminal many-flowered corymbs. Fruits 5-8 mm across, elipsoid, 2-loculed berries. Seeds angular, 4-6.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : BAHAKUD, DALTANGAR : Frequent along river-banks and coastal thickets.

*Notes* : H. F. Wenham in J. Bot. 51 : 58, 1913 explained in detail the transfer of the genus *Chomelia* to *Tarenna*.

## PAVETTA Linn.

***Pavetta indica*** Linn. Sp. Pl. 110, 1753 ; Hook. in Hook. f. Fl. Brit. India 3 : 150, 1880 ; Haines 2 : 456, 1922.

Shrubs or small trees, 3-5 m tall ; stems subquadrangular, glabrous, much-branched. Leaves 5-20 × 3-10 cm, ovate-oblong or elliptic-oblong, membranous, black-dotted, acute or acuminate at apex, cuneate at base ; stipules connate at base, abruptly acuminate. Flowers 1.4-1.6 cm long, white, fragrant, in terminal corymbose cymes ; bracts cupular ; peduncles with many nodes and internodes ; corolla trumpet-shaped ; stamens inserted on the throat of corolla tube ; styles filiform, much longer than corolla lobes. Fruits 4-5 mm in diam., globose drupe ; seeds 2, subglobose.

*Fl. & Fr.* : June-July ; August-September.

*Distrib* : PARADEEP, BAHAKUD : Common along sea-shores, riverbanks and scrubs.

*Notes* : Bremekamp in Fed. Rept. 37 : 112, 1934 & 47 : 25, 1939 states that "true *Pavetta indica* Linn, is only found in "S. India and Ceylon"

### IXORA Linn.

#### *Key to Species*

- |  |     |                 |
|--|-----|-----------------|
| 1a. Small trees ; flowers white, less than 1 cm long | ... | <i>arborea</i>  |
| 1b. Shrubs ; flowers scarlet, more than 1 cm long    | ... | <i>coccinea</i> |

*Ixora arborea* Roxb. ex Sm. in Rees, Cycl. 19 : 125, 1811 ; Bremek. in Bull. Jard. Bot. Btzg. 14 : 208, 1937. *I. parviflora* Vahl, Symb. 3 : 11, t. 52, 1794 non Lamk. ; Hook. in Hook f. Fl. Brit. India 3 : 142, 1880 ; Wt. Ic. t. 711 ; Haines 2 : 455, 1922.

Small trees, 4-6 m tall ; stems glabrous, much-branched, bark reddish-brown. Leaves 6-14 × 3-6 cm sessile, elliptic-oblong or oblanceolate, coriaceous, inequilateral, acute at apex, rounded or subcordate at base. Flowers 4-5 mm long, white odorous, densely arranged in terminal panicles ; flowering axis 5-8 cm long. Fruits 4-6 mm in diam., globose, sometimes 2-lobed, drupaceous ; pyrenes 1-2, thin-walled, concave within.

*Fl. & Fr.* : February-March ; May-July.

*Distrib.* : BHITARKANIKA, BAHAKUD : Frequent along the outer mangroves and sand bars in-between the creeks, usually in association with *Olar scandens* and *Maha huxifolia*.

***Ixora coccinea*** Linn. Sp. Pl. 110, 1753 ; Hook. in Hook. f. Fl. Brit. India 3 : 145, 1880 ; Haines 2 : 455, 1922.

Much-branched, pluricaulous shrubs 0.30-1.60 m tall. Leaves 2-10 × 1.5-6 cm sessile, ovate, ovate-oblong or obovate, coriaceous, acute or obtuse at apex, subcordate at base. Flowers 2-8 cm long, scarlet-coloured, densely arranged in terminal corymbiform cymes. Fruits 3-5 mm in diam., ovoid, rarely 2-lobed, dark-red when ripe ; pyrenes 1-2 brown, plano convex.

*Fl. & Fr.* : When wild September-December ; under cultivation, throughout the year.

*Distrib.* : BAHAKUD, SATYAVYA : Found wild along the sandy riverbanks, scrubs and coastal thickets ; cultivated in gardens.

#### MORINDA Linn.

***Morinda citrifolia*** Linn. Sp. Pl. 176, 1753 ; Hook. in f. Fl. Brit. India 3 : 155, 1810. Mooney in Suppl. Bot. B. & O. Append. 1, 231, 1950.

Trees, 3-8 m tall ; branches 4-angled, pithy. Leaves 10-25 × 3-12 cm elliptic or elliptic-ovate, membranous, reticulo-venose, acute at apex, narrowed into base ; stipules broadly ovate, connate at base. Flowers white, sessile, in axillary capitate heads ; peduncles 3-5 cm long ; corolla lobes glabrous, throats pubescent ; anthers slightly exerted. Fruits 2-3 cm in diam., a syncarpium ; drupes globose with many 1-seeded pyrenes winged along margin.

*Fl. & Fr.* : July-August ; September-December.

*Distrib.* : KUJANG, PARADEEP : Found wild along the sea-shore and sandy uplands : sometimes cultivated in the gardens.

*Uses* : Cultivated for red dye from roots.

*Notes* : Mooney (*J.c.*) reported it from Ranchi, Bihar ; hence it is a new record for Orissa.

#### CANTHIUM Lamk.

***Canthium diccocum*** (Gaertn.) Merr. in Ph. J. Sci. 35 : 8, 1928. *C. diccocos* Gaertn. Fruct. 1 : 125, t. 26, 1788. *Plectronia didyma* Kurz, For. Fl. 2 : 35, 1877. *Canthium didyma* Roxb. Fl. Ind. Careyed 535, 1832 ; Hook. in Hook. f. Fl. Brit. India. 3 : 132, 1880 ; Haines 2 : 459, 1922.

Small trees or shrubs 2-5 m tall, with drooping branchlets ; branches glabrous, 4-angled, unarmed. Leaves 6-18 × 3-5 cm, oblong-lanceolate, or elliptic-ovate, coriaceous, shining, acuminate at apex, narrowed at base, nerves 4-5 pairs. Flowers 4-5 mm across, white, in opposite, axillary umbelliform cymes ; Flower-buds salviformed ; pedicels many, 2-2.5 cm long. Fruits 1-1.5 cm long, ovoid or semiovoid, many, together ; pyrenes flat, concave.

*Distrib.* : HETAMUNDIA : Frequent along the sandy riverine scrubs, sand bars, in-between the creeks and channels and coastal thickets, in association with *Ochna squarrosa* and *Toddalia asiatica*.

*Fl. & Fr.* : January-February ; March-April.

*Notes* : Both the Linnean specimen and Burmann's figure in Pl. Afr. t. 94, 1739, were treated under the genus *Plectronia*. True *Plectronia* Linn. has been indentified with *Olinia* Thum. of *Oliniaceae*, and Burmann's figure has been indentified with *Canthium* Lamk. ; Sant. & Merc. in Bull. Bot. Surv. India 3 : 107, 1961, remarked that "typical variety of *Canthium dicoccum* occurs in Andhra and South India". However, the present collection compares well with the typical variety.

#### DENTELLA J. R. & G. Forst.

*Dentella repens* (Linn.) J. R. & Forst Char. Gen. Pl, Ins. Mar. Austr. 25, t. 13, 1776 ; Airy Shaw in Kew Bull. 1934 ; Subramanyam & Sharma in Bull. Bot. Surv. India 10 : 386, f. 1-6, 1968 ; Hook. in Hook. f. Fl. Brit. India 3 : 42, 1880 ; Haines 2 : 464, 1922. *Oldenlandia repens* Linn. Mant. 40, 1767 (*non* Burm. f.).

Dichotomously branched prostrate herbs, rooting at nodes. Leaves 2-8 × 1-3 mm, sessile, spatulate, oblong, sparsely hairy, acute at apex, narrowed at base ; stipules scariaceous. Flowers 4-5 mm, white, axillary, solitary, covered with blunt, hyaline setae. Fruits 4-5 mm long, obovoid, densely setose.

*Fl. & Fr.* : Mostly throughout the year.

*Distrib.* : KUJANG : Common on moist sandy river-beds, embankments and road-sides.

#### OLDENLANDIA Linn.

##### Key to Species

- 1a. Leaves sessile ; calyx teeth subulate :
  - 2a. Diffused herbs ; flowers not solitary :
    - 3a. Peduncles 2-4 cm long :

4a. Flowers white, in cymes	...	<i>corymbosa</i>
4b. Flowers lilac, in umbels	...	<i>umbellata</i>
3b. Peduncles 30-60 cm long	...	<i>stricta</i>
2b. Erect herbs ; flowers solitary	...	<i>herbacea</i>
1b. Leaves petiolate ; calyx teeth triangular	...	<i>biflora</i>

**Oldenlandia corymbosa** Linn. Sp. Pl. 119, 1753 ; Bremek, in Verh. Akad. Wet. 48 (2) : 254, 1952 ; Hook in Hook. f. Fl. Brit. India 3 : 64, 1880 ; Haines 2 : 468, 1922. *Hedyotis corymbosa* (Linn.) Lamk. Tab. Encyc. 1 : 272, 1792.

Diffused, slender, annual herbs ; stems quadrangular, glabrous. Leaves 8-24 × 1-3 mm, sessile, linear or linear-lanceolate, scabrescent, acute at apex, narrowed at base. Flowers 3-4 mm long, white, 2-3 (6), in axillary pedunculate cymes or sub-umbellate cymes. Fruits 1.5-2 mm across, globose, pyriform.

*Fl. & Fr.* : June-July ; August-September.

*Distrib.* : PARADEEP, KUJANG ; Frequent on waste places, road-sides, gravelled yards and Sea-shores.

**Oldenlandia umbellata** Linn. Sp. Pl. 119, 1753 ; Hook. in Hook. f. Fl. Brit. India 3 : 66, 1880 ; Haines 2 : 469, 1922. *Hedyotis umbellata* (Linn.) Lamk. Tab. Encyc. 1 : 272, 1792.

Much-branched, diffuse annual herbs ; stems angular, scabridulous. Leaves 6-15 × 1-2 mm, linear or oblong-lanceolate, pubescent, recurved along margins, acute at apex, sessile at base. Flowers 2-3 mm long, white or lilac, 6-10-flowered in axillary or terminal umbelliform cymes ; peduncles 6-15 mm long ; pedicels 2-3 mm long. Fruits 2-3 mm across, flat or truncate at apex, not protruding from calyx lobes.

*Fl. & Fr.* : March-April ; June-July.

*Distrib.* : KUJANG, PARADEEP ; Frequent on sea-shore, scrubs, riverbanks, road-sides and dry sandy places.

**Oldenlandia stricta** Linn. Mant. 200, 1781 ; Trimen in Hand. Fl. Ceylon 2 : 316, 1974 (Rep. ed.) ; Hook. in Hook. f. Fl. Brit. India 3 : 68, 1880. *Hedyotis graminifolia* Linn. f. Suppl. 1 : 119, 1781.

Branched perennial herbs ; tap root 40-60 cm long ; branches glabrous, wiry repeatedly trichotomous, sub-quadrangular. Leaves 10-25 × 3-5 mm, linear-lanceolate, sessile, adnate and amplexicaul, with recurved margins.

Flowers 5-8 mm long, purple, in axillary or terminal, elongated racemose cymes ; flowering branches 30-60 cm long, slender, wiry. Fruits 5-8 mm long, obovoid, ribbed, crowned by subulate calyx teeth.

*Distrib.* : HOOKITOLA, PARADEEP : More or less restricted along the sea-shore, riverine scrubs and coastal thickets.

*Fl. & Fr.* : April-May ; September-October.

*Notes* : Haines (1922) and Mooney (1950) have not reported this taxon from Orissa ; hence it is a new record for Orissa.

***Oldenlandia herbacea*** (Linn.) Roxb. in Fl. Ind. ed. Carey : 424, 1832 ; Haines 2 : 469, 1922. *Hedyotis herbacea* Linn. Sp. Pl. 102, 1753. *Oldenlandia heynii* G. Don, Gen. Syst. 3 : 531, 1834 ; Hook, in Hook. f. Fl. Brit. India 3 : 56, 1880.

Erect bushy, annual or biannual herbs ; stems prominently branched, glabrous, 4-angled ; branched dichotomous. Leaves 2-3 × 0.5-0.6 cm, linear-lanceolate, sessile, acute at apex, adnate to base. Flowers 4-5 mm long, white, solitary along both the axils or rarely in 2-flowered cymes ; pedicels 10-12 mm long, filiform. Fruits 3-4 mm across, globose, crowned by subulate, calyx lobes.

*Fl. & Fr.* : September-October ; December-January.

*Distrib.* : BAHAKUD, KUJANG : Frequent on waste places near the coast, along the river-banks and road-sides.

***Oldenlandia biflora*** Linn. Sp. Pl. 119, 1753 ; Hook. in Hook. f. Fl. Brit. India 3 : 70, 1880. *O. paniculata* Linn. Sp. Pl. ed. 2, 1667, *p.p.* ; Burm. f. Fl. Ind. 38, t. 15, f. 1, 1768 ; Haines 2 : 470, 1922 ; Hook. in Hook. f. Fl. Brit. India 3 : 69, 1880. *Hedyotis biflora* (Linn.) Lamk. Tab. Encyc. 1 : 272, 1792.

Erect or ascending, glabrous herbs ; stems quadrangular, sulcate, much-branched from the base. Leaves 1-5 × 0.5-2.5 cm, petiolate, elliptic-ovate or oblong, thick, acute at apex, attenuate at base. Flowers 2-3 mm long, white, in axillary or terminal paniculate cymes ; pedicels 2-12 mm long. Fruits 2-3 mm across, turbinate, ferunculate, not winged.

*Fl. & Fr.* : June-July ; September-October.

*Distrib.* : DALTANGAR, KUJANG : Frequent along road-sides, open sandy places, river-banks and scrubs.

***Hydrophylax maritima*** Linn. f. Suppl. 126, 1781 ; Hook. in Hook. f. Fl. Brit. India 3 : 199, 1880 ; Haines 2 : 473, 1922.

Succulent, creeping, perennial herbs with a prominent 50-70 cm long tap root ; stems much-branched, 4-angled, glabrous rooting at nodes. Leaves 1-3 × 0.5-1.5 cm, sessile, ovate, thick, coriaceous, acute or acuminate at apex ; stipules 5-7 mm long, membranous, truncate, toothed, forming a cup, combined with the petioles or leaf-bases. Flowers 8-12 mm long, pinkish-purple, white-tinge within, funnel-shaped, sessile, solitary, axillary. Fruits 12-15 × 6-8 mm ellipsoid, compressed, corky, 3-4 winged, crowned by calyx-teeth, 2-loculed, 2-seeded ; seeds 5-6 mm long, ovoid, black, grooved ventrally, peltately attached to the septum, usually one of the two very ill-developed.

*Fl. & Fr.* : June-July ; October-December.

*Distrib.* : SATYAVIA, HOOKITOLA : Common along sea-shores, restricted to beaches ; sometimes found as pure stands. It is a sand stabilizer, or sand binder, usually colonising over the first formed, small sandunes as a pioneering species along the windward sea-shore ecosystem and growing in association with *Cyperus arenarius* and others.

#### KNOXIA Linn.

*Knoxia sumatrensis* (Retz.) DC. Prodr. 4 : 570, 1830 ; Back. & Bakh. Fl. Java 2 : 319, 1965 ; *Spermacoce sumatrensis* Retz. Obs. 4 : 23, 1786. *Knoxia corymbosa* auct. non Wills. Sp. Pl. 1 : 582, 1799 ; Hook. in Hook. f. Fl. Brit. India 3 : 128, 1880 ; Haines 2 : 473, 1922.

Erect, sparingly branched slender herbs ; stems pubescent or densely hairy ; nodes longitudinally grooved. Leaves 8-12 × 2.5-3 cm, opposite, penninerved, ovate-lanceolate, or elliptic, pubescent, acute at apex, obtuse at base ; stipules sheath-like, toothed or bristle-like at base. Flowers 1-2 mm across, bluish-purple, in terminal many-flowered corymbs, densely pubescent. Fruits 1-2 mm across, ellipsoid, breaking into two halves ; halves of fruit 3-ribbed.

*Fl. & Fr.* : August-September ; October-December.

*Distrib.* : DALTANGAR : Rare in scrub jungles along the river-banks ; locally common.

#### BORREIA C. F. Mey. (*nom. cons.*)

*Borreia articularis* (Linn. f.) F. N. Williams in Bull. Herb. Boiss. 5 : 956, 1905 ; Sent. & March. Bull. Bot. Surv. India 3 : 107, 1961. *Spermacoce articularis* Linn. f. Suppl., 119, 1781. *S. hispida* Linn. Sp. Pl. 102, 1753 ; Hook. in Hook. f. Fl. Brit. India 3 : 200, 1880 ; Haines 2 : 472, 1922. *Borreria hispida* (Linn.) Sch. *non* Spruce ex K. Sch. 1888.

Erect or prostrate herbs, deep-rooted ; stems quadrangular, wingless, hispid or glabrous, much-branched, from woody rootstock. Leaves 5-15 x 4-12 mm, sessile, linear-lanceolate, elliptic, or ovate-oblong, coriaceous, recurved along margins, subacute at apex, narrowed towards base. Flowers 3-4 mm, pinkish-white, axillary, clustered within stipular cups. Capsules 3-4 mm, ellipsoid, crowned by calyx-teeth ; seeds black, narrowed.

*Fl. & Fr.* : July-September ; December-January.

*Distrib.* : PARADEEP, HOOKITOLA : Common along the leeward side of the sea-shore dunes, road-sides, river-banks, and dry grasslands ; locally abundant.

## COMPOSITAE

### *Key to Genera*

- 1a. Heads with 1-2 florets :
- 2a. Leaves pinnatifid :
- 3a. Heads solitary, yellow :
- 4a. Peduncles obraceolate ... GRAMMA
- 4b. Peduncles bracteolate ... LAUNABA
- 3b. Heads many, purple ... CYATHOCLINUS
- 2b. Leaves not pinnatifid :
- 3a. Flowers ciliolate :
- 6a. Receptacle flat, pappus absent ... ECLIPTA
- 6b. Receptacle not flat pappus present :
- 7a. Pappus-hairs not awned ... TRIDEX
- 7b. Pappus-awned ... SYNDELLA
- 3b. Flowers ligulate ... BLAINVILLEA
- 8a. Achenes in a spinous auricle ... XANTHOPUS
- 8b. Achenes otherwise :
- 9a. Anthers cleft at base ... VERNONIA
- 9b. Anthers tailed at base ... BLUMBA
- 10a. Woolly herbs, stems not winged ; pappus present ... GNAPHALIUM
- 10b. Not woolly herbs, stems winged ; pappus absent ... SPHARRANTHUS



## GRANGEA Adans.

*Grangea maderaspatana* (Linn.) Poir in Lamk. *Encycl. Suppl.* 2 : 825, 1811 ; Hook. in Hook. f. *Fl. Brit. India* 3 : 247, 1881 ; Haines 2 : 487, 1922. *Artemisia maderaspatana* Linn. *Sp. Pl.* 849, 1753.

Diffused annual or perennial, sticky, pubescent herbs with woody rootstocks and long tap roots ; branches radiating from the centre. Leaves 2-6.5 × 0.2-0.5 cm, sessile, pinnatifid, irregularly lobed ; cauline leaves more or less deformed. Heads 6-8 mm across, globose, yellow or purple, heterogamous, solitary or in twos in terminal peduncles. Achenes suberect, slightly compressed, glandular ; pappus cupular, fimbriate.

*Fl. & Fr.* : February-March ; May-June.

*Distrib.* : PARADEEP, SATYAVIA : Frequent on waste places near the sea-shores ; common locally along dry ditches and paddy fields.

## LAUNAEA Cass.

*Launaea sarmentosa* (Willd.) Alston in Trimen, *Handb. Fl. Ceylon* 6, *Suppl.* 173, 1931 ; Back. & Bakh. *Fl. Java* 2 : 434, 1965. *Prenanthes sarmentosa* Willd. *Sp. Pl.* 3 : 1540, 1803. *Launaea pinnatifida* Cass. in *Ann. Sc. Nat.* 23 : 85, 1881 ; Hook. f. *Fl. Brit. India* 3 : 416, 1881 ; Haines 2 : 521, 1922. *Microhynchus sarmentosus* (Willd.) DC. *Prodr.* 7 : 180, 1838.

Stoloniferous, glabrous herbs, with milky juice ; stolons branched, 5-60 cm long, rooting at nodes and producing secondary rosettes. Leaves 4-8.5 × 0.5-2.5 cm, rosulate, spatulate, dentate pinnatifid, rounded at apex, tapering into petiole. Heads 2-4 cm long, bright-yellow, solitary, axillary in bracteolate peduncles ; bracteoles 6-12, ovate-oblong, oblique, obtuse, each 2-3 mm. Achenes 1-2 mm, linear, 3-4-ribbed, pappus white, cottony, connate at base.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : PARADEEP, HOOKITOLA : Common along the sea-shores ; acts as a sand-binder. Pioneer along the foreshores covering new and old sanddunes in association with *Spinifex littoralis*, and *Hydrophylax maritima*.

## CYATHOCLINE Cass.

*Cyathocline purpurea* (Don.) Kuntze, *Rev. Gen.* 338, 1891. *Tanacetum purpureum* Don. *Prodr.* 181, 1825. *Cyathocline lyrata* Cass. in *Ann. Soc. Sci. : Nat.* (Ser. 1) 17 : 420, 1829 ; Hook. in Hook. f. *Fl. Brit. India* 3 : 246, 1881 ; Haines 2 : 486, 1922.

Erect or decumbent, aromatic, annual herbs with soft adpressed hairs ; stems much-branched, striate. Leaves 6-12 × 0.5-1 cm, pinnatisect, alternate, sessile, segments irregularly serrate, hispidulous. Heads 2-3 mm across, heterogamous, reddish-purple, in terminal panicles. Achenes minute, smooth ; pappus absent.

*Fl. & Fr.* : March-April ; June-July.

*Distrib.* CHAUMAHANI : Frequent along the river-banks, cultivated fields, and moist places.

#### ECLIPTA Linn. (*nom. cons.*)

*Eclipta prostrata* (Linn.) Linn. Mant. 286, 1771 ; Sant. in J. Bomb. nat. Hist. Soc. 54 : 457, 1956 ; Bull. Bot. Surv. India 3 : 15, 1961. *Verbesina prostrata* Linn. Sp. Pl. 902, 1753. *Eclipta erecta* Linn. Mant. 286, 1771. *E. alba* (Linn.) Hassk. Pl. Jav. Rar. 528, 1884 ; Hook. in Hook. f. Fl. Brit. India 3 : 304, 1881 ; Haines 2 : 503, 1922.

Annual or perennial, erect, decumbent or prostrate herbs up to 60 cm tall ; stems terete, much-branched, scabrous, often rooting at nodes. Leaves 1-6 × 0.5-2.5 cm, subsessile, elliptic or elliptic-oblong, hispidulous along both sides, acute or obtuse at apex, narrowed at base. Heads 4-8 mm across, white 1-3, mostly in upper axils. Achenes warted ; pappus absent or few with minute teeth.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : KUJANG, PARADEEP : Frequent along river-banks, locally common along road-sides, in moist places, rice-fields and grassland.

*Local uses* : Leaf-juice are applied for diseases of the hair.

*Notes* : Great variability in the habit and habitat of this taxon leads to the recognition of several forms as distinct species in the past which, however, have been lumped together into a single species. Santapau (*l.c.*) has discussed the nomenclature of this species in detail.

#### TRIDAX Linn.

*Tridax procumbens* Linn. Sp. Pl. 900, 1753 ; Powell in Brittonia 17 : 80, 1965 ; Hook. in Hook. f. Fl. Brit. India 3 : 311, 1881 ; Haines 2 : 509, 1922. Decumbent or rambling, branched, perennial scabrous herbs with woody root-stock. Leaves 1.5-5 × 0.3-0.7 cm, elliptic-ovate or ovate-lanceolate, serrate or irregularly lobed, acute at apex, cuneate at base. Heads 10-18 mm across, yellow, solitary on long, terminal peduncles. Achenes oblong, densely, silky-pubescent ; pappus numerous, aristate, with feathery bristles.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : PARADEEP, KUJANG : Common weed, along river-banks, road-sides, railway tracks, especially on dry localities ; frequent along sea-shore.

#### SYNEDRELLA Gaertn.

*Synedrella nodiflora* (Linn.) Gaertn. 2 : 456, t. 171, f. 7, 1791 ; Hook. in Hook. f. Fl. Brit. India 3 : 308, 1881. *Verbesina nodiflora* Linn. Cent. Pl. 1 : 28, 1755.

Erect herbs, 10-60 cm tall ; stems subangular, branched, adpressed pubescent when young. Leaves 3-12 × 1-5 cm, ovate, elliptic, or ovate-lanceolate, serrate or crenate, coarsely hispidulous along both surfaces, acute at apex, attenuate at base. Heads 6-8 mm, subsessile, yellow, 1 or few, in axillary clusters. Achenes dimorphic, muriculate ; ray-florets obovoid-oblong, compressed with pectinate wings ; disc-florets angled, narrowed at base with oblique awns at apex ; pappus 2-4, obliquely-awned.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : BAHAKUD : Rare, along waste places along the sea-shores ; locally common weed of cultivated land.

*Notes* : It is not mentioned by Haines in Botany of Bihar and Orissa (1922) or Mooney in the Supplement (1950) ; hence it is a new record for Orissa.

#### BLAINVILLEA Cass.

*Blainvillea acmella* (Linn.) Philip. in Blumea 6 : 350, 1950. *Verbesina acmella* Linn. Sp. Pl. 901, 1753. *Blainvillea latifolia* (L. f.) DC. ex Wt., Contr. Bot. Ind. 17, 1834 ; Hook in Hook. f. Fl. Brit. India 3 : 305, 1881 ; Haines 2 : 504, 1922.

Erect, much-branched, coarsely hairy annual herbs ; stems straw-coloured, furrowed, scabrid. Leaves 6-9 × 3-4 cm, ovate or ovate-lanceolate, serrate or crenate, acute at apex, obtuse at base. Heads 10-12 mm across, yellow, axillary or terminal. Achenes 2-3 mm, cuneiform, compressed ; pappus of 2-5 unequal bristles.

*Fl. & Fr.* : June-July ; August-September.

*Distrib.* : MACHOGAU : Frequently found in the scrub-jungles and along river-banks.

## XANTHIUM Linn.

*Xanthium inaequilaterum* DC. Prodr. 5 : 523, 1838 ; Back & Bakh. in Fl. Java 2 : 399, 1965. *X. indicum* Roxb. var. *inaequilaterum* (DC.) Miq. Fl. Ind. Bot. Suppl. 1 : 306, 1861. *X. strumarium* auct. non Linn. Hook. in Hook. f. Fl. Brit. India 3 : 303, 1881 ; Haines 2 : 502, 1922.

Erect, coarsely pubescent, monoecious annuals ; stems shallowly-furrowed ; branches subterete, often purple-tinged. Leaves 3-12 × 2-10 cm, alternate, broadly triangular-ovate or suborbicular, irregularly, lobulate, crenate, or serrate, adpressed, pubescent along both surfaces, acute at apex, cordate or truncate at base. Heads unisexual ; male heads globose, many-flowered, terminal ; female heads 2-flowered, sessile, ellipsoid, densely covered with hooked bristles, in lower leaf-axils ; involucre bracts with hooks or spines. Achenes oblong-ovoid, glabrous, enclosed within enlarged, fused involucre ; pappus absent.

*Fl. & Fr.* : Mostly during cold season.

*Distrib.* : KUJANG, SATYAVIA : Common on waste places, road-sides, river-banks and dry ditches ; frequently found along the sea-shore, sometimes forming pure stands in waste soils.

VERNONIA Schreb, (*nom. cons.*)

*Vernonia cinera* (Linn.) Less. in Linnæa 4 : 291, 1829 ; Koster. in Blumea 1 : 410, 1935 ; Hook. in Hook. f. Fl. Brit. India 3 : 233, 1881 ; Haines 2 : 484, 1922. *Conyza cinera* Linn. Sp. Pl. 862, 1753.

Decumbent or suberect, polymorphous, perennial herbs ; stems ribbed, finely pubescent, glandular. Leaves 5-20 × 2-5 cm, variable, elliptic, or ovate-lanceolate, puberulous, entire or sinuately denticulate, acute or obtuse at apex, attenuate or decurrent at base. Heads 3-5 mm across, pinkish purple, arranged in terminal corymbs on filiform dichotomously branched long peduncles ; involucre 4-seriate, purple-tinged. Achenes 1-2 mm, brown, pubescent ; pappus white, minutely barbellate.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : PARADEEP : Common weed, along road-sides, river-banks, cultivated fields and waste places ; frequent along the sea-shores, on sand-dunes in association with *Spinifex littoreus*.

BLUMEA DC. (*nom. cons.*)

*Blumea lacera* (Burm. f.) DC. in Wt. Cont. Bot. Ind. 14 : 1834 ; Randeria in Blumea 10 : 264, 1960. Hook. in Hook. f. Fl. Brit. India 3 :

263, 1881 ; Haines 2 : 493, 1922. *Conyza lacera* Burm. f. Fl. Ind. 180, t. 59, f. 1. 1768.

Erect herbs, 20-90 cm tall ; stems strongly scented, viscid, younger parts villose, with soft glandular hairs. Leaves 1.5-10 × 0.5-5cm, ovate-oblong or obovate, membranous, viscid-glandular along both surfaces, lower surface densely hairy, sinuate-dentate, obtuse or rounded at apex, tapering into the petiole. Heads 5-7 mm across, yellow, in axillary or terminal panicles ; involucre densely velutinous. Achenes slightly ribbed, brownish, sparsely hairy.

*Fl. & Fr.* : March-July ; September-December.

*Distrib* : PARADEEP : Common weed along road-sides, river-banks, cultivated fields and sea-shores.

#### GNAPHALIUM Linn.

*Gnaphalium indicum* Linn. Sp. Pl. 852, 1753 ; Hook. in Hook. f. Fl. Brit. India 3 : 289, 1881 ; Haines 2 : 498, 1922.

Slender, woolly-white annual or perennial herbs ; stems terete, much-branched from the base. Leaves 1-3 cm long, alternate, sessile, linear or spatulate, woolly along both surfaces, acute or obtuse at apex, tapering at base. Heads 2-3 mm across, heterogamous, yellow, crowded in upper axils forming a leafy-spike. Achenes minute, slightly papillose ; pappus 1.5 mm long, uniseriate, free, caducous.

*Fl. & Fr.* : December-January ; February-March.

*Distrib.* : BAHAKUD, KUIANG : Locally common, along road-sides, river, river-banks, dry ditches, and moist sandy places ; frequent along sea-shores on waste places.

#### SPHAERANTHUS Linn.

##### Key to Species

- |   |     |                  |
|---|-----|------------------|
| 1. Involucre bracts lanceate, acuminate | ... | <i>africanus</i> |
| 1. Involucre bracts ovate-obtuse        | ... | <i>indicus</i>   |

*Sphaeranthus africanus* Linn. Sp. Pl. ed. 2, 1314, 1763 ; Back. & Bakh. Fl. Java 2 : 391, 1965 ; Koster in Blumea 20 : 196, 1972 ; Hook. in Hook. f. Fl. Brit. India 3 : 275, 1881.

Erect, faintly aromatic herbs, 20-40 cm ; stems glabrous, winged, with divaricate branches ; wings entire or dentate. Leaves 1.5-5 × 0.3-1 cm, elliptic, lanceolate or oblong-lanceolate, decurrent minutely

denticulate, acutely mucronate at apex, tapering towards base. Heads 6-8 mm across, subglobose, purple, solitary, axillary; involucre of bracts 2.5-3.5 mm long, lanceolate, acuminate, glabrous, dentate at apex. Achenes 1-2 mm long, glandular, on a short stipe; pappus absent.

*Fl. & Fr.* : March-July; December-January.

*Distrib.* : BATIGHAR : Frequent on sandy or muddy sea-shores; locally common on moist places and rice-fields.

*Notes* : Haines (1922) and Mooney (1950) have not reported this taxon from Orissa; hence it is a new record for Orissa.

*Sphaeranthus indicus* Linn. Sp. Pl. 1314, 1753; Hook. in Hook. f. Fl. Brit. India 3 : 275, 1881; Haines 2 : 496, 1922.

Strongly aromatic, adpressed pubescent annuals; stems glandular, winged; wings coarsely dentate. Leaves 2.5-5.5 × 0.4-1.3 cm, ovate-oblong, pubescent, serrate or dentate, acute, mucronate at apex, narrowed at base. Heads 10-15 mm across, globose, pinkish-purple, solitary, axillary; peduncles winged; involucre bracts ovate-spathulate, ciliate at apex. Achenes angular, oblong, tipped by the persistent apically withering corolla; pappus absent.

*Fl. & Fr.* : Throughout the year but mostly during dry seasons.

*Distrib.* : BATIGHAR : Frequent along river-banks, dry ditches and moist sandy places near the coast. Locally common in dry rice-fields.

#### EUPATORIUM Linn.

*Eupatorium odoratum* Linn. Syst. Nat, ed. 10 : 1205, 1759; van Steenis in Reinw. 1 : 478, 1952; Hook. in Hook. f. Fl. Brit. India 3 : 244, 1881.

Erect herbs or straggling undershrubs; stems terete, pithy, pubescent in upper parts, woody at base. Leaves 2.5-8 × 2-6.5 cm, decussate, ovate or ovate-lanceolate, crenate-serrate, softly pubescent above, glandular beneath, acute at apex, cuneate at base. Heads 8-10 mm, bluish-white, arranged in dense terminal corymbs. Achenes 4-5 mm, angled, scabrescent; pappus 4-5 mm long, 1-seriate, white, barbellate.

*Fl. & Fr.* : November-December; January-February.

*Distrib.* : SATYAVIA, HOOKITOLA : Obnoxious weed, commonly growing along road-sides and hedges; frequently found along sea-shore.

*Notes* : It is not mentioned by Haines in Bot. Bihar and Orissa (1922) or Mooney in the Supplement (1950) from Orissa; hence this collection is a new distributional record for Orissa.

## SPHENOCLEACEAE

SPHENOCLEA Gaertn. (*nom. cons.*)

*Sphenoclea zeylanica* Gaertn. Fruct. 1 : 173, t. 5, 1788 ; Airy Shaw in Fl. Mal. 4 : 27, f. 1, 1948 ; Clarke in Hook. f. Fl. Brit. India 3 : 438, 1880 ; Haines 2 : 528, 1922. "*Jhill mirich*".

Erect annual herbs 40-150 cm tall ; stems somewhat spongy, glabrous, fistular ; branched often with fibrous roots. Leaves 3-6.5 × 1.5-2.5 cm, elliptic or ovate-lanceolate, thin, membranous, acute at apex, obtuse at base. Flowers white, in condensed terminal spikes ; spikes 4-6 cm long. Capsules globose, compressed, membranous, circumscissile ; seeds less than 1 mm long, oblong, many, striate or slightly verrucose.

*Fl. & Fr.* : During rainy season ; June-August.

*Distrib.* : TALCHUA, BHITARKANIKA : MONSOON weeds of low-lying areas and bordering paddy fields, occasionally found along the banks of back waters, in association with *Aegiceras corniculatum* and *Excoccaria agallocha*.

## PLUMBAGINACEAE

## AEGIALITIS R. Br.

*Aegialitis rotundifolia* Roxb. in Fl. Ind. 2 : 111, 1832 ; Clarke in Hook. f. Fl. Brit. India 3 : 479, 1880 ; Haines 2 : 529, 1922 ; van. Steenis in Fl. Male. 4 : 108, 1949.

Evergreen shrubs or small trees 1-7 m tall ; stems 5-20 cm in diam., straight, simple or very few-branched at the top, glabrous, with numerous leaf-scars, conically swollen at the base with stilt-roots ; bark thin, brownish, lenticellate. Leaves 2.5-9.5 × 3-9 cm, alternate, rotund, broadly ovate, or orbicular, entire, coriaceous, reticlovenous, rounded or cuneate at base, acute, slightly obtuse or short protruding at apex ; petioles 4-8.5 cm, thick, glandular, dilated, amplexicaul. Flowers 17-22 mm long, white bracteate, arranged in axillary leafy panicles, panicles sometimes forked ; bracts 10-12 mm long ; bracteoles 8-10 mm ; calyx 8-15 mm, tubular, barrel-shaped, persistent, 5-ribbed, 5-lobed, each lobe up to 1 mm, acute ; corolla white, united below, forming a connate-compact tube with the staminal base ; petals 5, imbricate, each 10-14 × 2-3.5 mm excluding the tube, spatulate, circumscissile from the top of the connate-tube. Stamens 5, each 13-17 mm long, base flat, plate-like connate with corolla tube ; anthers 2.5-3 mm, basifixed ; ovary 4-5 × 0.2-0.3 mm, ovoid-conical, angled, prominently 5-ribbed, one-loculed, one-ovuled ; ovule pendulous, suspended from a basal persistent funiculus ; funicle, enlarged at the time of dehiscence of fruit. Styles 5,

free at apex, adnate towards base, each 10-12 mm long ; stigma capitate. Capsules 8-9 × 0.4-0.5 cm, linear, curved 5-ribbed, splitting finally along the ribs from the apex, often tipped with staminal tube. Hypocotyle 6.5-8 cm with white membranous plumular cap and long funiculus.

**Germination** : During the months of May to July, the fruits are found floating on the water with the help of the spongy mesocarp : after coming in contact with the soft mud each fruit splits apically and the narrow radicular end of the hypocotyle penetrates into the soft mud developing into the root system and from the apical plumular cap the cotyledonary leaves are initiated.

**Fl. & Fr.** : February-March ; April-July.

**Distrib** : THAKURDIAN, JAMBU, BATIGHAR : Common along the muddy sea-shores and inside the mangroves ; and frequent along the sandy sea-shores ; often forming a pure stand, usually in association with *Excoecaria agallocha*, *Sarcostemma brevistigma* and *Bruguiera cylindrica*. Along sandy shores they present a stunted growth.

**Local name** : Bonoroa (Oriya).

**Notes** : van Steenis (*l.c.*) states "Field study is urgently needed to clear the life history and variability of this peculiar genus" He divided provisionally this genus into two species, *A. annulata* R. Br. and *A. rotundifolia* Roxb. on the basis of their different ecological behaviour and minor differences in their flowers. However, we have collected this genus from the sandy and rocky sea-shore as well as from the muddy mangroves ; but we observed that the range of variation in the flowers is not so distinct to separate them into two distinct species. Only the growth pattern was different in the two different ecological niches within the mangrove swamp, the plants were found growing up to 7 m tall, but along the sea-shore they were stunted presenting a shrubby appearance of 1 m long. Further, a study of the sclereids in the leaves (Rao 1980) of Australian and Indian materials revealed no differences.

## MYRSINACEAE

### Key to Genera

- |                              |     |           |   |
|------------------------------|-----|-----------|---|
| 1a. Fruits, globose berries  | ... | ARDISIA   | 1 |
| 1b. Fruits, cylindric drupes | ... | AEGICERAS | 2 |

### 1. ARDISIA Swartz, *nom. cons.*

**Ardisia solanacea** Roxb. Pl. Cor. 1 : 27, 1795 ; Haines 2 : 533, 1922. *A. humilis auct. non* Vahl, 1794 : A. DC. in Trans. Linn. Soc. 17 : 121, 1834 and Prodr. 8 : 129, 1844 ; Clarke in Hook. f. Fl. Brit. India 3 : 529, 1880.



Erect, evergreen shrubs or small trees, 3-8 m tall ; stems glabrous, brownish, marked with fallen leaf-scars. Leaves 6-20 × 3-8 cm, alternate, elliptic-oblong or oblanceolate, subcoriaceous, entire, acute or acuminate at apex, narrowed at base, usually crowded at the ends of branchlets. Flowers 8-12 mm long, rose-purple, in axillary pedunculate corymbose cymes ; pedicels 12-20 mm long. Fruits 6-10 mm across, globose or subglobose berries, black when ripe.

*Fl. & Fr.* : April-May ; June-August.

*Distrib.* : DALIANGAR : Frequent along the river-banks in scrub jungles, and around ditches and streams under shaded places.

## 2. AEGICERAS Gaertn.

*Aegiceras corniculatum* (Linn.) Blanco in Fl. Filip. 79, 1878. *Rhizophora corniculata* Linn. Sp. Pl. 635, 1753. *Aegiceras majus* Gaertn. Fruct. 1 : 216, t. 46, f. 1, 1788 ; Clarke in Hook. f. Fl. Brit. India 3 : 533, 1880 ; Haines 2 : 535, 1922.

Small, evergreen trees 3-8 m tall, 10-30 cm in diam. ; stems much-branched with brownish-grey bark and broom-shaped, stilt roots arising from base. Leaves 4-8.5 × 2-4.5 cm, alternate, obovate or ovate-oblong, coriaceous, entire, retuse or emarginate at apex, cuneate at base ; petioles 5-9 mm long. Flowers 1.5-2 cm long, white, fragrant, subsessile, mostly in leaf-opposed umbels. Fruits 6-8 cm long, falcate, sharply pointed, coriaceous, yellowish brown with persistent imbricate calyx ; mesocarp spongy ; epicarp membranous, hypocotyle 3-4 cm long, curved, pointed.

*Fl. & Fr.* : February-April ; June-September.

*Distrib.* : BATIGHAR, BHITARKANIKA : Common along the intertidal zones of the several creeks and channels in mangroves, often forming pure stands along the muddy sea-shores and replacing the communities of *Rhizophora*.

*Local name* : Khalsi (Oriya).

*Notes* : Honey-combs are mostly found on this plant. Germination takes place as in *Aegialites rotundifolia* during monsoon in the fresh water conditions.

