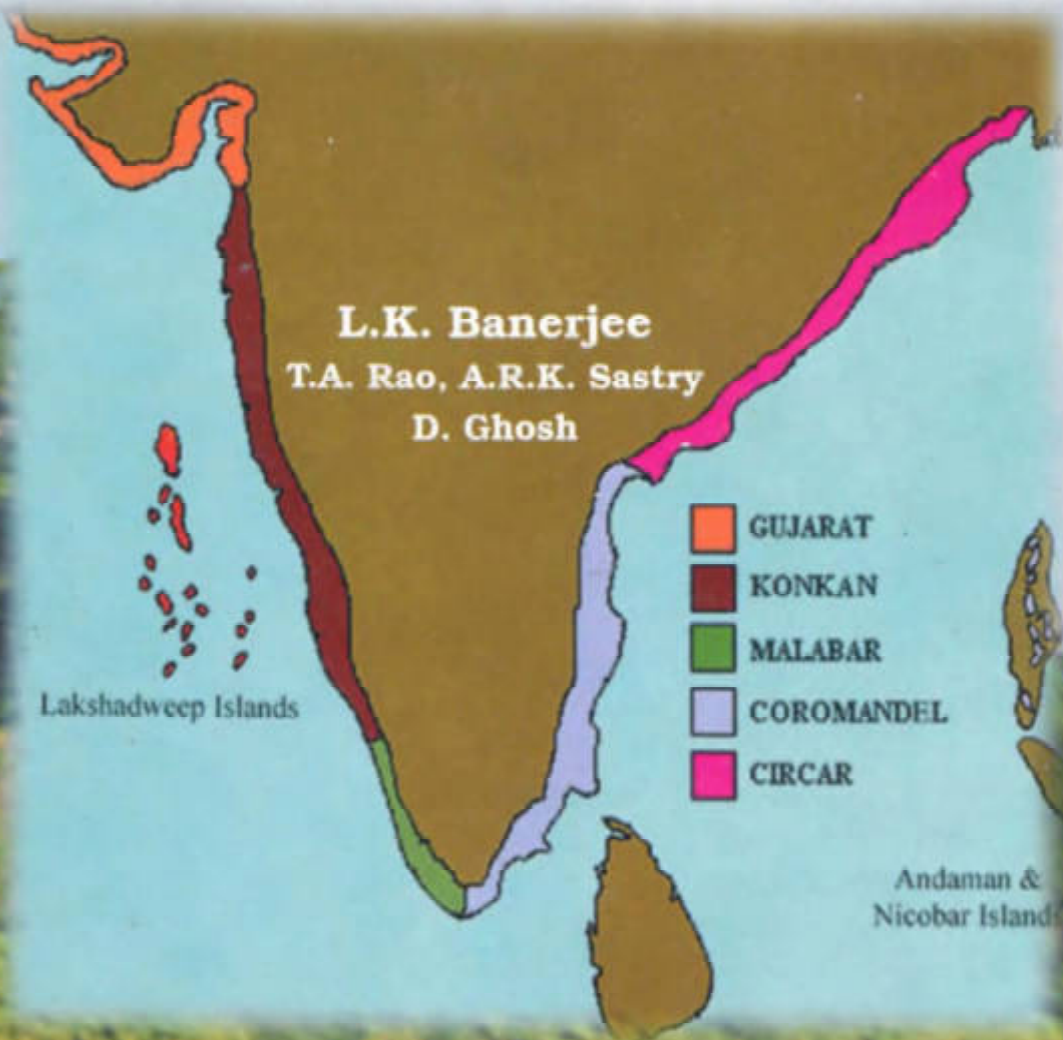







Diversity of Coastal Plant Communities in India



L.K. Banerjee
T.A. Rao, A.R.K. Sastry
D. Ghosh

-  GUJARAT
-  KONKAN
-  MALABAR
-  COROMANDEL
-  CIRCAR

Lakshadweep Islands

Andaman &
Nicobar Islands



भारतीय वनस्पति सर्वेक्षण
BOTANICAL SURVEY OF INDIA

ENVIS-EMCBTAP, Botanical Survey of India
Ministry of Environment & Forests, Kolkata



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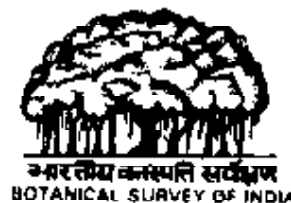
*Botanical Survey of India and
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Front Cover : Indian coastal regions

Back Cover : *Bruguiera gymnorrhiza* community in north Andaman

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FOREWORD

It gives me real pleasure and satisfaction to accede to the request from the ENVIS Centre, Botanical Survey of India, for a foreword for this very valuable book, 'Diversity of Coastal Plant Communities in India'.

Ecology Unit, Botanical Survey of India from 1964 had initiated the study on Indian Coastal Plants as one of its central theme of research. Thorough investigation on this specialised Coastal Flora and Ecology by several scientists resulted the publication of some important research papers on Ecology and Floristics of the Indian Coastal Ecosystem and provided some basic information on coastal plant communities in India. These research activities are so vast and so valued that they need a brief introduction.

7500 km long coastal line of India along with the oceanic areas serve as the biggest ecosystem and the largest economic resource of our country. Some of the most productive communities in this ecosystems such as Dry coastal plant communities, Mangroves, Salt marshes, Seaweeds, Sea grasses, estuaries, Backwaters, Lagoons and Coral reefs not only act as best ecological security for protection of our surrounding environment but provide optimum habitats for highest biological productivity. Though coastal zone constitutes only 10% of total oceanic area, it accounts for more than half of the ocean's biological productivity and supplies nearly 95% of the marine fish catch. Coastal ecosystem provides numerous livelihood opportunities, encouraging tourism activities and urban development and thus about 60% of the world's population live on or within 60 km of the coast. Social, economic and environmental significance of the coastal ecosystem makes high contribution to the GDP of the national economy. There are direct links between coastal environmental function and generation of goods, which may be used in more than one form of activity. Biodiversity of the coastal ecosystem is specially adapted morphologically, physiologically and biochemically for withstanding the stressed and complex ecological processes of this environment. The oceanic part of the coastal zone plays a major role in controlling green house gases by absorbing large amount of carbon dioxide and this is directly related to the presence of numerous seaweeds, seagrasses, phytoplankton and bacterial communities in the sea. Today the coastal areas have become man's garbage dump. The signs of various solid, liquid and oil pollution are obvious even to the most casual observer when beaches emit disgusting odours, jams with industrial wastes, smokes, commercial fishery waste and floating oils on the sea surface.

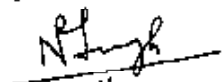
There are thousands of anthropogenic problems along with natural problems for management of the coastal system. Starting from 1958 up to 1999 a number of international and regional convention were aimed at protection of coastal zone from pollution.

International convention on Climate and Biodiversity at Rio de Janeiro in June 1992 also realized the protection of valuable coastal ecosystem. Ministry of Environment & Forests, Government of India, 1991 made regulations in the activities of the coastal zone under notification of CRZ (Coastal Regulation Zone) on coastal land ward sides up to 500 m from the high tide level and low tide level. However, unless a strict action is initiated now, the coastal zone may be irreversibly damaged by destructive approach of certain human activities.

Sustainable livelihood for coastal population are depending upon effective management of all interrelated activities in the coastal areas to achieve optimal use of both living and non-living resources and equitable distribution of the benefits arising. For this purpose a detailed survey, identification, distribution, description and ecological notes of all plant diversity of the coastal areas are the basic resources for preparation of coastal biodiversity documentation and a database. Botanical Survey of India was engaged in this work from the Ecology unit and surveyed critically the Dry and Wet coastal plant communities from different coastal regions in India. ENVIS Centre initiates for preparing database including oceanic islands like Andaman, Nicobar and Lakshadweep.

It is evident from the list of contents of the book that many aspects of Dry and Wet coastal ecosystem in India are dealt by the authors. It is represented in a simple and concise manner so as to be useful for researchers and experienced workers. The chapter on Dry and Wet coastal plant diversity, assessment, conservation and management strategies make very interesting reading. The present book should be very useful to the students, research workers and many allied fields like Marine Biology, Forestry, Mangrove Societies, Botanical research and General information technology on coastal biodiversity.

I am confident that this book will bring a new light for the preparation of coastal plant diversity database and will meet a real need for sustainable development of coastal livelihood. I am, therefore, glad to recommend this very helpful venture.



(N. P. Singh)

Director

Botanical Survey of India

Kolkata

14. 8. 2001

PREFACE

Indian coastline stretches over a length of 7500 km exhibit varied ecological and climatic zones with many valuable ecosystems such as dry coastal ecosystem, tropical evergreen ecosystem, estuarine, backwaters and deltaic mangrove ecosystem, coastal desert ecosystem, salt marsh ecosystem and infra-littoral sea-grass and seaweeds ecosystems. Not only the coastline is dominated with several sand binders in the dry coast and mangroves in the wet coast regions but many interesting off-shore oceanic island's components form a complex and unique patterns of vegetation, flora and ecology in these areas.

In the past, starting from 1964 to 1980, several distinguished scientists from the Ecology Unit, Botanical Survey of India had surveyed various parts of the Indian coast, though it was incomplete but they have published some important basic information on floral diversity and interrelated ecological factors. Present authors, scientists of the Ecology Unit, Botanical Survey of India had been associated with the prolong survey and study of the coastal ecosystem from the beginning and devoted their life mostly in the various aspects of coastal plant diversity. First author has completed the survey of all Indian coastal regions which were incomplete up to 1982 with special attention towards the Indian mangroves and oceanic islands.

The present endeavour took years of painstaking field tours, collection, preservation and preparation of herbarium materials, systematic research works, library and other information networks on the part of the authors. The present study deals with general introduction, topography, geomorphology, geology, soil and climatic features of different Indian coastal regions along with seaweeds, sea-grass, brief information on coastal fungi and lichens, some of the special habitats of the coastal areas, quantitative assessment of coastal plant communities, floristic studies of Indian coastal plant diversity including key to the genera and species under each family followed by description, distribution, ecological notes of each species. It also includes assessment of coastal plant diversity with special emphasis on rare, endangered and restricted taxa in different coastal zones and general threats, conservation and management strategies of the coastal areas. It also deals with the intricacies of coastal livelihood through the sustainable use of coastal resources. The main objectives of this study are to accumulate all scattered research works on coastal plants from Ecology Unit, Botanical Survey of India and to make detail survey, collection, identification and ecological investigation of the incomplete coastal areas of dry and wet coastal plant communities in India. It may approach towards the integrated network database on coastal plants, their physical and ecological parameters, qualitative and quantitative assessment with a view to obtain information on plant diversity, ecological notes, distribution and conservation measures.

The authors hope that this book will be of immense helpful to the students, researchers, foresters, planners and all others enthusiastic about nature and its conservation. This book will also provide basic resources of the coastal plant diversity which are highly valuable for preparation and documentation of the coastal database as a major tool for the modern information technology.

Authors

NOTE

The coastal regions of almost all the states of India are always under great pressure due to high population density and urban growth. Uncontrolled developmental activities in these areas cause changed land use pattern and are making communities vulnerable to sea storms. Recently the threat due to global warming and sea level rise may bring enormous losses to the coastal communities. In order to protect and conserve the coastal environment, Ministry of Environment & Forests has defined Coastal Regulation Zone (CRZ) and Regulating Activities via its Notification, 19th February 1991. The notification provides the norms of zoning the coastal areas into CRZ - I, CRZ - II, CRZ - III and CRZ - IV and guidelines for various activities either to be restricted or to be prohibited in CRZ. Detail survey and identification of plant diversity in all the maritime states of India would be a valuable database for preparation of Coastal Zone Management Plan (CZMP) using this guidelines.

Information available in this Book 'Diversity of Coastal Plant Communities in India' published from the BSI-ENVIS is a very important work as because within 48-100 years, lower parts of West Bengal, Orissa, Mumbai, Goa, large parts of coastal states in south India including Kerala, Lakshadweep and Andaman & Nicobar Island will be effected due to land inundation if global warming raises sealevel. Melting of Ice cap and glaciers due to global warming will bring more water in to the oceans. This will bring heavy loss to Indian coastal land and its biodiversity on which about 7.1 million people are depending for their livelihood. Total loss incase of sea level rises by a meter by 2100 will be more than 1200 higher plant species comprising of several million of coastal palms which are restricted along the coastal habitat for providing natural protection to the dry and wet coastal ecosystem in India. Though the sea level rise is a very slow and gradual phenomenon, but we have to take care and think in advance after making quantitative assessment, IRS mapping and regular monitoring of plants along the coast.

This document will help to keep record of all the coastal plant diversity if any damages occur in the future due to global warming and sea level rise. Though the Department of Ocean Development, Government of India with the help of National Ocean Information System (NOIS) has initiated preparation of Indian Coastal and Marine Data Collection through IMD, Pune, NIO, Goa, CS & CMRI, Bhabnagar, but data collection on the vascular plant diversity both in dry and wet coastal ecosystem in India remains a major gaps in the NOIS. The present information as documented by BSI-ENVIS would be no doubt an usefull data for coastal and marine plant resources.

Project Coordinator
EMCB-ENVIS-BSI.

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We greatly appreciate the enthusiastic support, constructive suggestions and everyday guidance by the Director, Botanical Survey of India.

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The authors would like to express their appreciation to their spouse for their immense support and specially for their forbearance during the preparation of the manuscripts and field trips.

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Authors

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INTRODUCTION

Coastal systems extend from the littoral region that is lying between the main land and the inner most margins of the sea shore and marine regions from the upper tidal limits out across the continental shelf, slope and rise (Brink, 1993). It includes rocky and sandy shores, beaches, estuaries, deltas, backwaters, lagoons and Exclusive Economic Zones (EEZ), approximately 200 nautical miles wide along the 440,000 km long outline of the continents (Ryther, 1969). The system is usually covered with dry coastal beach vegetation, beach forest of sandy or rocky habitat types, wet coastal mangroves, salt marshes, seaweeds, seagrasses, coral reefs and associated subtidal benthos (Goldberg, 1993). It also includes some of the most important endemic areas like continental and oceanic islands.

Biological diversity in the coastal ecosystem differs from terrestrial ecosystem both in respect to pattern of diversity and to the functional application of those patterns. In general, coastal systems have not only high diversity at species level but also at higher taxonomic level (Costilla, 1998). They show greater diversity of types of organism and types of adaptive specialities than the terrestrial system.

Coastal ecosystems command the world's highest importance by virtue of their biological productivity, specialised adaptive capacity of the biodiversity, complexity in the ecological processes and finally importance of the resources that have a wide range of natural functions and that are variously used for sustainable life support to the human and other biological components directly or indirectly. Indirectly various amenities provided by coastal ecosystems for conservation and protection of environment are so much valued that the cost could not be evaluated with the help of monetary measure. Due to dominance of large physical forces of wind, salt spray, temperature, saline tide water and unstable substrates, some regions of this system may harbour comparatively lower number of biodiversity components but these components show high range of taxonomic diversity and survive in the constrained ecological conditions by morphological, physiological and biochemical adaptation for adjusting

gradation of small scale variation of ecological and environmental factors (Ray, 1991; Grassle, 1991). This high level of diversity in the coastal system reveals that species within the functional group are physiologically and genetically more distinct from one another than the terrestrial assemblage. More the differences among the members of a functional group, more that members may respond differently to the gradation of environmental changes and more will be the physiological and genetic base for adaptation to change and finally it confers a great potential for ecosystem resilience (Heywood and Watson, 1995). Primary producers, phytoplanktons suspended in water column, which fix carbon in one place and are decomposed or consumed many kilometers away are taxonomically diverse and play most prominent role to the coastal or marine system than the terrestrial system. Biogeographic diversity patterns are also different at lower latitudes, mid latitudes and at higher latitudes along the coastal system (Bolton, 1994). Mangrove flora for example along the coastal system is more diverse in tropical coast than that of the temperate regions.

Importance of coastal system for sustainable life support and other amenities for environmental security is very high. Most of the world's people live within 80 km of the coast. Most of the sustainable living operations related to land and sea based activities are concentrated at the coastal margin (Sobel, 1993) such as world's richest fish catch, mariculture, tourism, domestic and industrial waste disposal, transportation, kelp forest, mining industries, recreation and nutrition (Norse, 1993). Many of the sustainable life support resources of the world like food, fuel, house and boat building materials, fishing and thatching materials, textile, tannins, furniture materials, oils, gums, resin, incense, paper pulp, softwood, honey, wax, reptile skin, fishes, shellfishes, crustaceans, tiger prawns, crabs, birds and mammals are found along the coastal lands. The coastal systems are very rich habitat for many biological components and without these many important biological germplasm would have been extinct. It serves as nursery ground for many estuarine fishes, shellfishes, crustaceans and

edible crabs. It acts as nesting ground for many resident and migratory birds, reptiles, Olive Ridley turtle and other wild animals. It serves as an unique habitat for Royal Bengal Tigers restricted along the Sunderbans and Bangladesh coast. Mangroves, Seagrasses and Seaweeds which forms potential habitats of the coastal system have become most vulnerable throughout the world due to heavy exploitation and environmental degradation.

Another important objective of coastal system is the global balance of atmospheric and climatic conditions by active and trace gases, produced by wide variety of phytoplanktons, bacteria and macrophytes in the marine system. Some of the marine biogases (Wolfe *et al.*, 1991) like carbon, sulphur, nitrogen, halogens and most important carbonylsulphur (COS) and Dimethylsulphur (DMS) which are the main biogenic source of coastal marine areas produced by phytoplanktons, bacteria and other macrophytes play a vital role on atmosphere and consequently on global climate. Loss of biodiversity, increased pollutants, eutrophication, sedimentation, depletion of ozone with consequent increase of UV radiation will alter the diversity and abundance of the producers and finally it will cause serious alteration of global climate (Hebling *et al.*, 1992).

The most surprising fact that the coastal systems which contribute vital support for human life are seriously affected mostly by human activities. The major threats including over exploitation, coastal aquaculture, alteration of habitat, coastal pollution, biological invasions, land based activities and many others are responsible for the changes or partial loss of coastal diversity (Carlton and Hodder, 1995). Documentation of coastal plant diversity and impact of threats have not been properly investigated in India. However, in the present study some sincere efforts for studying coastal plant diversity including the threats and conservation strategies in India have been focused for future conservation and management practices of Indian coastal plant communities.