## SAPOTACEAE

### MANILKARA Adanson, *nom. cons.*

#### *Key to Species*

- |     |  |     |                   |   |
|-----|--|-----|-------------------|---|
| 1a. | Shrubs or trees without buttresses ; filaments of stamens upto 0.4 mm long | ... | <i>hexandra</i>   | 1 |
| 1b. | Trees with buttresses ; filaments of stamens up to 0.8 mm long             | ... | <i>littoralis</i> | 2 |

1. *Manilkara hexandra* (Roxb.) Dubard, Ann. Mus. Col. Mars. 23 : 9, f. 2, 1915 ; van Royen in Blumea 7 (2) : 1953. *Mimusops hexandra* Roxb. Pl. Corom. 1 : 16, t. 15, 1795 ; Clarke in Hook. f. Fl. Brit. India 3 : 540, 1880 ; Haines 2 : 538, 1922.

Trees or bushy shrubs 6-20 m tall, with white milky latex ; stems much-branched, glabrous ; branches whitish-grey, smooth, with many short lateral branchlets. Leaves 12-15 × 3-4 cm, elliptic-oblong or obovate-oblong, coriaceous, dark-green above, whitish below with approximate lateral nerves, retuse at apex, rounded at base. Flowers 5-7 mm, rusty-white, solitary, axillary or cauliflorous ; calyx rusty-brown, segments 3+3, outer lobes ovate, each 3-3.5 mm long ; inner lobes ovate-oblong, each 3.5-4 mm long ; corolla-tube 2-3 mm long ; segments 6, each on the back with 2 collateral petaloid appendages, apparently 18 in number ; inner lobes ovate-oblong, each 2-2.5 mm long, shortly clawed, obtuse at apex ; outer lobes linear-lanceolate, each 3 mm long ; stamens 6 ; staminodes 6, with irregularly incised margins ; filaments 3-3.5 mm long ; anther locules 2, longitudinally dehiscent ; ovary 1.5-2 mm across, ovoid-globose, covered with retrorse unicellular hairs, 8-9 locular ; ovule 1 in each locule ; style glabrous, subulate, 4 mm long. Fruits 1.5-2 cm long, ovoid ; seed 1, smooth, shining.

*Fl. & Fr.* : March-April ; June-July.

*Distrib.* : BAHAKUD : Frequent in scrub jungles along the river-banks, and coastal thickets in association with *Memecylon umbellatum* and *Carissa spinarum* ; sometimes observed as avenue trees.

*Notes* : Haines (*l.c.*) (p. 539) stated "*M. hexandra* represented in two forms in Orissa, but whether the large tree is different from the small one is not known"

van Royen (*l.c.*) has established a Neotype for *M. hexandra* (Roxb.) Dubard, which is Hooker and Thompson *s.n.* (L.), Malabar Fl. ; he states that as no type could be traced, a neotype has been selected from new material from the same area as indicated by Roxburgh (Pl. Corom. 1, 16, t. 1795).

It may be pointed out in this connection that typification of *M. hexandra* may be questioned since in the absence of any authentic material, the plant must be typified by the Plate and not by any material (Neotype) collected from that locality.

2. *Manilkara littoralis* (Kurz) Dubard, Lam. C.S. 343, 1941 ; van Royen in Blumea 7 (2) : 411, 1953. *Mimusops littoralis* Kurz For. Fl. 2 : 123, 1877 ; Clarke in Hook. f. Fl. Brit. India 3 : 549, 1880.

Evergreen trees, 15-40 m tall, with latex ; stems 40-70 cm in diam, smooth, straight-holed, buttressed ; buttresses sometimes produced into knee-like bends, barks whitish-grey, with longitudinal furrows. Leaves 4-16 × 3-9 cm, obovate or pandurate, retuse or emarginate at apex, cuneate at base. Flowers in bud condition, rusty-brown, 3-4 mm across, solitary axillary or cauliferous ; floral-parts similar to *M. hexandra*, except the filaments or staminodes and stamens ; filaments very short, 0.8 mm long ; staminodes fimbriate. Fruits not observed.

*Fl. & Fr.* : In buds or small flowers ; October-November.

*Distrib.* : BHITARKANIKA : Frequent within the tidal forests on intertidal banks of the creeks, specially in sandy elevated regions towards the back mangroves, in association with *Heritiera littoralis* and *Xylocarpus moluccensis*.

*Notes* : van Royen (*l.c.*, p. 413) states that "*M. kurziana* and *M. littoralis* both seem to be very closely related to *M. hexandra* and might as well be conspecific, but as no material could be found, this question is left open" He has treated *M. littoralis* (Kurz) Dubard, under imperfectly known species and mentions the type specimen of this species as "Helfer 3613" with a question mark but our critical studies have revealed the following features:

Kurz first collected this plant from Andaman Island and named it *Mimusops indica* DC. In a subsequent paper entitled "New or noteworthy plants of India" he found that the plant in question was not the true *M. indica* DC. and at the same time had not settled its identity. He pointed out that his plant differs from *M. indica* DC. in its solitary flower and compares well with the description of *M. kauki* Linn. but again could not arrive at any decision since he had not examined any authentic specimen of *M. kauki* Linn.

In his Pegu-report in the addendum he first gave the name *M. littoralis* for this plant. The plant was first described in detail in his report from Nicobar Island and in the protologue he mentioned 'Katchall' as the place of its occurrence. There is sheet No. 9 in CNH from Katchall collected by Kurz and this sheet can be treated as the type of Kurz's *M. littoralis*.

As regards Helfer's sheet, Kurz did not take into consideration of Helfer's collection since it was a mixture of both Andaman and Tenasserim collection. Helfer's sheet represents *M. hexandra* with flowers 2-3 in each axil. Kurz was sure that his plant was having solitary flowers only. Moreover, there is a duplicate of Helfer's sheet in CAL, on which an annotation on *M. littoralis* was definitely done after Kurz, possibly by Gamble or Clarke. van Royen might have erroneously taken in consideration these annotation on the basis

of the remark made in Fl. Brit. India (*l.c.*), where Clarke mentioned *Helper's* No. 3613.

Haines (1922) and Mooney (1950) did not report this taxon ; hence the distribution of this species from Orissa is the first time report from Indian main land.

## EBENACEAE

### Key to Genera

- |                        |     |           |   |
|------------------------|-----|-----------|---|
| 1a. Flowers 3-merous   | ... | MABA      | 1 |
| 1b. Flowers 4,5-merous | ... | DIOSPYROS | 2 |

### 1. MABA Forst.

**Maba buxifolia** (Roxb.) Pers. in Syn. Pl. 2 : 606, 1807 ; Clarke in Hook. f. Fl. Brit. India 3 : 551, 1880 ; Wt. Ic. t. 763, 1840 ; Haines 2 : 540, 1922. *Ferreola buxifolia* Roxb. Pl. Cor. 1 : 35, t. 45, 1795.

Dioecious, bushy, evergreen shrubs or small trees 4-10 m tall ; stems blackish-grey with white markings ; branches many ; branchlets pendulous ; leaves 0.8-3.2 × 0.5-1.8 cm, obovate, ovate-oblong or suborbicular, subcoriaceous, entire retuse at apex, cuneate or obtuse at base. Flowers unisexual, 1-2 mm long, white, with brownish-pubescent calyx, axillary ; male flowers smaller than female, solitary ; female flowers 1-3-clustered together in the axils. Fruits 5-8 mm across, globose, or ellipsoid, fleshy, coriaceous, berries. Seeds 2, 3-4 mm across, globose, slightly depressed.

*Fl. & Fr.* : March-April ; June-July.

*Distrib.* : BAHAKUD, BHITARKANIKA : Common in scrub-jungles along river banks, coastal thickets and sand bars within the mangroves usually in association with *Ochna squarrosa*, *Alphonsea lutea* and *Eugenia bracteata*.

### 2. DIOSPYROS Linn.

#### Key to Species

- |                                     |     |                   |   |
|-------------------------------------|-----|-------------------|---|
| 1a. Fruits brownish-rusty tomentose | ... | <i>malabarica</i> | 1 |
| 1b. Fruits glabrous                 | ... | <i>cordifolia</i> | 2 |

1. **Diospyros malabarica** (Desr.) Kostel. Allg. Med. Pharm. Fl. iii 1099 ; Back. & Bakh. Fl. Java 2 : 188, 1965. *Garcinia malabarica* Desr., Lamk. Encyc. iii : 701, 1792. *Diospyros embryopteris* Pers. Syn. Pl. 2 : 624, 1807 ; Clarke in Hook. f. Fl. Brit. India 3 : 556, 1880 ; Haines 2 : 543, 1922, 'Bara kendu'

Evergreen, dioecious trees 5-16 m tall ; stems smooth, black, usually straight. Leaves 10-20 × 2.5-6.5 cm, oblong-lanceolate, coriaceous, darkgreen, flesh-coloured when young, obtuse at apex, truncate or rounded at base. Flowers yellowish-white, fleshy ; male flowers 1 cm across, in axillary pedunculate cymes ; corolla tube glabrous ; flowers solitary, axillary ; corolla tube pubescent. Fruits 4-7 cm across, subglobose, covered with brownish-rusty scurf ; seeds 5-8 or more.

*Fl. & Fr.* : March-May ; June-July.

*Distrib.* : BAHAKUD : Frequent in scrub-jungles along sandy riverbanks, and sandbars within the mangroves ; locally common along the sides of ditches and streams.

Viscid pulp used for caulking of boats and dyeing of fish-nets.

2. *Diospyros cordifolia* Roxb. Pl. Cor. 1 : 38, t. 50, 1795. *D. montana* auct. non Roxb. Clarke in Hook. f. Fl. Brit. India 3 : 555, p.p., 1880 Haines 2 : 541, 1922. *D. montana* Roxb. var. *cordifolia* Hiern. Monogr. Eben. 222, 1873.

Dioecious, small trees, 4-8 m tall ; stems straight, branches brownish-black. Leaves 6-20 × 2-3.5 cm, elliptic-oblong, or ovate-oblong, soft velvety-pubescent along both surfaces, acute or acuminate at apex, cordate at base. Male flowers : 2-3 mm across, white, 2-3 together in axillary cymes ; female flowers : solitary, axillary. Fruits 2-3 cm in diam., globose or subglobose, glabrous berries, yellow when ripe.

*Fl. & Fr.* : June-July ; August-December, from new shoots.

*Distrib.* : BAHAKUD : Frequent along the leeward sands and sandy scrub-jungles along the sea-shore and river-banks.

## OLEACEAE

### JASMINUM Linn.

*Jasminum sambac* (Linn.) Ait. Hort. Kew. 1 : 8, 1789 ; Green in Bailey 13 : 157, 1965 ; Clarke in Hook. f. Fl. Brit. India 3 : 591, 1880 ; Haines 2 : 549, 1922. *Nyctanthes sambac* Linn. Sp. Pl. 6, 1753. '*Bono-Mallika*.

Scandent, straggling shrubs ; stems terete, glabrous, pubescent when young. Leaves 2-6.5 × 1.5-3 cm, opposite, ovate, elliptic or oblanceolate, membranous, acute at apex, obtuse or acuminate at base. Flowers 1.5-2 cm, white, fragrant, in terminal dichasial cymes. Berries 5-9 mm across, globose, fleshy, surrounded by subulate calyx lobes.

*Fl. & Fr.* : April-July ; August-September.

*Distrib* : DALTANGAR, BAHAKUD : Frequent in sandy scrubs, and thickets along the river-banks ; often the single-flowered forms are cultivated in the gardens.

## SALVADORACEAE

### Key to Genera

- |                          |     |             |
|--------------------------|-----|-------------|
| 1a. Corolla polypetalous | ... | AZIMA 1     |
| 1b. Corolla gamopetalous | ... | SALVADORA 2 |

### 1. AZIMA Lamk.

*Azima tetracantha* (Salisb.) Lamk. Encl. Meth. 1 : 343, 1783 ; Clarke in Hook. f. Fl. Brit. India 3 : 620, 1880 ; Haines 2 : 557, 1922. *Monetia tetracantha* Salisb. Prodr. 65, 1796.

Rambling, bushy, spinous shrubs : branches quadrangular, slightly pubescent, with 2-3 paired spines in the leaf-axils. Leaves 4-8.5 × 1.5-5.2 cm ; broadly ovate to lanceolate, shining along both surfaces, acute and spinulose at apex, obtuse at base. Flowers 1-2 mm across, sessile ; male flowers many, axillary, clustered in 13-20 cm long cymes ; female flowers 1-2, axillary, situated towards base. Fruits 4-6 mm across, globose, 1-seeded berries.

*Fl. & Fr.* : March-April ; July-August.

*Distrib.* : BAHAKUD, GARHARISPUR : Frequent along sandy scrubs and coastal thickets ; locally common as hedge plants.

### 2. SALVADORA Linn.

*Salvadora persica* Linn. Sp. Pl. 122, 1753 ; Clarke in Hook. f. Fl. Brit. India 3 : 619, 1880 ; Haines 2 : 556, 1922. '*Mriga or Cheani*'.

Much-branched, evergreen trees, 6-8 m tall, 10-30 cm in diam., with white, corky bark and drooping branchlets ; wood soft, yellow. Leaves 3.5-8 × 1.7-3.5 cm, ovate-elliptic, or oblong-lanceolate, thick, coriaceous, acute or obtusely-rounded at apex, obtuse or cuneate at base. Flowers 2-3 mm long, pedicellate, white with yellow throat, fragrant, in terminal panicles ; pedicels 2-3 mm long ; peduncles 10-15 cm long. Fruits 4-6 mm across, globose, smooth, 1-seeded drupes with pungent smell.

*Fl. & Fr.* : February-March ; April-June.

*Distrib.* : BATIGHAR, BHITARKANIKA KALIVANIDIAN : Frequently common along the back mangroves and sand-bars inbetween the mangrove swamps. usually found in association with *Achrostichum* and *Tamarix* sp.

*Notes* : Verdcourt in Kew Bull. 19 : 147-154, 1964 remarks that *S. persica* is a very variable species. He observed that nearly all African forms bear sessile or subsessile flowers, whereas those from India have pedicellate flowers ; plants bearing sessile flowers do not occur in India. Again, according to him, the Indian pedicellate forms which had been considered in the past as a distinct species, now constitute two varieties and they are keyed as follows :

- |   |     |                          |
|---|-----|--------------------------|
| 1a. Pedicels of flowers up to 3.5 mm long     | ... | var. <i>wightiana</i>    |
| 2b. Pedicels very short or flowers subsessile | ... | var. <i>angustifolia</i> |

We have also observed that specimens from the Shingle Island and Rameshwarm, Rao 1553 (Ecol.) with narrow-lanceolate leaves and pedicels upto 1 mm long, represent the var. *angustifolia* Verdc. synonymous to *S. oleoides auct. non* Decne. Blatt. in Rec. bot. Surv. India 8 : 290, 1921.

Specimens from Bengal, Orissa, Madras, and Andhra in the (Ecol.) herbarium represent the variety *wightiana* (Plan. & Thw.) Verdc.

## APOCYNACEAE

### *Key to Genera*

- |   |     |                |
|---|-----|----------------|
| 1a. Shrubs or small trees ; Fruits berries or drupes :        |     |                |
| 2a. Spinescent shrubs ; faecal scales absent ; fruits berries | ... | CARISSA 1      |
| 2b. Small unarmed trees ; faecal scales present ;             |     |                |
| fruits drupes   | ... | CERBERA 2      |
| 1b. Lianas ; fruits cylindrical follicles                     | ... | ICHTHOCARPUS 3 |

### 1. CARISSA Linn.

#### *Key to Species*

- |                               |     |                      |
|-------------------------------|-----|----------------------|
| 1a. Ovule one in each locule  | ... | <i>paucinervia</i> 1 |
| 1b. Ovules two in each locule | ... | <i>spinarum</i> 2    |

1. *Carissa paucinervia* A.DC. 8 : 333, 1866 ; Hook. in Hook. f. Fl. Brit. India 3 : 631, 1882 ; Haines 2 : 559, 1922 ; Wt. Ic. t. 1290, 1840. *C. spinarum* Linn. var. *paucinervia* Haines, Ind. For. 45 : 385, f. 2 and 3, 1919.

Erect, spiny shrubs ; spines straight, often forked. Leaves 2.5-6.5 × 1.5-3.5 cm, elliptic-oblong, or broadly obovate, glabrous, acute with short mucro at apex, obtuse or rounded at base. Flowers 2-2.5 cm long, white, fragrant, in terminal cymes. Fruits 6-12 mm across, ellipsoid, one-seeded, deep-black when ripe.

*Fl. & Fr.* : March-April ; June-July.

*Distrib.* : BHITARKANIKA : Common along the back regions of mangroves and sand-bars within the mangroves.

2. *Carissa spinarum* Linn. Mant. 559, 1771 ; Hook in Hook. f. Fl. Brit. India 3 : 631, 1882 ; Haines 2 : 560, 1922 ; Wt. Ic., t. 427, 1839. '*Karenda*'.

Bushy, spinescent shrubs, erect or sometimes scandent ; branches glabrous, with divaricate, forked spines. Leaves 2-5.5 × 1.5-2.5 cm, ovate or ovate-oblong, coriaceous, apiculate at apex, obtuse at base. Flowers 1.5 cm ellipsoid, 4-seeded berries.

*Fl. & Fr.* : March-April ; July-September.

*Distrib.* : BAHAKUD, FALSE POINT : Common along the littoral regions, river-banks and coastal thickets.

## 2. CERBERA Linn.

*Cerbera manghas* Linn. Sp. Pl. 208, 1753 ; Hamilt. in Trans. Linn. Soc. 13 : 509, 1822 ; Bakh. in Blumea 6 : 386, 1950. *C. odollam* Gaertn. Fruct. 2 : 193, t. 124, 1791 ; Hook in Hook. f. Fl. Brit. India 3 : 638, 1882 ; Haines 2 : 562, 1922. '*Pani-ambo*'.

Trees, 4-6 m tall, 40-50 cm in diam. ; stems soft, glabrous, with whitish-grey papery bark, and milky juice ; branches marked with leaf-scars. Leaves 10-20.5 × 3-6.5 cm, alternate, closely set or whorled at the ends of branches, ovate-oblong, to oblanceolate, coriaceous, acuminate at apex, narrowed into the petioles ; petioles 1.5-2.5 cm long. Flowers 3.5-4 cm long, bracteate, white with yellow throat, turning purple, in terminal paniculate cymes ; throat of corolla with 5 scales. Fruits 7-9 × 4-6 cm, subglobose, smooth, dull-green, drupaceous with fibrous woody pericarp. Seed one, 2-2.5 cm across, glabrous.

*Fl. & Fr.* : January-March ; April-August.

*Distrib.* : BATIGHAR, BHITARKANIKA : Common along the intertidal zones of creeks and channels in the tidal forests, usually in association with *Sonneratia apetala*, *Amoora cucullata* and *Heritiera fomes*.



*Notes* : Haines (*J. c.*) remarks that it is wild, in Sunderbuns and Chittagong, and possibly occurring in the Mahanadi delta. However, it is found commonly occurring at Bhitarkanika R. F. Khola, near the Patshala river. Some authors consider *C. manghas* and *C. odollam* as two distinct species. The main basis for their distinction being that the corolla throat red in the former and yellow in the latter. However, the present field observations revealed that the corolla lobes are white with yellow-throat to start with which gradually changes to brownish-purple, possibly due to continuous spray of saline water.

### 3. ICHNOCARPUS R. Br. *nom. cons.*

*Ichnocarpus frutescens* (Linn.) R. Br. in Mem. Wern. Soc. 1 : 62, 1809 & Ait. f. Hort. Kew. ed. 2, 2 : 69, 1811 ; Hook. in Hook. f. Fl. Brit. India 3 : 669, 1882 ; Haines 2 : 573, 1922. *Apocynum frutescens* Linn. Sp. Pl. 213, 1753. '*Soyam-nata*'.

Laticiferous, rusty-tomentose, twining shrubs ; stems much-branched, brownish, woody below. Leaves 2.5-6.5 × 1.4-2.7 cm, opposite, elliptic or elliptic-oblong, thin, membranous, dull-green above, pale beneath, acute or acuminate at apex, narrowed at base. Flowers 3-4 mm long, salver-shaped, white, pubescent, in axillary or terminal thyrses, or in compound paniculate cymes. Fruits 10-15 cm long, slender, terete, curved and pointed follicles ; seeds 0.5-1 cm, brownish, flat, comose.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : BATIGHAR, BAHAKUD : Frequent forming littoral thickets, locally common in the evergreen forests.

## ASCLEPIADACEAE

### Key to Genera

- |                                     |     |               |
|-------------------------------------|-----|---------------|
| 1a. Pollinia pendulous :            |     |               |
| 2a. Erect shrubs                    | ... | CALOTROPIS 1  |
| 2b. Twining shrubs                  |     |               |
| 3a. Leaves absent                   | ... | SARCOSTEMMA 2 |
| 3b. Leaves present                  | ... | PENTATROPIS 3 |
| 1b. Pollinia erect :                |     |               |
| 4. Seeds comose                     | ... | HOYA 4        |
| 4. Seeds not comose                 | ... | SARCOLOBUS 5  |
| 5. Corona single, tubercle-like     | ... | TYLOPHORA 6   |
| 5. Corona double, not tubercle-like | ... | LEPTADENIA 7  |

## 1. CALOTROPIS R. Br.

*Calotropis gigantea* (Willd.) Dryand. ex Ait. f. in Hort. Kew. ed 2, 2 : 78, 1811 ; Back. & Bakh. Fl. Java 2 : 252, 1965 ; Hook. in Hook. f. Fl. Brit. India 4 : 17, 1883 ; Haines 2 : 577, 1922. *Asclepias gigantea* Willd. Sp. Pl. 1 : 1262, 1798. 'Akanda-madar'.

Laticiferous, powdery tomentose, erect shrubs, 1-2 m tall ; stems soft, woody with many ascending branches. Leaves 5-15 × 3-8.5 cm, decussate, ovate-oblong or elliptic-oblong, acute at apex, obtuse at base. Flowers 2-5 cm across, white or purple, tomentose, in lateral cymes ; peduncles 5-10 cm long. Follicles up to 10 cm long, ovoid-oblong, oblique at base, uncinatate at apex. Seeds ovoid, flattened ; coma silky-white.

*Fl. & Fr.* : March-July ; October-December.

*Distrib.* : GHARHARISPUR, PARADEEP : Common along roadsides, hedges and open fields ; often found to form pure stands along the sandy sea shore.

## 2. SARCOSTEMMA R. Br.

*Sarcostemma acidum* (Roxb.) Voigt, Hort. Sub. Calc. 542, 1845 ; Sant. & Irani in Bot. Mem. 4 : 76, 1962. *Asclepias acida* Roxb. Fl. Ind. (ed. Carey) 31, 1832. *Sarcostemma brevistigma* Wt. & Arn. in Wt. Contr. 59, 1834 ; Wt. Ic. t. 595 ; Hook. in Hook. f. Fl. Brit. India 4 : 26, 1883 ; Haines 2 : 582, 1922. 'Kulutaru'.

Much branched, fleshy, straggling shrubs ; stems terete, jointed, leafless. Flowers 5-7 mm across, cream-coloured, fragrant, in terminal umbelliform cymes. Follicles 4-6 cm, ovoid-lanceolate, tapering at both ends. Seeds compressed, pyriform, comose.

*Fl. & Fr.* : May-September ; October-December.

*Distrib.* : HETAMUNDIA, FALSE POINT : Frequent in sandy scrubs and coastal thickets.

## 3. PENTATROPIS Wt. &amp; Arn.

*Pentatropis capensis* (Linn. f.) Bullock in Kew Bull. 284, 1955 ; Sant. & Irani (*l. c.*) 69. *Cynanchum capense* Linn. f. Suppl. 168, 1781. *Pentatropis microphylla* (Roxb.) Wt. & Arn. in Wt. Contr. 52, 1834 ; Hook. in Hook. f. Fl. Brit. India 4 : 20, 1883 ; Haines 2 : 580, 1922.

Slender, glabrous twining herbs. Leaves 1-2.5 × 0.5-1.5 cm elliptic-oblong, or ovate, thick, coriaceous, apiculate at apex, subcordate at

base. Flowers 5-8 mm across, greenish-white, 4-6, in extra-axillary umbelliform cymes; pedicels slender. Follicles 6-10 cm long, smooth; seeds ovate, crenate, comose.

*Fl. & Fr.* : September-October; November-December.

*Distrib.* : FALSE POINT, BHITARKANIKA : Common on hedges along scrubs and coastal thickets.

#### 4. HOYA R. Br.

*Hoya parasitica* (Roxb.) Wall. in Wt. Contr. 37, 1834; Hook. in Hook. f. Fl. Brit. India 4 : 57, 1883; Wt. Ic. t. 587. *Asclepias parasitica* Roxb. Fl. Ind. (ed. Carey) 42, t. 64, 1832.

Large epiphytic climbers; stems terete, warty, lenticellate, swollen at nodes with tufts of adventitious roots. Leaves variable, 7-10.5 × 2.4-4.5 cm, lanceolate, elliptic-oblong or ovate-elliptic, fleshy, coriaceous, yellowish-green, acute at apex, obtuse or rounded at base; petioles fleshy, 5-12 mm long. Flowers 4-6 mm across, purple, fragrant in axillary umbelliform racemes; pedicels upto 2 cm long, slender; peduncles 5-7 cm long, stout, crowded with flower-scars; corolla segments fleshy, ovate-lanceolate, inflexed, deeply cleft, glabrous within; corona-scales 5, ovate-acute, inserted on the staminal tube; pollen mass 1 mm long, oblong, sessile. Follicles not observed.

*Fl. & Fr.* : June-July.

*Distrib.* : BHITARKANIKA ? FALSE POINT : Frequent along the intertidal regions of several creeks and channels in the mangrove forests, usually climbing on *Xylocarpus* sp. and *Avicennia officinalis*.

*Notes* : Haines (1922) and Mooney (1950) have not reported this taxon from Orissa; hence it is a new record for Orissa.

#### 5. SARCOLOBUS R. Br.

##### *Key to Species*

- |   |     |                    |
|---|-----|--------------------|
| 1a. Corolla glabrous within; follicles ellipsoid, keeled    | ... | <i>carinatus</i> 1 |
| 1b. Corolla pubescent within; follicles globose, not keeled | ... | <i>globosus</i> 2  |

1. *Sarcolobus carinatus* Wall. in Asiat. Res. 12 : 570, t. 5, 1816; Hook. in Hook. f. Fl. Brit. India 4 : 28, 1883; Haines 2 : 582, 1922.

Glabrous, twining shrubs with fleshy-rhizomes bearing roots. Leaves fleshy, variable, 3-7.5 × 2-5.5 cm, broadly elliptic or narrowly elliptic-oblong, entire, coriaceous, acute or obtuse at apex, rounded at base. Flowers 2-3 mm across, yellowish-white in axillary pedunculate cymes;

corolla glabrous within ; peduncles 5-8 mm long, thick. Follicles 4-6 × 2.5-3 cm, ellipsoid, keeled along the dorsal suture ; seeds flattened, shortly-winged, not comose.

*Fl. & Fr.* : March-July ; August-September.

*Distrib* : FALSE POINT, BHITARKANIKA : More or less restricted to the muddy sea shore and mangroves, usually in association with *Phoenix paludosa* and *Aegialitis rotundifolia*.

2. *Sarcolobus globosus* Wall. in *Asiat. Res.* 12 : 568, t. 4, 1816 ; *Wt. Ic.* t. 1273 ; *Hook. in Hook. f. Fl. Brit. India* 4 : 27, 1883.

Twining glabrous shrubs ; stems lenticellate, much-branched. Leaves 4-10.5 × 1.5-4 cm, ovate or ovate-oblong, coriaceous, apiculate at apex, obtuse at base ; petioles up to 2 cm long, slender. Flowers 4-6 mm across, light purple, arranged in axillary corymbose cymes ; peduncles fleshy, 3-5 cm long ; pedicels 0.5-0.8 cm long ; corolla pubescent within. Follicles 2-3 cm in diam., globose, thick, coriaceous, usually one ; seeds flattened, winged, not comose.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : FALSE POINT : Frequent along the muddy sea shore, tidal forest and back mangroves.

*Note* : Haines (1922) did not collect this species from Orissa although remarked that "*S. globosus* Wall. is common in the Sundarbans, is also likely to be found in the Mahanadi Delta". However, this species is found from the mouths of Mahanadi and Dhamra river.

## 6. TYLOPHORA R. Br.

### *Key to Species*

- |                               |     |                 |
|-------------------------------|-----|-----------------|
| 1a. Flowers scarlet, glabrous | ... | <i>renata</i> 1 |
| 1b. Flowers yellow, pubescent | ... | <i>indica</i> 2 |

1. *Tylophora tennis* Bl. *Bijdr.* 1062, 1826 ; *Bakh. f. in Blumea* 6 : 375, 1950 ; *Hook. in Hook. f. Fl. Brit. India* 4 : 42, 1883.

Slender, twining herbs ; stems terete, much-branched, glabrous. Leaves 2-6 × 0.5-1 cm, elliptic-oblong or lanceolate, glabrous, acute or acuminate at apex, cuneate or obtuse at base ; petioles slender, 8-12 mm long. Flowers 2-3 mm long, scarlet, in axillary or terminal, repeatedly forked panicles ; corona-scales knob-shaped ; peduncles 3-8 cm long ; pedicels 5-8 mm long, filiform. Follicles 7-10 cm long, divaricate, lanceolate, narrowly pointed at apex. Seeds many, silky-comose.

*Fl. & Fr.* : May-July ; August-September.

*Distrib.* : FALSE POINT, TALCHUA : Common along the intertidal regions in mangrove forests, and estuarine island, usually twining on *Kandelia candel* and *Xylocarpus* sp, often found in coastal thickets and scrubs along the river banks.

*Note* : Haines (1922) and Mooney (1950) have not reported this species from Orissa ; hence it is a new record for Orissa.

2. *Tylophora indica* (Burm. f.) Merr. in Philip. J. Sci. 19 : 373, 1921 ; Bakh. f. in Blumea 6 : 374, 1950. *Cynanchum indicum* Burm. f. Fl. Ind. 70, 1768. *Tylophora asthmatica* (Roxb.) Wt. & Arn. in Wt. Contr. 51, 1834 ; Hook. in Hook. f. Fl. Brit. India 4 : 44, 1883 ; Haines 2 : 587, 1922.

Perennial, twining shrubs ; stems terete, glabrous or puberulous with watery sap. Leaves 3-15 × 1.5-7.5 cm, ovate or ovate-elliptic, pubescent below, apiculate at apex, rounded or subcordate at base. Flowers 1-1.5 cm across, greenish-yellow, in axillary or terminal, many-flowered, umbelliform cymes or irregular cymes ; corona-scales flat, rounded ; pedicels 1-2 cm long ; peduncles 2-2.5 cm long. Follicles paired, in a line with each other, each 5-8 cm long, lanceolate, smooth, acuminate at apex.

*Fl. & Fr.* : March-May ; August-September.

*Distrib.* : PARADEEP, KUJAG : Common along the lee side of the sea shore sanddunes, river banks, scrubs and on the edges of open field.

Green leaves are found to be efficacious in extremely virulent types of asthma.

#### 7. LEPTADENIA R. Br.

*Leptadenia reticulata* (Retz.) Wt. & Arn. in Wt. Contr. 47, 1834 ; in Kew Bull. 271, 1955 ; Hook. in Hook. f. Fl. Brit. India 4 : 63, 1883 ; Wt. Ic. t. 350 ; Haines 2 : 589, 1922. *Cynanchum reticulatum* Retz. Obs. 2 : 15, 1781.

Climbing shrubs with watery sap ; stems much-branched, puberulous, woody towards base. Leaves 5.5-9.5 × 3-6.5 cm, ovate-lanceolate or broadly ovate, thinly adpressed pubescent, acute at apex, rounded at base. Flowers 1-2 mm across, greenish-white, in axillary or terminal, many-flowered umbelliform cymes ; corona double ; corolline coronas of 5 scales between corolla-lobes ; pedicels 1.5-2 cm long ; peduncles 0.6-1.5 cm long. Follicles 8-9 cm long, broadly lanceolate, tapering towards beaked apex, thick, more or less woody, smooth ; seeds flattened, winged, comose.

*Fl. & Fr.* : July-August ; September-December.

*Distrib.* : PARADEEP, SATAVYA : Frequent along the sandy sea shores and coastal thickets, usually in association with *Spinifex littoralis* and others.

## PERIPLOCACEAE

### *Key to Genera*

- |  |     |                |
|--|-----|----------------|
| 1a. Flowers pedicellate :                          |     |                |
| 2a. Flowers 4-6 cm across, reddish-violet          | ... | CRYPTOSTEGIA 1 |
| 2b. Flowers 3-4 mm across, white or cream-coloured | ... | FINLAYSONIA 2  |
| 1b. Flowers sessile                                | ... | HEMIDESMUS 3   |

### 1. CRYPTOSTEGIA R. Br.

*Cryptostegia grandiflora* R. Br. in Bot. Reg. 5 : t. 435, 1819 ; Wt. Ic. t. 832 ; Hook. in Hook. f. Fl. Brit. India 4 : 6, 1883 ; Haines 2 : 567, 1922.

Twining laticiferous shrubs ; stems brownish, much-branched, lenticellate. Leaves 4-10.5 × 2-5.5 cm, elliptic-oblong or ovate-oblong, coriaceous, shining above, pale reticulo-venous beneath, acute or acuminate at apex, obliquely rounded at base. Flowers 4-6 cm across, reddish-violet, in terminal, trichotomously-branched cymes. Follicles 8-10 × 3-3.5 cm, ovoid-oblong, 3-winged. Seeds flattened, comose.

*Fl. & Fr.* : August-September ; October-November.

*Distrib.* : SATAVYA : Rare along sandy sea shores. Commonly cultivated in the gardens as ornamental plants.

### 2. FINLAYSONIA Wall.

*Finlaysonia obovata* Wall. Pl. Asiat. Rar. 2 : 48, t. 162, 1831 ; Bakh. f. in Blumea 6 : 369, 1950 ; Hook. in Hook. f. Fl. Brit. India 4 : 7, 1883. *Finlaysonia maritima* (non Bl.) Back ex. Heyne, Denutt. Pl. Ned. Ind. ed. 2. 1293, 1927 ; non *Secamone maritima* Bl. Bijdr. 1050, 1826. '*Kansari nata, Khasai nata*'.

Glabrous, twining shrubs with milky latex ; stems brownish, rigid, much-branched ; bark thin, verrucose. Leaves variable, 4.5-16.5 × 3.5-9.5 cm, the shape ranging from narrow lanceolate to broadly obovate, thick, coriaceous, rounded, emarginate or obtusely apiculate at apex, cuneate at base. Flowers 3-4 mm across, white or purple, in axillary,



*Finlaysonia obovata* Wall. A common climber in the mangrove Swamps showing flowers and fruits.

trichotomously-branched cymes ; peduncles brownish purple, 4-6 cm long ; calyx-segments 5, ciliate ; corolla densely hairy inside ; coronal-scales linear, 5-6 mm long, coiled. Follicles 7-9 × 4-5 cm, fleshy, turgid, ovoid divaricate, 2-3-winged, narrowed into curved beaks ; seeds 2.5-3 cm long, obovoid, flattened, comose ; coma 1.5-2 cm long, reflexed, arranged sparsely along margins.

*Fl. & Fr.* : September-November ; December-March.

*Distrib.* : FALSE POINT, BHITARKANIKA : Common along intertidal zones of several creeks and channels in the mangroves and estuarine islands.

Haines (1922) and Mooney (1950) have not reported this species from Orissa ; Hence it is a new record for Orissa.

Although this monotypic genus exhibits several morphological variations, our field studies from the Mahanadi delta in Orissa and Sagar Island in West Bengal have revealed that this taxon occurs in two forms under the following ecological niches : (1) Plants with narrow lanceolate leaves and purple flowers along the estuarine islands ; (2) Plants with broadly obovate leaves and white flowers along the intertidal regions of creeks and channels of mangroves.

### 3. HEMIDESMUS R. Br.

*Hemidesmus indicus* (Linn.) Schultes in Roem. & Schult. Syst. Veg. 6 : 126, 1819 ; Wt. Ic. t. 594 ; Hook. in Hook. f. Fl. Brit. India 4 : 5, 1883 ; Haines 2 : 575, 1922, *Periploca indica* Linn. Sp. Pl. 211, 1753. '*Kaprimul*'.

Prostrate or twining, perennial shrubs with aromatic root-stock ; stems brownish, warty, lenticellate, woody at base. Leaves variable, usually 3-12 × 1-4.5 cm, linear-oblong, glabrous, acute or apiculate at apex, obtuse or rounded at base. Flowers 2-5 mm across, greenish-yellow, purple-tinged within, sessile, fascicled in axillary cymes ; coronal-scales, 5, thick, alternate with corolla-lobes. Follicles 12-18 cm long, slender, acuminate at apex. Seeds oblong-ellipsoid, comose.

*Fl. & Fr.* : June-July ; August-September.

*Distrib.* : BAHAKUD, BHITARKANIKA : Common in sandy scrubs and coastal thickets. Frequent on hedges and roadsides.

## LOGANIACEAE

### STRYCHNOS Linn.

*Strychnos nux-vomica* Linn. Sp. Pl. 189, 1753 ; Leenh. in Fl. Mal. 6 (2) : 349, 1962 ; Clarke in Hook. f. Fl. Brit. India 4 : 90, 1883 ; Haines 2 : 592, 1922, '*Kuchilla*'.

Trees 3-10 m tall ; stems glabrous ; young branches pubescent, with axillary thorns, old branches without thorns. Leaves 4-12 × 2.5-6.5 cm, elliptic-oblong, broadly ovate or sub-orbicular, glabrous, subcoriaceous. Flowers 1.5-2 cm long, salver-shaped, greenish-white, on shortly branched sub-umbellate cymes. Fruits 5-6 cm across, globose, smooth, bright-orange



when ripe. Seeds 2-2.5 × 1-1.5 cm, discoid, depressed in centre, surrounded by brittle pulp.

*Fl. & Fr.* : March-June : September-October.

*Distrib.* : BHITARKANIKA BAHAKUD : Frequent in sandy scrub-jungles, river-banks and road-sides. Locally planted near temples and river-sides.

## GENTIANACEAE

### NYMPHOIDES Seguiet

*Nymphoides cristatum* (Roxb.) O. Ktze., Rev. Gen. Pl. 429, 1891 ; Sent. in Bull. Bot. Surv. India 3 : 20, 1962 ; Subramanyam, Aqua. Angiosperm 24, f. 16, 1961. *Limnanthemum cristatum* (Roxb.) Griseb. Gen. & Sp. Gent. 342, 1839 ; Clarke in Hook. f. Fl. Brit. India 4 : 131, 1884 ; Haines 2 : 599, 1922.

Rhizomatous aquatic herbs ; stems slender, floating producing tuft of roots at the node. Leaves floating, 3-16 × 2-10 cm, suborbicular, thick, rounded at apex, cordate at base. Flowers white, yellow towards base, clustered at the nodes ; corolla throats with a ring of hairs all round. Capsules 5 mm across, subglobose, 10-20-seeded ; seeds orbicular, thick, scabrous.

*Distrib.* : BAITRAKUD : Frequent in fresh-water ponds, paddy fields, ditches and shallow channels.

*Fl. & Fr.* : September-October ; December-January.

## BORAGINACEAE

### Key to Genera

- |   |     |                 |
|---|-----|-----------------|
| 1a. Trees or shrubs, ovary entire :                                       |     |                 |
| 2a. Styles twice bipartite  | ... | CORDIA 1        |
| 2b. Styles bipartite  | ... | EHRETIA 2       |
| 1a. Erect or prostrate herbs. Ovary 4-lobed :                             |     |                 |
| 3a. Styles dilated above, forming a ring                                  | ... | HELIOTROPIMUM 3 |
| 3b. Styles not dilated, not forming a ring :                              |     |                 |
| 4a. Erect hispid herbs ; corolla bluish, ending in a long tortuous acumen | —   | TRICHODESMA 4   |
| 4b. Prostrate scabrid herbs ; corolla white, not as above                 | ... | COLDENIA 5      |

1. *CORDIA* Linn.

*Cordia dichotoma* Forst. f. *Prodr.* 18, 1786; John. in *J. Arn. Arb.* 32 : 8, 1951; *C. myxa* auct. non Linn. Clarke in *Hook. f. Fl. Brit. India* 4 : 136, 1883; Haines 2 : 602, 1922.

Trees 5-10 m tall, with many drooping branches. Leaves 3-10.5 × 2-8.5 cm, alternate, elliptic-oblong, or broadly obovate, subcoriaceous, furunculate, strongly reticulo-venose, acute or obtuse at apex, cuneate or rounded at base. Flowers 6-8 mm long, white, in terminal branched cymes on short branchlets; styles twice bipartite. Drupes 10-15 mm across, globose, pyrenous.

*Fl. & Fr.* : March-April; September-October.

*Distrib.* : KHOLA-BHITARKANIKA : Frequent in scrubs along river-banks and road sides; sometimes planted as a road-side tree.

Flowers are found either exclusively male, or hermaphrodite, but not male and female separately on the same plant.

2. *EHRETIA* Linn.

*Ehretia acuminata* R. Br. in *Prodr.* 497, 1810; Clarke in *Hook. f. Fl. Brit. India* 4 : 141, 1883; Mooney in *Suppl. Bot. Bihar & Orissa* 90, 1950.

Trees 6-12 m tall. Leaves 6-12.5 × 3-5 cm, elliptic-ovate or ovate-oblong, glabrous or slightly pubescent, shallowly serrate, acuminate at apex, obliquely rounded at base. Flowers 3-4 mm long, white clustered in terminal panicles. Fruits globose, 2-pyrenous drupes, red when ripe.

*Fl. & Fr.* : August-September; October-December.

*Distrib.* : SHASNPADA : Rarely found on the banks of the Mahanadi river towards inland.

3. *HELIOTROPIUM* Linn.

*Key to Species*

- |  |     |                       |
|--|-----|-----------------------|
| 1a. Plants glabrous, more or less fleshy           | ... | <i>curassavicum</i> 1 |
| 1b. Plants distinctly hairy, not fleshy :          |     |                       |
| 2a. Leaves small up to 2 cm long :                 |     |                       |
| 3a. Leaves ovate, woolly tomentose                 | ... | <i>supinum</i> 2      |
| 3b. Leaves linear-lanceolate, not woolly :         |     |                       |
| 4a. Cymes 5-6 cm long, calyx longer than corolla   | ... | <i>marifolium</i> 3   |
| 4b. Cymes 4-10 cm long, calyx shorter than corolla | ... | <i>strigosum</i> 4    |
| 2b. Leaves large, 5-12 cm long                     | ... | <i>indicum</i> 5      |

1. *Heliotropium curassavicum* Linn. Sp. Pl. 130, 1753 ; Burtt in Notes R. Bot. Gdns. Edinb. 26 : 357, 1966 ; Voigt. Hort. Suburb. Cal. 444, 1845 ; Biswas in J. Dept. Sci. Univ. Cal. 8 : 40, 1927.

Fleshy, glabrous perennial herbs with long tap root. Leaves 2.5-4.5 × 0.5-0.7 cm, linear-spathulate, rounded or shallowly retuse at apex, tapering to base. Flowers 2-3 mm long, white, in axillary or terminal single or one-forked cinnini, 5-8 cm long. Fruits 2 mm across, globose, breaking up into 4-rugulose nutlets.

*Fl. & Fr.* : March-August ; December-January.

*Distrib.* : KATISHA, TALCHUA : Frequent on the embankments near the mangrove swamps and along the border of the salt marshes. Occasionally found in the cultivated fields.

Haines (1922) and Mooney (1950) have not reported it from Orissa ; hence it is a new record for Orissa.

2. *Heliotropium supiaum* Linn. Sp. Pl. 130, 1753 ; Clarke in Hook. f. Fl. Brit. India 4 : 149, 1883 ; Wt. Ic. t. 1387, 1848 ; Haines 2 : 607, 1922.

Prostrate villose herbs with many spreading branches from woody rootstock ; branches terete, clothed with soft, adpressed hairs. Leaves 1-1.5 × 0.5-0.8 cm, ovate-elliptic, acute at apex, obtuse at base. Flowers 4-5 mm long, white, sub-sessile, in terminal cymes ; cymes villose, 4-6 cm long. Fruits 5-6 mm across, ellipsoid, warted ; seeds : 2-3.

*Fl. & Fr.* : March-April ; May-June.

*Distrib.* : KUJANG : Frequent along the river-banks and sandy scrubs, occasionally found along sandy sea-shores.

3. *Heliotropium marifolium* Retz. Obs. 2 : 8, 1781 ; John. Arn. Arb. 32 : 113, 1951 ; Haines 2 : 579, 1922. *H. scabrum* Retz. Obs. 2 : 8, 1781 ; Clarke in Hook. f. Fl. Brit. India 4 : 152, 1883.

Prostrate, much-branched, scabrid herbs with strong tap root. Leaves 1-3 × 0.1-0.2 cm, narrowly lanceolate, or linear, acute at apex, subsessile at base. Flowers 2-2.5 mm, white, in one to many-flowered, leafy cinnini ; calyx lobes longer than corolla-tubes. Nutlets 4, stiffy pubescent.

*Fl. & Fr.* : Throughout the year.

*Distrib.* FALSE POINT, BAHAKUD : Common in sandy scrubs, dry sandy places along the river-banks and sandy sea-shores, locally common on dry habitat and road-sides.

4. *Heliotropium strigosum* Willd. Sp. Pl. 743, 1798 ; John. Arn. Arb. 112 ; Clarke in Hook. f. Fl. Brit. India. 4 : 151, 1883 ; Mooney 90, 1950.

Strigosely hirsute, much-branched, suffruticose herbs; branches terete, procumbent or ascending from woody root-stock. Leaves 6-8 × 2-3 mm, linear-lanceolate, sub-sessile, recurved margined, acute at apex, obtuse at base. Flowers 2-3 mm long, white, in terminal or axillary branched spikes; spikes usually 3.5-10 cm long. Nutlets subglobose, hirsute, 4-6-seeded.

*Fl. & Fr.* : All through the year.

*Distrib.* : PARADEEP, KUJANG : Common along the river-banks, sandy scrubs, coastal thickets and sandy sea-shores.

5. *Heliotropium indicum* Linn. Sp. Pl. 130, 1753; John. Arn. Arb. 32: 111, 1951; Clarke in Hook. f. Fl. Brit. India. 4 : 152, 1883; Haines 2 : 607, 1922.

Erect annual herbs; stems terete, densely hirsute. Leaves 4-10.5 × 2-5 cm, ovate-lanceolate, scabrous on both surfaces, acute at apex, obliquely attenuate at base. Flowers light-purple, in extra axillary spikes; spikes 10-15 cm long. Fruits deeply bilobed, angular, pointed, 1-seeded.

*Fl. & Fr.* : March-April; May-June.

*Distrib.* : KUJANG : Common along road-sides, moist places and river-banks.

#### 4. TRICHODESMA R. Br.

*Trichodesma indica* R. Br. Prodr. 496, 1810; Clarke in Hook. f. Fl. Brit. India. 4 : 153, 1883; Haines 2 : 608, 1922.

Coarsely hispid. Much-branched, erect herbs. Leaves 4.5-6.5 × 1.5-2.5 cm, elliptic-oblong or linear-oblong, acute or obtuse at apex, cordate at base. Flowers 1-1.2 cm long, bluish-white, in axillary solitary or in terminal few-flowered cymes. Fruits 1-1.5 cm across, pyramidal, coarsely-hispid, 4-ribbed; nutlets ovoid, polished, smooth, and rugose inside.

*Fl. & Fr.* : August-September; October-November.

*Distrib.* : ALIPINGAL-DEVI RIVERS : Frequent along the river-banks, road-sides, and dry places.

#### 5. COLDENIA Linn.

*Coldenia procumbens* Linn. Sp. Pl. 125, 1753; Clarke in Hook. f. Fl. Brit. India 4 : 144, 1883; Haines 2 : 606, 1922.

Densely scabrous, prostrate annuals; branches somewhat compressed, ascending. Leaves 1-4.5 × 0.3-1.5 cm, thick, obovate or ovate-oblong, densely whitish scabrous between the impressed nerves and pilose beneath. Flowers small, white, solitary, extra axillary sessile or shortly pedicellate. Fruits 3 mm across, pyramidal, hairy, separating into 4, 1-seeded pyrenes.

*Fl. & Fr.* : April-May; June-July.

*Distrib.* : KUJANG : Common along roadsides, river-banks, and reclaimed soils near rice-fields or ditches.

## CONVOLVULACEAE

### *Key to Genera*

1a. Parasitic plants	...	CUSCUTA 1
1b. Non-parasitic plants :		
2a. Styles 2, free	...	EVOLVULUS 2
2b. Styles 1 :		
3a. Pollen grains smooth :		
4a. Stigma globose ; ovary 2-loculed	...	MERREMIA 3
4b. Stigma linear ; ovary 4-loculed	...	RIVEA 4
3b. Pollen grains spinulose	...	IPOMOEA 5

### 1. CUSCUTA Linn.

*Cuscuta reflexa* Roxb. Pl. Corom. 2 : 3, t. 104, 1798 ; van Ooststr. in Fl. Mal. 4 : 393, 1953 ; Clarke in Hook. f. Fl. Brit. India 4 : 225, 1884 ; Haines 2 : 635, 1922.

Large, twining herbaceous parasites ; stems yellowish or brown, leafless, attached to the host by means of haustoria. Flowers 1-1.5 cm long, white with red eye within, sessile, in compact cymose clusters ; corolla lobes much shorter, united into a tube at the base ; fringed scales attached below stamens as a whorl. Capsules 1-1.5 cm in diam., ellipsoid or subglobose, pale-brownish, circumscissile at base.

*Fl. & Fr.* : August-September ; October-November.

*Distrib.* : BAHAKUD, TALCHUA : Frequent in sandy scrubs, river banks, mostly parasitic on woody plants ; sometimes spreading as a forest undergrowth.

### 2. EVOLVULUS Linn.

#### *Key to Species*

Creeping herbs ; leaves suborbicular	...	<i>nummularius</i> 1
Ascending herbs ; leaves elliptic-oblong	...	<i>alsinoides</i> 2

1. *Evolvulus nummularius* (Linn.) Linn. Sp. Pl. ed. 2 : 391, 1762 ; Verdcourt in Fl. Trop. E. Africa Convolvulaceae ; 16, 1963 ; van Ooststr. in Fl. Mal. 5 : 558, f. 3, 1958 ; Mooney in Suppl. Bot. Bihar & Orissa 91, 1950. *Convolvulus nummularius* Linn. Sp. Pl. 157, 1753.

Perennial creeping herbs ; stems prostrate, rooting at nodes. Leaves 4-12 × 2.5-10 mm ovate-oblong or suborbicular, entire, glabrous, retuse at apex, cordate at base. Flowers 4-5 mm across, white or yellow, solitary, axillary ; corolla deeply lobed ; capsules 4-5 mm in diam., globose, 1-loculed, 4-seeded ; seeds globose, brown.

*Fl. & Fr.* : May-September.

*Distrib.* : BATIGHAR, JAGATHASINGPUR : Frequent along roadsides, riverbanks, grasslands and sandy waste places near the sea shore.

2. *Evolvulus alsinoides* (Linn.) Linn. Sp. Pl. ed. 2 : 392, 1762 ; Verdcourt (*l.c.*) 18 ; van Ooststr. Fl. Mal. 4 : 396, f. 5, 1953 ; Clarke in Hook. f. Fl. Brit. India 4 : 220, 1883 ; Haines 2 : 614, 1922.

Ascending herbs, sometimes decumbent ; stems usually covered with adpressed silky hairs. Leaves 6-15 × 2-6 mm elliptic-oblong or linear-lanceolate, subsessile, acute at apex, narrowed at base. Flowers 4-5 mm across, blue, rarely white, axillary, solitary ; corolla broadly funnel-shaped ; peduncles 2-2.5 cm long. Capsules 3-4 mm in diam., globose, 2-loculed, 4-valved, 4-seeded ; seeds 4, pale-brown.

*Fl. & Fr.* : July-October.

*Distrib.* : PARADREP : Frequent, along sea shores, river banks, and dry grasslands ; not uncommon along road sides.

### 3. *MERREMIA* Deenst. ex Hallier f.

*Merremia tridentata* (Linn.) Hall. f. in E. J. 16 : 552, 1893 ; Verdcourt in Fl. Trop. E. Africa Conv. 51, 1963 ; Ooststr. in Fl. Mal. 4 : 445, 1953. *Ipomoea tridentata* Roth in Roem. Arch. Bot. 2 : 38, 1798 ; Clarke in Hook. f. Fl. Brit. India 4 : 205, 1883 ; Haines 2 : 625, 1922. *Convolvulus tridentata* Linn. Sp. Pl. 157, 1753.

Prostrate or twining variable perennial herbs ; stems glabrous or hairy, spreading, from woody root-stock. Leaves 4-25 × 2-8 mm variable, linear-lanceolate or oblong, acuminate, emarginate or mucronulate at apex, truncate, or auriculate at base, often lobed and toothed towards base, sometimes basal lobes clasping the stems, sessile or shortly petiolate. Flowers 6-8 mm across, yellow, 1-2-flowered in axillary cymes ; calyx lobes obtuse or acuminate, corolla funnel-shaped. Capsules globose, 4-valved, 4-seeded ; seeds glabrous.

*Fl. & Fr.* : June-September ; October-December.

*Distrib.* : KUJANG, BHITARKANIKA : Common in dry sandy places, scrubs, coastal thickets and sea shore.

#### 4. RIVEA Choisy.

*Rivea hypocrateriformis* Choisy, *Convolv. Orient.* in *Mem. Soc. Phys. Genev.* 6 : 408, 1833 ; Clarke in *Hook. f. Fl. Brit. India* 4 : 184, 1883 ; Haines 2 : 614, 1922.

Annual or perennial large creeping herbs ; stems pubescent, rooting at nodes. Leaves 4-8.5×6-9.5 cm, broadly ovate or suborbicular, glabrous above, soft pubescent beneath, obtuse at apex, cordate or reniform at base. Flowers 3-4 cm long, purple, 1-3-flowered, in axillary cymes ; corolla widely funnel-shaped, with 2-3 cm long tube ; ovary 4-loculed ; stigmas linear ; capsules 1-2 cm in diam., globose, 4-seeded.

*Fl. & Fr.* : June-September ; October.

*Distrib.* : ALIPINGAL : Frequent, along sandy river banks, scrubs and open dry land.

Haines (1922) and Mooney (1950) have reported the occurrence of this species only from Bihar. Present collection of this taxon from alipingal, near Devi river mouth in Orissa is a new distributional record.

#### 5. IPOMOEA Linn.

##### *Key to Species*

- |   |     |                     |
|---|-----|---------------------|
| 1a. Leaves entire ; corolla white                   | ... | <i>tuba</i> 1       |
| 1b. Leaves not entire ; corolla purple or reddish : |     |                     |
| 2a. Leaves bilobed ; corolla reddish-purple         | ... | <i>pes-caprae</i> 2 |
| 2b. Leaves palmately divided ; corolla purple       | ... | <i>mauritiana</i> 3 |

1. *Ipomoea tuba* (Schlechtend) G. Don, in *Gen. Syst.* 4 : 271, 1838 ; Verdcourt in *Fl. Trop. E. Africa Convol* : 137, 1963 ; Ooststr. in *Fl. Mal.* 4 : 487, 1953. *Convolvulus tuba* Schlechtend. *Linnaca* 6 : 735, 1831. *Ipomoea grandiflora* Clarke in *Hook. f. Fl. Brit. India* 4 : 198, 1883, *non* (Linn. f.) Lamk. (1791). *I. glaberrima* Hook. in *Hook. Journ. Bot.* 1 : 357, 1834.

Glabrous, perennial twiners ; stems more or less woody, longitudinally wrinkled, straw-coloured. Leaves 7-14×6-11 cm, broadly ovate or orbicular, entire, cordate at base, acuminate at apex ; petioles 3-12 cm long. Flowers 6-15 cm long, white, axillary, solitary or rarely in 2-flowered cymes ; corolla salver-shaped with 7-8 cm long tube ;

peduncles 4-8 cm long. Fruits 2-3 cm in diam., globose, pale brown; seeds 4, hairy along margins.

*Fl. & Fr.* : June-August ; September-December.

*Distrib.* : GHANAGHOLIA, BAITRAKUD : Common, along the intertidal regions of creeks and channels in the mangroves, usually in association with *Hibiscus tiliaceus* and *Sonneratia apetala*.

Haines (1922) and Mooney (1950) have not reported this species ; hence it is a new record for Orissa.

2. *Ipomoea pes-caprae* (Linn) R. Br. in Tuckey, Narr. Exped. Zaire 477, March 1818 ; Hort. Sub. Lond. 35, July 1818 ; Roth, Nov. Pl. Sp. 109, 1821 ; Verdcourt in Fl. Trop. E. Africa Convol : 121, 1963 ; Ooststr. Fl. Mal. 4 : 475, 1953 ; Haines 2 : 597, 1922. *Convolvulus pes-caprae* Linn. Sp. Pl. 159, 1753. *Ipomoea biloba* Forsk. Fl. Aeg. Arb. 44, 1775 ; Clarke in Hook. f. Fl. Brit. India 4 : 212, 1883.

Glabrous, perennial creepers, often forming tangled mats ; stems much-branched, angular, with milky juice, rooting at nodes. Leaves 2.5-8 x 5-8 cm, kidney-shaped or suborbicular thick, emarginate or shortly 2-lobed at apex, cuneate or cordate at base ; petioles 3-10 cm long, with two apical glands. Flowers 5-7 cm long, pinkish or reddish violet, in 1-few-flowered cymes ; corolla funnel-shaped ; peduncles 3-5 cm long, erect ; capsules 1-1.5 cm in diam., globose, 4-seeded. Seeds brownish, tomentose.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : PARADEEP, HOOKITOLA : Common, along sea shore, often forming pure stands as a pioneer vegetation and act as a sandbinder.

3. *Ipomoea mauritiana* Jacq. Collect. 4 : 216, 1781 ; Verdcourt in Fl. Trop. E. Africa Convol : 135, 1963. *I. digitata* Vaucl. non Linn. Ooststr. Fl. Mal. 4 : 183, 1953 ; Clarke in Hook. f. Fl. Brit. India 4 : 202, 1883 ; Haines 2 : 602, 1922. 'Bhuikumra'.

Glabrous, trailing shrubs with tuberous roots ; stems much-branched, terete, angular. Leaves suborbicular, palmately divided towards middle into 5-7 lobes ; lobes elliptic-lanceolate, acuminate at apex. Flowers 4-8 cm across, campanulate, rose-purple, in axillary 2-8-flowered cymes ; peduncles 3-6 cm long. Capsules 6-8 mm long, ovoid. Seeds 5-6 mm long, woolly hairy.

*Fl. & Fr.* : July-August ; September-October.

*Distrib.* : HETAMUNDIA, BHITARKANIKA : Frequent, on sand bars in between the creeks and channels of the mangroves.

Haines (*J. c.*) recorded it from Bihar ; hence it is a new record for Orissa.



## SOLANACEAE

## Key to Genera

- |  |     |            |
|--|-----|------------|
| 1a. Fruit a smooth berry :                                   |     |            |
| 2a. Anthers longer than filaments ; opening by apical pores  | ... | SOLANUM 1  |
| 2b. Anthers shorter than filaments ; opening by lateral slit | ... | PHYSALIS 2 |
| 1b. Fruit a spiny capsule                                    | ... | DATURA 3   |

## 1. SOLANUM Linn.

## Key to Species

- |   |     |                     |
|---|-----|---------------------|
| 1a. Plants armed with prickles :                    |     |                     |
| 2a. Climbing shrubs                                 | ... | <i>trilobatum</i> 1 |
| 2b. Plants not climbing :                           |     |                     |
| 3a. Decumbent herbs ; leaves pinnately cleft        | ... | <i>surattense</i> 2 |
| 3b. Erect herbs ; leaves ovate, not pinnately cleft | ... | <i>incanum</i> 3    |
| 1b. Plants unarmed                                  | ... | <i>nigrum</i> 4     |

1. *Solanum trilobatum* Linn. Sp. Pl. 188, 1953 ; Sant. J. Bombay nat. Hist. Soc. 47 : 654, 1948 ; Clarke in Hook. f. Fl. Brit. India 4 : 287, 1884 ; Haines 2 : 613, 1922.

Climbing undershrubs, stems slender, cover with recurved prickles. Leaves 2.5-3.5 × 2-2.5 cm, ovate or ovate-elliptic, glabrous or sparsely prickly along mid-veins, irregularly lobed, obtuse at apex, truncate or sub-cordate at base. Flowers violet, leaf-opposed or in extra-axillary racemes. Berries 7-8 mm across, globose, year turn red when ripe.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : BAHAKUD : Frequent along river-banks and sea-shores. Locally common.

2. *Solanum surattense* Burm. f. Fl. Indica 57, 1768 ; Sant. in Bull. Bot. Surv. India 3 : 20, 1962. *S. xanthocarpum* Schrad. & Wendl. Sert. Hanov. 1 : 8, t. 2, 1795 ; Clarke in Hook. f. Fl. Brit. India 4 : 236, 1884 ; Haines 2 : 613, 1922. '*Kanti-kari*'.

Decumbent, much-branched, prickly herbs. Leaves 7-9.5 × 4-5.5 cm, ovate-elliptic, pinnately cleft, prickly along veins, acute at apex, obliquely rounded at base. Flowers 1.5-2 cm across, violet, very rarely white, arranged in lateral racemes. Berries 1-1.5 cm in diam., globose, turn yellow when ripe.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : KUJANG, PARADEEP : Frequent along the river-banks and sandy sea-shores. Locally common in sandy places and reclaimed soils along the road-sides.

3. *Solanum incanum* Linn. Sp. Pl. 188, 1753; Forsk. in Fl. Aeg. Arab. 46, 1775. *S. coagulans* Forsk. l.c. 47; Clarke in Hook. f. Fl. Brit. India 4: 236, 1884, and *S. melongena* P. P. auct. non. Linn. Clark. l.c. 235, 1884.

Erect herbs 30-70 cm tall, armed with recurved prickles. Leaves 4-5.5 × 3-3.5 cm, ovate or elliptic-ovate, puberulose, prickly along veins entire, acute at apex, subtruncate at base. Flowers 1.5-2 cm across, bluish, arranged in lateral racemes. Berries 2-3 cm in diam., globose, yellowish when ripe.

*Fl. & Fr.* : January-April.

*Distrib.* : PARADEEP : Frequent on sandy places and in thickets along the riverbanks and sandy shores.

Haines (1922) and Mooney (1950) have not reported this species from Orissa; hence it is a new record for Orissa.

4. *Solanum nigrum* Linn. Sp. Pl. 186, 1753; Sant. J. Bombay nat. Hist. Soc. 47: 652, 1948; Clarke in Hook. f. Fl. Brit. India 4: 229, 1884; Haines 2: 612, 1922.

Erect, unarmed herbs; stems much-branched, spreading or rarely climbing. Leaves 8-9.5 × 3.5-4.5 cm, ovate-elliptic or ovate-lanceolate, entire or often dentate, puberulent, acute at apex, truncate at base. Flowers white, in lateral umbellate cymes. Berries 8-10 mm across, globose, dark-purple when ripe.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : BAHAKUD, BHITARKANIKA : Frequent along road-side, hedges and waste places.

## 2. *Physalis* Linn.

*Physalis minima* Linn. Sp. Pl. 183, 1753; Sant. 657, 1948; Clarke in Hook. f. Fl. Brit. India 4: 238, 1884; Haines 2: 610, 1922.

Erect herbs, 50-100 cm tall; stems much-branched, spreading sticky-glandular. Leaves 2-8 × 1.5-3.5 cm, ovate-lanceolate, puberulent, irregularly sinuate, acute or acuminate at apex, obliquely rounded at base. Flowers greenish-yellow, or purple, solitary axillary, or often borne on the forks of branches. Berries 8-10 mm across, globose, yellow, turn orange when ripe.

*Fl. & Fr.* : September-March.

*Distrib.* : KUIANG : Frequent in waste places, gardens and cultivated fields.

## 3. DATURA Linn.

*Datura metel* Linn. Sp. Pl. 179, 1753; Sant. 657, 1948; *non sensu* Clarke in Hook. f. Fl. Brit. India 4: 243, 1884; *quae est D. innoxia* Mill. and *D. fastuosa* Linn. Syst. Nat. ed. 10, 962, 1759; Clarke l.c. 242, 1884; Haines 2: 615, 1922. '*Dhutura*'.

Glabrous undershrubs, 1-1.5 m tall; stems much-branched, often purple-coloured. Leaves 10-16 x 8-9 cm, broadly ovate-lanceolate, entire or shallowly lobed, acute at apex, obliquely truncate at base. Flowers 10-15 cm long, white, or white with tinged purple, often violet, solitary axillary. Capsules 3.5-4.5 cm in diam., subglobose covered with blind spine-like tubercles.

*Fl. & Fr.* : Mostly during January-April.

*Distrib* : SATAVYA : Frequent along the sandy sea-shores and river-banks. Locally common along the road-sides and waste places.

## SCROPHULARIACEAE

*Key to Genera*

1a. Leaves alternate	...	VERBASCUM 1
1b. Leaves opposite :		
2a. Calyx ebracteolate :		
3a. Anthers contiguous	...	BACOPA 2
3b. Anthers stipitate	...	LINDERA 3
2b. Calyx bibracteolate :		
4a. Calyx tubular, ribbed	...	STROPA 4
4b. Calyx spatheaceous, cleft on anterior side	...	CENTRANTHERA 5

## VERBASCUM Linn.

*Verbascum chinense* (Linn.) Sant. Fl. Par. 90, 1958. *Scrophularia chinensis* Linn. Mant. 250, 1771. *Celsia coromandeliana* Vahl, Symb. Bot. 3: 79, 1794; Hook. in Hook. f. Fl. Brit. India. 4: 251, 1883; Haines 2; 619, 1922. *Verbascum coromandelicum* (Vahl) O. Kuntze, Rev. Gen. Pl. 1: 468, 1891; Pennell in Acad. nat. Sci. Phil. Monogr. 5: 39, 1943; Sant. J. Bomb. nat. Hist. Soc. 49: 25, 1950; Chatt. & Bhara in Bull. Bot. Soc. Beng. 9: 1955.

Erect pubescent herbs 20-50 cm tall; stems terete, unbranched except towards inflorescence. Radical leaves 8-10 x 3-4 cm, lyrate-pinnatifid, elliptic-oblong, crenate or dentate, glandular, acute or obtuse at apex, narrowed at base; radical leaves gradually reducing to sessile bract-like cauline leaves above. Flowers 10-12 mm across, yellow, in terminal simple or branched, loose racemes; racemes 15-20 cm long.

pubescent. Capsules 4-5 mm across, ovoid, 2-valved, many-seeded; valves often bifid, separating from the axis.

*Fl. & Fr.* : April-June; August-September.

*Distrib.* : KUJANG, PARADEEP : Frequent along sandy river-beds, leeward sea-shore dunes and newly deposited sands in moist places.

Two Linnean genera *Verbascum* (1753) and *Celsia* (1753) are separated mainly on the number of stamens: 5 in the former and 4 in the latter. It was only in 1891, O. Kuntze (*l. c.*) correctly pointed out the artificiality of the delimitations of both the genera and combined *Verbascum* and *Celsia* with the necessary combination under the former. Kuntze's treatment has been followed by Pennell (*l. c.*) and others.

## 2. BACOPA Abul. *nom. cons.*

*Bacopa monnieri* (Linn.) Pennell, in Proc. Acad. nat. Sci. Phil. 98 : 94, 1964; Sant. Fl. Pur. 30, 1958. *Gratiola monniera* Linn. Syst. ed. 10 : 851, 1759. *Herpestis monniera* (Linn.) H.B.K., Nov. Gen. et Sp. Pl. 2 : 366, 1818; Hook. in Hook. f. Fl. Brit. India 4 : 272, 1884; Haines 2 : 622, 1922. *Bacopa monniera* (Linn.) Wettst. in Engl. & Prant. Pfam. 4(3b) : 77, 1891. 'Brahmi'.

Creeping or often floating herbs; stems succulent, solid, with many air-ducts rooting at nodes. Leaves 3-16 x 2-4 mm, subsessile, obovate, or oblong-spathulate, obtuse or rounded at apex, cuneate at base. Flowers pale-blue or whitish-blue, solitary axillary; pedicels 10-20 mm long; calyx lobes unequal. Capsules ovoid, septicidally dehiscent, 2-loculed; seeds ribbed.

*Fl. & Fr.* : Throughout the greater part of the year.

*Distrib.* : FALSE POINT, KUJANG : Frequent in moist and swamp places around cultivated fields, along the edges of sandy ditches and sandy-slaks, often found forming dense mat near the sandy shores.

Linnacus in 1759, proposed the specific name as *Monniera*, instead of retaining the generic ending. Pennell in 1935, first restored the original generic ending as *Monnieri*, but under the provision of code, orthographic error does not warrant the citation of the name of an author other than one who first published its name.

## 3. LINDERNIA All.

Delimitation of the four genera-*Vandellia* Linn., *Ilysanthes* Raf., *Bonnaya* Link & Otto, and *Lindernia* All. have been variously treated in the past basing upon the androecial structure; in *Lindernia*

and *Vandellia* the stamens being 4, whilst in *Ilysanthes* and *Bonnaya*, they are 2, with the anterior pair reduced to staminodes. Pennell (Acad. nat. Sci. Phil. Monogr. 1:137, 1935 & seq.) considered the treatments as too weak and artificial and thereby reduced *Vandellia*, *Bonnaya* and *Ilysanthes* to *Lindernia*, and Pennell's treatment has been followed in subsequent monographic work.

*Key to Species*

- |  |     |                    |
|--|-----|--------------------|
| 1a. Stamens 4, all perfect                   | ... | <i>crustacea</i> 1 |
| 1b. Stamens only 2-perfect, others imperfect | ... | <i>antipoda</i> 2  |

1. *Lindernia crustacea* (Linn.) F. V. Muell. Syst. Cens. Aust. Pl. 1:97, 1882; Pennell, Monogr. 5:29, 1943; Phicox in Kew Bull. 22:17, 1968. *Vandellia crustacea* (Linn.) Benth. Scroph. India 35, 1835; Hook. in Hook. f. Fl. Brit. India 4:279, 1884; Haines 2:631, 1922.

Partly decumbent, glabrous, low annual herbs; stems quadrangular, diffused, often rooting from nodes. Leaves 0.5-3×0.2-1.6 cm, decussate, elliptic or ovate-elliptic, bluntly serrate, obtuse at apex, rounded at base. Flowers 8-12 mm long, purple or whitish-purple, solitary axillary or in terminal racemes; pedicels 2-3 cm long; corolla 10-12 mm long; stamens 4; anthers stipitate. Capsules 4-5 mm long; corolla 2-valved, ovoid; seeds minute, alveolate.

*Fl. & Fr.*: July-August; September-October.

*Distrib.*: KIJANG, PARADEEP: Frequent along sandy river-banks, ditches within the mangroves, moist low-lying areas and lawns.

2. *Lindernia antipoda* (Linn.) Alston in Trim. Handb. Fl. Ceyl. 6, Suppl. 214, 1931; Philocox, 22:57, 1968. *Ruellia antipoda* Linn. Sp. Pl. 635, 1753. *Bonnaya veronicaefolia* (Retz.) Spreng. Syst. Veg. 1:41, 1824; Hook. in Hook. f. Fl. Brit. India 4:285, 1884. *Vandellia veronicaefolia* (Retz.) Haines 2:633, 1922.

Annual decumbent herbs; stems quadrangular, slender, much-branched, rooting from nodes. Leaves 0.8-3.2×0.5-0.8 cm, sessile, ovate-elliptic, or oblong-lanceolate, serrate or dentate, acute or obtuse at apex, narrowed at base. Flowers 5-6 mm long, pinkish or bluish-white, in axillary or terminal leafy racemes; posterior stamens 2, fertile; anterior stamens reduced to staminodes. Capsules 5-12 mm long, cylindrical; seeds many.

*Fl. & Fr.* : July-August ; September-October.

*Distrib.* : KUJANG ; Frequent around ditches and sandy river-banks, locally abundant.

### 3. CENTRANTHERA R. Br.

*Centranthera tranquebarica* (Spreng.) Merr. in Trans. Amer. Phil. Soc. N. S. 24 (2) : 1935. *Razumovia tranquebarica* Spreng. Syst. Vege. 2 : 812, 1825. *Centranthera humifusa* Wall. ex Benth. in DC. Prodr. 10 : 525, Hook. in Hook. f. Fl. Brit. India 4 : 301 ; Haines 2 : 638, 1922.

Erect, glabrous or hispid annuals with orange-coloured roots ; stems angular, branched from the base. Leaves 2.5-4 cm, upper ones ovate, or ovate-oblong, glabrous ; lower ones linear-lanceolate, glabrous or slightly hairy along margins, subsessile at base. Flowers up to 1.2 cm long, yellow with purple tinge inside, in axillary leafy, bracteate spikes. Capsules 3-4 mm across, subglobose, loculicidally 2-valved, many-seeded.

*Fl. & Fr.* : July-August : September-October.

*Distrib.* : BHITARKANIKA, HETAMUNDIA : Common in dry sandy places near the sea-shores and river-banks. Occasional along back mangroves on sand-bars.

### 4. STRIGA Lour.

*Striga asiatica* (Linn.) O. K. Rev. Gen. Pl. et Sp. Pl. 466, 1891 ; Sant. Rec. bot. Surv. India 16 (1) : 163, 1960. *Buchnera asiatica* Linn. Sp. Pl. 630, 1753. *Striga lutea* Lour. in Fl. Coch. 22, 1790 ; Hook. in Hook. f. Fl. Brit. India 4 : 299, 1884 ; Haines 2 : 641, 1922.

Erect, slender, scabrid herbs 15-50 cm tall ; stems simple, often branched. Leaves 2-3 cm long, linear, hispid, upper one transformed into bracts. Flowers 1.5-2 cm long, yellow, often reddish inside, in terminal spikes ; calyx bibracteolate at base, tube with 10-12 longitudinal ribs ; stamens 4, included, didynamous. Capsules 1-1.5 cm long, oblong, loculicidally 2-valved ; valves entire.

*Fl. & Fr.* : August-September ; October-November.

*Distrib.* : HETAMUNDIA, KUJANG, PARADEEP : Frequent on waste humas along sandy sea-shores, grass-fields, river-banks and road-sides.

## LENTIBULARIACEAE

## UTRICULARIA Linn.

*Key to Species*

- 1a. Aquatic herbs ; leaves divided into capillary segments :
- 2a. Float-leaves present at the base of the scape ... *stellaris* 1
- 2b. Float-leaves absent :
- 3a. Leaves only 2-3 times forked ; segments not setulose ; peduncles and pedicels very slender ; seeds lenticular with broad irregular wings ... *gibba* ssp. *exoleta* 2
- 3b. Leaves repeatedly forked into many segments ; segments setulose ; peduncles and pedicels stout ; seeds polygonal with narrow entire wings ... *aurea* 3
- 1b. Terrestrial herbs ; leaves entire :
- 4a. Flowers distinctly pedicellate :
- 5a. Scapes erect, more or less stout :
- 6a. Pedicels recurved in fruit ; flowers purple ; spurs straight ; seeds obovoid, striated and scrobiculate ... *polygaloides* 4
- 6b. Pedicels not recurved in fruit ; flowers bluish ; spurs curved ; seeds ovoid, reticulate with elongated areoles ... *graminifolia* 5
- 5b. Scapes twining, filiform ... *scandens* 6
- 4b. Flowers sessile :
- 7a. Scales and bracts semi-fixed ; scapes 10-30 cm long, not coloured... *caerulea* 7
- 7b. Scales and bracts attached by their base ; scapes 4-6 cm tall, usually coloured ... *minutissima* 8

1. *Utricularia stellaris* Linn. f. Suppl. 86, 1781 ; Taylor in Bull. Jard. Bot. Nat. Belg. 41 : 2717 cm ; Subramanyam in Aqua. Ang. 33, f. 23, 1962 ; Clarke in Hook. f. Fl. Brit. India 4 : 328, 1884 ; Haines 2 : 644, 1922. *U. inflexa* Forsk. var. *stellaris* (Linn. f.) Taylor in Kew Bull. 18 : 189, f. 6-11, 1964.

Aquatic free floating herbs ; stolons slender, glabrous. Leaves usually auricled at base, digitately divided into many capillary segments ; primary segments 2-4 cm long, pinnately divided ; pinnac repeatedly forked, ultimately setulose ; leaf-auricles present, usually divided into linear ciliate segments ; float-leaves 4-6, ellipsoid, arranged in whorls at the base of scape ; traps 1-2 mm long, many, ovoid, attached near the base of leaf-segments. Flowers 5-8 mm across, yellow, 3-8-flowered,

racemose arranged on emerged scapes; scapes 6-12 cm long, erect; bracts basifixed bracteoles absent; calyx lobes ovate, subequal; corolla marked with reddish-brown lines; lower lips 5-8 × 6-8.5 mm, orbicular; spur 6-7 mm long, conical. Capsules 3-4 mm in diam., globose; seeds tubular-prismatic, testa elongated.

*Fl. & Fr.* : July-August; September-October.

*Distrib.* : PARADEEP, KUIANG : Frequent in sandy slacks along the coast; common in tanks and ditches.

2. *Utricularia gibba* Linn. ssp. *exoleta* (R. Br.) Taylor, Kew Bull. 18: 204, 1964. *U. exoleta* R. Br. Prodr. 430, 1810; Clarke in Hook. f. Fl. Brit. India 4: 329, 1884; Haines 2: 645, 1922.

Aquatic herbs; stolons 10-15 cm long, filiform, branched. Leaves 10-15 mm long capillary, simple or 2-3 times forked into small capillary segments; ultimate segments not setulose; traps 1-1.5 mm long, many, ellipsoid, attached to the base of leaf-segments. Flowers 2-4 mm across, yellow, in a 4-flowered racemes; scape 6-8 cm long, erect, slender; scales usually one, basifixed, similar to bracts; bracts 1-2 × 1-1.5 mm semi-orbicular; calyx-lobes 2-3 × 1-2 mm, ovate, subequal; corolla broadly ovate-orbicular; upper-lips 4-8 × 3-4 mm, lower-lips narrower than upper ones; spur 4-5 mm long, cylindrical. Capsules 4-5 mm in diam., globose; seeds lenticular, surrounded by crenulate corky wing.

*Fl. & Fr.* : August-September; October-December.

*Distrib.* : SATAVYA, PARADEEP : Frequent in tanks and ditches, not uncommon in the rice-fields along riverbanks.

Ramamoorthy, T. P. (1976) on Podostemaceae (p. 564) in Flora of Hassan District, Karnataka, India ed. Saldanha C. J. & D. H. Nicolson (1976) states "Mr. P. Taylor in his personal communication informs us that he now intends to reinstate *U. gibba* ssp. *exoleta* as a distinct species".

3. *Utricularia aurea* Lour. Fl. Cochinch. 26, 1790. Merr. Trans. Amer. Phil. Soc. Philad. n.s. 24: 356, 1935. *U. flexosa* Vahl. Enum. 1: 198, 1804; Subramanyam in Aqua. Ang. 33, f. 24, 1962; Clarke in Hook. f. Fl. Brit. India 4: 329, 1884; Haines 2: 644, 1922.

Submerged floating herbs; stolons often branched. Leaves 3-6.5 cm long, usually in whorls of 4-rays; each ray repeatedly forked into many capillary segments; ultimate segments setulose, traps 1-1.5 mm long, globose, many, attached near the base of leaf-segments. Flowers 4-8 mm across, yellow, in 3-8 flowered racemes; scapes 8-16 cm long, erect; calyx-lobes 4-6 mm long, ovate-oblong, obtuse; lower lip of corolla 5-9 × 6-9.5 mm orbicular; spur 4-6 mm long, conical,



straight. Capsules 5-6 mm in diam., globose ; seeds fabulus prismatic, polygonal with narrow entire wings.

*Fl. & Fr.* : August-September ; October-November.

*Distrib.* : FALSE POINT, PARADEEP : Frequent in ditches, tanks and rice-fields.

Whorls of leaf-rachises sometimes inflated to serve as floats ; float-leaves absent.

4. *Utricularia polygaloides* Edgeworth Proc. Linn. Soc. 1 : 351, 1847 ; Basak, Taxon 25 : 189, 1976. *U. reticulata* Smith var. *uliginosa* Koenig ex Oliver in J. Linn. Soc. 3 : 180, 1859 ; *U. reticulata* Smith var. *uliginosa* Clarke in Hook. f. Fl. Brit. India 4 : 331, 1884 ; *pp* (excluding syn. *U. uliginosa* Vahl, 1804) ; *U. stricticaulis* (Koenig ex Oliver) stapf ex Gamble, Fl. Madras Presi. 981, 1924 ; *U. stricticaulis* (Koenig ex Oliver) Stapf in Herb. Kew ; *U. caerulea* var. *stricticaulis* Koenig in Herb. Brit. Mus. ; *U. humilis* Wt. Ic., t. 1572, 1850 (non Vahl, 1804.).

Terrestrial herbs ; roots numerous, in fascicles at base of scape. Leaves 6-8 × 1-2 mm, transparent, linear-oblong or spatulate, rounded at apex, tapering towards filiform petioles, usually rosulate at the base of scape and scattered along stolons ; traps 3-4 mm long, many oval, ecentrically attached on stolons and petioles. Flowers 6-8 mm across, purple, in 6-8-flowered racemes ; pedicels 2-4 mm long, recurved in fruit ; scapes 6-10 cm long, stout ; scales 1-2 mm long ovate, basifixed ; bracts similar to scale ; upper lip of corolla 2-3 mm broad, obovate ; lower lip of corolla 5-8 mm broad, suborbicular ; spurs 1.5-2 mm long, straight, conical. Capsules 2-3 mm in diam., ellipsoid, enclosed within the enlarged calyx-lobes. Seeds obovoid, testa finely straited, scrobiculate.

*Fl. & Fr.* : August-September ; October-November.

*Distrib.* : SATAVYA, PURI : Common on moist sandy places and edges of sandy slacks along the coast ; sometimes common under the *Casuarina* plantation.

Occurrence of this species from Orissa has not been recorded by Haines in Bot. Bihar & Orissa (1922) and Mooney in Suppl. Bot. Bihar & Orissa (1950) ; hence it is a new record for Orissa.

5. *Utricularia graminifolia* Vahl, Enum. 1 : 195, 1895. *U. caerulea* (non Linn.) ; Clarke in Hook. f. Fl. Brit. India 4 : 331, 1884. *U. uliginoides* Wt. Ic. t. 1573, 1850.

Terrestrial herbs with numerous roots from the base of scape. Leaves 8-12 mm long, linear, scattered on stolons and from base of scape.

Flowers 5-8 mm long, bluish-purple, 4-9-flowered racemes; scapes 8-15 cm long, slender, erect; pedicels 8-10 mm long, not recurved in fruit; scales 1-2 mm long, ovate, basifixed; calyx-lobes 4-5 × 1-2 mm ovate-acute; lower-lip of corolla 3-4 mm broad, suborbicular, reticulate; spur 4-5 mm long, narrowly curved. Capsules 1-2 mm in diam., globose, smooth; seeds ellipsoid; testa reticulate with elongated areoles.