India has a long coast line of 7,500 km, washed by the Bay of Bengal on the east, the Arabian Sea on the west and the Indian Ocean touching the southern end. The coast line or the littoral region, lying between the main land and the inner most edges of the sea shore is the meeting line of the sub-aerial and marine processes

of erosion and deposition. These continental and marine system are very different in their rate and intensity of the coastal processes and varies widely in its structure and function in different parts of the country due to various geomorphological features. It is narrow along the Konkan and Malabar coast of the west due to formation of cliffs, barriers, spits and lagoons immediately behind the shore and wider in the Coromandel-Circular regions due to formation of deltas, sand beaches and off-shore bars. The West coast is much narrower except around the Gulf of Khambat and the Gulf of Kutchh. The widening in these two places has become possible due to sedimentation and isostatic adjustment. The depositional action of the rivers on the West coast is very meagre along its length from the South of Gujarat to the Cape Comorin due to tilting of the West coast. Extreme southern part of the south Sahyadri is also wider in this coast. Formation of rocky shore line, cliffs, lagoons and back waters are characteristic features of the West coast. The East coast in contrast is much broader in outline and associated with depositional activities of the rivers. This is partly due to change of their base levels and due to formation of extensive deltaic complex like, the Ganga-Brahmaputra, the Mahanadi, the Krishna-Godavari and the Cauveri. All the major deltas along the East coast are in progressive stage into the sea and are still continuing. Formation of sandy beaches, dunes and vast estuarine tidal flats are the characteristic of the East coast.

Indian shore line has been divided into 6 types (Ahmed, 1972) in accordance with geomorphological conditions such as irrespective of emergence or submergence the shore in the deltaic areas continues to grow sea-wards is known as Neutral shore line. This shore line along the Ganga, Mahanadi, Godavari, Krishna and Cauvery characterised by progradation despite subsidence. The shore between the Ganga and Godavari is dominantly emergent type without any off-shore bar or barriers formation. The shore between the Krishna and Cape Comorin is emergent type with off-shore bars or barriers formation. The shore in Maharashtra and northern part of Mysore is remarkably submergent type with cliffed or rocky coastal formation. The shore in Khambat is also submergent type with characteristic marshy low land formation. The shore in Kerala and parts of Kathiawar are compound shore or

double shore characterised by an outer shore of the barriers towards the sea and inner, irregular shore towards mainland of the lagoons, that occur behind the barriers.

The land in between the mainland and immediately behind the inner edge of the shore zone i.e. behind the inner most limit of the tidal impact areas during storms and highest tides is known as coast land. The limitation or extent of coastal zone in India is very difficult to point out in real term. It is narrow where highlands are formed by mountains and plateaus, immediately behind the shore zone and wide in low relief along the areas of depositional plain or areas of recently emergent marine floor. Significance of the coastal zone of a country is its potential nature with respect to possible postglacial submergence. It is believed that if all the land ice of the present time melted, it would cause an eustation rise of the sea level by about 50 m. Thus the 50-meter-contour line may be taken as a very rough inner limit of the coastal zone of India and based on this fact the inner limit of the coastal zone would pass through the head of the Ganga delta, but on the Circar coast it would generally be within 30 km of the shoreline. In the deltaic regions of the Mahanadi, Godavari and Krishna, this line will penetrate much deeper up to 100 km. On the Coromandel coast this line would normally be 50 km from the shore line, penetrating deeper in the basins of the Cauvery and other larger streams and approaching nearer shoreline in the areas of rocky outliers. The coast zone reaches one of its narrowest points near Cape Comorin where the 50 m contour is only a few metres from the shoreline. On the west coast the inner margin of the coastal zone is approximately between 15 and 20 km from the shoreline on the Kerala and Karnataka coast and within 0 to 15 km from the waterline on the Maharashtra coast. Further north in the Khamhat region it is about 50-60 km from the shoreline. The coastal zone is variable in Kathiawar. On the south-east Kathiawar along the rocky and cliffed area, the inner margin of the coastal zone varies from 5 to 40 km from the shoreline. In south-west Kathiawar from Diu to Dwarka it is about 20-30 km inland. The position is more or less similar around the coast bordering the Gulf of Kutch.

The world ocean can be divided into two zones, the coastal ocean and the open ocean. It has been estimated that coastal waters to the edge of the

continental shelf constitute nearly 20 per cent of area of the world's oceans and includes estuaries, lagoons, lakes, inshore waters and many marginal seas and bays. These areas are the sites of high biological diversity and productivity.

The vegetation and flora of the Indian coastline have not been studied in their proper perspective although frequent references on the occurrence of sea-shore plants find place in several floras and papers, since the time of the publication of the Flora of British India. The coastal region which comprises diverse ecosystem presents very interesting aspects for ecological, physiological and phytogeographical studies. Only certain physiologically specialised and ecologically adapted plants which have evolved remarkable adaptations to survive in the saltwater conditions grow in this sensitive ecosystem.

The distribution pattern of the Indian maritime strand flora are mainly observed in two categories, such as Sand strand and Rock strand.

Characteristic plants of sand strand are: *Ardisia solanacea*, *Atalantia monophylla*, *Barringtonia racemosa*, *Barringtonia asiatica*, *Calophyllum inophyllum*, *Caesalpinia crista*, *Caesalpinia nuga*, *Cerbera manghas*, *Clerodendrum inerme*, *Colubrina asiatica*, *Dalbergia spinosa*, *Derris uliginosa*, *Guetarda speciosa*, *Hernandia ovigera*, *Heritiera littoralis*, *Hibiscus tiliaceus*, *Hydrophyllax maritima*, *Intsia bijuga*, *Leptadenia reticulata*, *Mucuna gigantea*, *Myriostachya wightiana*, *Paramignya armata*, *Pisonia aculeata*, *Premna corymbosa*, *Samadera indica*, *Scyphiphora hydrophyllacea*, *Spinifex littorius*, *Synostemon bacciforme*, *Tamarix troupii*, *Thespesia populnea* and *Urochondra setulosa*.

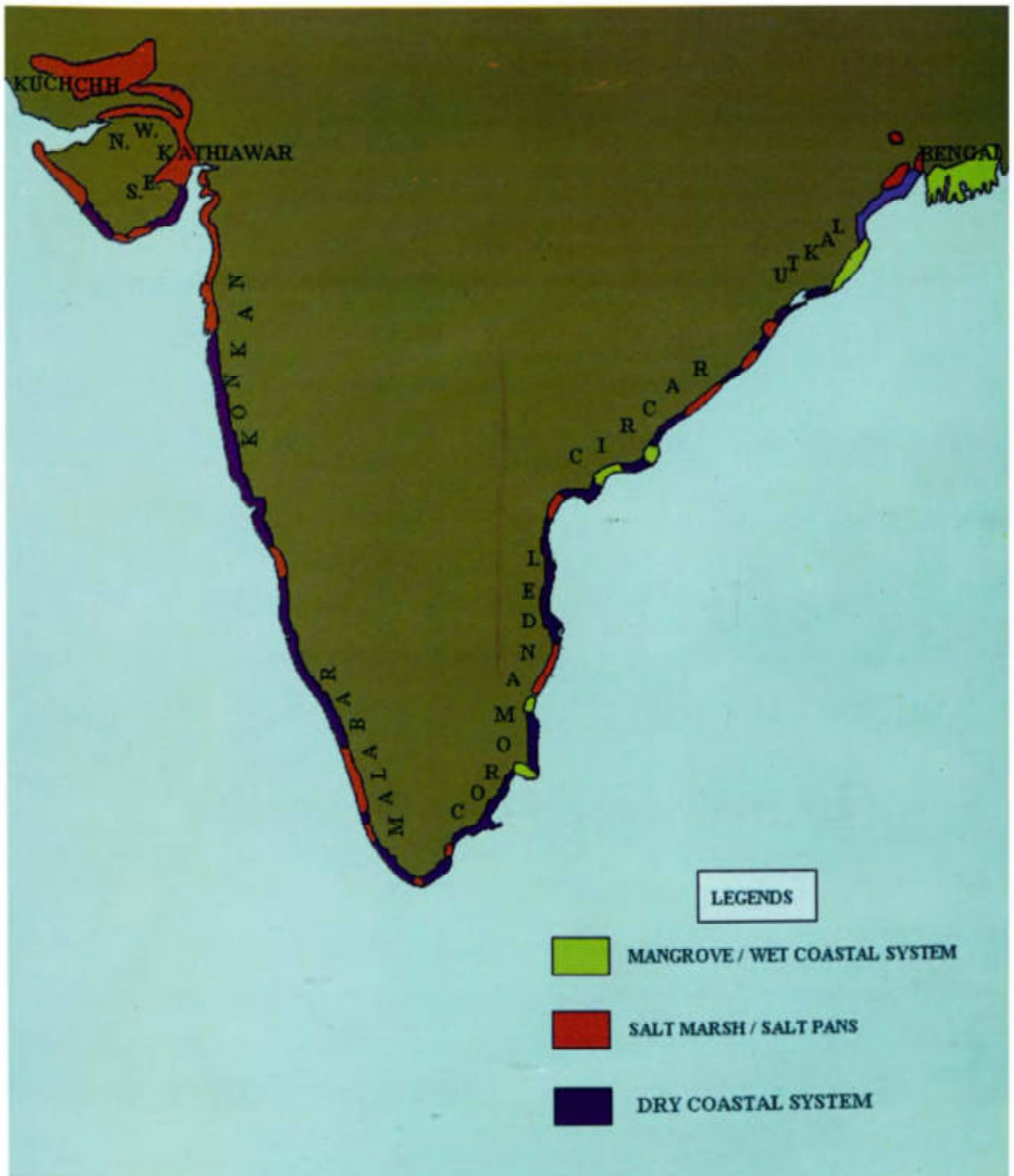
Characteristic plants of rock strand are: *Anotis foetida*, *Atriplex stocksii*, *Capparis brevispina*, *Commiphora wightii*, *Flagellaria indica*, *Jatropha gossypifolia*, *Limonium stocksii*, *Pemphis acidula*, *Polycarpaea spicata*, *Polygala arillata*, *Polygala erioptera* and others.

Besides the above two major types, there is a third category where plants extend from the seashore towards the interior and some times a few of them attain an altitude up to 2000 m. A few of them have their niche breadth more frequently under the maritime influence than in inland areas. Certain interesting plants are: *Acacia planifromis*, *Aerva javanica*, *Andrographis*

echeoides, *Azima tetracantha*, *Calotropis gigantea*, *Calotropis procera*, *Capparis decidua*, *Cassipoua filiformis*, *Cosmostigma racemosum*, *Drimeia indica*, *Drosera burmannii*, *Drosera indica*, *Dodonaea viscosa*, *Euphorbia caudicifolia*, *Euphorbia nivulia*, *Enicostema hyssopifolium*, *Hyphaene dichotoma*, *Gisekia pharnaceoides*, *Ischaemum santapauli*, *Jatropha gossypifolia*, *Kickxia ramossisima*, *Leptadenia reticulata*, *Leptadenia pyrotechnica*, *Lepidagathis cristata*, *Lindenbergia muraria*, *Diospyros buxifolia*, *Phaseolus trilobus*, *Pongamia pinnata*, *Premna latifolia*, *Salvadora persica*, *Sericostoma pauciflora*, *Sericostoma aecidium*, *Scilla hyacinthina*, *Syzygium ruscifolium*, *Stenotaphrum dimidiatum*, *Randia dumetorium*, and *Vitex trifolia*.

The detailed analysis of the Indian strand flora reveals that it is a mixture of Polynesian, Malaysian, Persio-Arabian or Western and a few Indian elements. The strand flora of Ceylon is well represented in the Coromandel coastline including the islands of the Gulf of Mannar. Further, they have spread north-westward

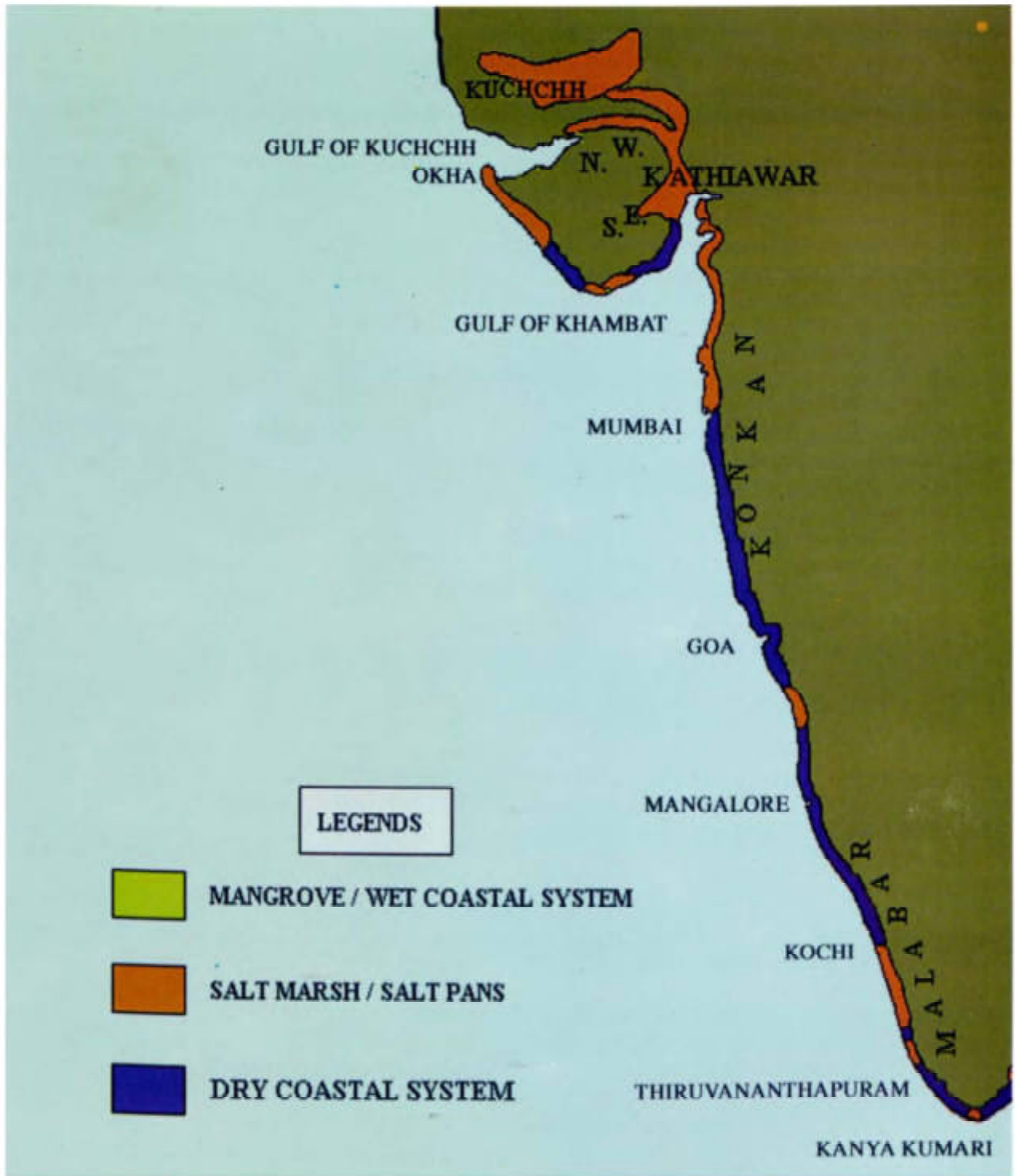
along the coast of Malabar (Kerala), Karnataka, Konkan and Kuchch coast, but the same is not the situation in the East coast. The interesting feature of the flora especially towards the north-eastward along the coasts of Andhra and Orissa is the absence of species like *Scaevola taccada*, *S. plumieri*, *Polycarpaea spicata* and *Cyperus pedunculatus* even though they are recorded along Tamil Nadu coast especially bordering the southern coastal areas. The other distinct aspect is the absence of dominant plants of Coromandel coast in the Sundarbans area. Finally certain species like *Thursea involuta*, *Lepturus repens*, *Guettarda speciosa*, *Hernandia peltata* hitherto reported in Andaman and Nicobar, Ceylon, Lakshadweep islands are yet to be located along the Indian main shores. The recorded presence of certain plants like *Suriana maritima*, *Cordia subcordata*, *Argusia argentea*, *Pemphis acidula* along the southern coastal strip and islands of the Andaman and Nicobar and Gulf of Mannar are yet to make a headway northwards along the Indian coasts (Rao, 1971).



Indian Coast showing different features



Gujarat Coast



West Coast



Kerala Coast



East Coast



Satellite Imagery (Gujarat I. D. E.)

Courtesy : Y. D. Singh



Karnataka Coast

(Courtesy : T. A. Rao)



Ganjam Coast



Karnataka Coast



Tamil Nadu Coast



Orissa Coast



Goa Coast



St. Mary Island



Kerala Coast



Little Andaman Coast

PHYSIOGRAPHY OF INDIAN COAST

Coastal landscape of the Indian sub-continent comprises an array of ecosystem and according to the nature of physiography, Indian coast line can be subdivided into 3 major regions such as :

- 1) Gujarat Coast Region, 2) West Coast Region and 3) East Coast Region.

PHYSIOGRAPHY OF THE GUJARAT COAST

Gujarat located in the northwestern parts of India (20°1' - 24°7' N and 68°4' - 74°4' E) occupies an area of 196, 024 sq. km and has a coastline 1663 km with a continental shelf of 165000 sq. km. About 35 rivers annually add 71,000 mm³ water to the sea around the state. The area mostly belong to the old peninsular region thrusting broadly into the Arabian Sea in between the Gulf of Khambat and the Gulf of Kuchchh. The core area of the peninsular land mass is the Saurashtra regions while the Gujarat proper is mostly situated on the alluvial zone on the flanks of the Vindhya-Aravalli hills.

Coastal plains of Gujarat extend from the north-west part of Rann of Kuchchh to the southern part of the Kathiawar or Saurashtra including the border lines of the Gulf of Khambat and Kuchchh up to the eastern marginal land masses of the Damans.

The Rann of Kuchchh in the northern part of Gujarat represents an unique terrain consisting of naked tidal mud flats transected by several dead and live creeks. This with the association of Little Rann characterised muddy terrains, small alluvial basins, dried creeks, whitish vertebrae of salts or scums, various marshes with aquatic plants and varying types of lakes are characteristic features of this region. Islets and Islands project over the bare and broken ribs here and there. With the silting of the Rann, two tongues of water known as Gulf of Kuchchh and Khambat enter the landmass to the peninsula of Kathiawar or Saurashtra regions.

It is bounded by the Arabian Sea in the south and south-west, by the Gulf of Kuchchh in the north-west, by the Gulf of Khambat and mainland Gujarat in the east and north-east region. Except for the alluvial

tract, Saurashtra is covered by undulating plains or broken hills which are higher in the south and west than in the north and east. The surface rocks are limestones in the south and sandstones in the north. The high hills are of granite and lower hills consist of trap and basalt. Saurashtra region can be physically divided into three types : the coastal plains, the inlands and the hills. This coastal plains can again be divided into 4 different regions according to the nature of soils, slopes, drainage and climate. These four types are located as follows :

1. The Gulf of Kuchchh to Okhamandal

This part consist of a through line of low reefs and muddy foreshore. Its low stretches are often transformed by the mirages into shifting scenes of rocks, castles and some still lakes.

2. Okhamandal to Diu

This region about 220 km long is generally arid and fringed with a line of wind blown sand humps.

3. Diu to Gopnath

This part of about 160 km long presents a succession of cliffs of moderate height and sometimes hollowed by the sea into caverns. The pleasing rolling plains, palm groves, estuaries and glimpses of distant hills are characteristic feature of this region.

4. Gopnath to Amli

This part of about 140 km long shows low muddy foreshore of partly rocky and partly sandy in outline associated with mangroves.

Eastern part of Gujarat is a projected jet of Sindhu-Ganga alluvial tract. The rivers Sabarmati, Mahi, Tapi and others carry enough silt load to advance their alluvial prongs in to the Gulf of Khambat.

PHYSIOGRAPHY OF WEST COAST

West coastal plains of India fall between the Sahyadris and Arabian Sea extending from 8°15' N to

20°22' N and 73°40' E to 77°30' E covering 1,400 km long and 10-80 km broad coastline. This coast land includes Konkan and Malabar coastal provinces within the states of Maharashtra, Karnataka, Kerala and the Kanya Kumari district of Tamil Nadu. The South of the river Narmada to Mangalore is known as Konkan coast and south of Mangalore to Cannanore is the Malabar coast. Western Ghats, the richest ecozone in India stretches from Ratnagiri to Cannanore in this coastal region. A distinct strip of low land interspersed by hills with the elevation of 150 m to 360 m is the characteristic feature of this coastal line. Its landscape is composed of one or more of the following types : sandy beach, coastal sand dunes, alluvial tracts of muddy flats along the rivers, lagoons or river laterite platforms, erosional surface in the hard basement rock or the residual hills. The Sahyadris rising in elevation from 700 to 1000 m, run almost parallel to this coast line and present their steep face to the coastal low levels but its continuity is interrupted by the presence of a few ghats or gaps. The steep, west-facing scarp of the Sahyadris may be the product of faulting which preceded the subsidence of the Arabian Sea, blocked between India and Africa during Eocene period. Geographical examinations of this coastal line from north to south reveals that recent submergence of Konkan coast, from the south of the river Narmada to Mangalore and emergence of Malabar coast, from Mangalore to Kanya Kumari. The submergent nature of Konkan coast may be seen by the occurrence of submerged forests on the western coast of the islands of Mumbai, along with the submerged nature of the streams.

Raised beaches and planes of marine erosion of earlier times are found at altitudes varying from 30 to 91 m all along the western coast of India. The raised beaches are nothing but littoral concrete composed of an agglutinated mass of gravel, sand, shells and corals. Occurrence of bevelled surface in Deccan Lava surmounted by isolated hills that look like off-shore islands has been noted in the Konkan coast. Besides the presence of laterite capped residual plateaus along the southern part of Ratnagiri district in south Konkan and also in Karnataka and in some parts of Malabar, platforms of marine erosion are also found prominent.

The undulating low lands of the Konkan are 530 km long and 30-50 km broad. These are widest near

Mumbai which has probably forced the Sahyadris in this part to recede inwards away from the coast. The north of the Vaitarini river or the northern Konkan is composed of two landscape forms : 1. the sandy spits intruding into muddy shallows, close to the sea and 2. low coastal ranges altering with longitudinal valleys farther inland. The southern Konkan, in contrast, is a rocky and rugged country. Lofty hills and elevated plateaus intersected by numerous creeks and streams are found close to the coast. The sea board from Bamkot or Fort Victoria to Reddi-Fort is rocky. Rocky projections from the Sahyadris almost reach the sea board of north and south Goa. The coast of Goa is a riatype and almost deltaic in nature due to presence of various estuaries.

KARNATAKA and MALABAR COAST

The coastal Karnataka, a part of the Malabar coast, extends 320 km with the width of 8-25 km towards the inland areas. The seaboard of this coast possesses headlands, bays, lagoons and backwaters due to formation of sand bars at regular intervals.

The entire coastal belt can be divided into three divisions, viz., Dakshina Kannada, Udupi and Uttara Kannada (Rao, T.A. & P.V. Suresh, 2001). The Dakshina Kannada and Udupi districts lie between 12°27' to 13°58' N and is a long narrow strip of broken territory with characteristic undulations of a plateau-land. Due to the presence of the Western Ghats in the Eastern part of Dakshina Kannada and Udupi districts all the rivers flow from east to west. In contrast Uttara Kannada lying between 13°58' to 15°31' N has a sea board extending in a long narrow straight line to the south-southeast except the shallow Karwar and Belkeri bays. The coast is broken by deep and wide-mouthed estuaries with many rocky islands and capes.

Three parallel belts of land forms are characteristic of Karnataka coastal plains in three forms: 1. Immediately behind the coast is a narrow belts of sand dunes, mud-flats and marshes formed commonly by lagoons and estuaries. 2. Further inland these belts are succeeded by high erosional platform associated with laterite deposits of Pleistocene age and dissected by steep-sided valleys. 3. Further inland are associated with isolated residual hills of Archaean gneiss and is very prominent along the south-east of Hanover and near Karwar.

Based on phyto-geomorphological features, the seaboard can be categorised under Beach or Strand ecosystem and Estuarine ecosystem. Strand ecosystem consists of lengthy or pocket-sized semi-lunar beaches, sandy ridges free from shifting dunes, cliffs including slacks, rocky platforms or mounds, spits and bars, and lateritic rocky headlands. Estuarine ecosystem on the other hand consists of tidal river banks chiefly represented by fringe mangroves which are also present on the banks of shallow lagoons, backwater creeks, mudflats and depressed or elevated man-made salt flats.

The Malabar coast is about 550 km long and 20 to 100 km wide, narrower in the north and south but wider in the middle, specially in the valley of Ponnani, the Periyar and Pambar. It shows prograding face from broader to the narrow ending of rocky projection near Kanya Kumari. Sand dunes of various forms are found all along the Kerala coast except to the south of Kovalam where rocky projection ends right up to the sea. These sand dunes of pleistocene and of recent origin have helped to form numerous shallow lagoons and backwater flows. Besides, these, there are some erosion platforms and laterite cliffs near Kozhikode district. The gneissic hill lies in further inland areas.

PHYSIOGRAPHY OF EAST COAST

The east coastal plains of India fall between Bengal and Orissa in the north and Andhra Pradesh and Tamil Nadu in the south extending from 8° to 22°13'30" N and 77°30'30" to 87°20' E., covering about 3,289 km long and 40-100 km broad coast line with an area of 1,02,882 km². In Bengal, the coastal plain includes the active deltaic plains of the Sunderbans and the significant sand dune forming part of the Midnapur coast. The Orissa coastal plain includes small part of Mayurbhanj, major part of Balasore, Cutack, Puri and Ganjam district. In Andhra Pradesh, coastal areas of Srikakulam, Vishakhapatnam, East and West Godavari, Krishna and Nellore districts are included in the coastal plain. In Tamil Nadu, coastal plain includes whole of Chingleput and Chennai, smaller part of North Arcot, most of South Arcot, the whole of Thanjavore, Tiruchirappalli, Madurai, Ramanathapuram, Tirunelveli, Ambasamudram, Tenkasi, Shencottah and Sankar-nayinarkovil taluks, Pondicherry and Korikal areas.

In contrast to the West coast, the East coastal plain being generally formed by the alluvial fillings of the littoral zone, comprises some of the largest deltas which along with the Ganga delta serve as active seaboards.

Between the Subarnarekha in the north and the Kanya Kumari in the south, the eastern coastal plains rise gradually from the Bay of Bengal to merge with the irregular alignment of the Eastern Ghats where about 150 m contour in the south and 75 m contour in the north separate the region from the Peninsular uplands. These coastal plains have straight shoreline with well-defined beaches of sand and shingles with deltas of the Ganga, Mahanadi, Godavari, Krishna and the Cauvery and form unindented emergent coast. The most famous beach formation is in Madras and beach ridges formation in Orissa. The long preserved sand bar is found in the Rameswaram island and coral islands in the Gulf of Mannar and the Palk Strait areas.

Along the strand, formation of sand dunes about 10 km inland are prominent on several places. In Orissa coast, parallel sand dunes and beach ridges of 10 to 20 m height are found due to ocean current and wind force. In Puri, due to coastal uplift this reach the height of 4.5 m to 9 m. Further south towards the Godavari-Krishna regions these sand dunes extend up to 10 m. In Tamil Nadu, sand dunes form peculiar features along the coast of Tirunelveli and are scattered elsewhere as in Mahabalipuram. They rise 20-25 m high and are composed of quartz, ilmenite and magnetic sands. Along the coast line there are lagoons and the Chika lake situated in Puri and Ganjam district is famous and important. Further south, on the border of Andhra and Tamil Nadu coastal plain, a backwater lake, the Pulicat which is cut off from the Bay by a long spit of sand and mud is also famous. Other backwaters are found in Eonore, Mahabalipuram, Marakara and Veakaranyam, and in the Krishna-Godavari regions at Kothapallam and Minipalam.

Thus, in general, the East coastal plains can be divided into four physiographic regions such as :

1. Rocky shore line near Ganjam and Vishakhapatnam,
2. Sandy shore line in most of the regions,
3. Alluvial and silty deltaic shore line along the deltas,
4. Lagoons and Backwaters.

GEOMORPHOLOGY OF INDIAN COAST

Geomorphologically coastal zone in India can be divided into three main features such as off-shore, on-shore and coast land features. Several interesting field work related to the coastal geomorphology in India are very valuable and some of the works may be mentioned here, such as Wadia's *Geology of India* (1961), *Records of the GSI*, vol. 2-59 (1869-1926), B. Ahmed's *Coastal Geomorphology of India* (1972), Mahadevan, C. (1949), Choudhuri, M. (1950), Rao, M.P. and C. Mahadevan (1959), Chattarjee, S.P. (1962) and many others.

I. OFF-SHORE GEOMORPHOLOGY

The off-shore land includes the continental shelf under water. Its origin, morphological nature, slope, deposit, geology and islands formation in India will be very much helpful for determining evolution of different shore lines in India.

A detailed submarine contour map shows that it is of about 100 fathoms (183-200m) where the most prominent break of slope occurs in the submarine floor in India. Evolution of different shore lines in India is intimately connected with the different formations of the continental shelf. This shelf is widest near the Gulf of Khambat, about 400 km across and narrowest off the delta mouths (Sundarbans or the Krishna mouth) about 30-35 km. The continental shelf near the Eastern coast is approximately one-third of the width from the shelf that of the Western coast of India.

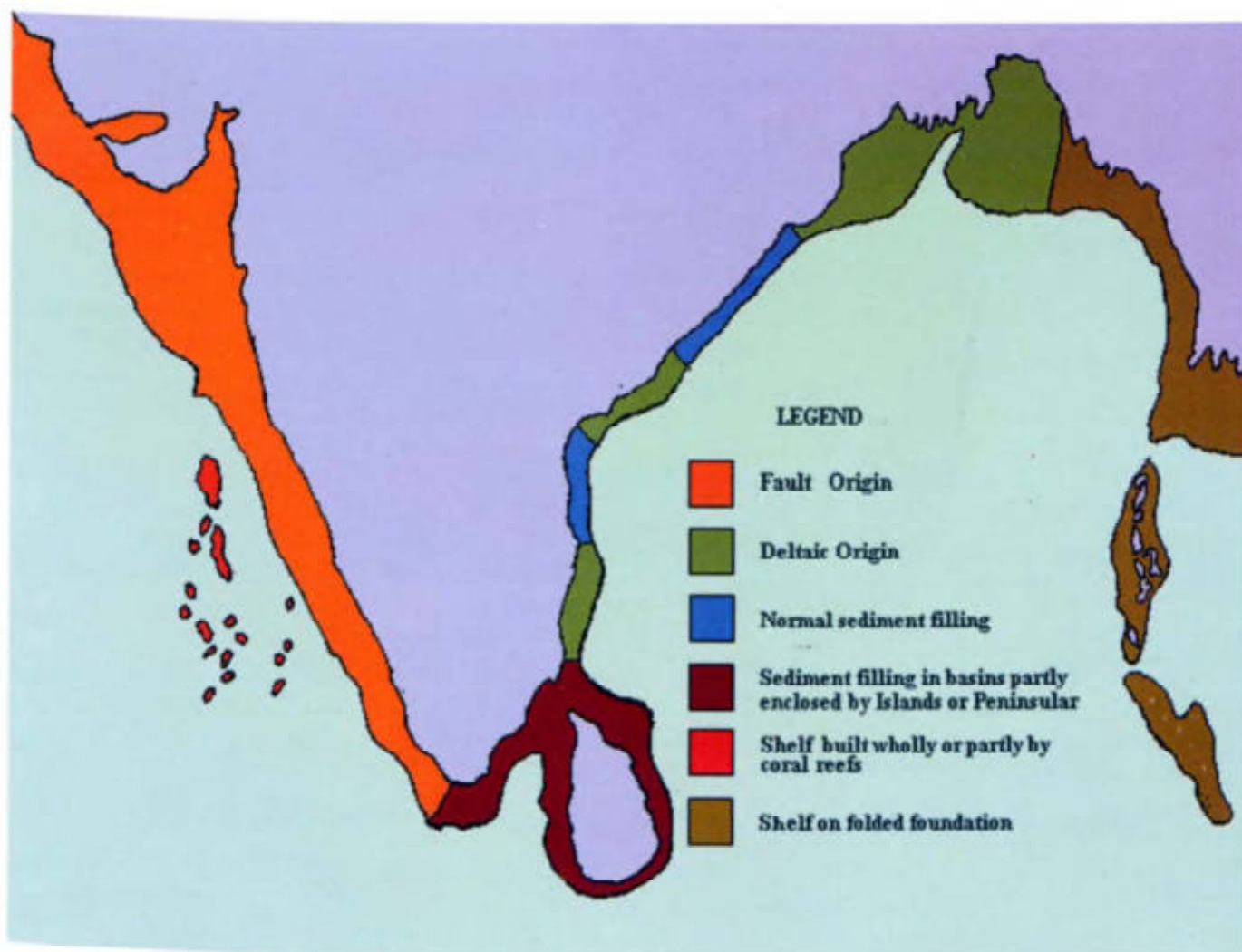
The shelf round India is about 300,000 sq. km and out of this the eastern shelf consists of 75,000 sq. km and Western shelf is about 2,25,000 sq. km. Similarly, it is seen that the most common slope of the eastern shelf ranges from 7 to 21 m and varies from 3.1 to 10 m near the Cape and 0.3 m in the Khamhat region.

Our knowledge of extension of continental shelf reveals that extent of continental shelf from Hooghly to Mahanadi (under 5 fathom or 9.1 m) submarine contour ranges from 1.5-2.2 km from the shoreline. After the Hooghly mouth towards east, the shelf is

very narrow due to formation of submarine canyon near the opening of the river Raimangal at Ganga delta. Between the Mahanadi and Krishna delta, submarine contour of shelf extends from 2-12 km from the shore, the similar narrowed structure is seen from Krishna to Cauvery delta. Further south from Krishna to Point Calimere, the extent of shelf is about 2-22 km from the shore. The Palk Strait, a submarine continental shelf is less than 100 fathom and is very shallow and flat. In the Gulf of Mannar the width of continental shelf is about 30 km from the shore and the nature of the shelf within the Tamil Nadu coasts remains more or less same, but suddenly it widens near Cape Comorin to about 60 km. After Cape Comorin the shelf gradually widens and at Gulf of Khambat it extends to over 400 km. The cut across coast in between the Cardamon hills and Trivandrum is having very steep continental shelf and extends up to 30 m from the shore. This high gradient nature of the shelf again becomes normal at the Trichur coast. Again near Karwar this shelf steepens near the shore and contour passes from the promontories and cliffs. From Karwar to Mumbai the continental shelf again extends from 6-15 km from the shore, but at Daman it intersects the shore. In the Kathiawar coast the width of continental shelf extends up to 140 km, it shows special significance due to shallow and dry sandy nature, the Gulf of Kutchchh is very shallow platform and the Rann of Kutchchh is a sandy desert representing very little continental shelf, it submerges only during monsoon through the creeks and channels of Rann.

Deposits on the shelf around India are mostly from subaerial erosion of land areas and from coastal erosion. These deposits are mostly gravels, sands, silt and muds. In the Andaman and Nicobar group of Islands, these deposits are of marine origin consisting of coral, sand and mud. The Lakshadweep, Minicoy and Amindivi islands are constituted by coral islands.