*Fl. & Fr.* : August-September; October-November.

*Distrib.* : CHANDBALI, KONARAK : Frequent on moist humus along the lee side of sea-shore; sometimes edges of small ditches along road-side.

Haines in Bot. Bihar & Orissa (1922), Mooney in Suppl. Bot. Bihar & Orissa (1950) have not recorded this species from Orissa; hence it is a new record for Orissa.

6. *Utricularia scandens* Benj. in *Linnaea* 20 : 309, 1874; Abrah. & Subram. in *Proc. Indian Acad. Sci.* 62 : 98, 1965. *U. walllichiana* Wt. Ic. t. 1572, 1850; Clarke in *Hook. f. Fl. Brit. India* 4 : 332, 1884; Haines 2 : 646, 1922.

Terrestrial herbs. Leaves 3-4 mm long, linear or spatulate, scattered on stolons and at the base of scape; traps many borne on stolons, small. Flowers 2-3 mm long, yellow, in 4-6-flowered racemes; scapes slender, twining, 5-10 cm long; scales less than 1.00 mm long, basifixed; calyx-lobes 2-2.5 mm long, ovate, acute; lower lip of corolla 2-3 mm broad, orbicular; spur 1.5-2 mm long, subulate, slightly curved upwards. Capsules 2-2.5 mm in diam., subglobose; seeds ellipsoid; testa reticulate.

*Fl. & Fr.* : August-October.

*Distrib.* : SATAVYA : Frequent in moist sandy areas and along road-side humus.

7. *Utricularia caerulea* Linn. *Sp. Pl.* 18, 1753; Abrah. & Subram. (*l. c.*) 98; Haines 2 : 645, 1922. *U. racemosa* Wall. *Cal.* 1496, ex *D. C. Prodr.* 8 : 21, 1836; Clarke in *Hook. f. Fl. Brit. India* 4 : 333, 1884. *U. nivea* Vahl, *Enum.* 1 : 203, 1805; Wt. Ic. t. 1582, 1850.

Terrestrial herbs; roots numerous, fasciculated at the base of scapes. Leaves 8-15 mm long, linear-spatulate. Traps 2-3 mm across, globose, borne on petioles and stolons. Flowers 4-5 mm long, purple, 4-8-flowered in sessile or subsessile racemes; scapes 10-25 cm long, erect, simple or branched; scales few, medifixed, similar to bracts; bracts 5-6 mm long, attached to the middle, oblong-lanceolate or ovate-acute; calyx-lobes 3-4 mm long, ovate; lower lip of corolla 3-4 mm broad, ovate-orbicular; spur 4-6 mm long, narrowly conical,

straight. Capsules 1-2 mm in diam., globose; seeds ovoid; testa reticulate.

*Fl. & Fr.* : September-October; November.

*Distrib.* : KONARAK, BALUKHAND : Frequent in paddy fields, moist sandy places and road-side humus.

8. *Utricularia minutissima* Vahl, Enum. 1: 204, 1804; Clarke in Hook. f. Fl. Brit. India 4: 334, 1884 (Under imperfectly known species); Abraham, V. in J. Bombay nat. Hist. Soc. 63 (2): 459-460, 1967.

Minute terrestrial herbs with many roots. Leaves 2-3 mm long, linear or linear-spathulate; traps 1-2 mm across, subglobose, attached on stolons or on petioles. Flowers 2-3 mm long, bluish-purple, 2-6 flowered racemes; scapes 2-4 cm long, brownish, often branched; scales similar to bracts; bracts 1-2 mm long, ovate-acute, basifixed; calyx-lobes 2-2.5 mm long, obtuse; lower lip of corolla 3-3.5 mm broad, suborbicular; spur 1.5-2 mm long, narrowly conical, obtuse at apex. Capsules 1-2 mm across, globose; seeds minute, reticulate.

*Fl. & Fr.* : September-October; November.

*Distrib.* : SATAVYA : Common on sandy slacks and moist sandy places along sea-shore; sometimes common under *Casuarina* plantation.

## PEDALIACEAE

### Key to Genera

- |   |     |            |
|---|-----|------------|
| 1a. Flowers axillary-solitary; fruits indehiscent with 4-spines on the margin | ... | PEDALIUM 1 |
| 1b. Flowers racemose; fruits dehiscent, not with spines                       | ... | MARTYNIA 2 |

### 1. PEDALIUM Linn.

*Pedaliem murex* Linn. Syst. Nat. ed. 10: 1123, 1759; Clarke in Hook. f. Fl. Brit. India 4: 386, 1884; Wt. Ic., t. 1615, 1840; Haines 2: 661, 1922. 'Gohkure'.

Erect or ascending annuals with yellow-coloured roots; stems branched, glabrous, gland-dotted, ascending or decumbent. Leaves 3-4.5 x 1.5-2 cm, broadly ovate, or ovate-oblong, shallowly sinuated, glabrous above, minutely scaled below, truncate at apex, cuneate at base. Flowers 1.5-1.8 cm long, yellow, in axillary solitary. Fruits ovoid-tetragonal, hard, woody, with 4-sharp spines from the marginal angles; seeds 2 - in each cell, superposed, pendulous.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : FALSE POINT, PARADEEP : Common along sandy shores, dry sandy places and scrubs along the river-banks.

## 2. MARTYNIA Linn.

*Martynia annua* Linn. Sp. Pl. 618, 1753. *M. diandra* Glox. Obs. Bot. 14, t. 1, 1785 ; Haines 2 : 662, 1922. '*Bilatisarsar*'.

Erect herbs or undershrubs 50-150 cm tall, densely and viscidly covered with patent glandular hairs. Leaves 10-25 × 12-26 cm, broadly ovate, or ovate-orbicular, sinuate-dentate, cordate at base, triangular at apex. Flowers 5-7 cm long, purple, drooping in terminal racemes. Drupes 1-2 cm across, green, ovoid, hispid, beaked at apex.

*Fl. & Fr.* : July-August ; September-October.

*Distrib.* : PARADEEP : Frequent in waste places along the lee-side of the sea-shore dunes, occasionally seen in the soil of old buildings and along road-sides.

## ACANTHACEAE

### Key to Genera

- |  |     |                |
|--|-----|----------------|
| 1a. Leaves coriaceous, toothed with spines       | ... | ACANTHUS 1     |
| 1b. Leaves not as above :                        |     |                |
| 2a. Anthers pubescent throughout their length    | ... | ANDROGRAPHIS 2 |
| 2b. Anthers not pubescent :                      |     |                |
| 3a. Placenta separating elastically from capsule | ... | RUNGIA 3       |
| 3b. Placenta not elastically separating          | ... | JUSTICIA 4     |

## 1. ACANTHUS Linn.

*Acanthus ilicifolius* Linn. Sp. Pl. 639, 1753 ; Bremck. in Dansk. Bot. Arkiv. 20 : 64, 1961 ; Clarke in Hook, f. Fl. Brit. India 4 : 481, 1884 ; Haines 2 : 703, 1922. '*Harakanch*'.

Erect, ascending or scandent, thistly herbs or undershrubs, 0.5-2 m tall ; stems terete, often provided with aerial roots, glabrous, except with two sharp spines in leaf axils. Leaves 5-11 × 3-10 cm, decussate, ovate-oblong, or lanceolate, coriaceous, spiny, narrowed at base, spiny at apex. Flowers 3.5-4 cm long, violet, pubescent within, arranged in terminal spikes ; spikes simple or branched 5-20 cm long ; bracts caducous, at or before anthesis ; bracteoles 3-4 mm long, subtending the calyx. Capsules 2-3 cm in diam., ovoid-oblong, compressed, apiculate, shining green or brown ; seeds reniform.

*Fl. & Fr.* : April-June ; September-December.

*Distrib.* : FALSE POINT, JAMBU, BHITARKANIKA : More or less common in and around the mangroves along the banks of creeks and channels. Sometimes found gregarious along the banks of fresh-water rivers. Usually shows a capacity for tolerating various ecological parameters.

## 2. ANDROGRAPHIS Nees

*Andrographis paniculata* (Brum. f.) Wall. ex Nees in Wall Pl. As. Rar. 3 : 116, 1832 ; Bremek. Dansk Bot. Arkiv. 20 : 75, 1961 ; Clarke in Hook. f. Fl. Brit. India 4 : 501, 1884 ; Haines 2 : 699, 1922. *Justicia paniculata* Burm. f. Fl. 9, 1768. 'Kalmeg'.

Much-branched, erect or often creeping perennial herbs, sometimes rooting at nodes ; stems quadrangular, grooved, swollen at nodes. Leaves 3-7 × 0.5-2 cm, subsessile, elliptic-oblong or lanceolate, glabrous, acute at apex, attenuate at base. Flowers 8-10 mm long, pubescent, white with purple and violet tinge inside, laxly arranged in axillary or terminal simple or branched racemes. Capsules 1-2.4 cm long, ellipsoid, longitudinally furrowed, pointed towards apex ; valves with 2-6 seeds.

*Fl. & Fr.* : January-March.

*Distrib.* : PARADEEP, FALSE POINT : Rare, along the sea-shores, river-banks and scrub-forests. Locally common along road-sides and cultivated fields.

## 3. RUNGIA Nees

*Rungia pectinata* (Linn.) Nees in DC. Prodr. 11 : 469, 1847 ; Sant. in Univ. Bombay bot. Mem. 2 : 77, 1951. *Justicia pectinata* Linn. Amoe. Acad. 4 : 299, 1759. *Rungia parviflora* Nees var. *pectinata* (Linn.) Clarke in Hook. f. Fl. Brit. India 4 : 550, 1884 ; Haines 2 : 960, 1924.

Much-branched, diffuse or often erect herbs ; stems quadrangular, puberulent, sometimes rooting at lower nodes. Leaves 0.6-4.5 × 0.3-2 cm, elliptic or elliptic-oblong, densely furunculate, entire, acute at apex, rounded at base. Flowers 4-5 mm long, bluish, subsessile, in axillary or terminal spikes ; bracts dimorphic with hyaline margins. Capsules 3 mm long, oval, shortly acuminate ; seeds discoid, compressed.

*Fl. & Fr.* : November-December ; January-March.

*Distrib.* : KUJANG, FALSE POINT : Frequent in sandy waste places near the coast, locally common in fields and along road-sides.

4. JUSTICIA Linn. (*sensu lato*)

*Justicia prostrata* (Cl.) Gamble, Fl. Pres. Mad. 2 : 108, 1924 ; Sant. Univ. Bombay bot. Mem. 2 : 88, 1951. *J. diffusa* Linn. var. *prostrata* Clarke in Hook. f. Fl. Brit. India 4 : 538, 1884 ; Haines 2 : 693, 1922.

Diffuse, creeping herbs with quadrangular, puberulous stems. Leaves 3-20 × 2-12 mm, ovate-oblong or elliptic, glabrous, or minutely pubescent, obtuse at apex, rounded at base. Flowers 5-6 mm long, purple, in terminal spikes ; bracts and bracteoles puberulous, ciliate along hyaline margins. Capsules 3 mm across, ellipsoid ; seeds suborbicular, curved.

*Fl. & Fr.* : March-April ; May-July.

*Distrib.* : KUJANG, PARADEEP : Frequent along sea-shores in waste places, locally common along road-sides, and grass-fields.

Recently Bremekamp (Dansk Bot. Arkiv 1961) restored the genus *Rostellularia* Reichb. and *Gendarissa* Nees as distinct genera but both these genera have been treated as a section of *Justicia* Linn. *sensu lato*, by several earlier authors and this is followed here.

VERBENACEAE

*Key to Genera*

- |  |     |                |
|--|-----|----------------|
| 1a. Flowers in spikes ; actinomorphic :              |     |                |
| 2a. Trailing herbs, rooting at nodes                 | ... | PHYLA 1        |
| 2b. Erect herbs or undershrubs, not rooting at nodes | ... | LIPPIA 2       |
| 1b. Flowers not in spikes ; zygomorphic :            |     |                |
| 3a. Leaves digitately compound                       | ... | VITEX 3        |
| 3b. Leaves simple :                                  |     |                |
| 4a. Drupes ovoid, 4-lobed, breaking into 4-pyrenes   | ... | CLERODENDRUM 4 |
| 4b. Drupes globose, 1-lobed with 1-pyrene            | ... | PREMNA 5       |

1. PHYLA Lour

*Phyla nodiflora* (Linn.) Green in Pitto' 4 : 46, 1899 ; Moldenke in Phytologia 4 : 296, 1939. *Lippia nodiflora* (Linn.) A. Rich. in Michx. Fl. Bor. Amer. 2 : 15, 1803 ; Clarke in Hook. f. Fl. Brit. India 4 : 563, 1885 ; Haines 2 : 706, 1922. *Verbena nodiflora* Linn. Sp. Pl. 20, 1753.

Creeping perennial herbs with long tap root ; stems quadrangular, sparsely adpressed-pubescent, rooting at nodes. Leaves 2.5-3 × 1.5-2 cm sessile, obovate, serrate above the middle, obtuse at apex, narrowed at base. Flowers 2-3 mm long, white turning purple, in axillary spicate heads. Fruits 1.5 mm long, breaking into 2-pyrenes.

*Fl. & Fr.* : May-June ; July-August.

*Distrib.* : PARADEEP : Frequent on moist sandy places forming dense mats along the sea-shore ; locally common on reclaimed soil.

## 2. LIPPIA Linn.

*Lippia alba* (Mill.) N. E. Br. ex Britton & Wilson in Sc. Porto Rico 6 : 141, 1925 ; Moldenke in Phytologia 12 : 48, 1965. *Lantana alba* Mill. Gard. Dic. ed. 8, 1768. *Lippia geminata* H. B. & K. Nov. Gen. 2 : 266, 1818 ; Clarke, in Hook. f. Fl. Brit. India 4 : 563, 1885 ; Haines 2 : 706, 1922.

Erect, aromatic shrubs up to 2 m tall ; stems loosely branched, puberulous, quadrangular. Leaves 7.5-9 × 3-4 cm decussate opposite, acute at apex, narrowed at base. Flowers 5-6 mm long, pink or white, in axillary capitate spikes. Drupes 1.5 mm across, subglobose, separating into 2-pyrenes.

*Fl. & Fr.* : April-May ; June-July.

*Distrib.* : KUJANG, CHANDBALI : Frequent in low-lying areas and waste places specially along the border of tanks and ditches.

## 3. VITEX Linn.

*Vitex negundo* Linn. Sp. Pl. 638, 1753 ; Clarke, in Hook. f. Fl. Brit. India 4 : 583, 1885 ; Haines 2 : 711, 1922. '*Nirgundi*'.

Shrubs or small trees 2-4 m tall ; branches densely tomentose when young. Leaves decussate opposite, aromatic, 3-5-foliolate ; leaflets 5.5-7 × 1.5-2 cm, lanceolate, dark-green above, silvery hairy beneath, acuminate at apex, narrowed at base. Flowers 4-5 mm long, violet, pubescent within, arranged in axillary or terminal panicles. Drupes 3-4 mm across, ovoid, 4-seeded.

*Fl. & Fr.* : April-May ; June-July.

*Distrib.* : BATIGHAR, KUJANG : Frequent along the river-banks and road-sides, locally cultivated.

## 4. CLERODENDRUM Linn.

### Key to Species

- |  |     |                   |
|--|-----|-------------------|
| 1a. Straggling shrubs ; calyx minutely toothed         | ... | <i>toernse</i> 1  |
| 1b. Erect undershrubs or shrubs ; calyx deeply lobed : |     |                   |
| 2a. Leaves glabrous, linear lanceolate                 | ... | <i>indicum</i> 2  |
| 2b. Leaves tomentose, broadly ovate                    | ... | <i>petrales</i> 3 |

1. *Clerodendrum inerme* (Linn.) Gaertn. Fruct. 1 : 271, t. 75, 1788 ; Lam & Bakh. in Bull. Jard. Buitenz. 3 : 77, 1942 ; Cl. in Hook. f. Fl. Brit. India 4 : 589, 1885 ; Haines 2 : 720, 1922. *Volkameria inermis* Linn. Sp. Pl. 637, 1753.

Straggling, much-branched shrubs 1-3 m tall ; branches adpressed pubescent when young. Leaves 1.5-6 × 1-3 cm, ovate-elliptic, or oblong-lanceolate, glabrous, obtuse or shallowly retuse at apex, narrowed at base. Flowers 3-3.5 cm long, tubular, white, in terminal or axillary, 3-flowered pedunculate cymes ; calyx lobes minutely toothed. Drupes 1.5-2 cm long, obovoid, 4-lobed, breaking into 4-pyrenes.

*Fl. & Fr.* : April-May ; June-July.

*Distrib.* : MAHANADI DELTA : Common along the intertidal zones of creeks and channels, sporadic towards back mangroves.

2. *Clerodendrum indicum* (Linn.) O. Kuntze, Rev. Gen. et Sp. Pl. 506, 1891 ; Lam & Bakh. (*l.c.*) 85. *Siphonanthus indica* Linn. Sp. Pl. 109, 1753. *C. siphonanthus* R. Br. in Ait. f. Hort. Kew 4 : 65, 1812 ; Cl. in Hook. f. Fl. Brit. India 4 : 595, 1885 ; Haines 2 : 722, 1922.

Erect, perennial shrubs, 1-3 m tall ; stems sparingly branched, glabrous, fistular with subterraneous stolons. Leaves 4-18 × 1-3 cm, usually in whorls of 3, linear-lanceolate, subcoriaceous, acute at apex, tapering towards base. Flowers 6-10 cm long, slender, white in axillary pedunculate cymes. Drupes 16 mm across, lobed, pyrenes 4.

*Fl. & Fr.* May-June ; July-August.

*Distrib.* : BATIGHAR : Frequent along the embankments and borders of low-lying areas ; locally cultivated.

3. *Clerodendrum petasites* (Lour.) Moore in J. Bot. 63 : 285, 1925 ; Meuse in Blumea 5 : 76, 1942. *Volkameria petasites* Lour. in Fl. Cochinch. 2 : 388, 1790. *Clerodendrum infortunatum auct. non* Linn. Cl. in Hook. f. Fl. Brit. India 4 : 594, 1885 ; Haines 2 : 723, 1922.

Erect perennial undershrubs or shrubs ; stems pithy, quadrangular, sulcate, tomentose when young. Leaves 15-20 × 10-12 cm, broadly ovate, or ovate-lanceolate, serrate or dentate, adpressed-pubescent above, tomentose below, acute at apex, cordate at base. Flowers 2-2.5 cm long, white, tinged purple, in axillary pedunculate cymes converging into terminal panicles. Drupes 6-10 mm across, globose.

*Fl. & Fr.* : February-March ; April-May.

*Distrib.* : FALSE POINT : Rare, along the river-sides and road-sides.



## 5. PREMNA Linn.

*Premna corymbosa* (Burm. f.) Rottl. & Willd. in Ges. Nat. Fr. Neusch. 4 : 87, 1803 ; Meuse in Blumea 5 (1) : 72, 1942 ; Clarke in Hook. f. Fl. Brit. India 4 : 573, 1885. *Cornutia corymbosa* Burm. f. Fl. Ind. 132, t. 141, f. 1, 1768. *Premna integrifolia* Linn. Mant. 2 : 252, 1771 ; Haines 2 : 715, 1922. *P. integrifolia* Linn. var. *angustior* Cl. in Hook. f. Fl. Brit. India 4 : 572, 1885.

Shrubs or small trees, 2-10 m tall ; stems glabrous, lenticellate ; branches smooth, aromatic. Leaves very variable 1.5-9 × 1-5.5 cm, oblong or ovate-oblong, glabrous or puberulous, minutely serrate, acute at apex, rounded or cuneate at base. Flowers 1-1.5 mm across, campanulate, white pubescent, in axillary or terminal corymbs. Drupes 5 mm in diam., globose, fleshy, black and wrinkled when dry ; pyrene one, tubercled.

*Fl. & Fr.* : April-May ; June-July.

*Distrib* : FALSE POINT, BHITARKANIKA : Frequent along the intertidal regions of creeks and channels, sometimes found along the lee-sides of sea-shore and in cultivated land.

## AVICENNIACEAE

## AVICENNIA Linn.

*Key to Species*

- |   |     |                      |
|---|-----|----------------------|
| 1a. Inflorescences spiciform ; leaves lanceolate ;<br>capsules narrowly pointed               | ... | <i>alba</i> 1        |
| 1b. Inflorescences umbellate, leaves obovate or elliptic ;<br>capsules not narrowly pointed : |     |                      |
| 2a. Trees 100-150 cm in diam., leaves obovate ;<br>capsules beaked                            | ... | <i>officinalis</i> 2 |
| 2b. Trees upto 40 cm in diam., leaves elliptic ;<br>capsules apiculate                        | ... | <i>marina</i> 3      |

1. *Avicennia alba* Blume in Bidjr. Fl. Neder. Ind. 821, 1826. *A. officinalis* (Linn.) var. *alba* (Bl.) Cl. in Hook. f. Fl. Brit. India 4 : 604, 1885 ; Haines 2 : 725, 1922. *A. marina* (Forsk.) Vierh. var. *alba* (Bl.) Bakh. in Bull. Jard. Buitenz. 3 : 207, tab. 14, 1921 ; Biswas in Notes Roy. Bot. Garden, Edin. 18 : 164, 1934. 'Kala bani'.

Shrubs or small trees, 4-10 m tall, 20-50 cm in diam. ; stems glabrous, black-coloured with thin lenticellate bark. Tap roots absent ; pneumatophores 8-15 cm long, straight, narrowly pointed, lenticellate, often hooked at apex. Leaves 8-15 × 2.5-4 cm, lanceolate dark-green or black shining above, silvery papillose below, acute or acuminate at apex, cuneate at base. Flowers 3-6 mm across, yellow, fragrant arranged in axillary or terminal spikes ; peduncles 2.5-3.5 cm long, branched. Ovary ovoid-oblong, upper-halves with patent adpressed hairs, lower-halves glabrous ; styles 1-1.5 mm long ; stigma minute, with two equal lobes. Capsules 3-4 cm long, ovoid or ellipsoid, narrowly acuminate, slightly curved at apex, densely tomentellous throughout.

*Fl. & Fr.* : June-July ; August-September.

*Distrib.* : MAHANADI DELTA : Common along the estuarine borders under the influence of high salinity and soft mud, frequently found as pure stands behind *Avicennia marina* community ; usually in association with *Bruguiera parviflora* and *Sonneratia caseolaris*.

*Germination.* : Embryo consists of two fleshy, green conduplicate cotyledons, larger one embracing the smaller one. It is found floating along the water current in the estuaries with hairy radicles and well-developed plumules. Germination of seedlings in our areas takes place only during the monsoon, may be due to less salinity of river-water.

Wood is good for fuel. It is a source for commercial honey, collection of honey is usually done during the months of June and July.

2. *Avicennia officinalis* Linn. Sp. Pl 110, 1753 ; Cl. in Hook, f. Fl. Brit. India 4 : 604, 1885 ; Haines 2 : 725, 1922 ; Bakh. (*f. c.*) 241. t. 20-21, 1921. '*Bara bani*'.

Trees, 10-30 m tall, 70-150 cm in diam. ; stems glabrous, much-branched ; bark thin, ash-coloured, tap root absent ; pneumatophores 10-50 cm long, straight, pointed, lenticellate, often forked with hook-like bending at apex. Leaves 6-10 × 3-6.5 cm, obovate or broadly ovate-oblong, coriaceous, dark-green above, silvery-papillose beneath, rounded at apex, narrowed at base. Flowers up to 1 cm long, yellow, fragrant, in axillary or terminal head-like congested cymes ; peduncles 8-15 cm long, trichotomously branched ; stamens usually excluded ; ovary conical, densely adpressed pubescent throughout ; styles 2-2.5 mm long, pubescent ; stigma capitate, unequally 2-lobed. Capsules broadly ovoid, almond shaped, densely silvery papillose, beaked at apex,

*Fl. & Fr.* June-July ; August-September.

*Distrib.* : MAHANADI DELTA : Frequent along the muddy coast and in the intertidal regions of creeks and channels of the mangrove forests. It prefers comparatively less saline areas than the other two species, and is found in association with *Sonneratia adetala*, *Heritiera fomes* and *Cerlops decandra*.

It is used for fuel, house-building, boat-making and source of honey.

3. *Avicennia marina* (Forsk.) Vierh. Beitr. Kennt. Fl. Sudarb. Socotra, in Denkschr. Akad. Wissensch. Band. 71, 435, 1907 ; Bakh in Bull. Jard. Buitenz. 3 : 102, 1921 ; Mooney in Suppl. Bot. B. & O. 258, 1950 ; Wt. Ic. t. 1482, 1849. *Sceura marina* Forsk. Fl. Aeg. Arab. Cent. 2 : 37, 1775. '*Peara Bani* or *Dhala-bani*'.

Shrubs or small trees, 3-6 m tall, 10-20 cm in diam. ; stems glabrous, much-branched ; bark thin, yellowish-grey, tap root absent ; pneumatophores 3-10 cm long, narrowly pointed, straight, not branched or hooked. Leaves 5-6 x 2.5-3 cm, elliptic-oblong, coriaceous, dark-green, shining above, yellowish papillose beneath, acute or obtuse at apex, cuneate at base. Flowers 2-4 mm across, yellow, fragrant, 6-10, crowded in terminal condensed cymes ; peduncles trichotomously branched ; stamens included ; ovary globose, densely pubescent ; styles very short, glabrous ; stigmas minutely bilobed. Capsules ovoid, half the size of *A. officinalis*, apiculate at apex.

*Fl. & Fr.* : June-July ; August-September.

*Distrib.* : FALSE POINT, BHITARKANIKA, HOOKITOLA : Common along the estuarine mouth under the influences of high salinity, tidal flow and silty soils. It forms a pioneer strand in association with *Avicennia alba*, *Bruguiera parviflora* and *Sonneratia griffithii*.

*Note* : In the Barua river mouth one variety : *Avicennia marina* (Forsk.) Vierh. var. *acutissima* Stapf & Moldenke, has been reported from this Delta as a new distributional record.

## LAMIACEAE

### Key to Genera

- |   |     |               |
|---|-----|---------------|
| 1a. Upper corolla-lip concave and villose         | ... | LEUCAS 1      |
| 1b. Upper corolla-lip erect, glabrous             |     |               |
| 2a. Lower lip of corolla flat                     |     |               |
| 3a. Erect herbs or shrubs ; Fruiting calyx deflex | ... | OCIMUM 2      |
| 3b. Prostrate herbs ; fruiting calyx not deflex   | ... | GENIOSPORUM 3 |
| 2b. Lower lip of corolla boat-shaped              |     |               |
| 4a. Stamens equal ; anthers confluent             | ... | HYPTIS 4      |
| 4b. Stamens didynamous ; anthers not confluent    | ... | ANISOMELIS 5  |

Erect, much-branched herbs ; stems 4-grooved, softly pubescent. Leaves 5-6 × 1.6-2 cm, lanceolate, or linear-oblong, pubescent, serrate, acute or obtuse at apex, tapering at base. Flowers white, subsessile clustered in upper axils ; calyx tubular, oblique, pubescent. Nutlets oblong, brown.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : KUJANG : Common winter-crops weeds, frequent on waste places along the lee side of the sandunes.

2. *Leucas stricta* Benth. in Wall. Pl. As. Rar. 1 : 61, 1830 ; Hook, in Hook. f. Fl. Brit. India 4 : 688, 1884 ; Haines 2 : 750, 1922 ; Mukherjee 170, 1942.

Erect, slender herbs ; stems hispidly hairy, with many branches from woodyroot-stock. Leaves 2-3.5 × 0.3-0.5 cm, linear-oblong, subsessile, hispidulous on both surfaces, obtuse at apex, narrowed at base. Flowers 1.5-2 cm long, white, 1-4, in terminal verticillasters ; calyx straight, 9-11 mm long, funnel-shaped, ribbed, adpressedly hairy. Nutlets 2.5 mm across, smooth, brown.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : SATYAVIA, CHANDBALI : Frequent along the sea-shores, scrubs and riverbanks. Sometimes locally common along road-sides.

## 2. OCIMUM Linn.

*Ocimum gratissimum* Linn. Sp. Pl. 1197, 1753 ; Mukherjee 20, 1942 ; Hook in Hook. f. Fl. Brit. India 4 : 609, 1884 ; Haines 2 : 728, 1922.

Erect, much-branched aromatic herbs or shrubs ; stems quadrangular, puberulent when young. Leaves 4-9 × 2-4 cm, ovate or ovate-lanceolate, coarsely serrate, puberulous above, gland-pitted below, acute at apex, cuneate at base. Flowers 4-6 mm long, white, interrupted whorls of cymes arranged in terminal racemes ; 5-10 cm long ; corolla 5 mm long, glandulose ; filaments with goldenhairy process ; anthers confluent at the top. Nutlets subglobose.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : HOOKITOLA, FALSEPOINT : Very rare along the sandy sea-shores ; locally common.

## 3. GENIOSPORUM Wail ex Benth.

*Geniosporum prostratum* (Linn.) Benth. in Bot. Reg. Sub. t. 1300, 1830; Wall. Pl. As. Rar. 2: 18, 1832; Mukherjee 33, 1942; Hook. in Hook. f. Fl. Brit. India 4: 610, 1884; Haines 2: 732, 1922. *Octmum prostratum* Linn. Mant. 166, 1767.

*G. tenuiflorum* (Linn.) Merr. is the correct name. Prostrate, much-branched, hirsutely hairy herbs with linear or linear-lanceolate leaves and reddish-purple or bluish-white flowers.

*Fl. & Fr.* August-September.

*Distrib.*: GOPALPUR COAST, GANJUM: Found common along the sandy sea-shores in association with *Hydrophylax maritima*.

4. HYPTIS JACQ. (*nom. cons.*)

*Hyptis suaveolens* (Linn.) Poit. in Ann. Mus. Hist. Nat. Paris 7: 472, t. 29, f. 2, 1806; Mukherjee 63, 1942; Hook. in Hook f. Fl. Brit. India 4: 630, 1884; Haines 2: 736, 1222.

Erect aromatic herbs, 50-150 cm tall; stems hispid, quadrangular. Leaves 4-6.5 × 3-4.5 cm. variable, ovate or ovate-lanceolate, sinuate dentate, puberulous above, tomentose beneath, acute at apex, obtuse or subcordate at base. Flowers 5-10 mm long, blue, 3-8, fascicled on the top of 8-25 mm long peduncles; bracts filiform or spatulate with long hairs. Calyx 4-6 mm long, funnel-shaped, 10-nerved; upper corolla-lip 4-lobed, flat, lower lip saccate, deflexed; filaments densely pillose. Nutlets ovoid, dark-brown.

*Fl. & Fr.*: October-November; December-February.

*Distrib.*: FALSEPOINT: Frequent in waste places along the leese of the sandunes; locally common along road-sides and forests.

## 5. ANISOMELES R. Br.

*Anisomeles indica* (Linn.) O. Kuntze, Rev. Gen. Pl. et Sp. Pl. 512, 1891; Mukherjee 152; Haines 2; 745, 1922. *Nepeta indica* Linn. Sp. Pl. 571, 1753. *Eptimeredl indicus* (Linn.) Rothm. Fedde. Rept. 53: 12, 1944. *Antsomeles ovata* R. Br. in Ait. Hort. Kew ed. 2, 2: 364, 1811; Hook. in Hook. f. Fl. Brit. India 4: 672.

Aromatic, tomentose herbs or undershrubs; stems quadrangular, often spreading. Leaves 5-8 × 3.5-4 cm, ovate or ovate elliptic, crenately-

serrate, acute at apex, cuneate at base. Flowers 1-1.5 cm long, pinkish white, in axillary cymes transforming into dense terminal spikes; calyx-teeth triangular, acute; corolla-tube with a ring of hairs inside; stamens didynamous. Nutlets ovoid, smooth, shining.

*Fl. & Fr.* : September-October : December-January.

*Distrib* : BAHAKUD : Frequent on waste sandy places along the river-banks, coastal thickets and road-sides, locally common.

Generic name *Anisomeles* R. Br. (Prodr. Fl. Nov. Holl- 503, 1810) is antedated by *Epimeredi* Adans. (Fam. Pl. 2 : 192, 1763) and its publication was taken up by Warner Rothmaler in Fedpe and Report 53 : 12, 1944. Recently Subramanyam and Henry in *Taxon* 18 : 595-96, 1969, proposed to conserve the generic name *Anisomeles* against *Epimeredi* in view of the usage of former name for more than a century and its wider application in more than half in all monographic and floristic works.

## NYCTAGINACEAE

### BOERHAVIA Linn.

*Boerhavia diffusa* Linn. Sp. Pl. 3, 1753; Stemmerik in Fl. Mal. 6(3) : 454, f. 1, f.g., 1964; Haines 2 : 757, 1924. *B. repens* Linn. Sp. Pl. 3, 1753; Hook. in Hook. f. Fl. Brit. India 4 : 709, 1886 (Incl. var. *procumbens* and *diffusa*.) 'Punarnava'.

Prostrate, ascending, glabrous herbs; stems terete, much-branched, often purple-coloured, with woody rootstock. Leaves 0.5-4 x 0.3-2.5 cm, opposite, variable, ovate-orbicular, or ovate-elliptic, furunculate, pale or whitish beneath, obtuse or subacute at apex, rounded, truncate, or subcordate at base. Flowers 1.5 cm across, pink, in axillary or pseudo-terminal 2-8-flowered umbelliform cymes; peduncles 3-4 cm long. Fruits about 3 mm across, clavate, 4-5-ribbed, viscidly glandular along ribs, 'Punarnava'.

*Fl. & Fr.* : February-March; May-June.

*Distrib.* : KUJANG : Frequent in coastal thickets, river-banks, and dry places near sea-shores, locally common along road-sides, pastures and old walls.

## AMARANTHACEAE

## Key to Genera

- 1a. Leaves alternate
- 2a. Flowers unisexual ... AMARANTHUS 1
- 2b. Flowers bisexual
- 3a. Fruits ending at the top with two hornlets not  
circumscissile ... DIGERA 2
- 3b. Fruits without hornlets ; circumscissile
- 4a. Flowers capitate ; fruits with one seed ... ALLMANIA 3
- Flowers in dense racemes ; fruits with more  
than one seed ... CELOSIA 4
- 1a. Leaves opposite, or fasciated
- 5a. Spikes woolly-tomentose, bracts, soft ... AERVA 3
- 5b. Spikes glabrous, with spinose bracts ... ACHYRANTHES 6
- 6a. Flowers in long spike. Imperfect  
flowers converted into hooked  
bristles ; anthers 2-celled ... PUPALIA 7
- 6b. Flowers clustered, in small heads  
not as above anthers 1-celled ... ALTERNANTHERA 8

## AMARANTHUS Linn.

*Amaranthus spinosus* Linn. Sp. Pl. 991, 1753 ; Hook. in Hook. f. Fl. Brit. India 4 : 718, 1886 ; Haines 2 : 761, 1924.

Erect or prostrate spinous annuals, with long tap root ; stems much-branched, glabrous, quadrangular. Leaves 1-6 x 0.5-3 cm, ovate or ovate-lanceolate, glabrous, obtuse at apex, cuneate at base. Flowers 1-2 mm across, greenish, sessile, axillary clustered, or terminal panicles ; axillary clusters entirely female, those of panicles entirely or partly male. Utricles 2 mm across, ovoid, rugose.

*Fl. & Fr.* : March-April, May-June.

*Distrib.* : PARADEEP, KUJANG : Rare, in waste sandy places, near sea-shores and coastal thicket. Locally common road-sides and gardens.

## 2. DIGERA Forsk.

*Digera muricata* (Linn.) Mart. Beitr. Amar. 77, No. 2, 1825 ; Beck. in Fl. Mal. 4 : 80, f. 3, 1949. *Achyranthes muricata* Linn. Sp. Pl. ed. 2,

295, 1762. *Digera arvensis* Forsk. Fl. Aegy. Arb. 65, 1775; Hook. in Hook. f. Fl. Brit. India 4 : 717, 1885. *D. alternifolia* (Linn.) Aschers. in Schweinf. Beitr. Fl. Archiop. 180, 1867; Haines 2 : 760, 1924.

Erect or ascending annuals; stems often branched, glabrous, Leaves 1.5-5.5 × 1-3 mm, variable, ovate-elliptic or ovate-lanceolate, glabrous, acute or acuminate at apex, truncate at base. Flowers 2-3 mm long, in axillary, peduncles, spiciform racemes; perianth pink, unequal. Utricles 2 mm across, globose, compressed, with two hornlets at the top.

*Fl. & Fr.* : July-September; November-December.

*Distrib.* : PARADEEP : Rare along road-sides and sea-shore; common locally on dry waste places, grasslands and embankments.

### 3. ALLMANIA R. Br. ex Wt.

*Allmania nodiflora* (Linn.) R. Br. ex Wight in Hook. J. Bot. 1 : 226, t. 128, 1834; Back. in Fl. Java 1 : 234, 1963; Haines 2 : 759, 1924. *Celosia nodiflora* Linn. Sp. Pl. 205, 1753. *Allmania nodiflora* R. Br. in wall. Cat. var. *roxburghii* Hook. in Hook. f. Fl. Brit. India 4 : 716, 1885.

Erect or ascending herbs with long woody, tap root; stems angular more or less fleshy, often yellowish-pink, glabrous or slightly puberulous when young, dichotomously branched. Leaves variable, 1.5-7.5 × 0.3-0.5 cm, linear-oblong, oblong or spatulate, glabrous, acute, obtuse, rounded or abruptly mucronate at apex, narrowed at base; petioles present or absent. Flowers yellowish-green or purple-pinkish in terminal or leaf-opposed globose heads on 2-2.5 cm long, glabrous or pubescent peduncles; bracts and bracteoles ovate-lanceolate, coriaceous. Utricles 3 mm across, glabrous, circumscissile below the middle; seeds lenticular, erect, pale-brown, with 2-lobed cupular basal arils.

*Fl. & Fr.* : February-March; April-July.

*Distrib.* : HATAMUNDIA : Frequent on sandy sea-shores and sand-bars, in-between the creeks and channels of the mangroves. Locally found along sandy places and road-sides.

*Notes* : We have so far observed very variable forms of leaves and flower-heads in this species among the coastal collections but in all these cases flowers were borne on pedunculate heads. We did not come across forms with sessile flower-heads. However, Hooker (*l. c.*) established 6



varieties on the basis of several characters which may not be consistent. Backer in Fl. Mal. 4 : 74, 1949, states that "there is only one variable species, described under several names. All forms pass gradually into each other". Critical studies of our Indian materials are needed to justify this observation.

#### 4. CELOSIA Linn.

*Celosia argentea* Linn. Sp. Pl. 205, 1753 ; Hook. f. Fl. Brit. India 4 : 714, 1885 ; Haines 2 : 758, 1924.

Erect, glabrous herbs ; stems simple or often branched, angular, strongly ribbed. Leaves 2.5-9.5 × 0.5-4 cm, alternate, linear-lanceolate or ovate-lanceolate, acute or obtuse at apex, attenuate at base. Flowers whitish-pink, in terminal condensed cylindrical spikes ; racemes during anthesis elongated, unbranched. Utricles 3-4 mm long, ellipsoid circumscissile about the middle.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : PARADEEP : Frequent, on moist sandy places along the leewards of the sea-shore sandunes, locally common on moist places along nullahs, gardens and cultivated field.

#### 5. AERVA Forsk. (*nom. cons*)

*Aerva lanata* (Linn.) Juss. in Ann. Mus. Paris 11 : 131, 1808 ; Hook. in Hook. f. Fl. Brit. India 4 : 728, 1885 ; Haines 2 : 766, 1924. *Achryanthes lanata* Linn. Sp. Pl. 204, 1753.

Erect, perennial herbs ; stems terete, woolly-tomentose when young. Leaves 0.5-4.5 × 0.3-3 cm, usually alternate, opposite or fascicled, spirally arranged, often purple, ovate-elliptic-oblong, adpressed-hairy above, woolly-tomentose beneath, acute at apex, attenuate at base. Flowers minute, white, woolly in dense axillary or terminal spikes. Utricles 1 mm across, ovoid, blackish.

*Fl. & Fr.* : November-December : February-March.

*Distrib.* : FALSE POINT : Frequent along river-sides, sandy waste places, and road-sides ; locally abundant.

#### 6. ACHYRANTHES Linn.

*Achyranthes aspera* Linn. Sp. Pl. 204, 1753 ; Hook. in Hook. f. Fl. Brit. India 4 : 730, 1885 ; Haines 2 : 767, 1924.

Erect or scandent perennial herbs; stems angular, rigid, strongly ribbed, adpressed-pubescent. Leaves 1.5-11 × 1-7 cm, decussate, obovate, or elliptic-lanceolate, glabrous or sparsely pubescent, acute or acuminate at apex, attenuate at base. Flowers 2-3 mm, greenish-white, in axillary or terminal many-flowered elongated spikes; spikes 8-20 cm long, deflexed; bracteoles 2, at the base of perianth, with long spines on either side of its membranous wings. Utricles 2 mm across, enclosed by persistent perianth and bracteoles.

*Fl. & Fr.* : March-June; September-December.

*Distrib.* : KUJANG, BHITARKANIKA : Frequent in waste places along the sea-shore, river-banks, road-sides and gardens; Locally common.

#### 7. PUPALIA Juss. (*nom. cons.*)

*Pupalia lappacea* (Linn.) Juss. in Ann. Mus. 2 : 132, 1803; Moq. in DC. Prodr. 13 (2) : 331, 1849; Hook. in Hook. F. Fl. Brit. India 4 : 724, 1885.