The deposit on the Continental Shelf around the mainland may be subdivided into 2 regions: 1. Littoral region, that is the shore zone between the high and low tides and 2. Neritic region that is the zone between low water and 200 m depth of the sea



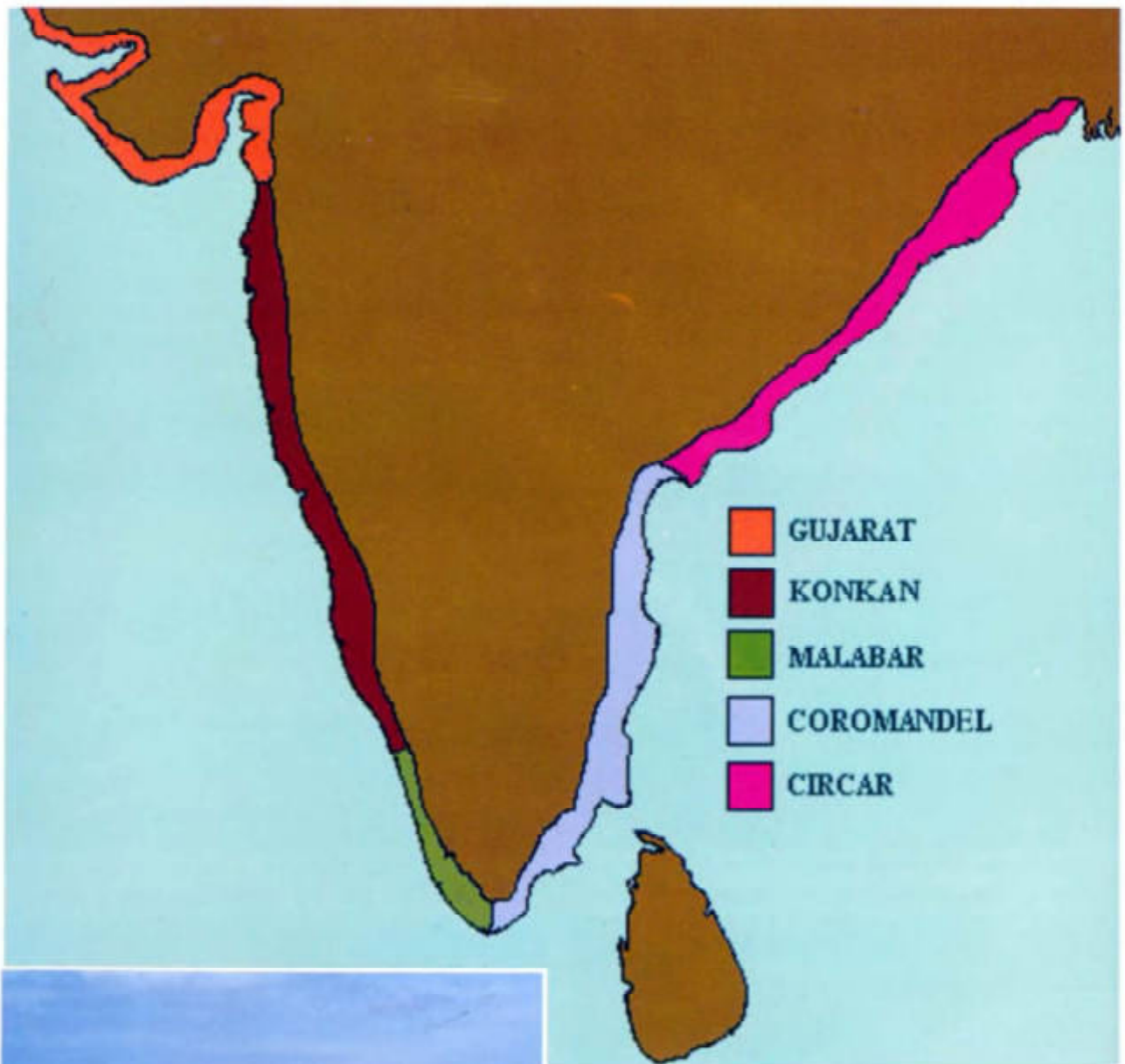
Origin of Shelf round India



Sand Dunes and backwater in Gopalpur Coast



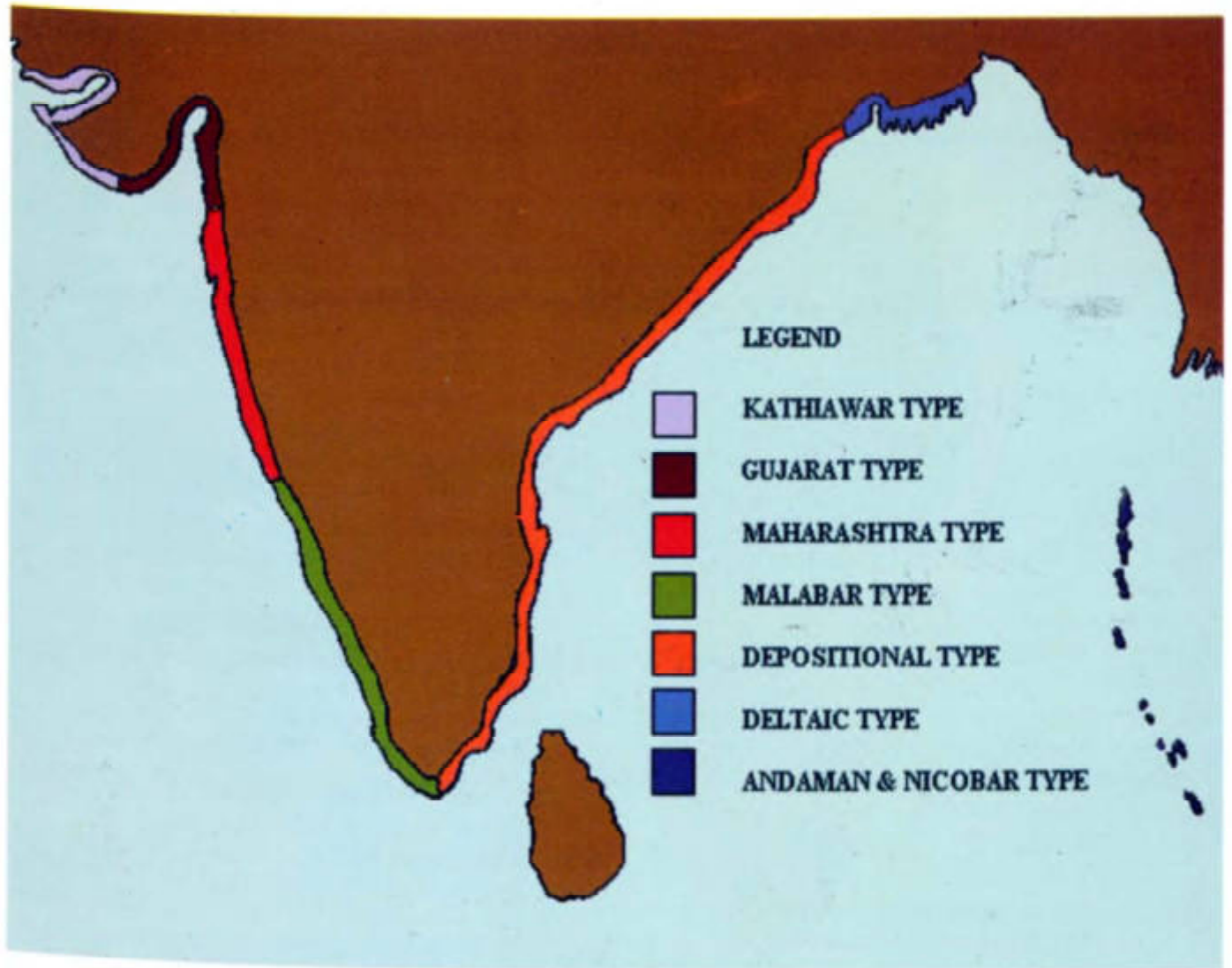
Mature Sand Dunes in Orissa Coast



Coastal Geomorphic Types



Series of Sand Dune formation in Ganjam Coast



Coastal Types



Mature Dunes in Goa Coast



Sand Dunes and Coastal Slack in Orissa



Geology of Indian Coastal Region

Among the littoral deposits, pebbles are most common on the West coast from Mumbai to Karwar. Sand beaches are common near Chennai, Puri and other areas of the Eastern coast. Mud flats are seen in the Gulf of Khambat. Deposits of fine sediments with large share of organic matters are seen among the lagoons of Kerala. Tidal deltaic deposits and mud flats are common in the deltas and estuaries of the Ganga, Mahanadi, Godavari, Krishna, Cauvery, Narmada and Tapi. Deposits in the Bay of Bengal Shelf show a correlation between its sediments, depth and inclination, up to 3 km and to the depth of 15 fm the sediments are sands (finer away from the shore line). Next, up to 3-20 km at depth of 15-30 fm is covered with mud and the next extending zone 20-30 km at the depth of 30-70 fm is covered with shells. In this zone, from a depth of 58-70 fm is covered with maximum quantity of shells consisting of hard rocks and old coral. From 40 fm starts the 4th zone which is nothing but concretion and extends up to the outer edge of the self. In this zone, the sediments consist of clay, fine sand and shell fragments. It is cemented about 1 m diameter and monazite and zircon, the radioactive sediments are concentrated in its central zone. (Ahmed, 1972)

Indian Continental Shelf must have extended with the same geological formation of the lands adjoining to the coast. Such as the solid geology of the major parts of the shelf between Ratnagiri and Kathiawar, consist of Deccan Lava and the shore line of the entire region from the Ratnagiri to Daman and Kathiawar peninsula is also found covered with Deccan Lava. Geologically the lands adjoining the coasts and behind the shore line may be grouped into 4 major types : 1. Alluvium in the deltas, part of East coast and Gujarat. 2. Archaean crystalline gneisses and granites occurs in part of N. Circars, Tamil Nadu, Kerala and South Mysore, 3. Deccan trap in Maharashtra, part of Kathiawar and Kuchchh and 4. Marine tertiaries in disconnected patches from Midnapur to Cape Comorin and in Kerala and near Ratnagiri. Andaman and Nicobar regions are covered by Arakanyoma, consisting of marine fossiliferous sandstones and limestones and some volcanic materials. Coraline limestones are common in Lakshadweep and Minicoy group.

Origin of Continental Shelf round India has

been classified by Ahmed (1972) into 6 types of geomorphic formations such as:

1. Due to deltaic sedimentation
2. Due to down-faulted submarine platform of the lava regions
3. Due to sediment filling in partly enclosed basin (Gulf of Mannar and Palk Strait)
4. Due to submerged sea-board of a folded mountain chain in Andaman and Nicobar
5. Due to coral reefs formation in Lakshadweep and Minicoy
6. Due to normal sediment filling in Tamil Nadu and N. Circars coast.

Importance of continental shelf and its impact in the formation of coastal geomorphology in India may be noted with the following points :

The peninsular region which is an uplift from the sea is a continental shelf dominated coastal geomorphology. Eastern coast in India is an emergent type where the shelf dominates in the shore zone. The geometrical straightness along the East and West coast is nothing but the uplift of gentle surface of the sea floor shelf. Frequency of off-shore bar in Kerala and Tamil Nadu shore are the important contribution of shelf.

Indian coastline is wellknown as regular coastline but few islands occur within the coastal zone. These islands are found in the offshore regions or they are found distantly. They are further alluvial types in the deltas or rocky or sandy types in the lagoons and coastal regions. The offshore islands are smaller islands situated within 1 to 5 km of the shore and the distant islands are larger ones, occur 1000 to 2000 km of the shore, such as 265 islands of Andaman and Nicobar. There are another important Group of islands and Atolls made of coral deposit in the Lakshadweep, Amindivi and Minicoy. About 20 such type of islands are situated out side the continental shelf adjascent to main land.

Geomorphological classification of off-shore and distant islands in India according to origin and characters has been made by Ahmed (1972) into 8 types as follows :

1. Deltaic land building and subsidence produce islands near the Ganga and Dhamra river mouths

2. Old coral banks produce islands near Palk Strait
3. Submerged crystalline islands found near the Cape Comorin
4. Off-shore submerged remnants formed islands near Mysore
5. Estuarine sedimentation formed islands near Gulf of Khambat
6. Exposure of submerged lava of harder basalt out crop formation, in the Gulf of Kuchchh
7. Coral deposits in the Lakshadweep group
8. Tops of a submerged tertiary mountain chains in Andaman and Nicobar group.

2. ONSHORE GEOMORPHOLOGY

The shore land may be defined as the junction of sea and land. In low tide, it becomes longer and more seaward and during high tide, it becomes shorter and more landwards. There is an upper limit during the highest ebbtide-flow and lower limit at lowest ebbtide-flow and the land mass which lies in between the highest and lowest ebbtide-flow is known as shoreline of the coast. This shore line may be divided into two types according to the nature of tidal flow as backshore and foreshore. The part of the landmass that lies between the ordinary low and high tide is known as foreshore and the part of land mass that lies above it, is known as backshore.

Numerous depositional features built mainly by the sea and lands within the shore line are responsible for formation of beach, coastal dunes, off-shore bars, barriers, spits, lagoons, lakes, cliffs, deltas, estuaries, coastal terraces and Rias.

BEACH FORMATION

Beach refers to the deposit of soil particle and debris in the shore zone from the land through streams and from the sea floor. With the wave action beach materials may range in grade from boulder through shingle, pebble and sand to silt.

It is very commonly a temporary deposit, alternately deposited and removed which is known as beach cycle. There are annual cycle marked by storms and high waves on most of the Indian coast during south-west monsoon. The fortnight cycle marked by spring and neap tide and other type of beach cycle formed by storm.

It is obvious that beaches are formed in calm and constructive wave action where wash is more powerful than backwash. In storm associated destructive wave action where backwash is more powerful than wash, the sediments are thrown far inside the sea instead of depositing on the shore line and causes shore erosion. Thus it is seen that beaches are well-developed along low or shallow shore line and under developed or ill-developed near the highly elevated eroded shore and cliffed shore. Beaches grow constantly on the shore line and in a pro-grading shore it become permanent but in retro-grading shore it becomes temporary. In permanent beach, sometimes, the materials are blown inland to form coastal dunes and sometimes part of the sediments are carried by land wind to the sea.

Beach formation is common and extensive on shallow coastline like the eastern shore of India and relatively uncommon on steep and cliffed shore along the western side from Mangalore to Daman. Eastern coast of India possesses a long stretches of shore where beach is a common feature.

In Kerala coast, the beach consists of off-shore bar and is known as 'Bar-beach' Between Mumbai and Karwar, the rocky and cliffed shore having beaches confined to the Bay head are known as 'Crescent beach' Near Ratnagiri and Goa where beaches occur in small inlets on cliffed coast, known as 'Pocket-beach'

The general characteristic of beach zone on Indian shore indicates that: Deltaic regions are free from sea beaches due to predominance of clay and mud. The subsiding zone between the land and the sea near deltas are filled with the finest sediments by aggrading rivers and distributaries where constant overflow of water and silt keep the condition marshy preventing the formation of beaches by sand and shingle. Thus, no beach formation is noted near the mouth of Ganga, Godavari and Krishna. The mouths of Mahanadi and Cauvery show some beach formation due to fewer distributaries, less flooding and more coarser discharges compared to that of the river Ganga.

Important rivers like the Baitarini, Rasulpur, Panchaora, Burhabalang, Subarnarekha, Anandpur and Haldia have ria-type mouths in these regions. Depending on the amount of hinterland sediments

from Chotanagpur and Orissa highlands, the width of the beach formation develops near these river mouths. The shore between the Brahmani and Hooghly is sheltered due to projecting headlands of the Mahanadi delta. There are common formation of beach ridges ranging the highest 4-20 m in these regions and the height of beach ridges diminish from the Mahanadi delta towards Hooghly. The shoreline is under low tide terrace at Chandipore, Balasore, where fine sand sediments become nicely leveled and firm and the same thing is found in Digha coast.

From the river Mahanadi to Godavari the shore is largely occupied by sandy beach marked by spits, some beach ridges, beach terrace and coastal alluvium. The beach is wider near Puri spanning 4.5 km. The huge deposits of sands are mostly from the distributaries of the Mahanadi carried out mainly from the crystalline and lateritic hills in the neighbourhood of the delta head at Cuttack.

In the case of Ganga delta this type of large sandy beach is absent because this delta is at the end of a long and extensive alluvial basin and is over moist, muddy and subsiding regions along the neighbourhood. Along the south-west of Puri, the width of beach zone is restricted landward by Chilka lake and the beach along the back shore is nothing but spit extending 100-200 m from Ganjam to south-eastern end of the lake. The beach ridges from Puri to Ganjam are elevated from 2-30 m at different places. The width of foreshore beach from Puri to Ganjam is about 200 m but south-western end of Chilka lake near Ganjam varies from 400 to 1,600 m with beach ridges and dunes towards land succeeded by marshes. Further, south-west near Gopalpur, the formation of off shore bar extends so inland that marshes and lagoons are about to cover by sand dunes. From Gopalpur to Kakinada except the limited cliffed and rocky feature of Waltair, Vishakapattanam and Elamanchi, the beach zone is variable in width within 800 to 1,600 m. The beach ridges are elevated here from 15 to 20 m. In the Vishakhapattanam and Waltair, though stretches of rocky hills, cliffs and sand hills are frequent, formation of beach is not uncommon. It is known that the hillocks are formed isolated for preventing the strong wind near Waltair from N.E. and N.W. end. The dunes are oriented parallel to the local wind direction with annual

movement (Ahmed, 1972). On the whole, the beach feature from the Godavari to Hooghly is a bar type formation except some pocket beach or bay beach formation due to hillocks near Vishakhapatam and Srikakulum.

The regions of Godavari-Krishna delta are devoid of sandy beaches and covered with mud flats and finest alluvial silts. In the Godavari delta wherever the sandy beach occurs, it is marked with 1-3 m high sand hills. In the harbour of Kakinada a remarkable feature of north-south formation of spit with width of 200-1200 m is interesting.

Between Krishna delta and Point Calimere there are sand hills and sand ridges in the backshore. The sand ridges extends 200-400 km with the height of 8-12 m. These ridges are more prominent in the regions where the monsoon and wind are parallel to the coast. The areas where wind is not parallel to the coast, formation of sand dunes are prominent. The foreshore between Krishna and the Point Calimere is about 200 m and south of Calimere extends up to 400 m. The backshore zone extends up to 300 m. Near Point Calimere the backshore beach is 200-400 m wide. The important feature of this beach zones is the formation of seven pagodas which is a continuous line of sand ridges between the shore line and lagoon zone which is about 18 km long, about 200 m wide.

In Pondicherry and along the seven pagodas there are very prominent sand beach on the back shore due to continuous formation of sand ridges in this coast. In the Tamil Nadu coast the shore is remarkably covered by long sandy beach as wide as 4.5 km, except at places where rivers and backwaters join the sea, the whole coast is a vast sandy beach and probably it is one of the largest beach in the world.

Between Point Calimere and Cape Comorin is more or less protected areas due to regional alignment of the shore. In the Palk Strait sandy beach of 1.5 km wide is found on backshore and 50-150 m broad on the foreshore. The Gulf of Mannar region is fully covered with coral reefs and oyster shells. Between Tuticorin sandy beach is narrowed but sand hills are as high as 20 m. Further to the west again sand beach appears as broad as 200-600 m with low height of sand hills. Along the Cape Comorin beach disappears and is replaced by

rocky and cliffed shore. Here most interesting is the terrace or red sand dunes usually formed due to south west monsoon carried red loam from the arid surface.

Beach formation between Cape Comorin and Mangalore regions are remarkable for well developed bars, lagoons, narrow barriers, spits and rocky cliffs. Therefore, sandy beach formation is relatively absent or discontinuous. Cardamon hills plunge into the sea at Cape Comorin region where sandy beach varies from 1 to 200 km in width. Near Trivandrum the sandy beach zone is about 25 km long but further north-west through Quilon up to Cochin sandy beach is absent or very narrow and replaced by spits, rocky cliffs, sand ridges, shingles, etc. North of Cochin to Calicut the shore is of unbroken stretch of sand, partly thrown up by the waves, partly formed by alluvium. North of Calicut, there are low cliffs alternate with pocket beaches and denuded headlands and bays formed by the waves. There are strong drift (ocean current) from May to October and weak drift from November to April. The absence of continuous sandy beach specially from south of Trichur suggest the shore erosion. Heavy slope of hinterland, forceful ocean current, strong backwash and heavy rainfall are very effective along this regions. (Ahmed, 1972)

From Mangalore to Malvan The areas between 13°N to 16°N in the Indian coast are most indented due to formation of ria-type river mouths, bays, bayheads, cliffs, spits and off-shore barriers. Some Pocket beaches are associated in bays and inlets except in the areas of cliffed and projected land beach.

Beach formation from north of Malvan areas with latitude 16°N to Kuchchh is composed of littoral concrete or beach rock. From Malvan to Kuchchh this rocky formation often strikingly continue for 14 km long and 100-1200 m broad either directly attached to the mainland or separated from mainland with the formation of either sandy beaches, muddy flats or marshy areas. Sometimes, the rocky formation is also located as isolated patches. This littoral concrete or rocky beach sometimes act as protection against the force of wave where it helps in the formation of sandy beach or marshy land or muddy swamps between the rocky beach and mainland. In some areas like Mahimbay, Kenery and Henry island this concrete acts as a rim of bank enclosing islands.

In western Kathiawar, this concrete is raised above the sea level. Composition and origin of the littoral concrete indicates that they are of marine deposits consisting of shells, corals, pebbles and sand cemented together by carbonate of lime. In most cases, it is used as building stone. From Malvan to Bulsar inspite of dominance of rocky cliffed and indented coast, the occurrence of pocket beach and sandy bay heads are commons. Along the Gulf of Khambat the sandy beach is 1.5 km in the western side and varies 200-400 m in the eastern side. Sometimes, these are prominent beach-ridge formation in between Navsar and Bulsar.

In a concluding summary, it is found that deltaic regions have no or very few sandy beach formation. Beach belt is wider where ever the streams are lesser in the coast line and the coastal zones are in depository phase. The beach formation is relatively shorter or absent along the prograding shore zone (Kerala) in erosional face and in rocky and cliffed coast from Mangalore to Daman. The backshore beach forms sand hills, beach ridges and sand dunes of various shape and sizes depending on the prevailing wind action. The width of sandy beaches in the backshore and foreshore ranges generally from 1 to 1.5 km but foreshore is narrower compared to backshore. Height of sand dunes and sand ridges vary from 10-20 m. Sometimes extends upto 30 m. The major causes of shaping the beach formation are wind force, nature of monsoon and ocean current.

One of the important component of beach formation is the off-shore bars or barriers which are most dominant in Indian shore. The ridges of sands and shingle and other sediments are deposited little away from the shore line above the high tide level in the form of a bar or barrier separated by lagoons and marshes on their back from the main land. From Ganga delta to Krishna these barriers are absent but from Krishna to Cape these barriers are prominent. Again in West coast starting from Kerala to Ratnagiri most remarkable development of barriers and spits occur.

3. COAST LAND GEOMORPHOLOGY

The inner limit of the coastal zone in the Ganga delta runs through highly indeterminate alluvial low plain country near Kulpi, but near

Balasore it roughly coincides with fairly steep outer edge of the crystalline plateau that marks the peninsula from Orissa to the Godavari delta. Between Krishna and Cape Comorin, the plateau edge is really a peneplain margin with gentler and wider slopes which should be regarded the characteristics of the inner limits of the coastal region in this part of the country. Beyond the Cape the inner limit of the coastal zone is steep and sharp coinciding with the lower edge of the Western Ghats. In detail, it is quite irregular as a result of enormous sub-aerial erosion following from high altitude and with marked rainfall and lithological variations. In the Khambat region, the inner limit of the coastal region lies in highly wavy plain, deep inland into the faulted basins of the Tapti and Narmada and remains nearer shore on the western edge of the Saurashtra coast. Towards the north of this Gulf the limit lies over a much gentler plain surface. In Kathiawar, it is irregular in the south east because of the nearness of the basaltic hill mass but it is rather even in the south and south west probably due to faulting. The eroded slopes of the basaltic interior land make the inner limit of the coastal zone irregular in the north of Kathiawar and in Kuchchh.

There is practically no coastal zone in the Lakshadweep group of islands because the coral reefs are nowhere more than 10 m above the sea level and only slightly above the highest tide storm level of the sea. In the group of Andamans and Nicobars the situation is different, here the interior of most of the islands consists of dissected high rocky ground. The highly dissected interior land is steeper on the eastern side of the islands, consequently the 50 m contour (or the inner limit of the coastal zone) occurs over highly dissected, densely forested rocky slopes and nearer the shore on the eastern side of the islands. (Ahmed, 1972).

GENERAL TOPOGRAPHY OF THE COASTAL ZONE

Wooldridge and Morgan (1959), Wooldridge *et al.* (1964) and Ahmed (1972) pointed out some general topography of Indian coast as follows :

The coastal zone along the Gangetic delta is marked by alluvial dead level plain traversed by

numerous distributaries and the accompanying levees of high ground separated by extensive water covered depressions along with the old beds of the ever shifting channels. Towards the shore the coastal zone adjoins the mangrove tidal forests of Sundarbans. Towards its west the monotony of the plain in Balasore and Midnapore is broken by sand hills representing inblown beach dunes. In Balasore the coastal zone is also marked by an escarpment having every appearance of a sea cliff from the seashore. Clusters of knolls appear along the country-side indicating the evidence of previous islands. In the Mahanadi deltaic regions, the topography of the coastal region is marked by mangrove swamps towards the shore but further inland it is plain country traversed by wide beds of the distributaries. The inner margin lies along the lateritic hills near Cuttack. Further south-west in the region of Chilka lake, the coastal zone is marked by a low marshy plain on the north-east of the lake but on the north and north-west there are rocky and hilly countries. In this part, the inner edges of the coastal zone lies close to the lake shore near Rambha railway station (less than a km from the water edge). Further south-west the coastal interior is more rugged and has steeper gradient, the 50 m contour being about 2 km from the shoreline. The hills behind the shore zone are highly dissected, and rocky interior along the south-west part of Vishakhapatnam approaches the shore but the cliffed hills abutting on the shore are not continuous. They are mostly isolated knolls, less than 200 m in height. Towards the inland, these hills increase in continuity, height, size, complexity and dissection. Near the cliffed points the 50 m contour or the inner margin of the coastal zone is almost at the water line.

In the deltas of the Godavari and the Krishna the topography of the coastal zone ranges from the tidal mangrove swamps near the shore through alluvial tracts carrying some sand dunes and traversed by the distributaries which diverge from Rajahmundry (in the case of Godavari) and Vijayawada in that of the Krishna. It is near these delta heads that the inner edge of the coastal zone may be deemed to lie and the rocky outliers begin to appear.

Between the Krishna delta and Pondicherry, i.e. up to the northern limit of the Cauvery delta, the

coastal topography is very tame without any hills in the immediate background except towards the extreme south in the Palar region where the surface is marked by sand hills. Here the coastal zone is a low plain surface extending from 1 to 1.5 km from the shoreline. Near Ongole in the north, the hills appear at about 20 km from the shoreline. Nearer to the shore, these are sand hills and further inland, swamps extend 6 to 8 km from the shore. In the extreme south and north-east of Pondicherry the rocky hills are at a distance of 3 to 5 km from the shoreline. Further south is the Cauvery delta where contour line along the rocky country lies deep inland extending 125 km from the shore but along the nearer shore line, the sandy hills more or less continuously rise to a relative height of 6-30 m. Proceeding southwards, the coastal zone is characterised by a low alluvial plain country up to Cape Comorin. There is usual occurrence of sand hills which occasionally occupy a 3-5 km wide belt along the nearer shore. In Rameshwaram peninsula the dune belt is 3 km wide. Some dunes are as long as 5 km to the west of this peninsula. Further south-west in Tirunelveli, there are sand hills spreading deeper into the plain over 4-6 km wide belts. There are some red sand dunes, often forested towards inland region known as Teris which is believed to be of terrestrial origin and distinct from the white coastal dunes of sea sand. This double dune formation is well distinguished by the presence of cultivated green belt in between. As the Cardamom hill approaches, the surface of the coastal zone gradually rises and near Cape Comorin, the cliffed high and rocky country brings the 50 m contour within 2 km of the shore. In this part of the country, the cliffed coastal high lands where the shore zone and the coastal zone are constricted to their minimum width.

Towards the western side of the Cape Comorin, a highly dissected coastal zone marked by pronounced meandering rivers, is interesting where seaward margin of the coastal zone is formed by the steep hilly slopes that flank the coastal lagoons and lakes which are sometimes cliffed. These characteristics prevail in the Kerala and Karnataka coastal zone. At a few points the hills and cliffs plunge directly into the sea where the shore and coastal zones practically disappear in

horizontal extent, but generally the coast lies behind a remarkably straight shoreline succeeded land-ward by off-shore bars and spits which are succeeded in the same direction by extensive lagoons and lakes at the mouth of rivers.

In Trichur and Ernakulam the linear settlements in the coastal belt with cultivation appear parallel to the shore. Even the islands in the lagoons to the west are also oblong and parallel to the shore. It appears that the cultivated and settled belts are nothing but earlier beach ridges. The inter-ridge lowlands are also marked by linear depressions indicating direction of tiny seasonal streams which were flooded from these regions. These coastal features suggest the dominance of marine action which has not only straightened the regional shoreline but has also caused landward migration of the successive beach ridges and intervening depression where permitted by local topography.

Towards the north of Karwar, the shoreward margin of the coastal zone is dominated by high sea cliff and promotories which are frequently at the waterline. This coast is crenulated or dentate and the coastal interior is marked by the highly dissected lower slopes of the Western Ghats and the coastal plain is generally very narrow or evanescent. Even where the cliffs and hills of the seaward coastal edge are not at the shore line, they are mostly less than a few hundred metres inland. Occasionally towards the shoreward margin of the coastal belt, sand hills are found parallel to the shores. Cliffed headlands may alternate with hill-flanked bays partly closed by spits. The coastal terrain in all situations is markedly dissected. Frequently the shore and coastal zone are constricted by the occurrence of high cliffed rocky coastal edge near the shore e.g. near Marmagaon and Ratnagiri fort. Behind the shoreward edge, the coast zone is frequently marked by stony treeless laterite wastes. Here the immediate as well as distant coastal hinterland is extremely dissected.

The crenulated rocky coastal region is rather suddenly replaced at about 18°32' N near Kolaba district by a coastal zone which is an imperceptibly rising low coastal alluvial tract marked by a series of successive belts consisting of shoreward rocky beach zone about 400 m wide, succeeded by a green belt of *Casuarina*, palm and coconut. This is further

succeeded by a wide belt of marshes or cultivation which finally gives place to forested hills representing the lower slopes of the Ghats. This is roughly the picture between 18°32' N and 20° N bearing few cliffed and rocky points, e.g. near Mumbai, Daman and Bulsar. Coastal topography of Gujarat shows much variation in its shoreline, near shore and off shore regions. It is divided into 3 segments :

1. Kuchchh Kori creek Mundra, Jakhau Kandla,
2. Saurashtra Navlakhi Dwarka, Dwarka Diu, Diu Bhavnagar and 3. Mainland- Khambhat Dahej and Hornset Umbargaon. The Kuchchh segment is irregular and dissected where western half facing Arabian sea is dominated by muddy substrate and made up of extensive tidal flats. Eastern side that lies inside the Gulf of Kuchchh is sandy and silty with narrow beaches and emerges with the Little Rann. Northern part of Saurashtra overlooking the Gulf, is crenulated rocky shoreline with sub tidal canals and islands. The SW point, Dwarka Diu is more or less straight with well developed sandy beaches. The mainland coast (Khambhat Dahej) faces the Gulf and represents a submerged alluvial coast characterised by steep, cliffy river mouths. Crossing the coastline is sandy between Hornset and Umbargaon. The shoreline on the estuarine mouth of Tapi river is associated with many tidal channels. The coastal topography in the Khambhat region is marked by low plain topography north of Bulsar and Bhavnagar, and as a result of such topography, the shoreward margin of the coastal zone adjoins the marshes which are 8 km in width. Within the marshes

there are interfluvial patches of higher cultivated ground carrying settlements. Occasionally there are rocky residuals 15 to 30 m high within these patches of cultivation and settlement. Further inland the coastal zone is marked by one of the worst types of gully erosion in India. Between Bhavnagar and Diu the coastal zone is markedly an irregular surface dotted by hills and swampy lowlands. Cliffs mostly 15 to 30 m high occur at the waterline. Further west the coastal zone is a more or less uniformly low plain tract. Shoreward the coastal margin between Diu and Dwarka adjoins narrow beach ridges, often a series of parallel ridges, stretching for miles at a stretch and with a height of 5 to 20 m are prominent. Landward of these sand hills, a few rocky hills appear on the plain tract and the surface runs imperceptibly to the margin of the main hill mass at a distance of about 15 km from the shoreline. Most of the hilly interior of Kuchchh can be regarded as the coastal zone but on the north, i.e. in the Rann of Kuchchh one of the most important features of the coastal zone is formation of dead and high cliffs e.g. a cliff line of 25 km long on the northern edge of Khadir Island.

Most of the islands of Andaman and Nicobars have N-S folded anticlines and synclines rising to a maximum elevation of about 600 m. The higher ground is nearer the eastern shores. The general topography of the coastal zone is a markedly sloping, dissected rocky but forested ground. It frequently terminates near shore in coral reefs or precipitous cliffs of sandstones, clays and limestones and pocket beaches on bays flanked by high rocky slopes.

CLASSIFICATION OF COASTAL ZONES IN INDIA

Due to the changes of the sea floor the sea coast formation appears to be different. There are mainly two types of movements on the sea floor such as 1. Localised change of coast due to "Earth movement", 2. Extensive change of coast during cold age due to melting of ice and expansion of sea water "Eustatic movement"

Due to earth movement, sea floor emerges out from the sea and forms emerged coast such as North Circular coast in between the Ganga and the Krishna delta and the coastlines between the Krishna and Cape Comorin. In these coasts, the coast lines become straight and long, but where coast lands subsidise into the sea, the coasts become submerged. Such submerged coasts are found along Maharashtra, Deccan lava coasts, from Karwar to Bulsar and Khambat to Bhavnagar. These are uneven and rough and near these coastline, islands and Baylands are common.

When in the same coast emerged and submerged processes are seen, then that coast is known as compound coast such as the coast of Karnataka and Kerala. Behind these coasts many "Kyals" or back water and lagoon formation are common.

In many parts, of the coast, there are no trace of emerged and submerged processes but the sediment deposits are found dominant. These types are known as Neutral Coasts, such types are seen along the Deltas of the Ganga, Mahanadi, Godavari, Krishna and Cauvery.

Based on the dominant physical characteristics, Indian coasts can be divided into the following categories (Ahmed, 1972) :

1. Founded type

Coastal zone is marked by a dominantly rugged terrain of north-south folded structure and belong to the founded basin between the Sunda shelf and the Burmese mountain. The rugged terrain is longitudinal to the East and West and transverse to the north and south. It is found in Andaman and Nicobar Island.

2. Deltaic Type

Estuaries of the Ganga, Mahanadi, Godavari, Krishna and Cauvery are dominated by deltaic deposition. According to the hydrographic features, these coasts are known as primary and neutral coast mainly shaped by terrestrial deposition.

3. Depositional Plain Type

Most of the coastal lines between the Ganga and Cape Comorin are marked by plains dominated by land or gently sloping surface whose physical characters are largely shaped by river deposition.

4. Malabar Type/Compound Coast Type

Here coastlines are highly irregular terrain with large relief and ancient gneiss and crystalline rocky grains occur parallel to the coasts. Here the tertiary sediments near the shore remain transverse to the coast. The coast lines are shaped by terrestrial erosion and tectonic disturbances. Occurrence of both submerged and emerged processes, backwater and lagoons are common. This type is mainly seen in Kerala and Karnataka.

5. Maharashtra Type/Submerged Type

The coast lines from Goa to Mumbai and rest of Gujarat are dominated by lava and there are no confirmed structure of the coast and if at all structured they are transversed to the coast. Lower slopes of the Western Ghats are supposed to be dominant faulting processes of the coastal zone due to terrestrial erosion from the high relief. They occupy larger part of the coastal zone above the cliffs or Rias and Bayheads. The dominant action is terrestrial erosion resulting from high relief.

6. Gujarat Type

The Gulf of Khambat where alluvial zone above the estuarine shore is fully eroded due to uplift behind the submerged shore zone and the worst type of erosion is very prominent.