Erect or rambling, much-branched perennial herbs; stems quadrangular, glabrous, swollen at nodes with woody rootstock. Leaves 2-8 × 1-4 cm, ovate-oblong or ovate-elliptic, glabrous, or pubescent, acute or acuminate at apex, obtuse at base. Flowers 3-5 mm, pale-green or pink, sessile, clustered in terminal speciform racemes; imperfect flowers reduced to fascicled reddish-brown hook-like bristles, villous at base. Utricles 2 mm across, 1-seeded; seeds shining brown.

*Fl. & Fr.* : October-November; December-January.

*Distrib.* : BAHAKUD : Frequent in sandy scrub-jungles and coastal thickets; locally common on hedges and gardens.

#### 8. ALTERNANTHERA Forsk.

##### *Key to Species*

- |  |     |                        |
|--|-----|------------------------|
| 1. Utricles longer than tepals; tepals 1-nerved  | ... | <i>sessilis</i> 1      |
| 1. Utricles shorter than tepals; tepals 3-nerved | ... | <i>paronychoides</i> 2 |

1. *Alternanthera sessilis* (Linn.) DC. Cat. Hort. Monap. 77, 1813; Melville in Kew Bull. 172, f. 1, 1958; Hook. f. Fl. Brit. India 4 : 731, 1885; Haines 2 : 768, 1924; *Comphera sessilis* Linn. Sp. Pl. 225, 1753.

Creeping or often floating perennial herbs; stems more or less soft, fleshy, glabrous, swollen at nodes. Leaves variable, 0.5-7 × 0.3-2 cm linear-oblong, or oblanceolate, glabrous, acute or obtuse at apex, attenuate at base. Flowers sessile, pink or whitish-pink, clustered, in

axillary globose heads. Utricles obcordate or obreniform, corky, 2 mm long, yellowish-brown.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : MUSADIA, KHOLA : Common in swampy places, ditches, rice-fields and road-sides. Frequently found floating along creeks and canals under freshwater conditions.

*Notes* : The authority for this species is often ascribed to R. Br. but Melville (*l.c.*) pointed out that De Candolle correctly made the combination in 1813 ; hence the authority is (Linn.) DC.

2. *Alternanthera paronychoides* St. Hil. Voy. Bres. 11, 2 : 432, 1833 ; Sant. in J. Bombay nat. Hist. Soc. 54 : 477, 1957 ; Dutta and Mitra in Indian For, 87 : 304, f. 2, 1961.

Prostrate, perennial, glabrous or pubescent herbs ; stems much-branched, rooting at nodes. Leaves variable. 0.5-2.5 × 0.2-1 cm, spatulate oblanceolate, glabrate, acute or obtuse at apex, tapering into short petioles. Flowers white, sessile, in axillary, globose or inspreading heads. Utricles 1 mm across, orbicular, brownish.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : FALSE POINT, PARADEEP : Frequent along road-sides, and embankments, specially in reclaimed alkaline soils. It is a creeper or rambler with long spreading branches and well-developed along the undisturbed areas ; white in disturbed areas. it is found to grow as deformed, carpet-like mats.

## CHENOPODIACEAE

### Key to Genera

- |   |     |               |
|---|-----|---------------|
| 1a. Stems joined, leafless              | ... | SALICORNIA 1  |
| 1b. Stems not jointed, leafy throughout |     |               |
| 2a. Leaves fleshy, terete or subterete  | ... | SUARDA 2      |
| 2b. Leaves not fleshy, lanceolate       | ... | CHENOPODIUM 3 |

### 1. SALICORNIA Linn.

1. *Salicornia brachiata* Roxb. Fl. Ind. ed. Carey 28, 1832 ; Hook. in Hook. f. Fl. Brit. India 5 : 12, 886 ; Haines 2 : 771, 1924.

Erect or decumbent herbs ; stems succulent, seemingly leafless, much-branched, with numerous jointed nodes ; each segment at apex forming a little cup usually with short teeth, embracing the base of the

next higher segment. Flowers minute, usually in groups of 3, each group sunken on either side of each segment ; sterile segments usually 5-10 mm long. Fruits ovoid, utricles membranous ; seeds laterally compressed, hairy ; hairs minute, white.

*Fl. & Fr.* : October-November ; January-March.

*Distrib.* : FALSE POINT : Common in salt marshes near the coast, often found gregarious in rice-fields when flooded with saline water.

## 2. SUAEDA Scop. ( *Nom cons.* )

### *Key to Species*

- |   |     |                    |
|---|-----|--------------------|
| 1a. Leaves terete, 5-12 mm long ; bracteoles pectinate                    | ... | <i>nudiflora</i> 1 |
| 1b. Leaves not terete, more than 12 mm long ; bracteoles entire           |     |                    |
| 2a. Flowers clustered in slender spikes ; stigmas included                | ... | <i>maritima</i> 2  |
| 2b. Flowers axillary or adnate to the sub-tending leaves ; stigma exerted | ... | <i>monaica</i> 3   |

1. *Suaeda nudiflora* (Willd.) Moq. in Ann. Sc. Nat. Ser. 23 : 216 1831 ; Roxb. Fl. Ind. ed. Carey 60, 1832 ; Hook in Hook. f. Fl. Brit. India 5 : 14, 1886 ; Wt. Ic. t. 1796, 1852 ; Haines 2 : 772, 1924. *Salsola nudiflora* Willd. Sp. Pl. 2 : 1313, 1799.

Erect or ascending perennial herbs or undershrubs, 40-80 cm tall ; stems much-branched from the woody base, glabrous, often reddish. Leaves 7-12 mm long, sessile, linear, fleshy, terete. Flowers 1.5-2 mm across, white, globose, clustered in terminal spikes ; bracts leafy ; bracteoles 1-2 mm long, ovate, acute, pectinate ; petals 1-2 mm broad, ovoid, transparent, with transverse thickenings at apex ; stamens included. Fruits ovoid, pericarp membranous ; seeds 1-1.2 mm in diam., horizontally arranged ; testa black, shining ; embryo coiled.

*Fl. & Fr.* : July-August ; September-October.

*Distrib.* : FALSE POINT, MOUTHS OF DEVI & BAURUA : Common in salt marshes and saline embankments near the coast and estuaries ; usually in association with *Suaeda maritima*, often found as a pure stand behind the estuaries.

Usually used as food by the local inhabitants after floods and cyclone.

2. *Suaeda maritima* (Linn.) Dum. Fl. Belg. 22, 1827 ; Hook. in Hook. f. Fl. Brit. India 5 : 14, 1886 ; Haines 2 : 772, 1924 ; Wt. Ic. t. 1793, 1852. *Chenopodium maritima* Linn. Sp. Pl. 221, 1753.

Erect or ascending herbs or undershrubs ; stems glabrous, woody, much-branched, often reddish-purple. Leaves 11-35 mm long, linear-oblong, crowded, occasionally purple-coloured. Flowers 1 mm or less than an mm across, whitish-green, in axillary clusters or on slender, elongated spikes, laxly arranged ; bracteoles ovate, entire, membranous ; stigmas included. Utricles ovoid ; seeds 0.8-1 mm in diam., horizontal, shining, brown.

*Fl. & Fr.* : December-January ; March-April.

*Distrib.* : FALSE POINT, KALIVANJDIAN, MAIPARA : Common in saline embankments and salt marshes near the coast and estuaries ; Sometimes found within the mangrove forests while the areas become suddenly elevated and devoid of regular tidal influences ; usually in association with *Suaeda nudiflora*, often found to form pure stands.

*Notes* : Once they get established within the mangroves forests, it becomes difficult to eradicate them and to make room for other species. In localised areas, they may occur to the exclusion of other species, specially in the paddy fields. Their high mortality and retarded growth under freely drained conditions suggest that germination and early growth may favour in wet situations ; but older plants favour areas free of excess moisture.

3. *Suaeda monoica* (Forsk.) ex J. E. Gmel., Syst. Nat. ed. 13, 2(1) ; 503, 1791 ; Turrit & Milneredhead in Fl. Trop. E. Africa : 23, 1954 ; Hook. in Hook. f. Fl. Brit. India 5 : 13, 1886 ; Mooney 259, 1950 ; Wt. Ic. t. 1792, 1852.

Erect or decumbent herbs or undershrubs, 50-100 cm tall ; stems glabrous, much-branched, woody at base, occasionally tubercled, with leaf scars, often rooting at nodes. Leaves 10-18 × 2-2.5 mm, alternatively crowded, linear-oblong or spatulate, obtuse or rounded at apex, narrowed into sessile base. Flowers 2-3 mm across, polygamous, greenish white, axillary, solitary occasionally 2-3-flowered, in groups adnate to the subtending leaves ; bracteoles ovate-acute, entire, transparent ; tepals 2-3 mm long, ovate, concave with transverse thickenings up to the middle ; stamens 5, included ; stigmas 3, more or less exerted. Utricles globose. Seeds 1-1.5 mm in diam., horizontally arranged ; testa lenticulate, shining, black.

*Fl. & Fr.* : June-July ; September-October.

*Distrib.* : THAKURDIAN, JAMBU : Common along the intertidal regions near the estuaries, usually in association with *Avicennia alba* and *Sonneratia griffithii*. They are capable of withstanding regular tidal influence and usually not found in salty marshes or saline beds.

*Notes* : Money (*l.c.*) collected one vegetative specimen from Jambu river-bank and remarked that since the specimen was neither in flower nor in fruit, its identity remained doubtful.

### 3. CHENOPODIUM Linn.

*Chenopodium ambrosioides* Linn. Sp. Pl. 219, 1753 ; Hook. in Hook. f. Fl. Brit. India 5 : 4, 1886 ; Haines 2 : 770, 1924 ; Wt. Ic., t. 1786, 1852.

Erect or ascending, aromatic annuals ; stems ribbed, glandular-pubescent. Leaves 4-10 × 1-3 cm, oblong-lanceolate, sinuately dentate, glabrous above, deeply gland-dotted beneath, acute or abuse at apex, narrowed at base. Flowers greenish-white, 1-2 mm across, clustered in axillary or terminal spikes. Fruits globose, utricles membranous ; seeds 1-1.5 mm in diam., orbicular, shining red or brown.

*Fl. & Fr.* : March-April ; May-June.

*Distrib.* : FALSE POINT, KUJANG : Frequent along the river-banks, waste places and moist sandy areas ; locally cultivated.

## BASELLACEAE

### BASELLA Linn.

*Basella alba* Linn. Sp. 227, 1753 ; van Steenis in Fl. Mal. 5 : 300, 1957. *B. rubra* Linn. Sp. Pl. 227, 1753 ; Hook. in Hook. f. Fl. Brit. India 5 : 20, 1886 ; Haines 2 : 772, 1924.

Succulent creeping or winding herbs ; stems yellowish or pink, slender. Leaves ovate-lanceolate with long petioles, acute at apex, narrowed at base. Flowers 2-3 mm across, rose-purple or white with pink-tipped, bracts and bracteoles acute. Fruits depressed globose.

*Fl. & Fr.* : February-March ; April-May.

*Distrib.* : BHITARKANIKA : Frequent in low-mangroves and coastal thickets usually winding on *Salvadora persica* and *Salacia prinoides*.

*Notes* : Cultivated forms are not described here. Plants found as a wild in the back mangroves can be distinguished certainly different from the cultivated forms, specially their leaves, petioles and thin slender, yellow-coloured stems.

According to van Steenis (1957) several forms differ by very minor characters. Linnaeus establishes two species in this genus, *B. rubra* Linn. and *B. alba* Linn. of which former having the narrower leaves. Since there is no definite certainty about the name of this two species, correct epithet by the first author (van Steenis) who united the synonyms was not possible.

## POLYGONACEAE

## POLYGONUM Linn

*Polygonum plebejum* R. Br. Prodr. 420, 1810 ; Hook. in Hook. f. Fl. Brit. India 5 : 27, 1886 ; Haines 2 : 775, 1924.

Deep rooting, decumbent or ascending annuals. Leaves 6-12 × 2-3 mm, alternate, sessile, linear or linear-oblong often lanceolate, glabrous, acute at apex, narrowed at base ; ochrea short, haline, lacerate. Flowers 2 mm across, pink, axillary solitary or 1-5, clustered together to form a leafy raceme. Nuts 2 mm across, trigonous, shining black.

*Fl. & Fr.* : December-January.

*Distrib.* : PARADEEP, FALSE POINT : Polymorphous species, frequent along the edges of moist sandy slacks near the coast or in dry sands along the lee-sides of sea-shore sandunes. Locally common around tanks and ditches and sandy river-beds.

Original spelling of this species is *Plebeium*, not *Plebejum*.

## ARISTOLOCHIACEAE

## ARISTOLOCHIA Linn.

*Aristolochia indica* Linn. Sp. Pl. 960, 1753 ; Hook. in Hook. f. Fl. Brit. India 5 : 75, 1886 ; Haines 2 : 785, 1924.

Woody glabrous, perennial, twining or creeping herbs ; stems ribbed, often purple-coloured. Leaves 5-15 × 3-6 cm, variable, obovate-oblong or sub-penduriform, membranous, entire, obtusely acuminate at apex, truncate or subcordate at base. Flowers 2-3 cm long, greenish-white in axillary racemes, often clustered with prominent bracts. Capsules 3-4 cm across, globose, septicidally dehiscing into 6 valves from below to the upwards at the same time pedicels splitting into 6-fids. Seeds many, 5-8 mm across. ovate-deltoid, Winged throughout.

*Fl & Fr.* : August-September ; November-December.

*Distrib* : SATYAVIA, PARADEEP : Frequent in open sandy areas along the shores, river-banks and scrubs.

## LAURACEAE

LITSEA Lamk (*nom. cons.*)*Key to Species*

- 1a. Perianth incomplete, involucre arranged in  
corymbose-like racemes ... *glutinosa* 1
- 1b. Perianth complete, involucre in racemose  
few-flowered umbel-like ... *nitida* 2

1. *Litsea glutinosa* (Lour.) C. B. Robins. in Philip. J. Sci. Bot. 6 : 321, 1911 ; Allen in Ann. Misso. Bot. Gdn. 25 : 385, 1938. *Sebifera glutinosa* Lour. Fl. Cochinch. 638, 1790. *Litsea sebifera* Pers. Syn. 2 : 4, 1807 (based on *Sabifera glutinosa* Lour.) ; Hook<sup>r</sup> in Hook. f. Fl. Brit. India 5 : 157, 1886 ; Haines 2 : 793, 1924.

Evergreen dioecious trees or shrubs 5-10m tall ; stems smooth, branched. Leaves 4-20 × 2-8 cm, variable, spirally arranged, elliptic-oblong or ovate, glabrous above, pale puberulous below, acute at apex, obtuse or narrowed at base. Flowers 5-6 mm across, yellowish-white, pubescent, in axillary racemes surrounded by 4 concave-globose involucre ; stamens and staminodes pubescent. Fruits 7-8 mm across, globose berries.

*Fl. & Fr.* : May-June ; August-September.

*Distrib.* : KUIANG ; BAHAKUD : Frequent in scrubs along the river-bank, shrub-berries around the tanks and ditches.

2. *Litsea nitida* (Roxb.) Hook. in Hook. f. Fl. Brit. India 5 : 174, 1886 ; Mooney 131, 1950. *Tetranthera nitida* Roxb. Fl. Ind. ed. Carey 3 : 819, 1832. *Cylicodaphne nitida* Nees in Wall. Pl. As. Rar. 2 : 67, 1832.

Evergreen dioecious trees 5-15 m tall ; stems glabrous, bark reddish-brown, Leaves 6.5-20 × 2-8 cm, broadly ovate-oblong or oblanceolate, coriaceous, dark-green, shining on both surfaces, obtuse or subacute at apex, cuneate or narrowed into short petioles. Flowers 1-1.5 cm long, in axillary or extra axillary racemes ; perianth-tubes terbiniate, silky hairy. Fruits ellipsoid, yellowish, 1-1.5 cm across, enclosed completely within the cupular perianth when young.



*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : BAHAKUD : Rare in sandy scrub-jungles along the river-banks and coastal thickets in association with *trychnose nux-vomica* and *Antidesma* sp.

Haines (1924) has not reported this plant. Mooney (*l.c.*) states "I have not seen it from Chotonagpur or Orissa, it is of course an eastern Bengal and Assam plants" Thus the occurrence of this species in Orissa is a new record for the State.

## LORANTHACEAE

### Key to Genera

- |  |     |              |   |
|--|-----|--------------|---|
| 1a. Plants with dichotomous leafy branches ; flowers unisexual   | ... | VISCUM       | 1 |
| 1b. Plants without dichotomous leafy branches ; flowers bisexual |     |              |   |
| 2a. Young parts rusty tomentose ; flowers 4-merous               | ... | SCURRULA     | 2 |
| 2b. Young parts glabrous ; flowers 5-merous                      | ... | DENDROPHTHOE | 3 |

### 1. VISCUM Linn.

*Viscum ovalifolium* Wall. *ex* DC. Prodr. 4 : 278, 1830 ; Back. & Bakh. Fl. Java 2 : 75, 1965 ; Hook. in Hook. f. Fl. Brit. India 5 : 225, 1888. *V. orientale auct. non* Willd. Haines 2 : 803, 1924. 'Banda'

Semi-parasitic, much-branched, glabrous herbs or undershrubs ; branches more or less stout, angular, grooved, flattened at internodes. Leaves 1.5-5.5 × 0.5-2.5 cm, ovate-elliptic or ovate-oblong, coriaceous, obtuse or rounded at apex, tapering into short petioles. Flowers small, greenish-yellow, in axillary 2-3-flowered clusters ; female flowers in the centre with male flowers in the centre with male flowers around. Fruits oblong-ellipsoid, 5-6 mm across, narrowed at both ends.

*Fl. & Fr.* : March-April ; May-August.

*Distrib.* : FALSE POINT : Frequently found parasitizing *Excoecaria aqallocha* in the mangroves and *Pongamia pinnata*, near back mangroves.

### 2. SCURRULA Linn.

*Scurrula philippensis* (Cham. & Schl.) G. Don. in Gen. Hist. 3 : 442, 1834 ; Back. & Bakh. Fl. Java 2 : 74, 1965 ; Danser in Blumea 2 (2) : 48, 1936 ; Sant. in Rec., bot. Surv. India 16 (\*) : 201, 1958. *Loranthus philippensis* Cham & Schl. in Linnæa 3 : 204, 1828. *L. scurrula* Hook. in Hook. f. Fl. Brit. India 5 : 208, 1888. *L. cordifolius* Wall. in Roxb. Fl. Ind. (ed. Carey) 2 : 223, 1822 ; Hook. in Hook. f. Fl. Brit. India 5 : 209, 1888 ; Haines 2 : 802, 1924.

Rusty tomentose, bushy parasitic herbs or undershrubs ; stems woody, brownish, lenticellate. Leaves opposite, 3-9.5 × 2-6 cm, ovate or elliptic-oblong, acute, obtuse or rounded at apex, subcordate or rounded at base, clothed with brownish adpressed tomentum. Flowers 16-20 mm long, light-coloured, axillary, 2-8-flowered, subracemosely fascicled, brownish-pubescent ; corolla-tube splitting into 4-short lobes, often dentate. Bones 9-11 mm long, tomentose, pyriform.

*Fl. & Fr.* : December-February ; March-May.

*Distrib.* : MUSADIA : Frequently found growing on *Hibiscus tiliaceus* in the low mangroves near the estuaries.

The range of distribution of this taxon from high altitudes to the mangroves is interesting.

### 3. DENDROPHTHOE Mart.

**Dendrophthoe falcata** ( Linn. f.) Etting. in Denkschr. Akad. Wissen. Math. Naturw. Cl. 32 : 52, 58, t. 13, f. 14, 1872 ; Sing in Bull. Nat. bot. Gdns. 69 (1) : 1-75, 162. *Loranthus falcatus* Linn. f. Suppl. 221, 1781. *L. longiflorus* Desr. in Lamk Encycl. 3 : 598, 1789 ; Hook. in Hook. f. Fl. Brit. India 5 : 214, 1888 ; Haines 2 : 801, 1924.

Large semi-parasitic woody shrubs. Leaves mostly 7-15 × 2.5-10 cm, coriaceous, variable, ovate-elliptic or ovate-lanceolate, often falcate, glabrous, obtuse or rounded at apex, narrowed at base. Flowers 3-4 cm long, bright red, in unilateral racemes. Berries globose, reddish-purple when ripe.

*Fl. & Fr.* : December-March.

*Distrib.* : BAHAKUD, TALCHUA : Frequently found parasitizing several tree species in the scrub-jungles along river-banks. Locally common.

## EUPHORBIACEAE

### Key to Genera

- |   |     |             |   |
|---|-----|-------------|---|
| 1a. Flowers arranged in cyathia             | ... | EUPHORBIA   | 1 |
| 1b. Flowers not in cyathia                  |     |             |   |
| 2a. Plants monoecious                       |     |             |   |
| 3a. Disc usually persistent in both the sex |     |             |   |
| 4a. Herbs, fruits capsules                  |     |             |   |
| 5a. Calyx-lobes 5                           | ... | PHYLLANTHUS | 2 |
| 5b. Calyx-lobes 6                           | ... | SYNSTEMON   | 3 |

4b. Usually shrubs, fruits berries	...	BRIDELIA	4
3b. Disc absent in both the sex	...	BREYNIA	5
2b. Plants dioecious	...	ANTIDESMA	6
6a. Petals present in male flowers			
7a. Leaves palmately lobed	...	JATROPHA	7
7b. Leaves not palmately lobed			
8a. Anthers erect in bud	...	CHROZOPHORA	8
8b. Anthers inflexed in bud	...	CROTON	9
6b. Petals absent			
9a. Trees or shrubs			
10a. Fruit a drupe	...	HEMICYCLIA	10
10b. Fruit a capsule			
11a. Stamens many, 10-60	...	SURGADA	11
11b. Stamens only 3	...	EXCOECARIA	12
9b. Plants usually herbs			
12a. Female flowers enclosed by foliaceous bracts	...	ACALYPHA	13
12b. Female flowers not enclosed by bracts	...	MICROCOCCA	14

### 1. EUPHORBIA Linn.

The genus *Euphorbia* with its broad circumscription is one of the highly polymorphic and largest genera among the angiosperms. Several authors have criticized this traditional circumscription of *Euphorbia* ; but, they have failed to evolved an obvious solution to this problem. However, the same is followed here ;

#### *Key to Species*

1a. Mostly erect herbs			
2a. Limb of involucre-glands pink and unequal ; capsules glabrous	...	<i>rosea</i>	1
2b. Limb of involucre-glands green and equal ; capsules hairy	...	<i>hypericifolia</i>	2
1b. Mostly prostrate, ascending herbs			
3a. Cyathia in glomerules	...	<i>hirta</i>	3
3b. Cyathia not in glomerules			
4a. Capsules addressed pubescent throughout	...	<i>thymifolia</i>	4
4b. Capsules stiff-hairy only along the angles	...	<i>prostrata</i>	5

1. *Euphorbia rosea* Retz. Obs. Bot. fasc. 4 : 26, 1786 ; Hook. in Hook. f. Fl. Brit. India 5 : 251, 1817 ; Trimen in Fl. Ceylon 4 : 6, 1874 (Rep. ed.) ; Haines 1 : 147, 1921.

Perennial glabrous herbs with many spreading branches from long woody root-stock. Leaves 4-8 × 2-6 cm, obovate, spatulate or suborbicular, thick, crenulate, rounded at apex, oblique at base. Cyathia purple, shortly stalked, in axillary cymes ; involucre campanulate glabrous ; limb of glands pick, upper two larger than the lower two. Capsules glabrous ; seeds transversely wrinkled.

*Fl. & Fr.* : December-February.

*Distrib.* : PARADEEP, SATYAVIA : Common along sandy sea-shores, rarely found along sandy river-beds.

**2. *Euphorbia hypericifolia*** Linn. Sp. Pl. 454, 1753 ; Hook. in Hook. f. Fl. Brit. India 5 : 249, 1887 ; Back. & Bakh. Fl. Java 1 : 504, 1963 ; Haines 1 : 146, 1921.

Variable, erect or decumbent ascending annuals ; stems cylindrical, glabrous, crispid hairy or patently pubescent. Leaves 0.4-3 × 0.2-1.3 cm, ovate-oblong or elliptic-oblong, glabrous or puberulose, entire or faintly serrulate, obtuse or rounded at apex, unequal at base. Cyathia in short-stalked axillary or terminal congested dichasial cymes forming glomerules involucre glabrous ; glandular appendages conspicuous, petaloid. Capsules obtusely 3-lobed, subglobose, crisp-puberulous.

*Fl. & Fr.* : August-December.

*Distrib.* : KUJANG, FALSEPOINT : Common weeds along river-banks, waste sandy places near the sea-shore and road-sides.

Haines (*l.c.*) had made two varieties under this species mainly on the basis of habit and nature of indumentum. Hurusawa in J. Fac. Sci. Univ. Tokyo 6 (3) : 285, 1954 ; Back. & Bakh. (*l.c.*) ; and several other workers of Asiatic floras interpreted *E. hypericifolia* Linn. as a highly variable species specially to the nature of indumentum. In American floras and monographs it has been considered as a glabrous plant.

Field observation reveals that this plant is very variable into its habit and nature of indumentum.

**3. *Euphorbia hirta*** Linn. Sp. Pl. 454, 1753 ; Sant. Rec. bot. Surv. India 16(1) : 214, 1958 ; Haines, 1 : 147, 1925. *E. pilulifera* Linn. Sp. Pl. 454, 1753 ; Hook. in Hook. f. Fl. Brit. India 5 : 250, 1884. *Chamaesyce hirta* (Linn.) Millsp. 303.

Erect or decumbent annuals 10-25 cm tall ; stems unbranched or often branched one or two from the base, sometimes tinged red, adpressed pubescent throughout. Leaves 0.4-3.5 × 0.2-1.5 cm, inequilateral, oblong, elliptic or lanceolate, pubescent, serrulate, acute or obtuse at apex, rounded or cuneate

at base. Cyathia in axillary and terminal leafless glomerules, strigosely hirsute : glandular appendages inconspicuous, or obsolete. Capsules ovoid, 3-lobed hairy.

*Fl. & Fr.* : Throughout the season.

*Distrib.* : KUJANG, PARADEEP : Common along road-sides, gardens, waste sandy places and river-banks.

4. *Euphorbia thymifolia* Linn. Sp. Pl. 454, 1753 ; Hook. in Hook. f. Fl. Brit. India 5 : 252, 1884 ; Haines 1 : 147, 1921. *Chamaesyce thymifolia* (Linn.) Mill. sp. Publ. Field Mus. Nat. Hist. Bot. 2 : 412, 1916.

Prostrate or often ascending annuals ; stems slender, diffusely branched, glabrous or often adpressed pubescent. Leaves 3-10 × 2-5 mm, ovate or elliptic, glabrous or thinly puberulous beneath, serrulate, acute at apex, oblique or subcordate at base. Cyathia solitary, or in pairs, or even few in glomerules, pubescent ; glandular appendages minute. Capsules broadly ovoid, pubescent ; seeds 4-angled.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : BHITARKANIKA, FALSEPOINT : Frequent along the lee-side of the sandunes, road-sides and dry open places.

5. *Euphorbia prostrata* Ait. Hort. Kew 2 : 139, 1789 ; Hook. in Hook. f. Fl. Brit. India 5 : 226, 1884 ; Sant., J. Bomb. nat. Hist. Soc. 46 : 380, 1946 ; Mitra in Ind. For. 95 : 925, 1969. *Chamaesyce prostrata* (Ait.) Small, Fl. South-East U.S. 713, 1903.

Prostrate annuals ; stems slender, branched, forming mat often up to 20cm, crisp-puberulous. Leaves 2-8 × 2-5 mm, broadly elliptic, or obovate-oblong, glabrous, acute at apex, obliquely rounded at base. Cyathia solitary, axillary ; involucre glabrous ; glandular appendages minute. Capsules broadly ovoid, 3-lobed, with stiff-hairs along the angles. Seeds tetragonal.

*Fl. & Fr.* : Throughout the year.

*Distrib.* : KUJANG : Frequent along river-banks, road-sides and open sandy places.

Previously it was recorded as doubtful species according to Hook. (*l.c.*) ; Santapau in J. Bomb. Nat. Hist. Soc. 46 : 380, 1946, recorded its widespread distribution all over India.

## 2. PHYLLANTHUS Linn.

### Key to Species

- |  |     |                        |   |
|--|-----|------------------------|---|
| 1a. Perennial herbs ; filaments free             | ... | <i>virgatus</i>        | 1 |
| 1b. Annual herbs ; filaments fused into a column |     |                        |   |
| 2a. Leaves obovate cuneate ; stipules peltate    | ... | <i>maderaspatensis</i> | 2 |
| 2b. Leaves rotundate ; stipules lanceolate       | ... | <i>roundifolia</i>     | 3 |

1. **Phyllanthus virgatus** Forst. f. Prodr. 65, 1786 ; Back. & Bakh. 1 : 469. *P. simplex* Retz. Obs. Bot. 5 : 29, 1788 ; Hook. in Hook. f. Fl. Brit. India 5 : 295, 1884 ; Haines 1 : 125, 1921.

Deep-rooted perennial herbs ; stems glabrous, much-branched, compressed, spreading radially from rootstock. Leaves 0.5-3.5 × 0.3-0.6 cm, elliptic-oblong, or linear-oblong, sub-sessile, glabrous, acute or mucronulate at apex, obtuse at base ; stipules peltate. Flowers small, greenish-white, in axillary intermixed unisexual cymes ; female flowers larger than male. Capsules 2-2.5 mm, 3-lobed, depressed, glabrous ; seeds trigonous.

*Fl. & Fr.* : June-December.

*Distrib.* : FALSEPOINT, KUJANG : Frequent along river-banks, embankments, cultivated fields and road-sides.

2. **Phyllanthus maderaspatensis** Linn. Sp. Pl. 982, 1753 ; Hook. in Hook. f. Fl. Brit. India 5 : 292, 1884 ; Haines 1 : 124, 1921 ; Wt. Ic. t. 1895, f. 3, 1852.

Annual, glabrous herbs ; stems erect with long ascending branches from woody rootstock, variable in habit. Leaves 4-6 × 2.5-3 cm, obovate-oblong, or oblanceolate, mucronate at apex, narrowed at base. Flowers greenish-white, axillary solitary or clusters ; male flowers usually in minute clusters, female flowers solitary. Capsules depressed, 3-lobed, glabrous ; seeds finely muriculate in lines.

*Fl. & Fr.* : December-March.

*Distrib.* : SATYAVIA, PARADEEP : Frequent along river-banks, leesides of the sea-shore sandunes, and open scrubs. Locally common in cultivated fields.

3. **Phyllanthus rotundifolius** Klein ex Willd. Sp. Pl. 4 : 584, 1805 ; Hook. in Hook. f. Fl. Brit. India 5 : 229, 1884 ; Haines 1 : 127, 1921.

Deep-rooted, much-branched, glabrous herbs ; stems rigid, spreading from woody rootstock. Leaves 4-6 × 1 mm distichous, subsessile, thick, rotundate, rounded and spiculate at apex, obtuse at base. Flowers white, in axillary clusters ; female flowers with larger pedicels than the males. Capsules depressed-globose, pale sparingly-3-lobed ; seeds with thin ribs.

*Fl. & Fr.* : July-September.

*Distrib.* : PARADEEP, SATYAVIA : Common along the sandy sea-shores, more or less restricted in this region.

3. *SYNOSTEMON* F. v. Mueller

*Synostemon bacciformis* (Linn.) Webster in *Taxon* 9 : 26, 1960. *Phyllanthus bacciformis* Linn. *Syst. Nat.* ed. 13, 707, 1774. *Agynestia bacciformis* (Linn.) A. Juss. *Euph. Gen. Tent.* 24, 1824 ; Hook. in Hook. f. *Fl. Brit. India* 5 : 285, 1884 ; Haines 1 : 123, 1921.

Much-branched, glabrous, perennial herbs with long woody taproot ; stems angular, prostrate. Leaves 0.5-3 × 0.3-1.3 cm, distichous, sessile, ovate-oblong or elliptic, fleshy, coriaceous, acute and mucronulate at apex, cuneate at base. Flowers yellowish green, unisexual ; males fascicled in lower axils, females solitary in higher axils. Fruits 5-6 mm across, ovoid contracted at apex ; seeds oblong, tuberculate.

*Fl. & Fr.* : January-June.

*Distrib.* : PARADEEP, BHITARKANIKA : Common along the muddy sea-shores, river-banks and grass-lands.

Webster (*l.c.*) discussed the generic status of *Agynestia* Linn. and revived the genus *Synostemon* F. v. Mueller, to accommodate *Phyllanthus bacciformis* Linn. which was hitherto incorrectly placed the genus *Agynestia* (*sensu* Vent.).

4. *BRIDELIA* Willd.

*Bridelia stipularis* (Linn.) Bl. in *Bijid.* 597, 1826 ; Back. & Bakh. *Fl. Java* 1 : 475 ; Hook. in Hook. f. *Fl. Brit. India* 5 : 271 ; Haines 1 : 121, 1921. *Clutia stipularis* Linn. *Mant.* 127, 1767.

Woody scandent shrubs ; branches many, pendent, glabrous, or puberulous when young, often with deflexed spines. Leaves 3-15 × 2-10 cm, elliptic-oblong, or obovate-oblong, glabrous above, pale-tomentose beneath, obtuse or rounded at apex, rounded or emarginate at base. Flowers monoecious, greenish-yellow in axillary clusters combined into interrupted spikes ; disk of male flowers broader than the females. Fruits 1.2-1.5 cm, across, broadly ellipsoid drupes, juicy, black when ripe.

*Fl. & Fr.* : September-December.

*Distrib.* : BHITARKANIKA, BAHAKUD : Frequent in sandy scrubs, sand-bars within the mangroves, back-mangroves and coastal thickets. Locally found along forest-edges.

## 5. BREYNIA J. R. &amp; G. Forst.

(nom. cons.)

*Breynia rhamnoides* (Retz.) Muell. Arg. in DC. Prodr. 15 (2) : 440, 1866 ; Hook. in Hook. f. Fl. Brit. India 5 : 330, 1884 ; Haines, 1 : 133, 1921. *Phyllanthus rhamnoides* Retz. Obs. 5 : 30, 1789. *Melanthesa rhamnoides* (Retz) Bl. Bijdr. 591, 1825.

Evergreen shrubs 1-4 m tall ; stems much-branched, smooth, light-coloured. Leaves 1-3.5 × 0.5-2.5 cm, spirally arranged along main branches, reduced, distichous along the twigs, elliptic-oblong, or suborbicular, glabrous dark-green above, pale beneath, obtuse or rounded at apex, obliquely rounded at base. Flowers minute, monoecious, greenish-white or often pinkish, solitary or in few-flowered clusters ; males and females often in separate branches. Berries 5-6 mm across, globose, mostly solitary, reddish-black ripe ; seeds 6-12, trigonous, imperforate.

*Fl. & Fr.* : June-December.

*Distrib.* : DALTANGAR, BHITARKANIKA : Frequent in scrub-jungles, coastal thickets and back mangroves.

## 6. ANTIDESMA Linn.

*Antidesma ghesaembilla* Gaertn. Fruct. 1 : 189, t. 39, 1788 ; Pax & Hoffm. in Engler, Pfl. Reich. 81 : 155, 1922 ; Hook. in Hook. f. Fl. Brit. India 5 : 357, 1884 ; Haines 1 : 139, 1922. '*Jamula*'.

Dioecious trees or shrubs 2-6 m tall ; stems 20-50 cm in diam., glabrous, lenticellate, barks grey-white ; branchlets rusty tomentose. Leaves 2.5-10.5 × 1.5-5.5 cm, variable, ovate-oblong or elliptic-oblong, often sub-orbicular, soft hairy above, densely lanate below, acute, obtuse, rounded or emarginate at apex, sub-truncate or sub-cordate at base. Flowers yellow, or brownish-green in axillary paniculate spikes ; spikes velutinous ; males usually yellow, females brownish. Fruits 4-6 mm across, sub-globose drupes, reddish-black when ripe.

*Fl. & Fr.* : March-September.

*Distrib.* : BAHAKUD, FALSEPOINT : Frequent along the river-banks, scrubs, and back mangroves. Locally frequent around trunks and ditches.

Airy Shaw in Willis Dict. Fl. Pl. & Ferns, ed. 7, 1076, 1966 ; Kew Bull. 23 : 277, 1969, reinstated the family Stilaginaceae C. A. Agardh. for the isolated genus *Antidesma* Linn. (*Stilago* Linn.), long included



in the Euphorbiaceae. According to him the small drupaceous fruits, with characteristic faveolate-reticulate and often flattened endocarps differ sharply from anything found in the Euphorbiaceae, and represent marked similarity to those of several genera of Icacinaceae.

## 7. JATROPHA Linn.

### *Key to Species*

- |  |     |                       |
|--|-----|-----------------------|
| 1. Plants mostly purple-red-coloured with glandular dissected stipules | ... | <i>gossypifolia</i> 1 |
| 1. Plants mostly greenish-yellow-coloured with obsolete stipules       | ... | <i>curcus</i> 2       |

1. *Jatropha gossypifolia* Linn. Sp. Pl. 1006, 1753 ; Hook. in Hook. f. Fl. Brit. India 5 : 383, 1884 ; Haines 1 : 101, 1921. 'Bherada'.

Erect shrubs with watery juice, 1-3 m tall ; stems soft, branched, greenish or reddish-purple with brown lenticells. Leaves 3.5-12 × 4.5-15 cm, viciid, broadly obovate or orbicular, palmately 3-5-lobed, purple gradually becoming dark-green, glandular-ciliated along the margins and veins cordate at base. Flowers unisexual, purple in lateral or terminal paniculate cymes or corymbs ; peduncles up to 10 cm long, hairy. Capsules 10-12 mm across, cylindrical, toricocous, sulcate, glabrescent. Seeds 4-6 mm long, ellipsoid, carunculate, smooth.

*Fl. & Fr.* : Mostly throughout the year.

*Distrib.* : BHITARKANIKA, FALSE POINT : Frequent and scattered in dry sandy areas along the lee-sides of sea-shores sandunes, locally common along road-sides, river-banks and hedges.

2. *Jatropha curcus* Linn. Sp. Pl. 1006, 1753 ; Pax & Hoffm. 77, f. 30 ; Hook. in Hook. f. Fl. Brit. India 5 : 383, 1884 ; Haines 1 : 101, 1921. 'Bara Bherada'.

Branched shrubs or trees with watery juice, 1-6 m tall ; stems greenish-white, soft ; barks brownish, often peeling off in flakes. Leaves 4-15 × 4-16 cm, broadly ovate-orbicular with 3-5 angular lobes, glabrous or puberulous along the veins below, acute at apex, cordate at base. Flowers greenish-yellow, unisexual, in lateral or terminal pedunculate corymbose cymes ; peduncles 4-10 cm long. Capsules 2-3 cm across, ellipsoid, turning yellow when ripe ; seeds ellipsoid, shining.

*Fl. & Fr.* : March-September.

*Distrib* : BHITARKANIKA : Frequent in sandy waste places along back mangroves and river-banks, locally common along road-sides and hedges.

Seeds are used for skin-diseases.

#### 8. CHROZOPHORA Juss. *nom. cons.*

*Chrozophora rottleri* (Geis.) Juss. ex Spreng, Syst. 3 : 850, 1826 ; Pax & Hoffm. 57 : 19 ; Haines 1 : 102, 1921. *Croton rottleri* Geis. *Crot. Monogr.* 57, 1807. *Chrozophora plicata auct. non* Juss. Hook. in Hook. f. *Fl. Brit. India* 5 : 410, 1887.

Annual or perennial herb or undershrubs ; stems branched, densely stellately hairy. Leaves 4-8 × 2-6 cm, broadly ovate, or ovate-orbicular, thick, crispy, stellately tomentose, obtuse at apex, cuneate or subcordate at base. Flowers unisexual, adpressed hairy, in axillary pedunculate racemes. Capsules globose, 3-lobed, reddish-tomentose.

*Fl. & Fr.* : March-September.

*Distrib.* : KUJANG, FALSEPOINT : Frequent in waste sandy places near the shores, river-banks, road-sides, embankments on reclaimed soils.

#### 9. CROTON Linn.

*Croton bonplandianum* Baill. in *Adansonia* 4 : 339, 1864 ; Croizet in *J. Bomb. nat. Hist. Soc.* 41 : 573, 1940. *C. sparsiflorum* Morong in *Ann. N. Y. Acad. Sci.* 7 : 22, 1892 ; Haines 1 : 104, 1921.

Aromatic bushy herbs or small undershrubs, 20-60 cm, tall ; stems much-branched, terete, striate. Leaves 2-5.5 × 0.5-2.5 cm, ovate-lanceolate, glabrous, crenato-serrate, acute at apex, rounded at base. Flowers unisexual, in terminal racemes ; females mostly solitary from nodes, males usually clustered from succeeding nodes. Capsules oblong, 3-lobed.

*Fl. & Fr.* : Throughout the year.

*Distrib* : KUJANG, PARADEEP : Common weeds along river-sides, seashores, road-sides and cultivated fields.

## 10. HEMICYCLIA Wight. &amp; Arn.

*Hemicyclia sepiaria* Wight. & Arn. in Edinb. New Phil. Jour. 14 : 297, 1833 ; Hook. in Hook. f. Fl. Brit. India 5 : 337, 1884 ; Wt. Ic. t. 1872, 1849 ; Triman in Fl. Ceylon 4 : 36, 1898.

Evergreen trees or shrubs 2-3 m tall ; stems glabrous, lenticellate, twigs minutely pubescent. Leaves 3.9 × 1.3 cm, elliptic-oblong, or ovate, coriaceous, entire or shallowly toothed, obtuse or retuse at apex, rounded or cordate at base. Flowers dioecious, villous, in axillary clusters ; males pedunculate, females sessile. Fruits 1-2 cm across, globose-fusiform, greenish.