7. Kathiawar Type

This is marked by lava interior coast. Southern part is dominated by an East-West fault which might be a prolongation of the Narmada rift. The northern



Baby Dune formation covered by *Hydrophylax maritima*



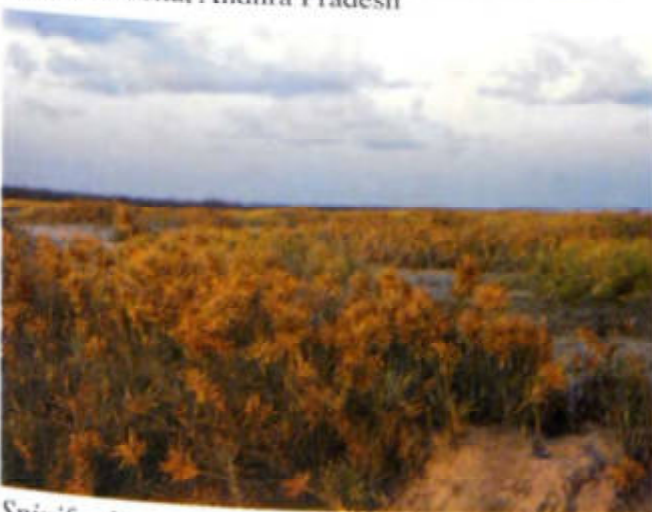
Pocket Beach formation with the sand binder *Canavalia maritima* in Malpe Coast, Karnataka



Spinifex littoreus, act as beautiful sand binders in Godavari delta, Andhra Pradesh



Three distinct shore formation (offshore, foreshore and backshore) in Andhra Pradesh



Spinifex littoreus community



Vegetation of Western Ghats



Exposed Continental Shelf (Ratnagiri)



Coconut plantation in Goa Sea Beach.



Pocket Beaches of Andaman and Coconut plantation



Vegetation of Eastern Ghats



Coastal Cliff formation at Ratnagiri Fort



Rocky Coast in Andaman

Foreshore Salt Pan and Mudflat in the Little Rann of Kuchchh



Mudflat formation in Kuchchh, West Gujarat

Foreshore Mudflat formation near Mundra Fort, Gujarat





Manilkara littoralis in Andaman Beach forest



Beach forest formation dominated by *Scaevola sericea*, *Manilkara littoralis* and others in Little Andaman

Coconut plantation along the beaches of Kerala



part of it is dominated by lava and due to which basalt occurs directly on the shore. In other areas wind-blown tertiaries and pleistocene sediments where terrestrial deposition is dominant and have shaped the coastal features. In Kuebchh and in Rann except western and eastern parts, the area is parallel to the structural trend of the interior lava formation.

GEOLOGY OF INDIAN COAST

Morgan and McIntire (1959), Pascoe (1964), Wadia (1961) and Ahmed (1972) have studied the following detail geological features of Indian coast. The regions of Ganga delta and the adjoining Mahanadi delta up to Chilka lake is pleistocene and recent alluvial deposit which are under sedimentation and subsidence. The coastal zone of these deltas are unstable due to recent faults and deltaic subsidence. The land surface is gradually rising and prograded into the sea. Though Ganga delta is completely alluvial but in the Mahanadi delta some patches of sedimentaries like limestones, laterite and sandstones are common near Baripada, Puri and Midnapur.

Coastal regions of N. Circars are formed by gneisses and granite with patches of Charnokites and Khondalite. Recent coastal alluvium also occurs in the rocky and hilly regions of inner coastal tract between Puri to Kakinada except in Vishakapattanam where cliffed rocky interior is bordering the shoreline. The inner coastal belt are frequently capped with laterite. The pre-Cambrian crystallines are known to represent the primordial crust in this zone. Absence of marine sediments mark the continued terrestrial aspect of the peninsular shield.

Geological formation of the Godavari and Krishna deltas is similar to that of the Mahanadi delta. Thickness of recent alluvium gradually decreases from the shore to the crystalline interior. A narrow belt composed of Gondwana sandstone, cretaceous sandstone, Deccan lava and fossiliferous marine sediments are common in between these alluvial and crystalline zones. Apart from deltaic subsidence the coastal region of this tract is underlain towards north-eastern and south-western margin by permo-carboniferous fractures that bordered with the ancient Gondwana rift valleys.

From the Krishna delta towards the south up to Cape Comorin, there is a continuous belt of coastal alluvium of varying width and the landwards of this belt is associated with sedimentaries of various ages

from the upper Gondwana, to Pleistocene. Near Ongole, Chennai, Trichinopoly, Madurai and Ramanathapuram, upper Gondwana sediment is prominent. Cretaceous fossiliferous bed occur near Utatur, Trichinopoly, and Ariyalur. Eocene limestone and extensive Cuddalore sandstones are found in Pondicherry. All these beds are slightly tilted eastward and some section across the coastal zone show successive stages from the oldest to youngest forms from the higher and inner coastal tracts to the lower and shoreward margin. These continuous sequences of marine beds are the real geological structure which has been preserved along the Coromandel coast.

Near Cape Comorin, crystalline gneiss of Cardamom hill mix in the same line with the shore. North-west part of this coast line up to the distance of 100 km, a very narrow alluvial bar towards the shore intermixes with the edges of gneisses and granitic interior on the east. This is known as Warkalli and Quilon series and consist of fossiliferous coralline lime stone, sand, clay and a band of lignite. This is also known as coastal tertiaries formations.

From north of Quilon to Karwar, coastal alluvium of various width directly adjoins the gneisses and granites of Deccan massif but between Mahe and Quilon about 350 km the lateritic cover of Warkalli and Quilon bed intervene between this coastal alluvium and to the interior gneisses.

North of Karwar in Goa, the Geology of coastal regions is of granites and gneisses. Further North up to 17° N, there is interruptions of gneisses and laterite cover beds in Ratnagiri district. Gneisses rock extends upto 16°15' N but further north, it is covered with Deccan lava. Coastal tertiaries of the Ratnagiri consist of white and blue clay with carboniferous seam resting upon Deccan trap and capped by a layer of ironstone having lignite, pyrite and mineral resin.

From North of the Ratnagiri, Deccan lava extends right up to the water line from Ratnagiri to Bulsar region. Deccan trap is the dominant geological formation between Karwar to Bulsar. Crystalline rocks of the Deccan lava in Maharashtra with adjoining parts of Goa and Karnataka directly adjoin the shore line. The presence of very hard lava formation in Goa to Bulsar along the shore line indicates the absence of coastal plain in these areas. From the north of Bulsar, coastal alluvium extends over most of the Khambhat regions. In Broach and Surat the coastal tertiaries capped with laterite are composed of clays, sandstones, lime stones and gravel of basalt.

Deposits of sea along these areas cause the joining of Khambhat with the Rann of Kutch. In Kathiawar, Deccan lava forms the inner part of coastal zone. Here coast and shore lines are of low plain and marshy. Some where it is cliffed. Some where it is covered with coastal alluvium and tertiary. There are some white lime stones which are of calcareous deposits of pleistocene consisting of wind blown grains of foraminiferous which are compacted into a lime stone.

Dwarka and south Kathiawar are covered with Dwarka bed which is formed by clays and foraminiferous lime stones. The coastal zone of Kutch is formed by alluvium which consist of loam, sand and clay. Along the Lakshadweep group the coastal zone is absent and the parts which sometimes remain the highest storm and tide are composed of coral lime stones.

In the Andaman and Nicobars the geological formation is interesting and varies in different islands. In the north Andaman, coastal zone is composed of coeene conglomerates and sandstones except a 10 km patch of erudacious serpentines. In south Andaman this clay and sandstones predominates the conglomerates. Middle Andaman represents a geological transition between the north and south Andaman. The sandstones are more common towards eastern side and clays towards the south. Basalts and serpentines occur in scattered localities. There are few pockets of limestones of pre-middle and tertiary time. Little Andaman is dominated with serpentine but Car-Nicobar is dominated by raised coral reefs. Katchal and Great Nicobar are also dominated by coral reefs. Ritchie's archipelago and Interview islands are mostly dominated by soft clays. (Ahmed, 1972).

EROSIONAL AND DEPOSITIONAL LAND FORMS OF INDIAN COASTAL ZONE

Land forms of the coastal zone may be divided into erosional and depositional features. The coastal highlands with marked slopes are characterised by the erosion processes and the coastal lowlands and level topographic situations are characterised by deposition processes. Along the Indian coast, erosional processes may be divided into 3 types : cliffing, sheet erosion and gully erosion (Ahmed, 1972; Pate, 1917; Foote, 1883).

EROSIONAL LAND FORMS

The cliffing processes are nothing but erosional stages. The cliffs are distributed mostly on the western shore zone in India. The higher parts of the cliffs, beyond the reach of storm waves are the coastal zones. In most cases, the shore and coastal zone of the West coast line is either overlapped or constricted to a minimum width as the cliffs. Gully erosion and formation of badlands are found specially along the coastal zone of the east and north of Khambhat and in the valleys of Narmada, Tapi, Mahi and Sabarmati i.e. North of the Narmada. Here extensive land erosion brings heavy sediments in the shore zone which is responsible for formation of mud flats and marshes in the Khambhat regions. Gully erosion also occur near the Kathiawar and in some parts of eastern coast between the Godavari and the Tunga.

All the gully eroded areas are also marked by sheet erosion but it is prominent in the regions of Western Ghats and North Circars.

DEPOSITIONAL LAND FORMS OR COASTAL DUNE FORMATION

Based on published work in the Sedimentary Geology (1967), Ahmed (1972), Pascoe (1967) and others and present survey regarding the depositional feature of the coastal land forms or coastal sand dune formation along the low lying coastal areas are highlighted as follows :

The coastal zone from Midnapur to Godavari is marked by sand dunes along the backshore as well as to the inner coastal line by the force of winds. The extent of sand dunes towards the inland of the shore line is 12 km in general depth but sometimes, the limit may be obstructed by topographic changes such as construction of canals, plantation or other obstructions. The dunes may be high in open areas and low in protected areas, such as due to heavy force of south west monsoon near Srikakulam, the dunes ridges are 15-25 m from the general level of ground. From Midnapur to Balasore where the coast line falls in the sea side of the Mahanadi delta, the dunes are low about 3-7 m due to protected situation of the coast and in the Godavari-Krishna delta where the coast line falls in the sea side of Eastern Ghats, the dunes are about 1-3 m. The force of the south west monsoon is not so active along these protected or sheltered areas.

Coastal zones in the Circar regions are made of oblong ridges extending from south west to north east. On the Coromandel coast, dunes are comparatively scarcer than in N. Circars. The dunes along this coast are more or less prominent and extend within a km of the shoreline. In the south of Palar dune hills are found one to more km long, 230-400 m wide and 8 to 13 m high and near Cuddalore they are 25-30 m high. These sand hills vary in dimension and layout, some are parallel, some are transverse and some are oblique to the shore and most of them are round and circular in outline. Up to Cape Comorin, the dune hills are more or less continuous and narrower to the shoreline. In the regions of Point Calimere, these low and narrow dune ridges are prominent. In Rameshwaram specially towards southern region, due to strong south west monsoon the dune hills become 3-30 m high and 3 km wide. Along the more exposed areas near Tuticorin, the dune ridges become more high about 15-35 m. In relatively arid region like Tirunelveli due to rain shadow of Cardamom hills, the "teris" or series of rounded sand hills are prominent. These teris consist of red clay-dust of inland origin carried down by south west monsoonal wind force. These sands are rounded quartz and coated with ferruginous matter. In the Tuticorin regions sand ridges are formed by white sands, cemented by calcareous shells. They become hard and form sandstones which are used as building stones. In Tinnevely and further north in Ramnad, the teris formation are like the shape of a caterpillar, here dunes extend over a length of 5 km with 200 to 400 m width and 20 m height. The teris formation towards inland and coastal dunes towards the shore are distinguished by colour of sand grains, vegetations pattern and stability of sand grains. The teris are densely vegetated due to more stability and characterised by older fossil dunes.

West of Cape Comorin in the neighbourhood of Trivandrum about 25 km long dune belts are found occupying partly on shore and partly on coastal zone. These are prominent but have less piles of sands. Such types of sand piles also occur along Cochin and Calicut. In the rocky surface of the coastal regions, such as from Mangalore to Calicut, these dunes are absent. There are probably 9 sand ridges of about 200 m wide and 300-500 m long in these regions. Near Kumta and Honavar there are long and narrow sand ridges along the landward side of the beach. Near Coondapur there is a line of sand dunes

running for about 10 km with 200 m width. Except some sand ridges it is found that the region from Cape Comorin to the Gulf of Khambat is a dune free zone. Some dunes are found in the coastal zones of Surat and Broach and between Veraval and Dwarka on the south-western Kathiawar coast with a series of 2-3 parallel lines and ridges of 10-20 m height.

Thus from the nature of sand dune formation it is clear that dunes are more common on low coastal plains of the east coast. In the high coastal plains on cliffed coast along the western regions, dune formations are very frequent. Again, the dimension and extension of dunes are more where the wind is oblique to the shore line and less where the wind is transverse to the shore line. There are 3 types of dune formation along the shore and coastal zones in India (Ahmed, 1972) :

(A) Ephemeral sand dunes which occur on the shore during high wind in low tide and are destroyed during high tide.

(B) Semi-stable dunes formed by the sea waves during storm and abnormally high tide along the back shore zone and not in the coastal zones.

(C) Permanent coastal dunes beyond the reach of sea waves are found along the coast line with vegetation cover for stabilization of the dunes.

Besides the deposits of sands, the river alluvium and laterite are another two important features along the coastal zone in India. The East coast has many large river mouths and deltas that extend to a greater distance with alluvium deposits than the west coast where rivers and catchments are less and in a steep slope and alluvium deposits are restricted only towards the vicinity of rivers. The extent of the alluvial plain determines the depth of shore zone and coastal dune formation.

Laterites in many parts of Indian coast are found as interrupted fringes. From Bombay to Ratnagiri it occurs as a plateau. Sometimes it is found to extend 25-30 km inland terminating in cliffs. Near Malvan it starts on gneiss base and in Kerala it overlies fossiliferous tertiaries. Along the East coast, laterites are found rising beneath the alluvium which fringes the coast and creates sloping gradually upwards towards the interior. It is present in thinner form than the West coast. In some form or other it can be traced with short intervals from Cape Comorin to Orissa and then northwards through Midnapur, Burdwan, and Birbhum along the western edge of the Ganga and Mahanadi alluvium to the flanks of Rajmahal hills.

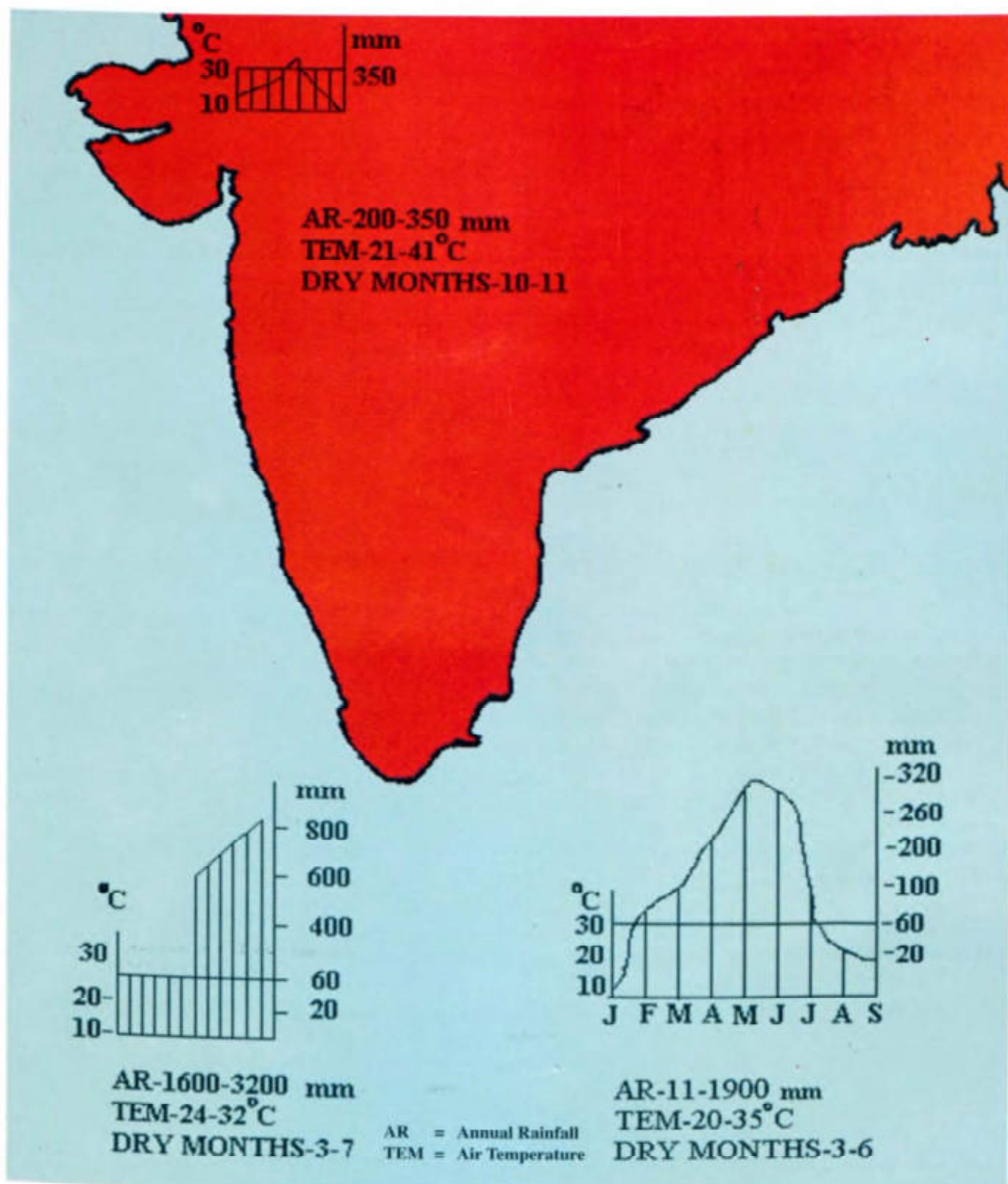
CLIMATE OF INDIAN COAST

The climate of the earth is intimately connected with the ocean through the atmosphere which serves as the common canopy for both, transferring enormous quantity of water vapour, thermal energy and momentum from the sea to the land. Extensive studies on the air-sea interaction will enable us to predict climatic changes over longer periods and will be helpful to diminish environmental disasters like drought, flood, etc. Like a flywheel, the ocean stores thermal energy when the supply is large during the day or summer and releases the energy when the supply is reduced during night or winter. When heated, the ocean responds by storing some of the heat and releases by increased evaporation. Since the heat is mixed in ocean for some metres by the wind, temperature rises much less than it does on dry land under the same heating conditions. The evaporation, however, has profound effects on the atmosphere and on climate, water vapour released into the atmosphere increases the greenhouse effect in the atmosphere. (Rao, B.R., 1983.)

When it condenses, the resulting heating of the air is a major source of energy for atmospheric motion. When the ocean is cooled, it responds by generating vertical convective motions, which bring heat to the surface land so that cooling is spread over considerable depth. Thus the temperature fall is much less than over land under the same cooling conditions. The ocean micro-layer that is 1 cm thickness of the ocean surface plays a major role in air-sea interaction. It not only transfers energy but also rich nutrients like nitrogen, phosphorous and potassium into the atmosphere. The temperature over the whole ocean ranges from -2°C (the freezing point of salt water) to 30°C and at any other place it hardly varies more than 1°C during the course of a day and 10°C during the course of a year. The ocean moves both horizontally and vertically, under the influence of wind force. The density differences generate during these periods by heating, cooling, evaporation, precipitation and run-off. While in movement, it redistributes heat and salt to the land in ways that

are very important for determining the details of earth's climate. In the tropics, solar heating and excess evaporation over precipitation and run off create an upper layer of relatively warm, and saline water.

The role of carbon dioxide is very important in the ocean and atmosphere interaction. The total CO_2 in the earth's atmosphere is 2300 billion tons which is 0.03% of its total mass. This amount is dependent on the quantity of CO_2 withdrawn or supplied from the oceans, rocks and living organisms. The total CO_2 in the ocean is 50 times as much as in the air. When atmospheric CO_2 increases, ocean tends to absorb the excess and when it falls, the ocean replenishes it. Usually, ocean comes to rescue of the atmosphere whenever there is an imbalance in CO_2 . Distinct temperature cycles in the ocean sediments indicate the exchange of CO_2 between ocean and air. If there is a lush growth of vegetation on land taking up large quantity of CO_2 , after sometime equilibrium with the ocean reduces the atmospheric concentration to nearly half of its original value and average temperature of earth falls by 3.9°C . This drop will cause glaciers to spread and oceans to shrink resulting in a slow release of excess CO_2 from the ocean into the atmosphere. This will again rise the temperature and restore the CO_2 in the atmosphere to the original value. Estimate of fossil fuels consumed in the world each year show that in the past 100 years man has added 360 billion tons of CO_2 to the atmosphere resulting in 13% increase in CO_2 to the atmosphere and which causes the rise of world's temperature by 0.5%, in this way, it will rise by 1.8°C . If it continues, then after 1000 years CO_2 would increase 18 times. However, after ocean-atmosphere attains equilibrium, there will be 10 times CO_2 than today, resulting in 2°C of world's temperature rise. There will be increased acidity and pH of sea water and it would not be possible for man to live on this planet. The increased temperature will cause increased volume of sea water which will result in submergence of all the land areas adjacent to the sea shore.



Climatic Map of Indian Coast



General Pattern of Soil (East & West Coast)

Table 1 : CLIMATIC TABLE OF INDIAN COASTAL REGIONS

(Source : Rao, T.A. & Meherhomji, 1998)

Stations	Altitude (m)	Annual average rainfall (mm)	Number of dry months	Temperature		Mean relative humidity of the dry period	Mean annual value of saturation deficit {mm(Hg)}
				Mean of the coldest month (°C)	Annual average (%)		
Arid							
Bhuj	10.4	326	10	19.7	34.7	45	13
Dwarka	11	354	10	20.3	26.0	71	7
Jamnagar	18	523	9	18.7	26.0	60	9
Semi-arid							
Veraval	8	558	8	20.5	31.2	58	7
Bhavnagar	16	561	8	21.9	31.4	40	14
Dry							
Surat	11	1192	8	22.4	31.5	51	11
Sub-humid							
Mumbai	11	2800	7	28.0	33.0	69	7
Humid							
Ratnagiri	64	2599	7	25.0	27.0	67	7
Mangalore	22	3275	5	26.4	27.0	69	6
Perhumid							
Kozhikode (Calicut)	8	3080	4	27.0	29.0	72	5
Trivandrum	61	1693	3	27.0	28.0	73	6
Dry							
Pamban	10	943	8	28.0	29.0	79	6
Sub-humid							
Chennai	20	1268	6	24.5	28.0	70	9
Visakhapatnam	36	961	6	23.3	27.3	72	7
Humid							
Puri	6	1464	5	17.8	24.5	55	9
Balasure	19	1579	6	19.8	26.5	67	7

CLIMATE AND SOIL OF GUJARAT COAST

The Gujarat coast is bounded by the Arabian sea with two major intrusions, the Gulf of Kuchchh and Khambhat which fall under arid, semi-arid, humid, sub-humid and very humid to semi-moist climate ranging in maximum temperature from 33.7°C to 41.3°C during summer while during winter, the maximum temperature ranges from 2°C to 20°C. In April, the isothermal lines of 27.5 °C and 30°C tend north to south. The average rainfall towards the south ranges from 600-1000 mm. It is intense in South Gujarat and decreases in the north-west. The Saurashtra peninsula and Gulf of Khambhat coast regions receive more than 700 mm rainfall but Jamnagar and Junagarh coastal regions record less than 600 mm. The coastal regions near Dwarka and Kuchchh are semi-arid and record an average rainfall of 500-600 mm with high variability.

The soil of Gujarat can be divided into 6 soil types: Deep black soil, Medium black soil, Coastal alluvium, Alluvium-sandy loam, Semi-arid sandy alluvium and Desert-saline soil. Except the alluvial plains of the western part of Saurashtra and N. Gujarat, the basic soil types of Gujarat comprises the volcanic rocks. The Saurashtra coast, north Khambhat and western coastal strip of Gujarat are associated with coastal alluvium and miliolites. Edaphic conditions of Gujarat coast have been studied from the Ecology Unit of BSI (Rao, T. A. and Agarwal, K. R., 1971.). Soil samples, sandy, rocky and saline mud were collected from 4 districts. Table-3 shows analysis of soil samples collected from different sandy strands. Here soils are water-laid loose sands to loamy sands. At Okha, Dwarka and Veraval these sands are of marine origin and associated with shells and coral fragments, rich in calcium carbonate. Other quartz derived sands are also calcareous and contain small proportions of felspar and heavy minerals. pH values exhibit moderate alkalinity and organic matter is very low. Table-4 shows analysis of soils samples collected from rocky strands of Dwarka and Porbandar. Here sands are associated in the rocky crevices or the mantle of soils are present over the underlying rock, due to weathering action. It is a mixture of conglomerate rock and water-laid or wind blown sands. The soils are loamy sands with moderate alkalinity, calcareous and higher organic matter content in salt marsh. Table-5 shows that general character of

salt marsh soils and wet slacks which are sandy loam, sandy clay and silt loam with mild alkalinity and higher organic matter content. Dissolved solids and sodium chloride are very high due to evaporation of salt water from the sea. All the soils are highly calcareous. Table-6 shows analysis of soil samples from three places of semi-arid coastal plains of Dwarka, Somnath and Mandavi areas which are immature soils having loamy character with low sand particles. pH is mild alkaline, organic matter decreases with depth of soil surface. Calcium carbonate is high and Sodium chloride is lower than other soils.

CLIMATE AND SOIL OF WEST COAST

The west coast represents more or less equable climate with high temperatures almost throughout the year associated with evening cool breezes on the shore. The Konkan coastal region shows distinct climatic diversities ranging from sub-humid type in Mumbai to humid type in Ratnagiri and Goa. The Malabar coastal region also shows two distinct climatic variations such as humid climate in Mangalore to perhumid climate in Kozhikode and Trivandrum.

TEMPERATURE

In general, the mean monthly temperature ranges between 24°C and 31°C. The maximum rarely exceeds 32°C and the minimum rarely falls below 21°C. The annual range of temperature decreases southwards as follows: 5.7°C at Mumbai to 5°C at Karwar, 4°C at Mangalore and 3.3°C at Cochin. April and May are the hottest months of the year. The high humidity and evening sea breezes are characteristic features of this region.

RAINFALL

The rainfall is usually high in this coast and shows considerable variation in Konkan, Karnataka and Kerala regions. In Konkan, rainfall is 2800 mm, in Karnataka 3100 mm and in Kerala 2400 mm. Most of the rainfall in Konkan and north Karnataka is found during June to September months. The length of rainy season increases also from north to south in the West coast. It ranges 4-5 months in the Konkan coast, 7 months near Mangalore and 8-9 months in Kerala. In Kerala, rainfall

Table 2 : Climate data of Dwarka and Veraval

Month	Temperature °C		Relative humidity		Rainfall	
	Daily max.	Daily min.	8.30 hr.	17.30 hr.	Mean monthly total in	No. of rainy days
Dwarka : Lat. 22°22' N, Long. 69°05' E height above MSL 37 ft						
January	25.5	15.2	70	44	0.10	0.3
February	25.8	17.3	74	57	0.24	0.5
March	27.9	21.4	79	64	0.11	0.2
April	29.5	24.6	86	74	0.03	0.1
May	31.1	27.0	86	77	0.02	0.1
June	31.8	28.0	85	75	2.01	2.3
July	30.3	27.6	86	80	6.95	6.0
August	29.2	25.8	89	78	2.85	3.8
September	29.5	25.3	88	77	1.47	2.0
October	30.7	24.1	82	73	0.25	0.3
November	30.6	21.3	70	49	0.08	0.1
December	27.3	16.6	67	38	0.09	0.2
Annual total or mean	29.1	22.7	80	65	13.93	15.9
Veraval : Lat. 20°55' N Long. 70°22' E height above MSL 26 ft						
January	27.7	15.4	53	60	0.04	0.1
February	27.8	16.1	59	66	0.07	0.2
March	29.7	16.9	66	72	0.05	0.1
April	30.1	22.4	77	81	0.00	0.0
May	30.0	25.9	85	84	0.28	0.3
June	30.2	27.5	85	86	4.66	3.9
July	28.8	26.5	88	89	7.78	9.2
August	28.0	25.8	89	87	3.61	5.9
September	28.7	24.9	87	86	2.49	3.9
October	31.7	22.9	69	76	0.62	0.8
November	31.7	20.0	55	68	0.17	0.2
December	29.8	17.0	52	63	0.07	0.2
Annual total or mean	29.5	21.9	72	76	19.84	24.8

Table - 3 : Analysis of soil samples collected within the sandy strand habitat (0-10 cm depth)

Location	Soil colour	Soil texture	pH	Organic matter	TSS %	NaCl %	CaCO ₃ %
Sand bar, Okha	dull white with some brown particles	loamy sand	8.8	0.08	0.039	0.028	45.67
Sandy hump, near light house, Okha	dull white	—	8.4	0.02	0.042	0.029	79.00
Sandy hump, near Burmah Shell, Okha	do	—	8.4	0.21	0.060	0.036	92.9
Sandy shore, Okha	do	—	8.4	0.61	0.155	0.118	72.95
Sand bar, Rupan, Dwarka	dull white with brown particles	—	8.3	0.25	0.064	0.025	76.67
Sand bank, Porbandar	dull white with brown particles	—	8.4	0.25	0.038	0.010	70.53
Sandy hump, Porbandar	dull white	—	8.2	0.64	0.140	0.044	70.07
Sandy shore, Veraval	dull white with brown particles	—	8.2	0.58	0.083	0.048	65.65
Sandy shore, Somnath temple	mixed white, light brown and black particles	sand	8.3	0.25	0.038	0.013	31.73
Sandy shore, Tribeni Saugam, Somnath	white with black particles	sand	8.2	0.17	0.090	0.042	23.00
Sandy shore, Mandavi	white	fine sand	8.0	0.43	0.10	0.068	28.52
Sandy hump, Mandavi	dull white	—	8.2	0.32	0.160	0.022	55.73
Sandy hump, Mandavi	do	fine sand	8.2	0.21	0.083	0.022	40.00
Dune field, Mandavi	do	—	8.2	0.11	0.050	0.014	55.63
Dune field, Mandavi	do	loamy	8.1	0.18	0.165	0.018	49.36
Base of mobile dune, Mandavi	dull white with brown particles	fine sand	8.0	0.29	0.060	0.008	26.63
Base of consolidated dune, Mandavi	dull white with brown particles	fine sand	7.9	0.63	0.175	0.008	22.18

Table - 4 : Analysis of soil samples collected within the rocky-sandy strand habitat (0-12.5 cm)

Location	Soil colour	Soil texture	pH	Organic matter	TSS %	NaCl %	CaCO ₃ %
Rocky-sandy strand, near Baroda Maharaja's palace, Dwarka	light brown	loamy sand	7.8	0.81	0.04	0.015	25.38
Rocky-sand strand, near Govt. R. H., Dwarka	dull white to light brown	—	7.8	0.46	0.075	0.028	69.59
Rocky-sandy strand, near light house, Dwarka	light brown	—	7.8	0.39	0.061	0.024	69.35
Rocky-sandy strand, near Rupan, Dwarka	do	loamy sand	8.1	0.43	0.086	0.044	40.28
Rocky-sandy strand, Rupan, Bander, Dwarka	do	do	8.2	0.72	0.059	0.029	42.25
Rocky-sandy strand, Dhuyu off Dwarka	light black	—	8.3	—	—	—	62.71
Rocky-sandy, Kyu, Okha	black	—	7.9	—	—	—	47.80
Rocky-sandy strand, Porbandar	light pink	—	8.1	—	—	—	58.81
Rocky-sandy strand, Porbandar	dull white	—	8.1	0.22	0.120	0.059	59.68

Table - 5 : Analysis of soil sample collected within salt pans (0-10 cm depth)

Location	Soil colour	Soil texture	pH	Organic matter	TSS %	NaCl %	CaCO ₃ %
Salt pan behind Okha sand bar	greyish	—	7.8	2.55	2.285	1.710	82.65
Salt pan, Okha Dwarka Rly. line	grey	silt loam	7.6	1.90	3.656	3.073	12.11
Salt pan, Dwarka-Veraval Road	light grey	—	7.8	2.91	3.987	3.339	53.75
Salt pan, Gomati creek, Dwarka	do	loam	7.7	1.86	2.589	2.172	15.97
Salt pan near Mandavi	blackish loam	silt	7.8	1.93	3.020	2.039	14.42
Salt pan, Gogla	light grey	sandy loam	7.8	2.49	2.035	1.640	21.80

Table - 6 : Analysis of soil samples collected within slacks and mud formation (0-10 cm depth)

Location	Soil colour	Soil texture	pH	Organic matter	TSS %	NaCl %	CaCO ₃ %	
Wet slack behind Okha sand bar	dull white with pinkish tinge	—	8.3	0.63	0.038	0.007	76.64	
Dry slack, Dwarka	light brown	loamy sand	8.2	0.47	0.114	0.066	45.31	
Swamp near Veraval, soil from within	blackish	sandy clay loam	7.8	0.53	0.0714	0.018	27.09	
Swamp near Veraval, soil from periphery	dull white	loamy sand	7.9	0.26	0.174	0.062	28.11	
Wet slack behind Dhuyu sand bar off Dwarka	dull white with pinkish tinge	—	8.3	0.30	0.047	0.013	77.80	
Dry muddy flat, Okha	grey	sandy loam	7.8	4.69	0.058	0.030	18.29	
Dwarka Rly. line about 3 km from Dwarka	light grey brown	sandy loam	7.9	2.13	0.032	0.012	16.52	
			Hard kankar nodules					
Dry slack in-between Mandavi sand-dunes	very light grey	loamy sand	8.0	1.76	0.100	0.290	40.97	
	dull white	sandy loam	8.1	0.64	0.085	0.015	47.95	
	do	—	8.2	0.25	0.065	0.012	54.69	
	do	—	8.2	0.15	0.050	0.008	56.58	

decreases from north to south that is 2400 mm to 1600 mm in Trivandrum and 1000 mm in Kanya Kumari. This coast receives a double influence of rainfall from both the summer monsoon and winter monsoon during June-July and October-November. This coast enjoys little seasonal variation, the cool season extends from December to February and hot season from March to May. Other 6-7 months may be observed as rainy seasons. During the month of June and again during October, the wind spread and cyclonic storm from the Arabian Sea may develop a severe cyclone mainly on Konkan and Karnataka coast.

SOIL

Soils of the West coastal regions show diversity from north to southwards. According to the physiographic unit and geological formation, the soil occur in belts parallel to one another along the coast. The formation of soil texture can be divided into 6 types : such as sandy soil, coarse sands, lateritic yellow or red soil, black clay soil and peat soil. The sea beaches, shore land, coastal dunes, plains and islands of back waters are usually covered with sandy, lateritic and black clay soil. The sands are mostly marine in origin and contents of organic matters, nitrogen, phosphorous, potassium are very low in percentage and sodium chloride and calcium are higher. In Karnataka, these sands are associated with alluvium and other materials of parent laterite. These sands are also mostly marine in origin, saline and associated with low organic matter, nitrogen, phosphorous and potassium.

The river mouths, lagoons and back water estuarine areas are found dominated with the alluvial soil. It is originated from river-alluvium, mud and estuarine silts. The wide belt of alluvial soil is common towards the north Konkan region, then it becomes narrower to the south Konkan and almost disappears in north Karnataka regions. Along the Netravati river valley in Mangalore, this alluvial soil belt is prominent between the sandy and lateritic belt. In Kerala, it is restricted in some pockets of river valley. These soils have various percentage of sands, silts and clay particles with high organic matter, nitrogen, phosphorous and potassium and lower salinity than the sandy soil.