*Fl. & Fr.* : January-April.

*Distrib.* : BHITARKANIKA : Frequent on sandy scrubs and back mangroves.

Fruits are edible.

Haines (1921) and Mooney (1950) have not recorded this species ; hence it is a new record for Orissa.

## 11. SUREGADA Roxb. ex Rottl.

*Suregada multiflora* (Juss.) Baill. Etude Gen. Euph. 396, 1856. *Gelonium multiflorum* Juss. Tent. Euph. 3 : t. 10, f. 31, 1828 ; Pax & Hoffm. in Eng. Pfreich. 52 : 16, f. 3, 1912 ; Hook. in Hook. f. Fl. Brit. India 5 : 459, 1884 ; Haines 1 : 114, 1921. 'Kukra'.

Dioecious evergreen trees 4-12 m tall, 40-60 cm in diam. ; branches pale, marked with stipular scars. Leaves 5.5-14 × 2.5-6.5 cm, elliptic-oblong, or lanceolate, coriaceous, pellucid-punctate, shining-glabrous above, pale beneath, entire or minutely serrate at the base, acute or acuminate at apex, cuneate at base. Flowers 7-10 mm across, yellow, 1-5-flowered in leaf-opposed corymbose clusters ; males sweet-scented glabrous, females minutely puberulous. Capsules 1-2 cm across, 3-gonous, depressed globose, fleshy, orange-yellow when ripe.

*Fl. & Fr.* : March-August.

*Distrib.* : CHANDBALI, BHITARKANIKA : Frequent in sandy scrubs around tanks and ditches, gardens and road-sides.

Legitimate name *Suregada* Roxb. ex Rottler (Gesell. Naturf. Freunde, Neue schrift. 4 : 206, 1803), for this genus, was repeatedly neglected owing to misconception and its deliberate rejection in favour of *Gelonium* Roxb. ex Willd. (1806) non Gartner (1791), by several workers. Since its publication *Suregada* Roxb. ex Rottl. was correctly taken up by Baillon (*l.c.*) and subsequently upheld by O. Kuntze. Croizat (Bull. Jard. Bot. Butz 3, 17 : 212-17, 1942) while reinstating *Suregada* discussed in detail. (Back. & Bakh. Fl. Java 1 : 497, 1963, accredited *Suregada* Roxb. ex Willd. though manuscript name of Roxb. validly published by Rottler not by Willdæow.).

#### EXCOECARIA Linn.

*Excoecaria agallocha* Linn. Syst. Nat. ed. 10, 1288, 1759 ; Hook. in Hook. f. Fl. Brit. India 5 : 472, 1886 ; Haines 1 : 117, 1921. 'Gaungod'.

Evergreen trees with milky acridjuice, 4-20 m tall, 10-80 cm in diam. ; barks greyish-white, lenticellate ; woods soft, light. Taproot insignificant, lateral roots spreading like snakes intermingled each other, supraterranean bends produce elbo-shaped pegs instead of pneumatophores. Leaves 2-8 × 1.5-3 cm, ovate, ovate-elliptic or ovate-oblong, coriaceous, shining dark-green, turn red before shedding, obtuse or acute at apex, narrowed at base. Flowers unisexual, fragrant, male flowers 2-3 mm across, sessile, yellow, in axillary many-flowered catkin-like spikes, 3-7 cm long ; female flowers 2.5-3.5 mm across, pedicellate, in axillary few-flowered racemes, racemes 1-2.5 cm long. Fruits 1-1.5 cm across, depressed-globose, 3-lobed ; seeds subglobose smooth.

*Fl. & Fr.* : February-September.

*Distrib.* : MAHANADI DELTA : Common along the intertidal zones of creeks and channels in the mangroves, estuaries and muddy sea-shores, usually in association with *Avicennia officinalis*, *Bruguiera parviflora* and *Aegialitis rotundifolia*. It can tolerate high salinity near the estuaries and also fresh-water-condition while occurs along the banks of fresh-water-river.

*Notes* : Woods are very light, much used for packing box, which may be utilised for good quality of paper.

Flowers unisexual, males and females may be found in different branches or plant may be dioecious.

#### ACALYPHA Linn.

*Acalypha indica* Linn. Sp. Pl. 1003, 1753 ; Pax & Hoffm. 85 : 33 ; Hook in Hook. f. Fl. Brit. India 5 : 416, 1884 ; Haines 1 : 113, 1921.

Erect glabrous herbs with many angular branches. Leaves 1.6-6 × 1-4 cm, ovate-rhomboid, crenato-serrate, obtuse or acute at apex, cuneate at base. Flowers small, greenish, in axillary elongated spikes; males ebracteolate, clustered towards the apex: females 3-5 together subtended by leafy bracteoles. Capsules 2 mm across, concealed within bracts.

*Fl. & Fr.* : Throughout the season, mostly March-July.

*Distrib.* : CHANDBALI; FALSE POINT : Frequent on sandy sea-shores, river-banks, locally common along road-sides, old buildings and hedges.

#### MICROCocca Benth.

*Micrococca mercurialis* (Linn.) Benth. in Hook. Niger. Fl. 503, 1849; Pax & Hoffm. 63 : 133, f. 18D-F. Bennet in Ind. For. 92 : 227, 1966. *Tragia mercurialis* Linn. Sp. Pl. 980, 1753. *Claoxylon mercurialis* (Linn.) Thw. Enum. Pl. Zeyl. 271, 1861; Hook. in Hook. f. Fl. Brit. India 5 : 412, 1884; Haines 1 : 112, 1921.

Erect annuals with pale-green branches, puberulous, woody below. Leaves ovate or lanceolate, membranous, acute or acuminate at apex, cuneate at base. Flowers unisexual, greenish-yellow, clustered in axillary racemes. Capsules 3-4 mm across, sub-globose, 3-lobed, more or less hispid.

*Fl. & Fr.* : June-August.

*Distrib.* : SATYAVIA : Rare in sandy waste places and embankments near the coast. Locally along the road-sides and hedges.

### MORACEAE

#### FICUS Linn.

##### *Key to Species*

- |                             |     |                 |
|-----------------------------|-----|-----------------|
| 1a. Leaves obovate-rhomboid | ... | <i>retusa</i> 1 |
| 1b. Leaves elliptic-oblong  | ... | <i>virens</i> 2 |

1. *Ficus retusa* Linn. Mant. 129, 1767; Back. & Bakh. Fl. Java 2 : 35, 1965; Corner Gard. Bull. 393, 1959. Hook. in Hook. f. Fl. Brit. India 5 : 511, 1888; Haines 2 : 828, 1924.

Trees 5-10 m tall glabrous, much-branched. Leaves 4-10 × 3-6 cm, obovate-oblong, or rhomboid, sometimes broadly rounded, coriaceous, shining, obtuse or rounded at apex, truncate, cuneate or tapering at base, prominently nerved beneath. Syconia 0. -1 cm across, obovoid, yellowish-red, crowded in leaf-axils.

*Fl. & Fr.* : August-December.

*Distrib.* : BHITARKANIKA : Frequent in sandy scrubs, road-sides and villages ; sometimes found along the back of mangroves.

2. *Ficus virens* Ait. Hort. Kew 3 : 451, 1789 ; Back. & Bakh. 2 : 35 ; Corner l. c. 377 ; *E. infectoria* Roxb. non Willd. Fl. Ind. 3 : 551, 1832 ; Hook. in Hook. f. Fl. Brit. India 5 : 515, 1888 ; Haines 2 : 830, 1924

Laticiferous deciduous trees 10-30 m tall. Leaves 10-18 × 3-5.5 cm, ovate-oblong or oblong, glabrous, entire or wavy, tapering into an acuminate apex, rounded, truncate or slightly acuminate at base ; petioles 3-5.5 cm long, articulated. Syconia globose, pale-red, paired, in leaf-axils or fallen leaves.

*Fl. & Fr.* : June-July ; August-September.

*Distrib.* : KUJANG, BHITARKANIKA : Frequent in sand-bars situated in-between the creeks and mangroves. Locally common along river-banks and open forests near villages.

## SALICACEAE

### SALIX Linn.

*Salix tetrasperma* Roxb. Cor. Pl. 1 : 66, t. 97, 1796 ; Hook. in Hook. f. Fl. Brit. India 5 : 626, 1888 ; Haines 1 : 839 ; Back. & Bakh. Fl. Java 2 : 1, 1965.

Small, evergreen trees or shrubs 3-8 m tall ; twigs densely pilose ; bark greyish-brown, fissured. Leaves variable, 5-20 × 2-5.5 cm, ovate-oblong or oblanceolate, glabrous, shining along upper surface, pale, glaucous or whitish beneath, acute at apex, obtuse or rounded at base. Catkins not observed.

*Distrib.* : JAGAT-SINGPUR : Very rare along the river and streams towards the fresh-water condition.

## CERATOPHYLLACEAE

### CERATOPHYLLUM L.

*Ceratophyllum demersum* Linn. Sp. Pl. 992, 1753 ; van Steenis in Fl. Mal. 4 : 41, f. 1, 1949 ; Hook. in Hook. f. Fl. Brit. India 5 : 639, 1888 ; Haines 2 : 841, 1924.

Slender, submerged, monoecious aquatic herbs; stems much-branched, rootless. Leaves 1-2.5 cm long, 7-10 in whorls from each node, dichotomously 2-4 cleft into slender brittle segments. Flowers solitary, axillary, subsessile. Fruits ellipsoid, compressed with a spinescent style at apex and 2-lateral spines at base.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : PARADEEP : Fresh-water plants, frequently found within sandy slacks along the sea-shores.

## MONOCOTYLEDONS

### HYDROCHARITACEAE

#### HYDRILLA L. C. Rich.

*Hydrilla verticillata* (Linn. f.) Royle, *Illustr. Bot. Himal.* t. 376, 1839 ; Hartong in *Fl. Mal.* 5 : 385, f. 1, 1957 ; Subramanyam *Aqua. Ang.* 55, f. 37, 1962 ; Hook. in Hook. f. *Fl. Brit. India* 5 : 659, 1888 ; Haines 2 : 852, 1924. *Serpicula verticillata* Linn. f. *Suppl.* 416, 1781.

Slender, much-branched, submerged perennial herbs. Leaves 4-14 × 1-3 mm, whorled, sessile, linear-lanceolate, entire or serrulate, acute, short mucronate at apex. Flowers dioecious ; male spathes flattened, globose, containing solitary pedicellate flower ; female spathes cylindrical, bifid, with solitary flower. Fruits linear-subulate, softly echinate.

*Fl. & Fr.* : October-December.

*Distrib.* : SAJYAVIA : Frequent in ponds and puddles under fresh water along the shores, locally common.

### AMARYLLIDACEAE

#### CRINUM Linn.

##### *Key to Species*

- |                           |     |                    |
|---------------------------|-----|--------------------|
| 1a. Leaves 10-20 cm broad | ... | <i>asiaticum</i> 1 |
| 1b. Leaves 2-3 cm broad   | ... | <i>defixum</i> 2   |

1. *Crinum asiaticum* Linn. *Sp. Pl.* 419, 1753 ; Back. & Bakh. *Fl. Java* 3 : 136, 1968 ; Hook. in Hook. f. *Fl. Brit. India* 6 : 280, 1892 ; Haines 2 : 1108, 1924.

Stout herbs ; bulbs tunicated, long-necked. Leaves 1-1.5 m long, 10-20 cm broad, flat-lanceolate, shortly acuminate at apex, sheathing at base. Flowers white, fragrant, 10-30, in umbels, subtended by spathaceous bracts ; peduncles 40-120 cm long. Fruits globose, spongy, each 3-5 cm across.

*Fl. & Fr.* : July-September ; February-March.

*Distrib.* : BHITARKANIKA : Commonly found under shade of *Heritiera fomes* within mangrove swamps. Locally cultivated as ornamental plants.

2. *Crinum defixum* Ker. Gawl. in Jour. Sci. & Arts 3 : 105, 1817 ; Hook. in Hook. f. Fl. Brit. India 6 : 281, 1892 ; Haines 2 : 1108, 1924.

Herbs with subterranean ovoid, fusiform, long-naked bulbs, whose apex grows out into long or short primary, secondary and tertiary subterranean spurious stems. Leaves 60-80 × 2-3 cm, linear-lanceolate, glabrous, thick, dark green, rounded at apex. Flowers white, 4-8, in axillary umbels ; peduncles erect, cylindrical, 60-100 cm long ; anther filaments shorter than perianth lobes, bright red or white. Fruits subglobose, shortly beaked.

*Fl. & Fr.* : July-September, December.

*Distrib.* : BHITARKANIKA : Common in the intertidal zones along the creeks and channels, often found as pure formations in front of *Sonneratia apetala* under considerable influence of brackish water.

Interesting field observations on this plant showed that while the plants were found growing in soft tidal mud, they produced three consequent subterranean bulbs at the same level one above the other with the intermediate short or long necks. This could be well seen in the mounted herbarium specimens. The cause for the development of this primary, secondary and tertiary bulbs one above the other is not established ; however, since the area is under continuous inundation, deposition of silt and clay layers caused the soil to rise the level higher and higher, resembling in the neck of the primary bulb producing the secondary bulb and the neck of secondary bulb producing tertiary bulbs.

## DIOSCOREACEAE

### DIOSCOREA Linn.

#### *Key to Species*

- |  |     |                        |
|--|-----|------------------------|
| 1a. Leaves broadly ovate-cordate or suborbicular               |     |                        |
| 2a. Stems frequently with bulbils ; leaf and capsule glabrous  | ... | <i>bulbifera</i> 1     |
| 2b. Stems infrequent with bulbils ; leaf and capsule pubescent | ... | <i>puber</i> 2         |
| 1b. Leaves elliptic-oblong or lanceolate                       | ... | <i>oppositifolia</i> 3 |

1. *Dioscorea bulbifera* Linn. Sp. Pl. 1033 ; Burkill in Fl. Mal. 4 : 311, f. 4, 1951 ; Haines 2 : 1122, 1924. *D. sativa* auct. non. Linn. Hook.



in Hook. f. Fl. Brit. India 6 : 295, 1892 ; Prain and Burkill in Ann. R. bot. Gard. Cal. 14 : 111, Pl. 49 & 59, 1936. "*Pita Alu*".

Twining bulbiferous, shrubs ; stems terete, glabrous, with frequent bulbils. Leaves 5-30 × 4-16 cm, opposite or often alternate, broadly ovate-cordate or suborbicular, membranous palmately 7-9-nerved beneath, acute, acuminate or cuspidate at apex, cordate with shallow sinus at base. Male flowers numerous, fragrant, greenish-white, turning to purple in axillary pendulous spike. Females in axillary spikes ; spikes 2-5-nate, 12-30 cm long. Capsules quadrately oblong, winged, broader towards the apex. Seeds 3-5 mm in diam., winged.

*Fl. & Fr.* : September-October ; fruits mature during December.

*Distrib.* : BAHAKUD : Frequent along the river-banks and coastal scrubs.

2. *Dioscorea puber* Blume, En. Pl. Java 1 : 21, 1827 ; Burkill Fl. Mal. 333, Prain & Burkill 402, *D. anguina* Roxb. Fl. Ind. 3 : 803, 1832, *excl. ref.* Rumph ; Hook. in Hook. f. Fl. Brit. India 6 : 293, 1892 ; Haines 2 : 117, 1924.

Softly tomentose, twining shrubs. Leaves 15-25 × 10-20 cm, broadly ovate-cordate or cordate, glabrous above, pubescent below, acuminate at apex, cordate at base. Male flowers greenish-white, in axillary pendulous spikes ; female flowers slightly pubescent, in axillary panicles. Capsules subcordate, pubescent along the wings ; seeds orbicular.

*Fl. & Fr.* : September-December.

*Distrib.* : September-December.

3. *Dioscorea oppositifolia* Linn. Sp. Pl. 1033, 1753 ; Sant. Rec. bot. Surv. India 16 : 251, 1958 ; Hook. in Hook. f. Fl. Brit. India 6 : 292, 1898 ; Prain & Burkill Pl. 139 ; Haines 2 : 1118, 1924.

Glabrous twining shrubs ; stems terete, slender, greenish or greenish-purple. Leaves opposite, 4-9 × 3-5 cm, elliptic-oblong or lanceolate, not prominently veined, acuminate at apex, rounded at base. Male flowers small, greenish-yellow, in axillary, pendulous spikes ; spikes often fascicled on axillary rachis ; female flowers distant, on solitary or fascicled spikes. Capsules 3-3.5 cm across, suborbicular or broadly ovoid, glabrous, winged ; seeds 8-10 mm across ; orbicular, winged all round.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : BAHAKUD : Frequent in sandy scrubs, along the river-banks, coastal thickets and rarely back mangroves.

## SMILACEAE

## SMILAX Linn.

*Smilax perfoliata* Lour. Fl. Cochinch. 622, 1790 ; Koyama in Adv. Front. Pl. Sci. 4 : 59, 1963. *S. prolifera* Wall. ex Roxb. Fl. Ind. 3 : 795, 1832 ; Hook. in Hook. f. Fl. Brit. India 6 : 312, 1892 ; Haines 2 : 1087, 1924.

Dioecious, prickly, climbing shrubs. Leaves 5-19 × 2-14 cm broadly elliptic, ovate or suborbicular, coriaceous, reticulo-venose, acute, retuse or mucronate at apex, rounded or contracted at base ; petioles winged below ; tendrils stout, as long as the lamina. Flowers greenish-yellow, fragrant, arranged in axillary 2-3-nate pedunculate umbels. Berries ovoid, 5-1 mm across, red when ripe

*Fl. & Fr.* : July-August ; November-December.

*Distrib.* : BAHAKUD : Frequent in sandy scrubs along the river-banks and coastal thickets.

## LILIACEAE

*Key to Genera*

- |   |     |             |
|---|-----|-------------|
| 1a. Root-stock tuberous ; leaves not radical                              |     |             |
| 2a. Leaves well developed, terminating in tendril                         | ... | GLORIOSA 1  |
| 2b. Leaves not well developed, cladodes, needle-like ;<br>tendrils absent | ... | ASPARAGUS 2 |
| 1b. Root-stock bulbs or corns ; Leaves radical                            | ... | SCILLA 3    |

## GLORIOSA Linn.

1. *Gloriosa superba* Linn. Sp. Pl. 305, 1753 ; Hook. in Hook. f. Brit. India 6 : 358, 1892 ; Haines 2 : 1093, 1924. "*Gaichera*".

Glabrous scrambling or climbing shrubs with tuberous rootstock ; stems leafy, 20-60 cm, or often more long, sometimes forked. Leaves 6-15 × 1-3 cm, spirally arranged or partly subopposite, ovate-lanceolate, terminating into a coiled tendril with prominent midrib. Flowers yellowish-red, or flame-coloured, 8-15 cm across, juxtafoliar, solitary on reflexed pedicels ; perianth wavy or crisped. Fruits 4-6 cm, oblong, ovoid ; seeds orange-red.

*Fl. & Fr.* : September-October ; November-December.

*Distrib.* : CHANDBALLI, BAHAKUD & FALSE POINT : Frequent on sandy scrubs and coastal thickets, often found common along the sandy banks of the Mahanadi river. Frequent along the back mangroves.

## ASPARAGUS Linn.

*Asparagus recemosus* Willd. Sp. Pl. 5 (2) : 152, 1799 ; Hook. in Hook. f. Fl. Brit. India 6 : 316, 1892 ; Haines 2 : 1088, 1924. "*Satamuli*".

Much-branched, scandent shrubs ; stems terete, woody, with straight or curved spines. Cladodes 4-8 together, alternate, 5-20 mm long, linear, subulate, triquetrous with pointed spinous tip. Flowers 4-6 mm across, fragrant, purplish-white, in axillary racemes with 3-4 mm long articulated pedicels. Fruits 5-6 mm across, globose. Berries, 1-3 seeded, red when ripe,

*Fl. & Fr.* : September-October.

*Distrib.* : BAHAKUD, CHANDBALI : Common on scrub jungles and coastal thickets.

## SCILLA Linn.

*Scilla hayacinthina* (Roth.) Macbride, Back. & Bakh. Fl. Java 3 : 91, 1968. *Ledebouria hyacinthina* Roth. Nov. Pl. Sp. 195, 1821. *Scilla indica* Baker in Saund. Refug. Bot. 3 : 12, 1870 ; Hook. in Hook. f. Fl. Brit. India 6 : 348, 1892 ; Haines 2 : 1096, 1924.

Herbs with subterraneous tunicated bulbs. Leaves 10-20 × 3-6 cm, radical, oblong-lanceolate, or linear-lanceolate, rather fleshy, often marked with blackish-brown blotches. Flowers greenish-purple arranged in many-flowered racemes. Capsules 1.5 cm across, membranous.

*Fl. & Fr.* : July-September.

*Distrib.* : PARADEEP, SATYAVIA : Very frequent along the sandy seashores.

This plant was collected in vegetative condition ; tubers were planted and they flowered during June-July.

## XYRIDACEAE

## XYRIS Linn.

*Xyris indica* Linn. Sp. Pl. 42, 1753 ; van Royen in Fl. Mal. 4 : 373, 1953 ; Hook. in Hook. f. Fl. Brit. India 6 : 364, 1892 ; Haines 2 : 1072, 1924.

Erect annual herbs, 10-20 cm tall. Leaves 5-20 × 0.5-1 cm linear-ensiform, glabrous, straight or falcate above, acute or obtuse at apex, sheathing at base. Flowers 0.6-1 cm across, bright yellow, in terminal globose or ellipsoid heads. Fruits 3-4 mm across, obovoid, 3-gonous capsules.

*Fl. & Fr.* : June-August.

*Distrib.* : PARADEEP : Occasionally found in moist sandy places near the shore ; common in paddy-fields adjacent to the coast.

## COMMELINACEAE

### *Key to Genera*

- |  |     |             |
|--|-----|-------------|
| 1a. Fertile stamens 3 ; staminodes 2-4           |     |             |
| 2a. Cymes 1-2, subtended by spathaceous bracts   | ... | COMMELINA 1 |
| 2b. Cymes paniculate, without spathaceous bracts | ... | MURDANNIA 2 |
| Fertile stamens 6 ; staminodes absent            | ... | CYANOTIS 3  |

### 1. COMMELINA Linn.

1. *Commelina attenuata* Koen. ex Vahl, Enum. 2 : 168, 1806 ; Hook in Hook f. Fl. Brit. India 6 : 372, 1892 ; Haines 2 : 1076, 1924.

Slender, much-branched, creeping herbs, rooting at nodes. Leaves 1.5-3.5 × 0.4-0.8 cm, ovate-lanceolate, falcate, acute at apex, sheathing at base ; leaf-sheath 2-3 mm broad, ciliate. Spathes sagittately cordate with large auricles. Flowers 1-2 mm across, deep-blue, in 2-fid terminal cymes emerging out from funnel-shaped spathe. Capsules 4-6 mm, oblong, compressed ; seeds 1-2 brownish with white appendages.

*Fl. & Fr.* : Throughout the season.

*Distrib.* : PARADEEP, KUJANG : Frequent on moist sandy places along the shores and river-beds, locally common.

### 2. MURDANNIA Royle (*nom. cons.*)

*Murdannia nudiflora* (Linn.) Brenan in Kew Bull. 1952 ; 189, 1952 ; Panigrahi & Kammathy in Proc. nat. Acad. Sci. India B 33 : 495, f. 7, 1963. *Commelina nudiflora* Linn. Sp. Pl. 41, 1753, p. p. ; Hook. f. Fl. Brit. India 6 : 369, 1892 ; Haines 2 : 1075, 1924.

Erect, ascending, creeping or pendent, tufted annuals. Leaves 2.5-15 × 0.4-0.8 cm, linear-lanceolate, acute at apex, contracted at base ; sheaths 5-11 mm long, striated, hairy along margins. Flowers purple, in terminal corymbose cymes ; peduncles up to 4 cm long. Capsules 3-4 mm, oblong, trigonous, apiculate ; seeds brownish rugose.

*Fl. & Fr.* : August-Sept.

*Distrib.* : SATYAVIA, PARADEEP : Frequent in moist sandy waste places along the shores ; locally common.

3. *CYANOTIS* D. DON (*nom. cons.*)

*Cyanotis cristata* (Linn.) Schult. f. Syst. 7: 1150, 1830; Hook. f. Fl. Brit. India 6: 385, 1892; Haines 2: 1081, 1924. *Commelina cristata* Linn. Sp. Pl. 42, 1753.

Ascending, erect or creeping herbs, rooting at nodes; branches slender, terete, with patent hairs. Leaves 2-6 × 0.5-1 cm, lanceolate, minutely velutino-puberulent along both surfaces, acute at apex, rounded at base; sheaths 4-8 mm, pubescent along margins. Flowers blue, in terminal or axillary, curved, biseriate cincinni, enclosed by conspicuous, foliaceous bracts. Fruits 3-4 mm long, ellipsoid, trigonous.

*Fl. & Fr.* : Mostly July-September.

*Distrib.* : KUJANG, FALSE POINT : Frequent on moist sandy places along the shore, river-beds, and moist fields amidst grasses. Common locally along roadsides, and on old brick-walls.

## FLAGELLARIACEAE

## FLAGELLARIA Linn.

*Flagellaria indica* Linn. Sp. Pl. 333, 1753; Hook. f. Fl. Brit. India incl. var. *minor*, 6: 391, 1892; Haines 2: 1073, 1924; Back. in Fl. Mal. 4: 245, Fig. 1, 1951.

Perennial climbers, 2-8 m tall; stems, woody, smooth, glabrous, turning yellow when dry. Leaves bifarious, 8-25 × 2 cm, ovate-lanceolate, shining glabrous with prominent longitudinal veins, tapering into long, coiled tendrils at apex, rounded or subcordate at base; base abruptly contracted into short petioles; leaf-sheath terete. Flowers 1-1.5 mm across, cream-coloured, fragrant, arranged in densely packed terminal panicles, subtended by bracts; panicles forked consistingly into two main branches from the base, each 5-8 cm long. Drupes 5-7 mm across, globose, apiculate, bright red when ripe; seed one, globose with white powdery endosperm.

*Fl. & Fr.* : September-January.

*Distrib.* : BHITARKANIKA : Common along the banks of creeks and channels in the mangroves, frequently found inside the forests.

Another species of this genus was collected from Bhitarkanika Reserved Forest which differs from the above taxon on the following features:

Robust climbers; stems with long internodes; leaves 30-40 × 3-4 cm; leaf-sheath not closed up to the very apex. Since the specimens were in vegetative condition, it was not possible to identify; it appears close to *Flagellaria gigantea* Hook. f.

*Specimen examined* : Bhitarkanika, Cuttack Dt., Orissa; *Banerjee* 9430 (CAL).

## ARECACEAE

### PHOENIX Linn.

*Phoenix paludosa* Roxb. Fl. India, ed. Carey 3 : 789, 1832; Beccari & Hook., f. Fl. Brit. India 6 : 427, 1893; Haines 2 : 882, 1924. '*Hatal*'.

Bushy gregarious, sobliferous palms, 3-8 m tall, 20-40 cm in diam.; stems often inclined, annulated, covered with fibrous sheath and petiolar base. Roots spongy, velaminous, producing small needle-like perforated breathing roots. Leaves 2-3.5 m long, imparipinnate with dilated petioles and fibrous sheath, embracing stems; leaf-segments many, lanceolate or ensiform, waxy-glabrous, narrowly pointed at apex into a short spine, the lower few pairs modified into sharp spines. Flowers 5-8 mm across, dioecious, whitish-yellow, coriaceous, in simply branched interfoliar spadices. Spathes 20-30 cm long, brownish. Fruits 10-12 mm long, ellipsoid, smooth, 1-seeded drups; seeds with longitudinal grooves along ventral side, bony.

*Distrib.* : MAHANADI DELTA : Most common and more or less confined to muddy maritime swamps along the lee-side of the coastal sand dunes where the land is interconnected by several channels from the adjacent rivers; deposition from the river and sand from the sea produce some sort of elevated muddy-swamps; very often it forms pure community along the muddy coast starting from the intertidal zones up to 10-20 kms away. It is also found along the elevated banks of tributaries and rivers where it appears as a first mangroves community along the course of the river from the up-stream towards the sea; the root-system characteristically anchors with the soil firmly, and the soil level rises year after year. Under this condition other genera of mangroves like *Cerlops*, *Heritiera*, *Excoecaria*, which require to be sub-merged under water at least for a period of one to two hours a day, are associated in lesser numbers.

*Fl. & Fr.* : February-April; June-August.

Leaves and stems are extensively used for temporary and permanent huts and sun-hats. It is one of the most common natural barrier for soil erosion and cyclones.

Lee-side of Paradeep coast was completely covered with a pure community of *P. paludosa*, spreading vast stretches ; now with the construction of recent Paradeep Port, this community is being destroyed gradually by the local inhabitants.

## PANDANACEAE

### PANDANUS Linn. f.

*Pandanus tectorius* Soland ex Park. in J. Voy. H. M. S. Endeavour, 46, 1773 ; Haines 2 : 877, 1924 ; *P. fascicularis* Lamk. Encyc. Methd. 1 : 372, 1783 ; Hook. f. Fl. Brit. India 6 : 485, 1893.

Trees 3-6 m tall, laxly branched, erect or inclined, with many prop-roots, often with aerial roots from branches. Leaves 1-2.5 m long, ensiform, coriaceous, pointed, spinous margined, gradually tapering into a long triquetrous acumen. Male spadix yellowish, fragrant, with many cylindric spikes enclosed by caudate-acuminate spathes. Female spadix splitary, 5-8 cm in diam. Fruits 10-20 cm long, oblong ; syncarpium, yellow, red when ripe ; carpels 3-7 cm long, fragrant, angular, convex depressed at apex ; mesocarp of pyrenes fibrous.

*Fl. & Fr.* : April-May ; July-September.

*Distrib.* : PARADEEP, SATYAVIA : Wild along the sea-shore, often found along the interior sand-bars in-between the creeks and channels. Locally cultivated.

## TYPHACEAE

### TYPHA Linn.

*Typha angustata* Bory & Chaub. Exp. Sc. Mores 1 : 338, 1832 ; Subramanyam 74 ; Hook. f. Fl. Brit. India 6 : 489, 1892 ; Haines 2 : 876, 1924.

Perennial palustrial herbs with thick fleshy creeping rhizomes. Leaves distichous, 1.5-3.5 m long, spongy, semi-cylindrical above the sheath, stiffer along margins, obtuse at apex. Flowers minute, brownish, in compact, superimposed, cylindric, unisexual spikes ; upper portion of spike with male flowers up to 26 cm long ; lower part with female flowers, longer than male. Fruits minute, fusiform, subtruncate at base.

*Fl. & Fr.* : May-July ; August-September.

*Distrib.* : TALCHUA : Specially in fresh-water swamps, frequently found in slightly brackish water at low-laying areas and in paddy fields.

*Note* : Mooney (1950) in Suppl. Bot. Bihar & Orissa, collected only from Bolangir which is the only record from Orissa so far known, but he also remarked that it may be found in the Mahanadi delta.

## ARACEAE

### CRYPTOCORYNE Fisch. ex Wydl.

*Cryptocoryne cillata* (Roxb.) Schott. Melet. 1 : 16, 1832 ; Back. & Bakh. Fl. Java 3 : 126, 1968 ; Hook. f. Fl. Brit. India 6 : 492, 1893. *Ambrosinia cillata* Roxb. Cor. Pl. 3 : 90, t. 294 ; Jacobsen, Bot. Notiser 130 : 72, 1977.

Erect, Marshy herbs 40-50 cm tall with short subterranean stolons. Rhizomes 40-50 mm long, erect or slightly curved. Leaves dimorphic, 2-3, each 30-50 cm long, including the petioles ; normal leaves lanceolate, inequilateral, acute at apex, acute or shortly lobed at base ; petioles subterete, 20-30 cm long ; lamina 15-25 x 4-6 cm. Flowers yellowish-green, in 9-13 mm long spadix ; spathe fleshy, tubular part, slightly oblique ; male part of the spadix 4-6 mm long ; female part 5-8 mm long.

*Fl. & Fr.* : Very rarely found during July-August.

*Distrib.* : BHARKHANASHI : Common in intertidal regions of creeks and channels under brakish water ; usually in association with species of *Excoecaria*, *Rhizophora* and *Cerriops* ; occasionally found under seasonal fresh-water conditions.

## ALISMATACEAE

### LIMNOPHYTON Miq.

*Limnophyton obtusifolium* (Linn.) Miq. Fl. Ind. Bat. 3 : 242, 1855 ; Subrm. 86 ; Hook. f. Fl. Brit. India. 6 : 560, 1893 ; Haines 2 : 844, 1924.

Erect, laticiferous, succulent, aquatic herbs. Leaves emersed, 8-10 x 12-15 cm. pellucid-punctate, obtuse or rounded at apex, sagittate at base ; basal lobes acutely acuminate ; petioles 20-40 cm long. Flowers 8-10 mm across, white, many-flowered whorls, arranged on long-branched panicles ; upper whorls mostly males and the lower hermaphrodite ; scapes angular, 20-40 cm long. Ripe carpels 15-many, reticulate, ribbed, crowded on a small receptacle with swollen achenes serving as floating apparatus.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : BAHAKUD, SATYAVIA ; Frequent in low ditches inside the scrubs and lee-side of the sea-shore, under fresh-water condition. Locally very common in pools.



## APONOGETONACEAE

## APONOGETON Linn. f.

*Key to Species*

- 1a. Leaves floating ; Flowers densely arranged ; tepals longer than follicles ... *natans* 1
- 1b. Leaves submerged flowers laxly arranged ; tepals shorter than follicles ... *crispum* 2

1. *Aponogeton natans* (Linn.) Engl. & Krause in Engl. Pflanzenr. 24 : 22, 1906 ; Subramanyam in Aqu. Angs. 92, 1962. *Saururus natans* Linn. Mant. 2 : 227, 1767. *Aponogeton monostachyon* Linn. f. Suppl. 214, 1781 ; Hook. f. Fl. Brit. India 6 : 564, 1893 ; Haines 2 : 846, 1924.

Aquatic herbs with stoloniferous rootstock and many fibrous roots. Leaves floating, 6-12 × 1-2 cm, linear-oblong or linear-lanceolate, entire, acute or obtuse at apex, cuneate at base ; petioles slender, 20-45 cm long, depending on water depth. Flowers white, pale-blue or pinkish, densely set in solitary spikes ; enclosed in a sheath while young. Follicles 3, subglobose, 3-8-seeded.

*Fl. & Fr.* : September-December.

*Distrib.* : BAHAKUD : Frequent in low-lying ditches inside scrubs and coastal thickets ; locally common under fresh-water condition.

2. *Aponogeton crispum* Thunb. Nov. Gen. 1 : 73, 1781 ; Subramanyam 92 ; Hook. f. Fl. Brit. India 6 : 564, 1893 ; Haines 2 : 847, 1924.

Aquatic herbs with round tubers. Leaves 10-20 × 1.5-2 cm, submerged, acute or obtuse at apex, narrowed into petioles ; petioles 6-15 cm long. Flowers white, arranged in lax spikes ; spikes 6-8 cm long. Follicles 3, oblong, beaked with 2-3 seeds.

*Fl. & Fr.* : August-September ; November-December.

*Distrib.* : JAGATSINGPUR : Frequent in shallow river-beds and ditches under fresh-water condition.

## ERICAULACEAE

## ERIOCAULON Linn.

*Eriocaulon sieboldianum* Sieb. & Zucc. ex Steud. Stn. Pl. Cyp. 2 : 272, 1855 ; Ruhland in Engler, Pfl. III, f. 15A-G, 1903 ; Fyson in J. Indian bot. 3 : 15, Pl. Pl. 50 & 51, 1922 ; Hook. f. Fl. Brit. India 6 : 577, 1886 ; Haines 2 : 1068, 1924.

Stemless, tufted herbs. Leaves 7-30 x 1-2 mm, narrowly linear, subulate with acuminate tip. Peduncles 1-10 cm long, slender; sheaths shorter than leaves, glabrous. Heads 2-4 mm across, globose, white; involucre bracts scarious; floral bracts linear-oblong, shining with purple bands; receptacles columnar; flowers shortly stipitate.

*Fl. & Fr.* : October-December.

*Distrib.* : PARADEEP, SATYAVIA : Frequent in most sandy places along the lee-side of the sea-shore sand dunes. Locally common in paddy fields.

### HALORAGACEAE

#### MYRIOPHYLLUM Linn.

*Myriophyllum indicum* Willd. Sp. Pl. 4: 407, 1805; Subramanyam Aquat. Ang. 17, 1962; Meijden in Blumea. 17: 308, 1969. Clarke in Hook. f. Fl. Brit. India 2: 433, 1887; Haines 1: 345, 1921.

Slender submerged herbs; branches floriferous, floating when water-level recedes. Leaves heterophyllous, whorled, 4-5 cm long, pectinate-pinnatifid with denticulate distal margins. Flowers minute, pinkish-white, sessile, solitary, axillary. Fruits muriculate with 4-dorsally keeled mericarps.

*Fl. & Fr.* : September-October; November-December.

*Distrib.* : PARADEEP, KUJANG : Frequent in sandy slacks and ponds near the coast; locally common in fresh-water ponds.

### CYPERACEAE

#### Key to Genera

- |  |     |                |
|--|-----|----------------|
| 1a. Glumes distichous; inflorescence capitate                                | ... | CYPERUS 1      |
| 1b. Glumes usually spirally imbricate; inflorescence umbellate or corymbose. |     |                |
| 2a. Hypogynous bristle absent.   |     |                |
| 3a. Style-base not deciduous   | ... | FIMBRISTYLIS 2 |
| 3b. Style-base deciduous   | ... | BULBOSTYLIS 3  |
| 2b. Hypogynous bristle present   | ... | ELAEOCHARIS 4  |
| 4a. Glumes awned on the back   | ... | FURCINA 5      |
| 4b. Glumes not awned on the back   | ... | SCIROPUS 6     |

#### I. CYPERUS Linn.

##### Key to Species

- |  |     |                      |
|--|-----|----------------------|
| 1a. Rhachilla deciduous as a whole.                      |     |                      |
| 2a. Rhizome 15-20 cm long; keel setulose; nuts elongated | ... | <i>brevifolius</i> 1 |
| 2b. Rhizome 6-8 cm long; keel crested; nuts suborbicular | ... | <i>kyllingia</i> 2   |

## 1b. Rhachilla persistent.

## 3a. Nut compressed radially to the rhachilla.

4a. Glumes cuspidate ; apex retuse ... *pumilus* 3

4b. Glumes not cuspidate ; apex not retuse.

5a. Nut ellipsoid with apiculate apex ... *globosus* 45b. Nut narrowly oblong with obtuse apex ... *polystachyos* 53b. Nut compressed at right angles to the rhachilla ... *alopecuroides* 66a. Stems robust, 3-angled ; glumes ovate, boat-shaped, mucronate ; nut with corky angles ... *platystylis* 76b. Stems tufted, weak ; glumes obovate, rounded ; nut not with corky angles ... *diformis* 8

## 7a. Inflorescence a single head.

8a. Rootlets glabrous ; stem rigid, terete  
glumes ovate-rounded ; nut trigonous,  
black ... *arenarius* 98b. Rootlets densely woolly ; stems robust,  
trigonous ; glumes ovate-acute or cuspi-  
date ; nut trigonous brown ... *pachyrrhizus* 107b. Inflorescence umbellate, not a single head ... *haspan* 119a. Rhachilla of spikelets not winged ;  
inflorescence umbellate.10a. Glumes cuspidate or aristate ;  
umbels simple with sessile head ... *compressus* 1210b. Glumes obtuse ; umbels decom-  
pound with many rays ... *iria* 1311a. Rhizome creeping ; stems  
robust ; umbels simple,  
compound or congested,  
longer one corymbose ; glumes  
oblong, rounded, not keeled ... *malaccensis* 1411b. Rhizome not creeping ; stems  
solitary or 2-3 ; umbels com-  
pound, large ; glumes elliptic-  
distant, obtuse, slightly keeled ... *distans* 159b. Rhachilla of spikelets distinctly  
2-winged ; inflorescence corymbose ... *corymbosus* 1612a. Base of stem thickened  
by chestnut-brown  
sheaths ; inflorescence of  
a single head ... *dubius* 1712b. Base of stem not as  
above, stoloniferous ;  
inflorescence umbellate  
with many rays ... *rotundus* 18

## CYPERUS Linn.

*Cyperus corymbosus* Rottb. Descr. & Ic. 42, t. 7, f. 4, 1773; Kern in Reinwardtia 6 : 55, 1961; Clarke in Hook. f. Fl. Brit. India 6 : 612, 1888; Haines 2 : 900, 1924.

*Distrib.* : FALSE POINT : Frequent in marshy places and river-banks along water courses.

*Cyperus platystylis* R. Br. Prodr. Fl. Nov. Holl. 214, 1810; Kuekenh. in Eng. Pfreich. 185, Pl. 21, 1936; Kern 2 : 112, Fig. 8, 1952; Clarke in Hook. f. Fl. Brit. India 6 : 598, 1888; Haines 2 : 893, 1924.

*Distrib.* : SATYAVIA : Frequent in sandy places near back mangroves and lee-side of the sea-shore sand-dunes.

*Cyperus kyllingia* Endl. Cat. Hort. Ac. Vindob. 1 : 94, 1842; Kern 2 : 67, 1952. *Kallinga monocephala* Rottb. Descr. & Ic. 13 : t. 4, f. 4, 1773; Clarke in Hook. f. Fl. Brit. India 6 : 588, 1888; Haines 2 : 907, 1924.

*Distrib.* : KUJANG, TALCHUA : Common along road-sides, river-banks, and waste sandy places.

*Cyperus polystachyos* Rottb. Progr. 21, 1772; Kern 2 : 61. *Pycneus polystachyos* (Rottb.) Beauv. Pl. Oware & Benin 2 : 48, t. 86., 1807; Clarke in Hook. f. Fl. Brit. India 6 : 592, 1888; Mooney 145, 1950. *P. odoratus* (Linn.) Beauv. Haines 2 : 905, 1924.

*Distrib.* : HOOKITOLA, FALSE POINT : Frequent in moist sandy places and muddy fringes near the coast.

*Cyperus laevigatus* Linn. Mant. 2 : 179, 1767. Kuekenh. 101 : 321, f. 5, 1936; Korlahalli in Bull. bot. Surv. India 9(1-4) : 238, 1967. *Juncellus laevigatus* (Linn.) Clarke in Hook. f. Fl. Brit. India 6 : 593, 1888.

*Distrib.* : DHAMARA RIVER MOUTH : Common in newly formed sandy beds along the estuaries and along the margins of estuarine islands. Pioneer sand-binder in this areas.

Haines (1924) and Mooney (1950) have not reported this plant from Orissa; hence it is a new record for Orissa.

*Cyperus malaccensis* Lamk. Illustr. 1 : 146, 1791; Kuekenh. 86, 1935; Kern 6 : 55, 1961; Clarke in Hook. f. Fl. Brit. India 6 : 608, 1888; Haines 2 : 899, 1924.

*Distrib.* : JAMBU, FALSE POINT : Common along the muddy banks of channels and creeks in the mangroves.

*Cyperus dubius* Rottb. Descr. & Ic. 20, t. 4, f. 5, 1773 ; Kern 6 : 65. *Mariscus dregeanus* Kunth, Encl. 2 : 120, 1837 ; Clarke in Hook. f. Fl. Brit. India 6 : 620, 1888 ; Haines 2 : 908, 1924.

*Distrib.* : FALSE POINT : Frequent in elevated muddy banks near the estuaries. Locally common in open grasslands.

*Cyperus compressus* Linn. Sp. Pl. 1 : 46, 1753 ; Clarke in Hook. f. Fl. Brit. India 6 : 605, 1888 ; Haines 2 : 896, 1924.

*Distrib.* : PARADEEP : Frequent in sandy sea-shore, sandy river-banks, and road-sides near the sea-level.

*Cyperus iria* Linn. Sp. Pl. 45, 1753 ; Kern 6 : 55 ; Clarke in Hook. f. Fl. Brit. India 6 : 606, 1888 ; Haines 2 : 895, 1924.

*Distrib.* : FALSE POINT, BHITARKANIKA : Common in the paddy-fields, and water-logged areas near the sea.

*Cyperus rotundus* Linn. Sp. Pl. 45, 1753 ; Kuekenth, 107, f. 13, 1935 ; Kern 6 : 53 ; Clarke in Hook. f. Fl. Brit. India 6 : 614, 1888 ; Haines 2 : 903, 1924.

*Distrib.* : PATHALA RIVER MOUTH : Common from sea-shores to inland marshy places and newly formed islands near the estuaries.

Haines (1924) collected this plant only from Bihar.

*Cyperus brevifolius* (Rottb.) Hassk., Cat. Hort. Bog. 24, 1844 ; Kern 6 : 66. *Kyllinga brevifolia* Rottb. Descr. & Ic. 13, t. 4, f. 3, 1773 ; Clarke in Hook. f. Fl. Brit. India 6 : 588, 1888 ; Haines 2 : 907, 1924.

*Distrib.* : CHANDBALLI, FALSE POINT : Common near the streams and moist places near the sea.

*Cyperus distans* Linn. f. Suppl. 103, 1781 ; Kern 53 ; Clarke in Hook. f. Fl. Brit. India 6 : 607, 1888 ; Haines 2 : 898, 1924.

*Distrib.* : BAHAKUD, PARADEEP : Frequent in moist places and river-banks, often locally common in water-logged areas.

*Cyperus haspan* Linn. Sp. Pl. 45, 1753 ; Kern 6 : 58 ; Clarke in Hook. f. Fl. Brit. India 6 : 600, 1888 ; Haines 2 : 894, 1924.

*Distrib.* : KUJANG : Frequent along margins of ditches and low-water pools, often found in moist sandy places near the sea-shores.

Haines (1924) collected it from Bihar.

*Cyperus difformis* Linn. Cent. Pl. 2 : 6, 1756 ; Kuekenth. 237, f. 27, F-H, 1936 ; Kern 6 : 58 ; Clarke in Hook. f. Fl. Brit. India 6 : 599, 1888 ; Haines 2 : 893, 1924.

*Distrib.* : KUJANG, FALSE POINT : Frequent in marshy places and around the paddy-fields.

*Cyperus exaltatus* Retz. Obs. 5 : 11. 1789 ; Kuekenth. 64, f. 9A-F, 1935 ; Kern 6 : 52 ; Clarke in Hook. f. Fl. Brit. India 6 : 617, 1888 ; Haines 2 : 902, 1924.

*Distrib.* : JAMBU, DANGMAL : Frequent in marshy places, and river-line ditches and water-logged areas along the low-lying muddy swamps.

Haines (1924) collected it from Bihar. Sometimes it may be mistaken with *C. alopecuroides* from which it differs having 3-styles.

*Cyperus pumilus* Linn. Cent. Pl. 2 : 6, 1756 ; Kern 6 : 62 : Kuekenth. 375. *Pycnus pumilus* (Linn.) Domin in Bibl. Bot. 85 : 417, 1916 ; Haines 2 : 905, 1924. *P. nitens* (Retz.) Nees in Nova Acta Nat. Cur. 19, Suppl. 1 : 53, 1843 ; Clarke in Hook. f. Fl. Brit. India 6 : 591, 1888.

*Distrib.* : SATYAVIA, FALSE POINT : Common along the river-banks and moist sandy places.

*Cyperus globosus* All. Fl. Pedem. Auct. 49, 1789 ; Kern 6 : 61. *Pycnus globosus* (All.) Reichenb. Fl. Gern. Exc. 2 : 140, 1830 ; Haines 2 : 905, 1924. *P. capillaris* (Roxb.) Nees, Linnaeae 9 : 283, 1834 ; Clarke in Hook. f. Fl. Brit. India 6 : 591, 1888.

*Distrib.* : BAHAKUD : Frequent in moist sandy river-banks, margins of ponds and pools, often along the lee-sides of sea-shores.

*Cyperus alopecuroides* Rottb. Descr. et Ic. 38, Pl. 8, f. 2, 1773 ; Kern 2 : 101, 1952. *Juncellus alopecuroides* (Rottb.) Clarke in Hook. f. Fl. Brit. India 6 : 595, 1888.

*Distrib.* : KUJANG : Frequent in swampy areas, along the margins of lakes and Jhils.

Haines (1924) and Mooney (1950) have not reported before from Orissa and Bihar ; hence it is a new record for Orissa.

*Cyperus pachyrrhizus* (Nees) Kuekenth. Pflanzenrich, Hft. 101 ; 275, 1956. *C. pachyrrhizus* Nees ex Bocck Ic. 545 ; Clarke in Hook. f. Fl. Brit. India 6 : 603, 1888.

Creeping, rhizomatous, perennial herbs ; roots densely woolly, covered with chestnut-coloured scales ; stems trigonous with single head inflorescences, consisting of many congested spikelets. Nuts trigonous.

*Distrib.* : **HOOKITOLA** : Frequent along the sandy sea-shore, accumulating sand-grains by its woolly rootlets.

Haines (1924) and Mooney (1950) have not reported this taxon from Orissa ; hence it is a new record for Orissa.

*Cyperus arenerius* Retz. Obs. Bot. 4 : 9, 1786 ; Clarke in Hook. f. Fl. Brit. India 6 : 602, 1888 ; Triman Handb. Ceyl. 5 : 23, 1974 (Rep. ed. ) ; Haines 2 : 897, 1924.

Wiry, much-branched, creeping sedges running deep down the sand.

*Distrib.* : **PARADEEP** : Common along the sandy beaches, as a pioneer sand-binder. It forms the first vegetation zone after intertidal region along the Orissa coast.

#### SCIRPUS Linn.

*Scirpus articulatus* Linn. Sp. Pl. 47, 1753 ; Kern 6 : 34 ; Subramanyam in Aqua. Angs. 107, f. 59, 1962 ; Clarke in Hook. f. Fl. Brit. India 6 : 656, 1888 ; Haines 2 : 926, 1924.

*Distrib.* : **FALSE POINT** : Common in marshy places in and around paddy-fields.

#### BULBOSTYLIS Kunth

*Bulbostylis barbata* (Rottb.) Clarke in Hook. f. Fl. Brit. India 6 : 651, 1888 ; Haines 2 : 923, 1924. *Scirpus barbata* Rottb. Prodr. 27, 1772.

*Distrib.* : **PARADEEP, SATYAVIA** : Common in sand-dunes, river-banks, sandy open places and often road-sides.

#### FIMBRISTYLIS Vahl

*Fimbristylis aestivalls* (Retz.) Vahl, Eru. 2 : 288, 1806 ; Kern 6 : 48 ; Clarke in Hook. f. Fl. Brit. India 6 : 637, 1888 ; Haines 2 : 920, 1924. *Scirpus aestivalls* Retz. Obs. 4 : 12, 1786.

*Distrib.* : **PARADEEP, KUJANG** : Common along the sea-shores and moist river-banks, Often along the road-sides and villages.

*Fimbristylis squarrosa* Vahl, Eru. 2 : 288, 1806 ; Kern 6 : 48 ; Clarke in Hook. f. Fl. Brit. India 6 : 635, 1888 ; Haines 2 : 920, 1924.

*Distrib.* : **KUJANG, PARADEEP** : Common along the river-banks, moist sandy places near the sea-shores, locally common in sandy places.

Sometimes it is mistaken in the field with *F. aestivalls*. However, it is distinguished by pendent hairs along the stylar-base and long recurved awns around the glumes.

*Fimbristylis complanta* (Retz.) Link, Hort. Berol. 1 : 292, 1827 ; Kern 6 : 38 ; Clarke in Hook. f. Fl. Brit. India 6 : 646, 1888 ; Haines 2 : 916, 1924. *Scirpus complantus* Retz. Obs. 5 : 14, 1789.

*Distrib.* : BHITARKANIKA : Frequent in moist sandy places near the sea-shores, and river-banks. Locally common along the edges of tanks and pools.

*Fimbristylis monostachyos* (Linn.) Hassk. Pl. Jav. Rar. 61, 1848 ; Clarke in Hook. f. Fl. Brit. India 6 : 649, 1888 ; Haines 2 : 917, 1924.

*Distrib.* : FALSE POINT, BHITARKANIKA : Frequent in sandy sea-shores, river-banks and open scrubs.

Haines (1924) collected it from Bihar only.

*Fimbristylis cymosa* R. Br. Prodr. 288, 1810 ; Kern 6 : 39 ; *F. spathacea* Roth, Nov. Pl. Sp. 24, 1812 ; Clarke in Hook. f. Fl. Brit. India 6 : 640, 1888 ; Haines 2 : 922, 1924.

*Distrib.* : MAHANADI DELTA : Very common along sandy sea-shores, river-banks and sand-bars in between the creeks.

*Fimbristylis dichotoma* (Linn.) Vahl, Enu. 2 : 287, 1806 ; Kern 6 : 46. *Scirpus dichotomus* Linn. Sp. Pl. 1 : 50, 1753. *S. diphylla* Retz. Obs. 5 : 15, 1789. *Fimbristylis diphylla* (Retz.) Vahl, Enu. 2 : 289 ; Clarke in Hook. f. Fl. Brit. India 6 : 636, 1888 ; Haines 2 : 920, 1924.

*Distrib.* : PARADEEP, SATYAVIA : Common in sandy sea-shores and inward dry places.

Haines collected it from Bihar and has remarked that 'probably it occurs from Orissa'.

*Fimbristylis ferruginea* (Linn.) Vahl, Enu. Pl. 2 : 291, 1806 ; Kern 6 : 45 ; Clarke in Hook. f. Fl. Brit. India 6 : 638, 1888 ; Haines 2 : 921, 1924.

*Distrib.* : FALSE POINT, BHITARKANIKA : Common in tidal swamps and mangroves, in association with *Phoenix peludosa* and *Hibiscus tillaceus*.

Haines has not collected this plant from Orissa, although he described it with the remarks that 'it probably occur in Orissa'.

#### ELEOCHARIS R. Br.

*Eleocharis capitata* R. Br. Prodr. 1 : 225, 1810 ; Clarke in Hook. f. Fl. Brit. India 6 : 627, 1888 ; Haines 2 : 913, 1924.



*Distrib.* : FALSE POINT : Frequent in marshy places, paddy-fields and around ditches.

FUIRENA Rottb.

*Fuirena ciliaris* (Linn.) Roxb. Fl. Ind. 1 : 184, 1820 ; Kern 6 : 31. *Scirpus ciliaris* Linn. Man. 2 : 182, 1771. *Fuirena glomerata* Lamk. Tab. Encl. Meth. Bot. 1 : 150, 1791 ; Clarke in Hook. f. Fl. Brit. India 6 : 666, 1888 ; Haines 2 : 928, 1924.

*Distrib.* : FALSE POINT : Frequent in marshy places and paddy-fields.

POACEAE

*Key to Genera*

1a. Spikelets 2-flowered.

2a. Glumes firm and rigid ; Lemmas hyaline , usually awned.

3a. Spikelets similar, unarmed ; panicle silvery-plumose ... SACCHARUM 1

3b. Spikelets dissimilar, awned ; panicle not as above.

4a. Spikes reduced to 1-node ; spikelets enclosed in a boat-shaped spathe ... APLUDA 2

4b. Spikes many-noded ; spikelets not enclosed in a boat-shaped spathe.

5a. Spikes with joints ; pedicel fused completely, compressed ... HEMARTHRIA 3

5b. Spikes not jointed ; pedicel not fused, not compressed ... ROTTBOELLIA 4

6a. Lower glume tuberculate ... VETIVERIA 5

6b. Lower glume not tuberculate ... CHRYSOPOGON 6

2b. Glumes membranous ; Lemmas papery, awnless.

7a. Inflorescence in panicles, heads or racemes ; spikelets not in groups.

8a. Spikelets dioecious ; Leaves rigid, spiny ... SPINIFEX 7

8b. Spikelets monoecious ; Leaves flat, not spiny ... PANICUM 8

9a. Lower glume turned towards the rachis.

10a. Lemmas 2, equal lower lemma with 5-7-nerved ... DIGITARIA 9

10b. Lemmas 2, unequal ; lower lemma not distinctly nerved ... BRACHIARIA 10

9b. Lower glume turned away from the rachis ... OPLISMENUS 11

- 7b. Inflorescence not as above.
- 1b. Spikelets 1-many-flowered.
- 11a. Lemmas hairy all over the back ; rachilla glabrous ... ARUNDO 12
- 11b. Lemmas glabrous ; rachilla hairy ... PHRAGMITES 13
- 12a. Lemmas 3-nerved ; glumes papery, awned ... SPOROBOLUS 14
- 12b. Lemmas smooth ; cartilaginous, not awned ... MYRIOSTACHYA 15
- 13a. Inflorescence paniced ; rachis not flexuous.
- 14a. Lower florets represented by 2-bristles ; glumes scale-like ... PROTERASIA 16
- 14b. Lower florets suppressed ; glumes absent ... LEERSIA 17
- 13b. Inflorescence spicate ; rachis flexuous ... ERAGROSTIS 18
- 15a. Upper glumes 3-5-nerved.
- 15b. Upper glumes smooth, not nerved ... ZOYSIA 19

### 1. SACCHARUM Linn.

*Saccharum spontaneum* Linn. Mant. 183, 1771 ; Bor. 214 ; Hook. in Hook. f. Fl. Brit. India 7 : 118, 1896 ; Haines 2 : 1011, 1924.

*Distrib.* : FALSE POINT : Frequent in sand-bars in-between the creeks and channels in mangroves. Locally gregarious around tanks and ditches.

### 2. APLUDA Linn.

*Apluda mutica* Linn. Sp. Pl. 82, 1753 ; Bor, Grass. Burm. Ceyl. Ind. Pak. 93, 1960 ; Majumdar in Bull. bot. Soc. Beng. 10 : 102, 1956. *A. varia* Hack. ssp. *mutica* (Linn.) Hack. in DC. Monogr. Androp. 196, 1889 ; Hook. f. Fl. Brit. India 7 : 150, 1896 ; Haines 2 : 1056, 1924.

*Distrib.* : BAHAKUD, HARISHPUR : Frequent in sandy scrubs and coastal bushes, locally common in dry places.

### 3. HEMARTHRIA R. Br.

*Hemarthria compressa* (L. f.) R. Br. Prodr. 207, 1810 ; Bor 161 ; Haines 2 : 1016, 1924. *Rottboellia compressa* Linn. f. Suppl. 114, 1781 ; Hook. f. Fl. Brit. India 7 : 153, 1896.

*Distrib.* : MAHANADI DELTA : Common in muddy areas along the river-sides and muddy sea-shores, under brakish water influences ; creeper, rooting from nodes, mostly in saline areas.

## 4. ROTTBOELLIA Linn. f.

*Rottboelia exaltata* Linn. f. Suppl., 114, 1781; Bor 206, Fig. 13; Hook. f. Fl. Brit. India 7 : 156, 1896; Haines 2 : 1059, 1924.

*Distrib.* : BAHAKUD, HARISHPUR : Frequent in sandy river-banks and coastal thickets.

## 5. VETIVERIA Bory.

*Vetiveria zizanioides* (Linn.) Nash ex Small, Fl. South-East U. S. 67, 1903; Bor, 258; Haines 2 : 1032, 1924. *Andropogon squarrosus auct. non* Linn. f. 1781; Hook. f. Fl. Brit. India 7 : 186, 1896.

*Distrib.* : KUJANG, BHITARKANIKA : Frequent in sandy river-beds, dry sandy places inside the mangroves, lee-side of the sea-shores. Locally cultivated for the aromatic roots and vetiver oils.

6. CHRYSOPOGON Trin. (*nom. cons.*)

*Chrysopogon aciculatus* (Retz.) Trin. Fund. Agrost. 188, 1820; Bor 115; *Andropogon aciculatus* Retz. Obs. 5 : 22, 1789; Hook. f. Fl. Brit. India 7 : 188, 1896; Haines 2 : 1035, 1924.

*Distrib.* : KUJANG : Frequent in fallow fields and lawns near the rivers.

## 7. SPINIFEX Linn.

*Spinifex littoreus* (Burm. f.) Merr. in Philip. J. Sci. Bot. 7 : 229, 1912; Bor, 366. *S. squarrosus* Linn. Mant. 2 : 300, 1771; Hook. f. Fl. Brit. India 7 : 63, 1896; Haines 2 : 1010, 1924. *Stipa spinifex* Linn. Mant. 1 : 34, 1767. *S. littoreus* Burm. f. Fl. Ind. 29, 1768.

*Fl. & Fr.* : March-September.

*Distrib.* : PARADEEP, SATYAVIA, CHANDBALLI : Common along the sea-shore sand-dunes, sand-bars and sometimes inwards raised sandy areas; often found in sand-bars between the creeks within mangroves. This spiny, polygamo-dioecious, bushy grasses are very effective sand-binder which controls the movement of sand-grains by its thick, spiny leaves. The broken spike-heads of the female plants are blown about along the sandy beaches like an animal and thus the seeds spread from one places to other.

## 8. PANICUM Linn.

*Panicum repens* Linn. Sp. Pl. ed. 2, 87, 1762; Bor 330; Hook. f. Fl. Brit. India 7 : 49, 1896; Haines 2 : 994, 1924.

*Distrib.* : KUJANG, PARADEEP : Frequent in moist sandy places near sea-shores, paddy-fields and waste places.

#### 9. DIGITARIA Heist. ex Fabric.

*Digitaria longiflora* (Retz.) Pers. Syn. Pl. 1 : 85, 1805 ; Bor 302 ; Haines 2 : 1008, 1924. *Paspalum longiflorum* Retz. Obs. 4 : 15, 1786 ; Hook. f. Fl. Brit. India 7 : 17, 1896.

*Distrib.* : PARADEEP, SATYAVIA : Frequent along the river-banks, and sandy sea-shores.

#### 10. BRACHIARIA Linn.

*Brachiaria reptans* (Linn.) Gard. & C. E. Hubbard in Hook. Ic. Pl. Sub. t. 3363, 1938 ; Bor, 285 ; *Panicum reptans* Linn. Syst. Nat. ed. 10, 870, 1759, *Urochloa reptans* (Linn.) Stapf in Prain Fl. Trop. Afr. 9 : 601, 1920 ; Haines 2 : 1003, 1924. *Panicum prostratum* Lamk. Tab. Encl. 1 : 171, 1791 ; Hook. f. Fl. Brit. India 7 : 33, 1896.

*Distrib.* : DANGMAL, KUJANG : Common weeds of cultivated fields, fallow lands and gardens.

#### 11. OPLISMENUS P. Beauv.

1. *Oplismenus burmannii* (Retz.) P. Beauv. Ess. Agrost. 54, 1812 ; Bor 317 ; Hook. in Hook. f. Fl. Brit. India 7 : 68, 1896 ; Haines 2 : 999, 1924. *Panicum burmannii* Retz. Obs. 3 : 10, 1783.

*Distrib.* : KUJANG, CHANDBALLI : Frequent in damp places, river-banks, edges of shubberies and road-sides.

2. *Oplismenus compositus* (Linn.) P. Beauv. Ess. Agrost. 54, 1812 ; Bor 317 ; Hook. f. Fl. Brit. India 7 : 66, 1896 ; Haines 2 : 999, 1924. *Panicum compositus* Linn. Sp. Pl. 57, 1753.

*Distrib.* : KUJANG, PARADEEP : Frequent along the road-sides and sandy waste places.

#### 12. ARUNDO Linn.

*Arundo donax* Linn. Sp. Pl. 81, 1753 ; Bor, 413, f. 44 ; Hook. in Hook. f. Fl. Brit. India 7 : 302, 1896 ; Haines 2 : 953, 1924.

*Distrib.* : FALSE POINT : Rarely found in swampy places near the villages.

## 13. PHRAGMITES Trin.

*Phragmites karka* (Retz.) Trin. ex Steud. Nom. Bot. ed. 2, 2 : 324, 1841 ; Bor, 416 ; Hook. in Hook. f. Fl. Brit. India 7 ; 304, 1896 ; Haines 2 : 952, 1924.

*Fl. & Fr.* : September-March.

*Distrib.* : FALSE POINT, BAHAKUD, BHITARKANIKA : Frequent along the intertidal regions of creeks and channels in the mangroves under less brakish water condition, locally common along fresh-water river-banks and ditches, often cultivated in gardens as ornamental plants.

Young plant of *Phragmites* and *Arundo* are very mistaken in the fields ; the silky beard at the base of panicle in case of *Phragmites* is very distinct from *Arundo*.

## 14. SPOROBOLUS R. Br.

1. *Sporobolus marginatus* Hochst. ex A. Rich. Tent. Fl. Abyss. 2 : 397, 1851 ; Bor, 632. *S. arabicus* Boiss. Diagn. Ser. 1 (13) ; 47, 1853 ; Hook. in Hook. f. Fl. Brit. India 7 : 252, 1896.

*Distrib.* : HOOKITOLA : Frequent in dry sandy areas and sand-dunes along the sea-shores and coastal scrubs.

Haines and Mooney have not reported this plant from Orissa ; hence it is a new record for Orissa.

2. *Sporobolus diander* (Retz) P. Beauv. Ess. Agrost. 26, 1812 ; Clayton in Kew Bull. 19 : 293, 1965 ; Bor, 629 ; Hook. in Hook. f. Fl. Brit. India 7 : 247, 1896 ; Haines 2 : 973, 1924. *Agrostis diander* Retz. Obs. 5 : 19, 1789.

*Distrib.* : FALSE POINT : Common in fallow fields, road-sides and around marshy lands.

## 15. MYRIOSTACHYA Hook. f.

*Myriostachya wightiana* (Nees ex Steud.) Hook. f. in Hook. f. Fl. Brit. India 7 : 327, 1897 ; Rao & Ban. in J. Bomb. nat. Hist. Soc. 66 (3) : 1970. *Leptochloa wightiana* Nees ex Steud. Synop. Glurum. Gram. 1 : 209, 1854.

*Fl. & Fr.* : April-September.

*Distrib.* : SARLAKUD, BHITARKANIKA : Common as a pioneer, along the sandy elevated intertidal regions of creeks and channels in the mangroves usually in association with *Heritiera fomes*, and *Xylocarpus* sp.

Haines (1924) and Mooney (1950) have not reported this plant from Orissa ; hence it is a new record for Orissa.

#### 16. PORTERESIA Tateoka

*Porteresia coarctata* (Roxb.) Tateoka in Bull. Nat. Sci. Mus. Tokyo 8 : 406, 1965 ; Henry in Bull. bot. Surv. India 11 : 214, 1969. *Oryza coarctata* Roxb. Fl. Ind. 2 : 206, 1832 ; Hook. in Hook. f. Fl. Brit. India 7 : 93. 1896. *Sclerophyllum coarctatum* (Roxb.) Griff. Notul 3 : 8, 1851 non Gaud (1829). *Indoryza coarctata* (Roxb.) Fl. Ind. 2 : 206 ; Henry & Roy Bull. bot. Surv. India 10 : 274, 1968.

*Fl. & Fr.* : May-August.

*Distrib.* : FALSE POINT : Common specially on newly deposited silts along the intertidal regions of creeks, channels and distributaries very near the estuaries. It is found as a pioneer stand under high salinity and silt- deposition.

Wild paddy, locally used for thatching purposes. Haines and Mooney have not reported this plant from Orissa ; hence it is a new record for Orissa.

Tateoka (*l.c.*) proposed the new name *Porteresia* for the genus *Sclerophyllum* Griff. (1851) non Gaud (1829). According to Henry (*l.c.*) the genus *Proteresia* includes the species of *Indoryza*. Genus *Sclerophyllum* Griffith (1851) was sunk in *Oryza* Linn. by subsequent authors until recently Sharma and Shastry (Bull. bot. Surv. India 8 : 42, 1966) resurrected *Sclerophyllum* as a distinct genus from *Oryza* Linn. The generic name *Sclerophyllum* Griff. is illegitimate as a later homonym of *Sclerophyllum* Gaud (1829). Therefore, the name *Indoryza* is proposed as an avowed substitute for *Sclerophyllum* Griff. by Henry & Roy (*l.c.*) and the new genus *Proteresia* Tate. includes the species of *Indoryza*.

#### 17. LEERSIA Soland. ex Swartz (*nom. cons.*)

*Leersia hexandra* Swartz, Prodr. Veg. Occ. 21, 1788 ; Bot 599, f. 68 ; Subramanyam, 111, f. 62 ; Hook. in Hook. f. Fl. Brit. India 7 : 94, 1896 ; Haines 2 : 981, 1924.

*Distrib.* : TALCHUA : Floating aquatic herbs, frequent in marshy places and ditches. Locally common in paddy-fields.

#### 18. ERAGROSTIS P. Beauv.

*Eragrostis tenella* (Linn.) P. Beauv. ex Roem. & Schult. Syst. Veg. 2 : 576, 1817 ; Bor, 513 ; Hook. in Hook. f. Fl. Brit. India 7 : 315, 1896 ; Haines 2 : 956, 1924. *Poa tenella* Linn. Sp. Pl. 69, 1753.

*Distrib.* : KUJANG, FALSE POINT : Frequent in sandy sea-shores, road-sides, and lawns.

#### 19. ZOYSIA Willd. (*nom. cons.*)

*Zoysia matrella* (Linn.) Merr. Philip. J. Sci. Bot. 7 : 230, 1912 ; Bot 684. *Agrostis matrella* Linn. Mant. 185, 1771. *Zoysia pungens* Willd. in Ges. Naturf. Freu. Berlin, Neueschr. 3 : 441, 1801 ; Hook. in Hook. f. Fl. Brit. India 7 : 99, 1896 : Haines 2 : 979, 1924.

*Distrib.* : PARADEEP, FALSE POINT : Common and widespread in everywhere, from sea-shores to inland.

#### 20. CYNODON Rich. (*nom. cons.*)

*Cynodon dactylon* (Linn.) Pers. Syn. Pl. 1 : 85, 1805 ; Bor 468, f. 52 ; Hook. in Hook. f. Fl. Brit. India 7 : 288, 1896 ; Haines 2 : 1924.

*Distrib.* : KUJANG, FALSE POINT : Common everywhere, in lawn, garden and road-sides.

#### 21. ELEUSINE Gaertn.

*Eleusine indica* (Linn.) Gaertn. Fruct. 1 : 8, 1789 ; Bor, 493 ; Hook. in Hook. f. Fl. Brit. India 7 : 293, 1896 ; Haines 2 : 970, 1924. *Cynosurus indicus* Linn. Sp. 72, 1753.

*Distrib.* : KUJANG, CHANDBALI : Frequent in the river-banks, waste places, and cultivated fields.

### POLYPODIACEAE

#### ACROSTICHUM Linn.

*Acrostichum aureum* Linn. Sp. Pl. 1525, 1753 ; Clarke in Ferns of Northern India 582, 1879 ; Haines 2 : 1209, 1924. Rao *et. al* Current Sci. 42 (15) : 1973.

Erect ferns 1-1.5 m tall ; stipes many, woody, glabrous ; each 50-150 cm long, arising from a strong rhizome ; fronds unipinnate ; pinnae 8-14, alternate ; each 8-15 x 1.5-3 cm, linear-oblong, coriaceous, cuneate or sub-cuneate at base, acutely rounded or retusely mucronate at apex ; upper pinnae ruddy-brown, soriferous. Sori densely covered along the undersurface of upper pinnae. Indusium absent.

*Distrib.* : BATIGHAR, BHITARKANIKA : Common specially in back mangroves and sand-bars in-between the creeks and channels within the mangrove-swamps, where the area is under occasional tidal flood and having acid-soils.

Sori-formation : June-December.

In Sunderbuns it is found along the intertidal banks of creeks and channels under regular tidal floods and in deep black clay soils.

STENOCHLAENA J. Sm.

*Stenochlaena palustre* Bedd. Ferns Brit. India Suppl. 26, 1876 ; Haines 2 : 1209. 1924. *Acrostichum palustre* Bedd. Ferns Brit. India 26 ; Clarske Ferns. Nor. India 577, 1879.

Climbing ferns 10-15 m tall ; stipe glossy more or less woody ; fronds simple pinnae, dimorphic ; sterile pinnae 20-25 × 3-6 cm, oblong-lanceolate, shining, serrate, acute at apex, cuneate or rounded at base ; fertile pinnae 15-23 cm, linear, very narrowly contracted into rolled margins. Sori many, covering the whole underside.

*Distrib.* : BHITARKANIKA : Rare in sandy scrubs and inside-sandy places of the mangroves.

SUPPLEMENTS

*Cyperus malaccensis* Lamk. Ill. 1, 146, 1791 ; Miq. Fl. Ind. Bat. 3 : 297, 1858 ; Kern. in Fl. Mal. 7 : 613, 1974 ; Clarke in Hook. f. Fl. Brit. India 6 : 608, 1893 ; Haines 955, 1924.

*Distrib.* : FALSE POINT : Common along the river banks and lowlying swamps.

*Cyperus tegetiformis* Roxb. Naves, Nov. App. 303, 1882 ; Kern. in Fl. Mal. formis 7 : 661, 1974 ; Clarke in Hook. f. Fl. Brit. India 6 : 612, 1893 ; Haines 956, 1924.

*Distrib.* : PARADEEP : Frequent along the riverbanks, and damp places in the forest.

*Eleocharis retroflexa* (Poir) URB. Symb-Ant. 2 : 165, 1900 ; Kern. in Fl. Mal. 7 : 534, 1974 ; *E. chaetaria* R. & S. Syst. Veg. 2 : 154, 1817 ; Clarke in Hook. f. Fl. Brit. India 6 : 629, 1893 ; Haines 956, 1924.

*Distrib.* : BHITARKANIKA : Frequent along the riverbanks and lowlying areas.

*Eragrostis cillata* (Roxb.) Nees, Agrost. Bras. 512, 1829 ; Bor, 506 ; Hook. f. Fl. Brit. India 7 : 313, 1896 ; Haines 1003, 1924.

*Distrib.* : FALSE POINT : Frequent along sandy river beds and swamps.



*Eragrostis nutans* (Retz.) Nees ex Steud. Nom. Bot. ed. 2, 563, 1840 ; 511. *E. stenophylla* Hochst. 1851 ; Hook. in Hook. f. Fl. Brit. India 7 : 318, 1896 ; Haines 1004, 1924.

*Distrib.* : KUJANG : Common along the river banks and low lying areas.

*Eragrostis termila* Hochst. ex Steud. syn. Pl. Glum. 1 : 269, 1854 ; Bor, 514 ; Hook. in Hook. f. Fl. Brit. India 320, 1896 ; Haines 1005, 1924.

*Distrib.* : BAHAKUD : Frequent in dry sandy areas along the riverine scrubs.

*Chloris dolichostachya* Lagasca, Gen. et Spec. Pl. 5 : 5, 1816 ; Bor, 466. *C. incompleta* Roth Nov. Pl. Sp. 60, 1821 ; Hook. in Hook. f. Fl. Brit. India 7 : 290, 1896 ; Haines 1014, 1924.

*Distrib.* : KUJANG : Rare in damp places and along the river banks.

*Leptochloa panicea* (Retz.) Ohwi in Bot. Mag. Tokyo 55, 311, 1941 ; Bor, 517, *L. filiformis* non P. Beauv. Hook. in Hook. f. Fl. Brit. India 7 : 298, 1896 ; Haines 1017, 1924.

*Distrib.* : PARADEEP : Frequent along the margin of the slacks and river beds.

*Sporobolus fertilis* (Steud.) W. D. Clayton in Kew Bull. 19 : 291, 1965. *S. indicus* (Linn.) R. Br. Bor, 630 ; Hook. in Hook. f. Fl. Brit. India 7 : 247, 1896 ; Haines 1019, 1924.

*Distrib.* : PURI : Frequent along the sea coast and sand bars in between the tidal forest.

*Aristida setacea* Retz. Obs. Bot. 4 : 22, 1786 ; Bor, 412 ; Hook. in Hook. f. Fl. Brit. India 7 : 225, 1896 ; Haines 1023, 1924.

*Distrib.* : BAHAKUD : Common along the sand bars and coastal thickets.

*Perotis indica* (Linn.) O. Kuntze. Rev. Gen. Pl. 2 : 787, 1891 ; Bor, 611 ; Hook. in Hook. f. Fl. Brit. India 7 : 787, 1896 ; Haines 1024, 1924.

*Distrib.* : PARADEEP : Common along the sandy sea shore, river banks and dry areas.

*Sacciolepis interrupta* (Willd.) Stapf in Prain Fl. Trop. Afr. 9 : 757, 1920 ; Bor, 358 : Hook. in Hook. f. Fl. Brit. India 7 : 239, 1896 ; Haines 1037, 1924.

*Distrib.* : DUNG-MAL : Frequent in swamps and damp places in the forest.

*Heteropogon contortus* (Linn.) P. Beauv. ex Roem. et Schult. Syst. Veg. 2 : 836, 1817 ; Bor, 163 : Hook. in Hook. f. Fl. Brit. India 7 : 1896 ; Haines 1088, 1924.

*Distrib.* : BAHAKUD : Frequent in dry forests and riverine scrubs.

*Brachiaria distachya* (Linn.) Stapf in Prain, Fl. Trop. Afr. 9 : 565, 1919 ; Bor, 281 ; *Digitaria distachya* Bojer. Hook. in Hook. f. Fl. Brit. India 7 : 14, 1896 ; Haines 1050, 1924.

*Distrib.* : HARISPUR GHARH : Frequent in moist sandy places, river banks and sea shores.

*Setaria tomentosa* (Roxb.) Kunth, Rev. Geom. 1 : 47, 1829 ; Bor, 365. *S. intermedia* (Roth.) Roem. et Schult. Syst. Veg. 2 : 489, 1817 ; Hook. in Hook. f. Fl. Brit. India 7 : 80, 1896 ; Haines 1035, 1924.

*Distrib.* : KUJANG : Rare along the river banks and low lying areas.

*Setaria verticillata* (Linn.) P. Beauv. Ess. Agrost. 51 : 178, 1812 ; Bor, 365 : Hook. in Hook. f. Fl. Brit. India 7 : 79, 1896 ; Haines 1035, 1924.

*Distrib.* : CHANDBALLI : Frequent in sandy places and dry fields.

*Paspallidium punctatum* : (Burm.) A. Camus in Lecomte, Fl. Gen. de L' India China 7 : 419, 1922 ; Bor, 333 ; Hook. in Hook. f. Fl. Brit. India 7 : 20, 1896 ; Haines 1047, 1924.

*Distrib.* : KUJANG : Common in lowlying areas and river banks.

*Dinebra retroflexa* (Vahl) Panz. in Denkschr. Acad. Wiss. Munchen, 270, 1814 ; Bor, 491 ; Hook. in Hook. f. Fl. Brit. India 7 : 297, 1896 ; Haines 1017, 1924.

*Distrib.* : SATYAVIA : Rare along low lying areas and Jheels.

*Notes* : Haines (1924) reported it only from Bihar hence it is a new record for Orissa.

## POLYPODIACEAE

### Key to Genera

- |  |     |              |
|--|-----|--------------|
| 1a. Erect ferns ; fronds unipinnate        | ... | ACROSTICHUM  |
| 1b. Climbing ferns ; fronds simply pinnate | ... | STENOCHLAENA |

## ACROSTICHUM L.

*Acrostichum aureum* L. Sp, Pl. 1525, 1753; Clarke in Ferns of Northern India 582, 1879; Haines 2 : 1209, 1924. Rao. T. A. *et al* Current Sci. 42 (15) : 1973.

Erect ferns 1-1.5 m tall; stipes many, woody, glabrous; each 50-150 cm long, arising from a strong rhizome; fronds unipinnate; pinnae 8-14, alternate; each 8-25 × 1.5-3 cm, linear-oblong, coriaceous, cuneate or sub-cuneate at base, acutely rounded or retusely mucronate at apex; upper pinnae ruddy-brown, soriferous, Sori densely covered along the undersurface of upper pinnae. Indusium absent.

*Fl. & Fr.* : Sori formation during June to December.

*Distrib.* : BATIGHAR, BHITARKANIKA : Common along the back mangroves and sand-bars in-between the creeks and channels within the mangrove swamps where the area is under occasional tidal flood and soil is acidic.

## STENOCHLAENA J. Sm.

*Stenochlaena palustre* Bedd. Ferns Brit. India Suppl. 26, 1876; Haines 2 : 1209, 1924. *Acrostichum palustre* Bedd. Ferns Brit. India 26; Clarke Ferns. Northern India 577, 1879.

Climbing ferns 10-15 m tall; stipe glossy, more or less woody; fronds simply pinnate, dimorphic; sterile pinnae 20-25 × 3-6 cm, oblong lanceolate, shining, serrate, acute at apex, cuneate or rounded at base; fertile pinnae 15-23 cm, linear, very narrowly contracted into rolled margins, Sori many, covering the underside.

*Fl. & Fr.* : Sori formation during July-Nov.

*Distrib.* : BHITARKANIKA : Rare in sandy scrubs and inside the mangrove forests on sand bars.

## REFERENCES

- Arora, R. K and K. R. Aggarwal. Observation on the vegetation of malpe coast and neighbouring Islands. *J. Indian bot. Soc.* 4 : 314-324, 1960.
- Banerjee, L. K. and G. C. Das. New distributional records from Orissa. *Bull. Bot. Surv. India* 14 (1-4) : 184-186. 1975.

- Vegetation of the Bhitarkanika sanctuary, in Cuttack dist. Orissa. *J. Econ. Tax. Bot.* 5 (5) : 1065-1079. 1984.
- and T. A. Rao. Mangals of : Mahanadi Delta Cuttack dist., Orissa state, India. All India *symp. mar. plants Dona paula*. Goa. India 137-152. 1985.
- Ecological Studies on the Mangals in the Mahanadi Estuarine Delta. *Trop. Ecol.* 28 : 117-125, 1987.
- Comparative study on Mangroves of Sundarbans and that of the Mahanadi delta in Eastern India. *J. Econ. Tax. Bot.* Vol. 9(1) : 119-131. 1987.
- Bandyopadhyaya, A. K. Soil and Water characteristic of mangrove forests of Sundarbans. *Indian For.* 112 (1) : 58-65. 1986.
- Bharucha, F. R. & Navalkar, B. S. Studies in ecology of mangroves. *J. Univ. Bombay* 10(5) : 99-106. 1942.
- and ——— *Ibid.* 16 : 35-45. 1948.
- and ——— *Ibid.* 17 : 17-35. 1949.
- *Ibid.* 18 : 7-16. 1950.
- Blasco, F. & Caratini, C. Mangroves Dep pichavaram Trans. Doc. 1973.
- C. S. Chandra and G. Thanikaimoni, Main characteristics of Indian mangroves. *Symp. Int. Biol. Mgt. Mangr. Honolulu* 1 : 71-87. 1974.
- Blasco, F. Mangroves of India. Inst. Fr. Pondicherry. *Trav. Sect. Sci. Tech.* 14 : 180. 1975.
- Outlines of Ecology, Botany and Forestry of the mangals of the Indian Sub-continent. *Ecosystem of the World. 1 : Wet coastal ecosystem.* 241-260. 1977.
- Blatter, E. The mangroves of Bombay Presidency and its Biology. *J. Bombay nat. hist. soc.* 16 : 644-656. 1905.
- Flora of the Indus delta. *J. Indian Bot. Soc.* 6 : 1929.
- Burns, W. A study of the sea shore vegetation. *J. Bombay nat. Hist. soc.* 20 : 1024. 1910.
- Champion, H. G. A preliminary survey of the forest types of India and Burma. *Ind. For. Rec. (N.S.)* 1(1) : Dehra Dun. 1936.

- and S. K. Seth. A revised survey of the forest types of India. Manager of publications, Delhi-6. 1968.
- Caratini, C., G. Thanikaimoni and C. Tissot. Mangroves of India : Palynological study and recent history of vegetation. *IV Int. Palynol. Conf.* Lucknow. 3 : 49-59. 1980.
- Chapman, V. J. The new perspective in the Halophytes. *Quart. Rev. Biol.* 17 (4) : 291-311. 1942.
- Coastal vegetation. Pergamon, London. 245. 1964.
- Some factors involved in mangrove establishment. *symp. humid. trop.* UNESCO, 219-225. 1966.
- and Ronaldson. The mangrove and salt marsh flats of the Auckland isthmus. *Bull.* 125, *D.S.E.R.N.* 2 : 79. 1958.
- Mangrove phytosociology. *Trop. Ecol.* 11 : 1-19. 1970.
- Mangrove vegetation. *J. Cramer, FL-9490, Vaduz.* 1976.
- Wet coastal formation of Indomalasia and papua-newguinea. Ecosystem of the World. I. wet coastal ecosystem. *Elsevier, New York.* 261-270. 1977.
- Clarke, C. B. Presidential address to the Linnean society on the Sunderbans of Bengal. *Proc. Linn. Soc., London,* 14-29. 1896.
- Cooke, T. The Flora of the Presidency of Bombay, London. 1901-1908.
- Cowan, J. M. The Flora of the chakaria Sunderbans. *Rec. Bot. Surv. India* 11 : 197-225. 1928.
- Curtis, S. J. Working plan for Sunderbans division, Forest department, W. Bengal. 1933.
- Danieal, J. C. The point calimer sanctuary, Madras. *J. Bombay nat. Hist. Soc.* 64 : 512-523. 1967.
- Dwivedi, S.N., A. H. Parulekar and S. C. Goswami. Ecology of mangrove swamps of the Mandovi estuary. Goa, India. *Int. symp. Biol. Mgt. Mangroves. Hawaii* 1 : 115-194. 1974.
- R.M.S. Bhargava and A. G. Untawale. Marine living resource and ecosystem along the west coast. India. *The 3rd Ind. Ocean Develop. Tokyo* 3 : 31-41. 1975.

- Erlanson, E. W. Plant colonization on two new tropical islands ; *The J. Ind. Bot. Soc.* 15 : 193-214. 1936.
- Fosberg, E. W. Mangrove v. Tidal Waves. *Biological conservation*, 4 : 38-39. 1971.
- Gamble, J. S. Flora of the Presidency of Madras. *Rep. ed. Bot. Surv. of India*, Calcutta. 1957. 1915-1936.
- Griffith, W. On the family of Rhizophoraceae. *Trans. Mej. Phys. Soc. Calcutta*, Vol. 8. 1836.
- On the development of the ovulum in *Avicennia*. *Trans. Linn. Soc. Lond.* 20 : 1-6. 1851.
- Haines, H. H. The Botany of Bihar and Orissa. *Rep. ed. Bot. Surv. India*, Calcutta, 1961. 1922-1925.
- Heining, R. L. Blind Root Suckers of Sunderbans. *J. Asiat. Soc. Bengal* 62 (2) : 158-161. 1893.
- List of plants of the Chittagong Collectorate and Hill Tracts. 1907.
- Hemming, G. F. The Ecology of the coastal area of Northern Eritrea, *J. Ecol.* 49 : 55-78. 1961.
- Hooker, J. D. A sketch of the Flora of British India, London. 1904.
- The Flora of British India Vol. 1-7, London. 1875-1897.
- Jain, S. K. The vegetation and succession of plant communities in Kutch, Gujarat. *Proc. Symp. Recent Adv. Tropical ecology*, 426-437, 1968.
- Joshi, G. V. & Shinde, S.D. Ecogeographical studies in vashisti & Terekhol rivers. Shivaji University publication Kolhapur, India. 1978.
- Karsten, G. Mangrove vegetation in Malayschen Archipel. *Ber. d. Bot. Gesell.* 8 : 49-55. 1890.
- Kassas, M. On the Ecology of the Red sea coastal land. *J. Ecol.* 45 : 187-242. 1957.
- Krishnamurthy, K. L., M. J. Kannan, Prince Jeyaseelan, Palaniappan P., M. A. Sultan Ali. A floristic study of Halophytes of Pichavaram Mangroves. *Bull. Bot. Surv. India* 23 (3 & 4) : 114-120. 1981.

- Macnae, W. A general account of the Indo-West pacific region. *Adv. Mar. Biol.* 6 : 73-270, 1968.
- Meher-Homji, V. M. Zonation of the mangrove vegetation in the Vellar Estuary. *Proc. 60th Ind. Sci. Congress.* p. 388. 1973.
- Misra, R. Ecology work book. Oxford & IBH Publishing Co. 1968.
- Mitra, R. L. and L. K. Banerjee. The Genus *Brugulera* Lamk. (Rhizophoraceae) in India. *Bull. Bot. Surv. India* 21 (1-4) : 142-150. 1979.
- Moldenke, H. N. Materials towards a Monograph of *Avicennia*. *Phytologia* 7 : 123-293. 1960.
- Mooney, H. Supplement to the Botany of Bihar and Orissa, Govt. of Orissa.
- Mudaliar, C. R. and H. S. Kamath. Back water flora of the West coast of South India. *J. Bombay nat. Hist. Soc.* 54 : 69-89. 1952.
- Mukherjee, B. B. and J. Mukherjee. Mangroves of Sunderbans, India. *Phytomorphology* 28 (2) : 217-229. 1978.
- Navalkar, B. S. Studies in the Ecology of Mangroves. *J. University of Bombay (N.S.)* B, 8 (5) : 58-59. & 9 (5) : 78-91. 1940.
- Succession of Mangrove Vegetation in Bombay & Salsette Islands. *J. Bomb. nat. Hist. Soc.* 50 : 157-160. 1951.
- Geographical distribution of the halophytic plants of Bombay and Salsette Islands. *Ibid.* 53 : 335-345. 1956.
- Importance of Mangroves. *Tropical Ecology*, 2 : 89-93. 1961.
- "Progress of plant Ecology in India". Vol-I Today and Tomorrow printers, Delhi, India. 1973.
- and F. R. Bharucha, Studies in the ecology of the mangroves : Chemical factors of the mangrove soil. *J. University of Bombay (N.S.)* 18 (3) : 17-35. 1959.
- Nayar, M. P. Vegetation of Kanya Kumari dist. *Bull. Bot. Surv. India* 1 : 122-126. 1959.
- Parlukar, A. H. and A. G. Untawale. Report on Flora and Fauna of Pirotan Islands in the Gulf of Kutch. Report submitted to the World wildlife Fund. 1976.

- Pradhan, D. Mangroves of Bombay. M.Sc. thesis, University of Bombay. 1957.
- Prain, D. Flora of the Sunderbans. *Rec. Bot. Surv. India*, 2 : 231-370, 1903.
- Puri, G.S. Indian Forest Ecology, Vol. 2. Oxford Book & Stationary Co., New Delhi, 1960.
- Raju, D.C.S. The vegetation on West Godavari. A study of tropical delta. Proceedings of the symposium on recent advances in *Tropical Ecology*, Part 1 : 348-358. 1968.
- Rao, R. S. Observations on the mangrove vegetation of the Godavari Estuary. *Proc. Mangrove symposium* pp. 36-44. 1957.
- Rao, T. A., K. R. Aggarwal and A.K. Mukherjee. Ecological studies on the soil and vegetation of Krusadi group of Islands in the Gulf of Mannar. *Bull. Bot. Surv. India*, 5 : 141-148, 1963.
- An Ecological account of the vegetation of Rameswaram Island, *Bull. Bot. Surv. India*, 6 : 201-323. 1963.
- and K. R. Aggarwal. Ecological studies on Saurashtra coast and neighbouring Islands I. Diu Island. *Bull. Bot. Surv. India* 6 : 173-183. 1964.
- Ecological studies on Saurashtra coast and neighbouring Islands III. Ckhamandal to Diu Island. *Arid Zone Symposium* (in press). 1964.
- and A.K. Mukherjee. Distribution of some plants along Midnapur coast in West Bengal State. *Curr. Sci.* 34 : 599. 1965.
- K. R. Aggarwal. Ecological studies on Saurashtra coast and neighbouring Islands II. Beyt Island. *Bull. Bot. Surv. India* 8 : 16-24. 1966.
- and A.K. Mukherjee. Ecological studies on Saurashtra coast and neighbouring Islands. IV. Piramn Island. *Bull. Bot. Surv. India* 8 : 60-67. 1966.
- and A.R.K. Sastry. An ecological approach towards classification of coastal vegetation of India I. Strand vegetation. *Indian Forester* 98 : 597-607. 1971.



- Rao, T.A., and A.K. Mukherjee. Ecological aspects along shore of Burabalanga tidal estuary, Orissa. *Proc. India Acad. Sci.* 76(b) : 201-206. 1971.
- and P.G. Shanware and A.K. Mukherjee. Ecological studies on the coastal sand dunes and slacks in the vicinity of Digha, Midnapore district, West Bengal. *Indian Forester* 100 : 101-107. 1974.
- and A.R.K. Sastry. An ecological approach towards classification of coastal vegetation of India. II Estuarine vegetation. *Indian Forester* 100 : 438-452. 1974.
- The distributional resume of the Indian Maritime strand flora. *Bull. Bot. Surv. India* 13 : 192-202. 1974.
- A.K. Mukherjee and L.K. Banerjee. A few unrecorded taxa for the Kanya Kumari shore. *J. Bombay nat. Hist. Soc.* 71(2) : 346-349. 1974(1975).
- A.R.K. Sastry, P. Basu and N.R. Mandal. A contribution to the coastal flora and vegetation of Tamil Nadu. *Indian Forester* 101 : 460-475. 1975.
- and A.K. Mukherjee. An ecological study on the strand vegetation of the Orissa coast. *Indian Forester*, 101 : 629-702. 1975.
- and K.R. Aggarwal. Ecological studies on Saurashtra coast and neighbouring Islands V. Bhavnagar to Jafarabad coastal area. *Bull. Bot. Surv. India* 9 : 79-87. 1967.
- and L.K. Banerjee. Some plant records for Orissa State. *J. Bombay Nat. Hist. Soc.* 64 : 583-584. 1967.
- and ——— Tidal mangroves of the Mahanadi delta, Utkal coast. *Proc. Semi. Reso. Devp. and Environ. in the Eastern Ghat.* Andhra University. 1985.
- and P.G. Shanware. Ecological studies of Saurashtra coast and neighbouring Islands. VI. An approach to the classification of Saurashtra coast land. *Bull. Bot. Surv. India* 9 : 244-248. 1967.
- and ——— Habits and plant communities of the Saurashtra coast. *Proc. Recent Advance in Trop. Ecology* p. 40. 1967.

- Rao, T.A. Distributional resume of the maritime strand flora of India—  
A survey. *Bull. Bot. Surv. India*. 13(3&4) : 192-202. 1968.
- and V.M.Meher-Homji. Strand plant communities of the Indian  
Subcontinent. *Proc. Indian Acad. Sci.* 94 (2&3) : 505-523. 1985.
- A.K.Mukherjee, L.K.Banerjee. Some interesting plant records.  
from the Orissa coast. *J.Bomb.Nat.Hist.Soc.* 67 : 128. 170.
- and A.R.K. Sastry. An outline of the coastal vegetation of India.  
*Bull. Bot. Surv. India* 16 (1-4) : 101-115. 1977.
- Richards, P.W. The Tropical Rain Forest : An ecological Study. University  
Press, Cambridge. 1966.
- Roxburgh, W. Hortus bengalensis. Serampur Mission press, p.105.1814.
- Sanyal, A. Additional notes on the Botany of Bihar and Orissa by H.H.Haines  
and its suppliment by H.Mooney. *Indian For.* 83 : 230-234. 1957.
- Sanyal, P., L.K.Banerjee, and M.K. Chowdhury. Dancing Mangals of Indian  
Sunderbans, *J.Indian Soc. Coastal Agric. Res.* 2 (1) : 10-16. 1984.
- Satyanarayan, Y. Ecological studies of Bombay coast line. Strand vegetation.  
*J.Biol. Sci.* 1 : 53-55. 1958.
- Shah, G.L. The vegetation along the sea shore in Salsette Islands Bombay.  
*Bull.Bot.Surv.India*, 4 : 239-240. 1962.
- Sidhu, S.S.Studies on mangroves. National Academy of Sciences. Allahabad.  
India.pp. 111-112. 1960.
- Mangrove vegetation of east Godavari. Proc. 48th Ind. Sc. Cong.  
pp. 358-359. 1961.
- Studies on the Mangroves of India : I-East Godavari region. *Indian  
For.* 89 : 337-351. 1963.
- Srinivasan, K.S. Aspects of vegetation of Church Island Tuticorin, South  
India. *J.Bombay Nat. Hist. Soc.* 57 : 348-358. 1960.
- Stephenson. T.A. and A. Stephenson. The universal features of Zonation  
between tidemarks on rocky coasts. *J.Ecol.* 37 : 289. 1949.

- Subramanyam, K. Aquatic Angiosperms. Bot. Monograph No. 3, C.S.I.R., New Delhi, 1962.
- D.D. Sundarraj and M.Nagarajan. The Flora of Hare and Church Islands. Tuticorin. *J. Bombay nat. Hist. Soc.* 61 : 587-602. 1964.
- Tansley & Fritsch. Sketches of vegetation at home and abroad. The Flora of the Ceylon littoral. *New. Phytol.* 4 : 1-17 & 27-29. 1905.
- Thomas, K.J. A survey of vegetation of Veli with special reference to ecological factors. *J. Ind. Bot. Soc.* 41 : 104-130. 1962.
- Thothathri, K. Studies on the mangroves of peninsular India versus the Andaman and Nicobar Islands. *Bull. Bot. Surv. India* 23 (3 & 4) 151-154. 1981.
- Toor, P.S. Studies in the vegetation of Gujarat coast, W. India. *Proc. Indian Sci. Cong.* part-III. 1958.
- Untawale, A. G., S. N. Dwivedi and S. Y. S. Singral. Ecology of Mangroves in Mandovi and Zuari estuaries and the interconnecting cumbarjua canal of Goa, *Indian J. Mar. Sci.* 2 : 47-53. 1973.
- Untawale, A. G. Review of the "Proceedings of the International symposium on Biology and management of Mangroves-Honolulu, Hawaii : Mahasagar *Bull. Natn. Inst. Oceanar.* 1976.
- Vartak, V.D. Enumeration of plants from Gomantak. India. *Maharashtra Assoc. for the cultn. Sci.* Poona. 1968.
- Venkatesan, K.R. The mangrove of Madras State. *Indian For* 92 : 27-34. 1966.
- Venkateswarlu, W. The estuarial Flora of the Godavary. *J. Bombay Nat. Hist. Soc.* 44 : 432-435. 1944.
- Vesey-Fitzgerald, D.F. Vegetation of the Red Sea Coast, South of Jeddah, Saudi Arabia. *J. Ecol.* 43 : 477-489. 1955.
- *Ibid.* 45 : 547-562. 1957.
- Womersly, H.B.S. and S.J. Edmonds. Marine coastal Zonation in southern Australia in relation to a general scheme of classification. *J. Ecol.* 40 : 84-104. 1952.

## INDEX

### A

- Abrus precatorius* Linn. 137  
*Abutilon indicum* (Linn.) Sweet. 99  
ACANTHACEAE 229  
*Acanthus ilicifolius* Linn. 229  
*Achynanthes aspera* Linn. 242  
*Achyranthes corymbosa* Linn. 92  
*Aegialitis rotundifolia* Roxb. 192  
*Aegiceras corniculatum* (Linn.) Blanco 194  
*Aerva lanata* (Linn.) Juss. 242  
*Aeschynomene indica* Linn. 134  
*Aglaia cucullata* (Roxb.) Pellegrin 107  
AIZOACEAE 173  
*Albizia lebbek* (Linn.) Benth 145  
*Allmania nodiflora* (Linn.) R. Br. 241  
*Alphonsea ventricosa* (Roxb.) Hook. f. & Thoms. 86  
*Alternanthera paronychoides* St. 244  
*Alternanthera sessilis* (Linn.) DC. 243  
*Alysicarpus monilifer* (Linn.) DC. 134  
*Alysicarpus vaginalis* (Linn.) 135  
AMARANTHACEAE 240  
*Amaranthus spinosus* Linn. 240  
*Ammania baccifera* Linn. 165  
*Ammania multiflora* 165  
ANACARDIACEAE 122  
*Anacardium occidentale* Linn. 122  
*Andrographis paniculata* (Burm.f.) Wall. 230  
*Anisomeles indica* (Linn.) O. Kuntze 238  
ANNONACEAE 86  
APOCYNACEAE 200  
*Ardisia solanacea* Roxb. 193  
*Aristolochia indica* Linn. 248  
ARISTOLOCHIACEAE 248  
ASCLEPIADACEAE 202  
*Atylosia scarabaeoides* (Linn.) Benth. 143  
*Avicennia alba* Blume 234  
*Avicennia marina* (Forsk.) Vierh. 236  
*Avicennia officinalis* Linn. 235  
AVICENNIACEAE 234  
*Azadirachta indica* A. Juss. 111  
*Azima tetraacantha* (Salisb.) Lamk. 199

### B

- Bacopa monnieri* (Linn.) Pennell. 221  
*Basella alba* Linn. 247  
BASELLACEAE 247  
*Blumea lacera* (Burm.f.) DC. 189  
*Boerhavia diffusa* Linn. 239  
BORAGINACEAE 210  
*Borreia articularis* (Linn.f.) F.N. Williams 184  
*Brachiaria distachya* (Linn.) Stapf 291  
*Brachiaria reptans* (Linn.) Gard. 285  
*Breynia rhamnoides* (Retz.) Muell. 257  
*Bridelia stipularis* (Linn.) Bl. 256  
*Brownlowia tersa* (Linn.) Kosterm. 104  
*Bruguiera cylindrica* (Linn.) Bl. 155  
*Bruguiera gymnorrhiza* (Linn.) Savigny 153  
*Bruguiera parviflora* (Roxb.) W. & A. 154  
*Bruguiera sexangula* (Lour.) Poir. 153  
*Bryophyllum pinnatum* (Lamk.) Oken. 151  
*Bulbostylis barbata* (Rottb.) Clarke in Hook. 280

### C

- CACTACEAE 172  
*Caesalpinia bonduc* (Linn.) Roxb. 146  
*Caesalpinia crista* Linn 147  
*Callophyllum inophyllum* Linn. 95  
*Calotropis gigantea* (Willd.) Dryand. 203  
*Canavalia maritima* (Aubl.) Thou. 142  
*Canavalia cathartica* Thou. 142  
*Cansiera rheedii* Gmelin. 112  
*Canthium dicoccum* (Gaertn.) Merr. 180  
CAPPARACEAE 89  
*Capparis brevispina* DC. 89  
*Capparis zeylanica* (non L.) Hook. f. 89  
*Carissa paucinervia* A. DC. 200  
*Carissa spinarum* Linn. 201  
CARYOPHYLLACEAE 92  
*Cassia occidentalis* Linn. 148  
*Cassia sophera* Linn. 148  
*Cassia tora* Linn. 148  
CELASTRACEAE 112  
*Celosia argentea* Linn. 242

- Centranthera tranquebarica* (Spreng.) Merr. 223  
**CERATOPHYLLACEAE** 263  
*Ceratophyllum demersum* Linn. 263  
*Cerbera manghas* Linn. 201  
*Ceriops decandra* (Griff.) Ding Hou. 157  
*Ceriops tagal* (Perr.) C.B. Rod. 156  
**CHENOPODIACEAE** 244  
*Chenopodium ambrosioides* Linn. 247  
*Cipadessa baccifera* (Roth) Miq. 110  
*Chloris dolichostachya* Lagasca 290  
*Chrozophora rotleri* (Geis.) Juss. 259  
*Chrysopogon aciculatus* (Retz.) Trin. 284  
*Cissampelos pareira* Linn. var. *hirsuta*  
 (Buch.-Ham. ex DC.) Forman 87  
*Citrullus colocynthis* (Linn.) Schr. 172  
**CLAUSIACEAE** 95  
*Clerodendrum indicum* (Linn.) O. Kuntze 233  
*Clerodendrum inerme* (Linn.) Gaertn. 232  
*Clerodendrum petasites* (Lour.) Moore 233  
*Coldenia procumbens* Linn. 213  
**COMBRETACEAE** 161  
*Commelina attenuata* Koen. 269  
**COMMELINACEAE** 269  
**COMPOSITAE** 185  
**CONNARACEAE** 124  
**CONVOLVULACEAE** 214  
*Corchorus aestuans* Linn. 105  
*Cordia dichotoma* Forst. 211  
**CRASSULACEAE** 151  
*Crateva adansonii* DC. ssp. *odora*  
 (Buch.-Ham.) Jacobs 89  
*Crateva odora* Buch.-Ham. 89  
*Crateva religiosa* Forst. F. 89  
*Crinum asiaticum* Linn. 264  
*Crinum defixum* Ker.-Gawl. 265  
*Crotalaria levigata* Lamk. 128  
*Crotalaria nana* Burm. f. 127  
*Crotalaria pallida* Ait. 127  
*Crotalaria retusa* Linn. 127  
*Crotalaria verrucosa* Linn. 126  
*Croton bonplandianum* Baill. 259  
*Cryptovoryne ciliata* (Roxb.) Schott. 273  
*Cryptostegia grandiflora* R. Br. 207  
*Cucumis callosus* (Rottl.) Cog. 171  
**CUCURBITACEAE** 170  
*Cuscuta reflexa* Roxb. 214  
*Cyanotis cristata* (Linn.) Schutt. f. 270  
*Cyathocline purpurea* (Don.) Kuntze 186  
*Cynodon dactylon* (Linn.) Pers. 288  
*Cynometra irripa* Kostel. 149  
*Cynometra ramiflora* Linn. 150  
**CYPERACEAE** 275  
*Cyperus alopecuroides* Rottb. 279  
*Cyperus arenarius* Retz. Obs. 280  
*Cyperus brevifolius* (Rottb.) Hassk. 278  
*Cyperus compressus* Linn. 278  
*Cyperus corymbosus* Rottb. 277  
*Cyperus difformis* Linn. 279  
*Cyperus distans* Linn. 278  
*Cyperus dubius* Rottb. 278  
*Cyperus exaltatus* Retz. 279  
*Cyperus globosus* All. 279  
*Cyperus haspan* Linn. 278  
*Cyperus iria* Linn. 278  
*Cyperus kyllingia* Endl. 277  
*Cyperus laevigatus* Linn. 277  
*Cyperus malaccensis* Lamk. 277, 289  
*Cyperus pachyrrhizus* (Nees) Kükenth. 279, 280  
*Cyperus platystylis* R. Br. 277  
*Cyperus polystachyos* Rottb. 277  
*Cyperus pumilus* Linn. 279  
*Cyperus rotundus* Linn. 278  
*Cyperus tegetiformis* Roxb. 289  
**D**  
*Dalbergia sissoo* Roxb. 138  
*Dalbergia spinosa* Roxb. 138  
*Dendrophthoe falcata* (Linn. f.) Etting. 251  
*Dentella repens* (Linn.) J.R. 181  
*Derris heterophylla* (Willd.) Back. 141  
*Derris scandens* (Roxb.) Benth. 141  
*Desmodium biarticulatum* (Linn.) F.V.M. 135  
*Desmodium gangeticum* (Linn.) DC. 136  
*Desmodium triflorum* (Linn.) DC. 136  
*Digera muricata* (Linn.) Mart. 240  
*Digitaria longiflora* (Retz.) Pers. 285  
*Dinebra retroflexa* (Vahl) Panz. 291

- Diospyros malabarica* (Desr.) Kostel. 197  
*Dioscorea bulbifera* Linn. 265  
*Dioscorea oppositifolia* Linn. 266  
*Dioscorea puber* Blume 266  
**DIOSCOREACEAE** 265  
*Diospyros cordifolia* Roxb. 198  
*Drosera burmanni* Vahl 152  
*Drosera indica* Linn. 152  
**DROSERACEAE** 152  
**E**  
**EBENACEAE** 197  
*Eclipta prostrata* (Linn.) Linn 187  
*Ehretia acuminata* R. 211  
*Eleocharis capitata* R. Br. 281  
*Eleocharis retroflexa* (Poir.) URB. 289  
*Eleusine indica* (Linn.) Gaertn. 288  
*Eragrostis nutans* (Retz.) Nees. 290  
*Eragrostis ciliata* (Roxb.) Ness 289  
*Eragrostis tenella* (Linn.) P. 287  
*Eragrostis termila* Hochst. 290  
**ERICAULACEAE** 274  
*Eriocaulon sieboldianum* Sieb. 274  
*Erythrina variegata* Linn. 137  
*Eupatorium odoratum* Linn. 191  
*Euphorbia hirta* Linn. 253  
*Euphorbia hypericifolia* Linn. 253  
*Euphorbia prostrata* Ait. 254  
*Euphorbia rosea* Retz. 252  
*Euphorbia thymifolia* Linn. 254  
**EUPHORBIACEAE** 251  
*Evolvulus alsinoides* (Linn.) Linn. 215  
*Evolvulus numularius* (Linn.) Linn. 215  
*Excoecaria agallocha* Linn. 261  
**F**  
*Ficus retusa* Linn. 262  
*Ficus virens* Ait. 263  
*Fimbristylis aestivalis* (Retz.) Vahl, 280  
*Fimbristylis complanta* (Retz.) Link. 281  
*Fimbristylis cymosa* R.Br. 281  
*Fimbristylis dichotoma* (Linn.) Vahl 281  
*Fimbristylis ferruginea* (Linn.) Vahl 281  
*Fimbristylis monostachya* (Linn.) Hassk. 281  
*Fimbristylis squarrosa* Vahl 280  
*Finlaysonia obovata* Wall. 207  
**FLACOURTIACEAE** 90  
*Flacourtia indica* (Burm.f.) Merr. 90  
*Flacourtia ramotchi* Herit. Stirp. 90  
*Flagellaria indica* Linn. 270  
**FLAGELLARIACEAE** 270  
*Fuirena ciliaris* (Linn.) Roxb. 282  
**G**  
*Geniosporum prostratum* (Linn.) Benth. 238  
**GENTIANACEAE** 210  
*Glinus lotoides* Linn. 173  
*Glinus oppositifolius* (Linn.) A. DC. 174  
*Gloriosa superba* Linn. 267  
*Gmelina indica* Burm.f. 90  
*Gnaphalium indicum* Linn. 190  
*Grangea maderaspatana* (Linn.) Poir 186  
*Grewia rhamnifolia* Heyne ex Roth. 104  
*Guatteria korinti* Dunl. 86  
*Guazama ulmifolia* Lamk. 102  
**H**  
**HALORAGACEAE** 275  
*Heliotropium marifolium* Retz. 212  
*Heliotropium curassavicum* Linn. 212  
*Heliotropium indicum* Linn. 213  
*Heliotropium strigosum* Willd. 212  
*Heliotropium supinum* Linn. 212  
*Hemarthria compressa* (L.f.) R. 283  
*Hemicyclia septaria* Wight 260  
*Hemidesmus indicus* (Linn.) Schultes 209  
*Heritiera fomes* Buch.-Ham. 100  
*Heritiera littoralis* Ait. 101  
*Heteropogon contortus* (Linn.) P. Beauv. 291  
*Hibiscus tiliaceus* Linn. 99  
**HIPPOCRATEACEAE** 122  
*Holigarna longifolia* Roxb. 123  
*Hoya parasitica* (Roxb.) Wall. 204  
*Hybanthus enneaspermus* (Linn.) F.v. Muell. 90  
*Hydrilla verticillata* (Linn.f.) Royle 264  
**HYDROCHARITACEAE** 264  
*Hydrophylax maritima* Linn. 183  
*Hyptis suaveolens* (Linn.) Poit. 238

## I

- Ichnocarpus frutescens* (Linn.) 202  
*Indigofera aspalathoides* Vahl 129  
*Indigofera glabra* Linn. 130  
*Indigofera linifolia* (Linn.) Retz. 128  
*Indigofera linnaei* Ali 129  
*Indigofera tinctoria* Linn. 130  
*Intsia bijuga* (Colebr.) O. Kuntze 149  
*Ionidium enneaspermum* (Linn.) Vent. 90  
*Ionidium suffruticosum* (Linn.) Roem. 90  
*Ipomoea mauritiana* Jacq. 217  
*Ipomoea pes-caprae* (Linn.) R. Br. 217  
*Ipomoea tuba* (Schlechtend) G. Don. 216  
*Ixora arborea* Roxb. 179  
*Ixora coccinea* Linn. 180

## J

- Jasminum sambac* (Linn.) Ait. 198  
*Jatropha curcus* Linn. 258  
*Jatropha gossypifolia* Linn. 258  
*Justicia prostrata* (Cl.) Gamble 231

## K

- Kandelia candel* (Linn.) Druce 158  
*Knoxia sumatrensis* (Retz.) DC. 184

## L

- LAMIACEAE 236  
*Lannea coromandelica* (Houtt.) Merril 123  
*Launaea sarmentosa* (Willd.) Alston 186  
LAURACEAE 249  
*Lagerstroemia speciosa* (Linn.) Pers. 165  
*Leersia hexandra* Swartz, 287  
LENTIBULARIACEAE 224  
*Lepisanthes tetraphylla* (Vahl) Radlk. 121  
*Leptadenia reticulata* (Retz.) Wt. 206  
*Leucas stricta* Benth. 237  
LILIACEAE 267  
*Limnophyton obtusifolium* (Linn.) Miq. 273  
*Lindernia antipoda* (Linn.) Alston 222  
*Lindernia crustacea* (Linn.) F.v. Muell. 222  
*Lippia alba* (Mill.) N.E. 232  
*Liptochloa panicea* (Retz.) Ohwi 290  
*Litsea glutinosa* (Lour.) C.B. 249

- Litsea nitida* (Roxb.) Hook. 249  
LOGANIACEAE 209  
LORANTHACEAE 250  
*Ludwigia adscendens* (Linn.) Hara 168  
*Ludwigia hyssopifolia* G. Don 168  
*Ludwigia perennis* Linn. 169  
*Lumnitzera littorea* Jack. 162  
*Lumnitzera racemosa* Willd. 161  
LYTHRACEAE 164

## M

- Maba buxifolia* (Roxb.) Pers. 197  
*Malachra capitata* (Linn.) Syst. 97  
MALVACEAE 96  
*Manilkara hexandra* (Roxb.) Dubard. 195  
*Manilkara littoralis* (Kurz) Dubard. 195  
*Martynia annua* Linn. 229  
*Maytenus emarginata* (Willd.) Ding. 112  
MELASTOMATACEAE 163  
MELIACEAE 106  
*Melochia corchorifolia* Linn. 103  
*Memecylon edule* Roxb. 163  
MENISPERMACEAE 87  
*Merremia tridentata* (Linn.) Hall. 215  
*Micrococca mercurialis* Linn. 262  
*Mimosa pudica* Linn. 144  
MOLLUGINACEAE 176  
*Mollugo cerviana* (Linn.) Seringe. 177  
*Mollugo disticha* (Linn.) Seringe. 176  
*Mollugo pentaphylla* Linn. 176  
MONOCOTYLEDONS 264  
MORACEAE 262  
*Morinda citrifolia* Linn. 180  
*Mucuna gigantia* (Willd.) DC. 140  
*Mucuna monosperma* DC. 140  
*Mucuna prurita* Hook. 140  
*Mukia maderaspatana* (Linn.) M. J. Roem. 170  
*Murdannia nudiflora* (Linn.) Brenan 269  
*Myriophyllum indicum* Willd. 275  
*Myriostachya wightiana* (Nees ex Steud.) Hook. 286  
MYRSINACEAE 193  
MYRTACEAE 162

## N

- Neptunia oleracea* Lour. 144  
 NYCTAGINACEAE 239  
*Nymphaea lotus* auct. non Linn. 88  
*Nymphaea nouchali* auct. (non Burm.f.)  
     Subramanyam. 88  
*Nymphaea nouchali* Burm. 88  
*Nymphaea pubescens* Willd. 88  
*Nymphaea stellata* Willd. 88  
 NYMPHAEACEAE 88  
*Nymphoides cristatum* (Roxb.) O. Ktze. 210

## O

- Ochna obtusata* DC. 106  
 OCHNACEAE 106  
*Ocimum gratissimum* Linn. 237  
 OLACACEAE 111  
*Olax scandens* Roxb. 111  
*Oldenlandia biflora* Linn. 183  
*Oldenlandia corymbosa* Linn. 182  
*Oldenlandia herbacea* (Linn.) Roxb. 183  
*Oldenlandia stricta* Linn. 182  
*Oldenlandia umbellata* Linn. 182  
 OLEACEAE 198  
 ONAGRACEAE 168  
 OPILIACEAE 112  
*Oplismenus burmannii* Retz. 285  
*Oplismenus compositus* Linn. 285  
*Opuntia dillenii* Haw. 172

## P

- PANDANACEAE 272  
*Pandanus tectorius* Soland ex Park. 272  
*Panicum repens* Linn. 284  
 PAPILIONACEAE 125  
*Parkinsonia aculeata* Linn. 146  
*Paspalidium punctatum* (Burm.) A. 291  
*Passiflora foetida* Linn. 169  
*Passiflora suberosa* 170  
 PASSIFLORACEAE 169  
*Pavetta indica* Linn. 178  
*Pavonia procumbens* (W. & A.) Walp. 98  
 PEDALIACEAE 228  
*Pedaliium murex* Linn. 228

- Pentatropis capensis* (Linn. f.) Bullock 203  
 PERIPLOCACEAE 207  
*Perotis indica* (Linn.) O. Kuntze 290  
*Phoenix paludosa* Roxb. 271  
*Phragmites karka* (Retz.) Trin. 286  
*Phyla nodiflora* (Linn.) Green. 231  
*Phyllanthus maderaspatensis* Linn. 255  
*Phyllanthus rotundifolius* Klein. 255  
*Phyllanthus virgatus* Forst. 255  
*Physalis minima* Linn. 219  
 PLUMBAGINACEAE 192  
 POACEAE 282  
*Polyalthia korinti* (Dunl.) Thw. 86  
*Polyalthia suberosa* (Roxb.) Thw. 87  
*Polycarpaea corymbosa* (Linn.) Lamk. Tabl 92  
*Polycarpon prostratum* (Forsk.)  
     Aschers. & Schweinf. 92  
*Polygala arvensis* Willd. 91  
*Polygala chinensis* (auct. pl. non. Linn.) 91  
*Polygala ciliata* Linn. 91  
 POLYGALACEAE 91  
 POLYGONACEAE 248  
*Polygonum plebejum* R. Br. 248  
 POLYPODIACEAE 291  
*Pongamia pinnata* (Linn.) Pierre. 138  
*Porteresia coarctata* (Roxb.) Tateoka 287  
*Portulaca pilosa* Linn. 93  
*Portulaca quadrifida* Linn. 93  
 PORTULACACEAE 93  
*Portulaca oleracea* Linn. 93  
*Premna corymbosa* (Burm.f.) Rottl. 234  
*Pterospermum xylocarpum* (Gaertn.) Sant 102  
*Pupalia lappacea* (Linn.) Juss. 243

## R

- Randia malabarica* Lamk. 178  
*Rhizophora apiculata* Bl. 159  
*Rhizophora mucronata* Poir. 160  
*Rhizophora stylosa* Griff. 161  
 RHIZOPHORACEAE 152  
*Rivea hypocrateriformis* Choisy 216  
*Rotala verticillaris* Linn. 164  
*Rothia indica* (Linn.) Druce 126  
*Rottboelia exaltata* Linn. 284



- Rourea minor* (Gaertn.) Leenih. 124  
 RUBIACEAE 177  
*Rungia pectinata* (Linn.) Nees 230  
 S  
*Saccharum spontaneum* Linn. 283  
*Sacciolepis interrupta* (Willd.) Satpf 291  
*Salacia prnoides* (Willd.) DC. 122  
*Salix tetrasperma* Roxb. 263  
*Salicornia brachiata* Roxb. 244  
*Salomonina ciliata* (Linn.) DC. 91  
*Salomonina oblongifolia* DC. Prodr. 91  
*Salvadora persica* Linn. 199  
 SALVADORACEAE 199  
 SAPOTACEAE 194  
*Sarcolobus carinatus* Wall. 204  
*Sarcolobus globosus* Wall. 205  
*Sarcostemma acidum* (Roxb.) Voigt, 203  
*Scilla hayacinthina* (Roth.) Macbride. 268  
*Scirpus articulatus* Linn. 280  
 SCROPHULARIACEAE 220  
*Scurula philippensis* (Cham. & Schl.)  
 G. Don. 250  
*Sesuvium portulacastrum* (Linn.) Linn. 175  
*Setaria tomentosa* (Roxb.) Kunth 291  
*Setaria verticillata* (Linn.) P. 291  
*Sida cordata* (Burm.f.) Borss. 98  
*Sida cordifolia* Linn. 99  
 SMILACEAE 267  
*Smilax perfoliata* Lour. 267  
*Smithia sensitiva* Ait. 134  
 SOLANACEAE 218  
*Solanum incanum* Linn. 219  
*Solanum nigrum* Linn. 219  
*Solanum surattense* Burm. 218  
*Solanum trilobatum* Linn. 218  
*Sonneratia alba* J. Smith. 167  
*Sonneratia apetala* Buch. -Ham. 166  
*Sonneratia caseolaris* (Linn.) Engl. 167  
*Sonneratia griffithii* Kurz. 166  
 SONNERATIACEAE 166  
*Sphaeranthus africanus* Linn. 190  
*Sphaeranthus indicus* Linn. 191  
*Sphaeranthus africanus* Linn. 190  
*Sphenoclea zeylanica* Gaertn. 192  
 SPHENOCLEACEAE 192  
*Spinifex littoreus* (Burm.f.) Merr. 284  
*Sporobolus diander* (Retz.) P. 286  
*Sporobolus fertilis* (Steud.) W.D. 290  
*Sporobolus marginatus* Hochst. 286  
*Stenochlaena palustre* Bedd. 289  
*Stenochlaena palustre* Bedd. 292  
 STERCULIACEAE 100  
*Striga asiatica* (Linn.) O.K tze. 223  
*Strychnos nux-vomica* Linn. 209  
*Suaeda maritima* (Linn.) Dum. 245  
*Suaeda monoica* (Forsk.) ex J.E. Gmel. 246  
*Suaeda nudiflora* (Willd.) Moq. 245  
*Suregada multiflora* (Juss.) Baill. 260  
*Synostemon bacciformis* (Linn.) Webster. 256  
*Syzygium cumini* (Linn.) 163  
*Syzygium ruscifolium* (Willd.) Sant 163  
 T  
 TAMARICACEAE 94  
*Tamarix dioica* Roxb. 94  
*Tamarix ericoides* Rottl. 95  
*Tamarix troupii* Hole in Ind. 94  
*Tarenna asiatica* (Linn.) Alst. 178  
*Taverniera cuneifolia* Arn. 133  
*Tephrosia maxima* (Linn.) Pers. 131  
*Tephrosia purpurea* (Linn.) Pers. 130  
*Tephrosia villosa* (Linn.) Pers. 131  
*Teramnus labialis* (Linn.f.) Spreng. 139  
*Thespesia populnea* (Linn.) Sol. 97  
*Thespesia populneooides* (Roxb.) Kostel. 96  
 TILIACEAE 104  
*Trianthema portulacastrum* Linn. 174  
*Trianthema triquetra* Rottl. 175  
*Trichodesma indica* R. Br. 213  
*Trichosanthes cucumerina* Linn. 171  
*Tridax procumbens* Linn. 187  
*Triumfetta rhomboides* Jacq. 105  
*Tylophora indica* (Burm.f.) Merr. 206  
*Tylophora tenuis* Bl. 205  
*Typha angustata* Bory & Chaub. 272  
 TYPHACEAE 272

## U

- Utricularia aurea* Lour. 225  
*Utricularia caerulea* Linn. 227  
*Utricularia gibba* Linn. 225  
*Utricularia graminifolia* Vahl 226  
*Utricularia minutissima* Vahl 228  
*Utricularia polygaloides* Edgeworth. 226  
*Utricularia scandens* Benj. 227  
*Utricularia stellaris* Linn. 224  
*Uvaria suberosa* Roxb. 87  
*Uvaria ventricosa* Roxb. 86

## V

- Vahlia dichotoma* (Murray) Kuntze. 151  
**VAHLIACEAE** 151  
*Verbascum chinense* (Linn.) Sant. 220  
**VERBENACEAE** 231  
*Vernonia cinera* (Linn.) 189  
*Vetiveria zizanioides* (Linn.) Nash 284  
*Viola enneasperma* Linn. 90  
**VIOLACEAE** 90  
*Viscum ovalifolium* Wall. 250  
*Vitex negundo* Linn. 232

## W

- Waltheria americana* Linn. 103

## X

- Xanthium inaequilaterum* DC. 189  
*Xylocarpus granatum* Koen. 109  
*Xylocarpus mekongensis* Pierre. 109  
*Xylocarpus moluccensis* (Lamk.) 110

**XYRIDACEAE** 268

- Xyris indica* Linn. 268

## Z

- Zornia diphylla* (Linn.) Pers. 132  
*Zornia gibbosa* Span. 132  
*Zoysia matrella* (Linn.) Merr. 288