The low hills and plateaus of the north Konkan regions are dominated with coarse sands which are saline and having low fertility character. The platforms of marine denudation, about 60-125 m high, the low-lying plateaus and residual hills of Kerala, Karnataka, south and north Ramagiri and Palghat gap are associated with laterites or red soils. These are gravelly and sandy with small percentage of clay particles. These are free draining, highly acidic, rich in iron, aluminium and manganese oxides but poor in lime and organic matters. In some pockets of Kerala, a small patch of black soil, very rich in organic matter and potassium are found. These are known as peat soils which are highly acidic. In places like Kuttanad, Vaikom and Shertallai these peat soil formations are found in junction of sandy and laterite soils.

In north Konkan region, black soil is associated along the trap of the rocks. They are very fertile for having rich iron, magnesium and calcium content and high moisture retaining capacity.

CLIMATE AND SOIL OF EAST COAST

The regions extend from Coromandel-Circar coastal plains of Tamil Nadu and Andhra Pradesh in the south-eastern India and Utkal and Bengal coastal plains towards north-east. The Coromandel-Circar region exhibits a tropical climate with dissymmetric regime of rains and Utkal-Bengal region exhibits tropical humid climate with mostly unisymmetric regime of rainfall.

TEMPERATURE

In general, the East coast represents a hot tropical climate characterised by oppressive summer, low daily range of temperature, high humidity and moderate rainfall. This coastal strip experiences local climatic variation in regard to the variation of physiographic conditions such as from the coastal tract of Bengal-Orissa to the Godavari-Krishna delta, it enjoys tropical savanna climate and from the Krishna delta to the Vaippar, it represents tropical wet and dry climate with distinct dry summer. The parts of the southern coastal districts experience a tropical monsoon climate with a short dry winter season and the interior parts of these districts have a tropical arid steppe climate with winter

drought. Temperature increases from the month of February to the end of May. During the hottest months, in Bengal and Utkal coastal regions, temperature varies between 31°C-34°C while the interior parts experience 33°C-36°C. Similarly, along the Andhra-Tamil Nadu coast temperature varies between 35°C-38°C and their interior parts experience over 40°C. January is the coldest month and temperature recorded along Bengal-Utkal coastal areas ranges from 13°C-20°C and that along the Andhra-Tamil Nadu coastal regions, from 18°C-23°C. In the interior parts of these coastal tracts temperature ranges from 12°C-20°C during the coldest month. Therefore, it is found that due to moderate influence of sea, the East coastal regions have very little variation in annual normal temperature pattern.

RAINFALL AND HUMIDITY

Annual rainfall along the East coastal belt usually ranges from 1130 mm to 1840 mm and decreases towards the interior parts. From Bengal to Utkal coastal areas up to Balasore rainfall ranges from 1686 mm to 1840 mm, whereas in Puri coastal regions, it experiences 1482 mm. Along the Andhra coast in Kakinada, it shows 1179 mm. In Tamil Nadu coast, rainfall varies in different regions such as 1216 mm in Chennai, 1367 mm in Nagapattanam and 602 mm in Tuticorin. Thus, it indicates wide range of variation of rainfall pattern from north to southern parts along the Eastern coast. The rainfall is highest along the Bengal and Balasore and decreases in amount till it reaches Krishna-Godavari region as in Kakinada, again towards south it increases up to Nagapattanam and again decreases towards Tuticorin. It is found that due to south-west monsoon, Bengal-Utkal and northern Andhra Pradesh get maximum rainfall. The Kakinada and southward up to Krishna delta shows decrease in rainfall as these areas fall out of the main monsoonal tract, associated with depressions. Further south, most of the rainfall is caused by retreating monsoon which is mainly associated with the storms and depressions originating in the Bay, providing various amount of rain fall on the coast. Decrease of rainfall in Tuticorin is due to the barrier-like effect that cyclone exerts by preventing the rain-bearing winds from reaching this region. Humidity prevails very high throughout the year along the coastal areas. In Bengal-Utkal coast, it is 70% in the driest

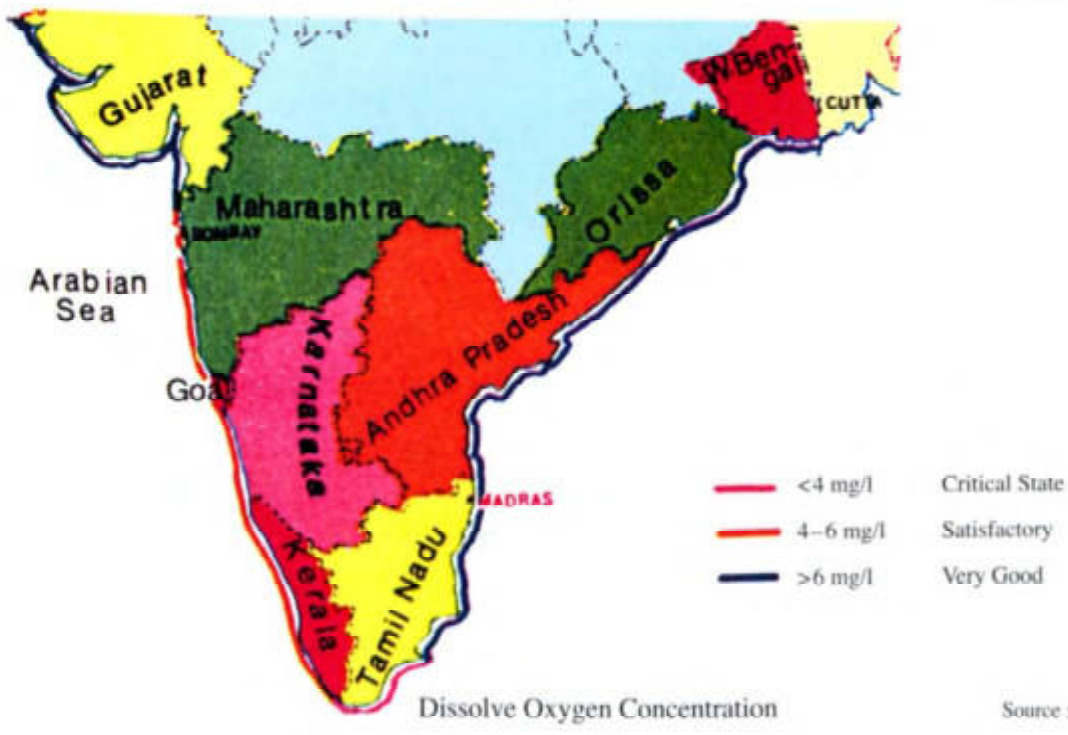
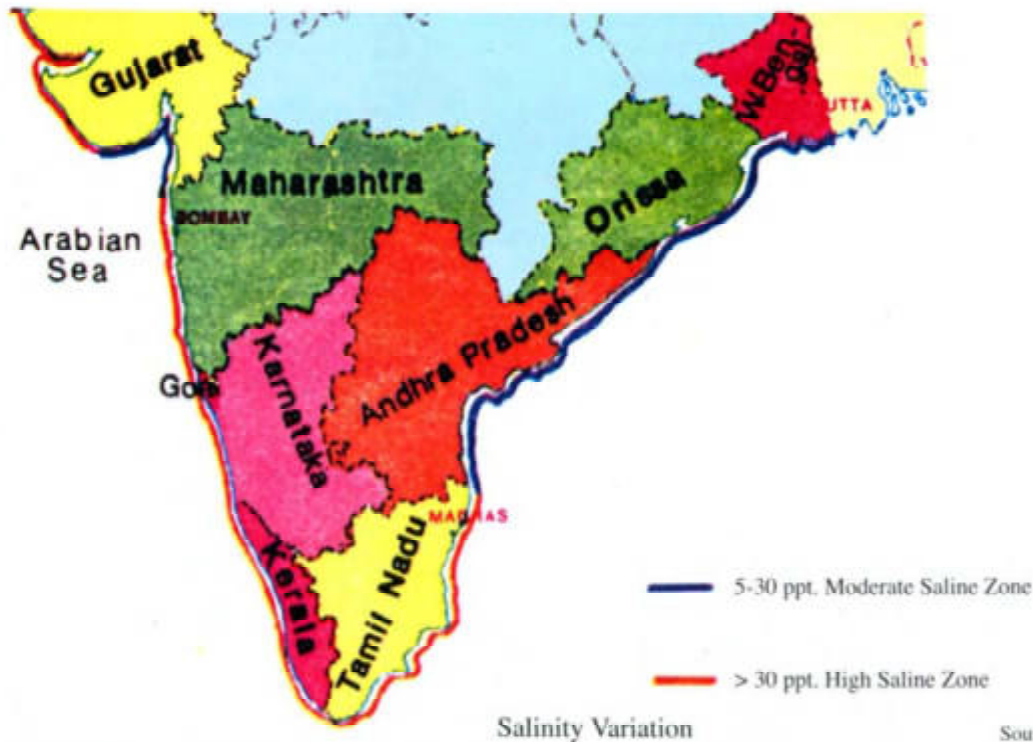
months and above 82% during wettest months. In Tamil Nadu, it varies from 60% during June and above 80% during November-December. During the post monsoon and early part of the north-eastern monsoon, storms and depressions originating in the Bay effect the weather of this Eastern coast. Some of these depressions intensify into severe storms with the wind velocity 180 to 200 km per hour, resulting in heavy rains and cyclones to these coastal belts. The entire Orissa, Bengal, Andhra Pradesh and some parts of Tamil Nadu are especially vulnerable to cyclones. More than 200 cyclones are reported to have hit these coastal regions during the last 100 years and in most of the cases the regions like Sundarbans, Cuttack, Balasore, Kakinada, Krishna and Godavari mouths, Cauveri mouth, Machilipattanam, Nizampattanam and others have been found seriously affected.

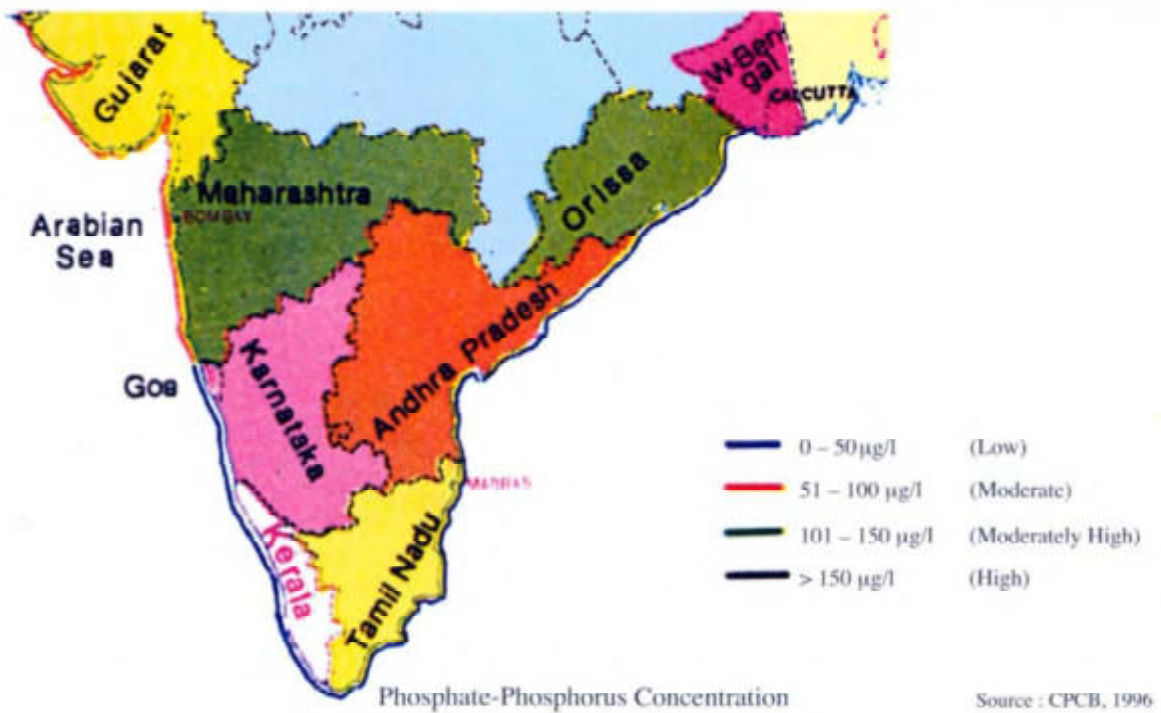
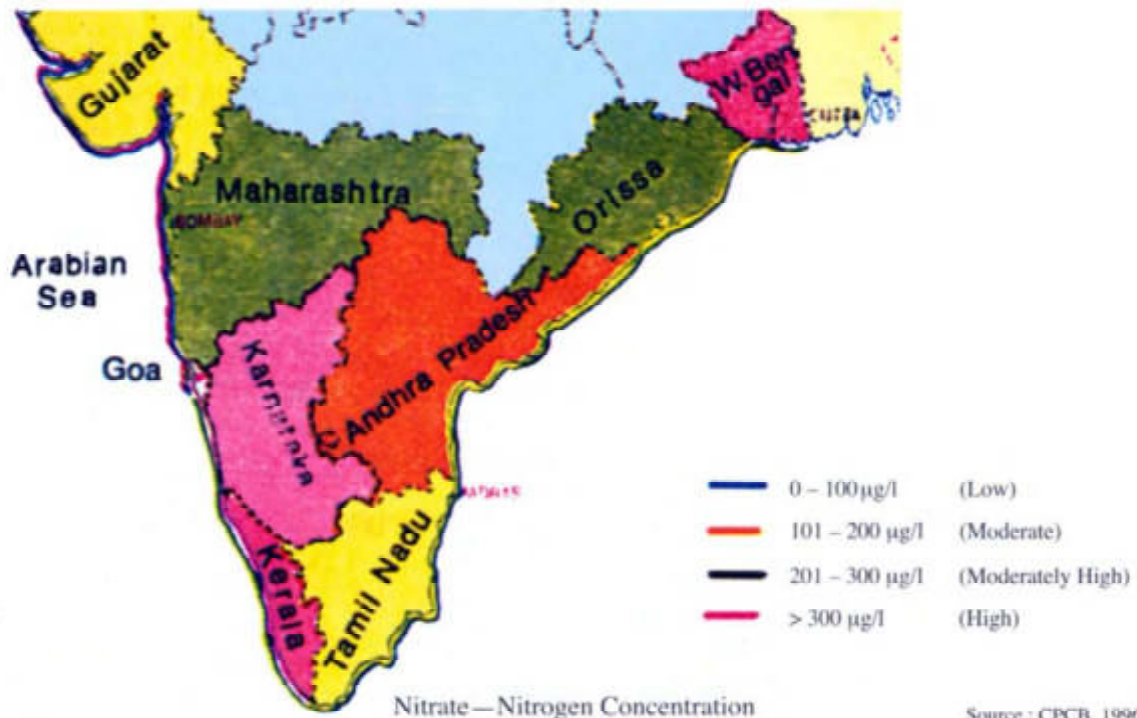
SOILS

The soil of the east coastal plains predominate with alluvium. In some areas behind the sandy zone or in association with the sandy alluvium, traces of black soil and lateritic soil are prominent as transported soil. A special class of soil, usually known as saline and alkaline soil also occurs along the saline flats and salt marshes bordering the estuarine areas of the coast. This soil is nothing but transformed soil due to the change of ecological and topographical situation of the areas.

The coastal alluvium soils are of two major types such as : all along the sandy coast from Midnapur to Kanya Kumari, the littoral parts varying the width of 10 to 20 km are covered with sandy alluvium which are in most cases of marine origin. In general, these are known as coastal sands composed of coarse sands, fine sands and silts, rich in lime and poor in nitrogen and phosphoric acids.

All along the deltas and estuarine regions where the rivers meet the sea and the areas are constantly influenced by saline tide water the soil is mainly composed of alluvial bed. These alluvial soil, occupy the Ganga, Baitarini, Brahmani, Mahanadi, Godavari, Krishna and Cauvery deltas and are of riverine origin and mostly composed of clay, silts and sand particles. These soils are very fertile, rich in nitrogen and phosphoric acid. The extent of these soils are also found





along the creeks and canals from few metres to several kilometers in width on the shore line up to the zone of influence of saline tide water flow. Topographically, these are gently sloping in nature having an elevation less than 10 m above the mean sea level in three terraces : lower terraces, middle terraces and higher terraces. The lower terraces remain at normal high tide level, the middle terraces merge with the lower terraces but face occasional high tide level and upper terraces usually remain free from normal tidal effect but are inundated during exceptional situations and form tertiary fill. The lower terraces are the youngest phase and all the deposits carried by rivers and channels are associated here with the tidal action towards the deltaic head of the fan. These are mainly predominated with fine sands and silt particles. Due to fluvial action, the deposits of coarse to fine particles are arranged from the upper to lower terraces in all sedimentary basins.

Since these alluvial soils along the coast have a special configuration depending upon the saline tide water influence associated with the changing nature of salt water level fluctuations and seasonal salinity conditions, these have been usefully named as "Coastal Saline Alluvium Soils". Mangrove swamps are found better developed in these areas. Along the upper terraces, these soils are naturally reclaimed due to leaching of salts by rain water. Physical characteristics of the coastal saline soils of eastern India are silty clay dominated texture, saline, with sodium chloride as dominant salt associated with sodium sulphate. Organic matter content ranges from 0.61 to 1.25%. Soil reaction is in the acidic to alkaline range subjected to wide seasonal variation. Electrical conductivity is higher and ranges towards 30-31 mmhos/cm. Soil mineral study shows that in Cauvery delta, smectite is predominant with few kaolinite. Godavari delta has smectite with little kaolinite and illite in traces. The Ganga delta is dominated with micro-chlorite in which mica is made up essentially of muscovite and the Mahanadi delta contains montmorillonite associated with halloysite and illite. The presence of quartz, clay and feldspars is also common in this soil type.

The acidification of these soils result in oxidation of sulphide to sulphate with the release of sulphuric acid. Sulphur content of these soils is less than 5%. Magnesium is found dominant and is followed by calcium, sodium and potassium. Along the Utkal coast

of Balasore, in Andhra coast near the Godavari and Nellore, in Tamil Nadu at Chinglaput and Tanjavur, laterite soils are found in small patches where the coastal line exhibits rocky formation. The dominant components in these soils are iron, alumina and silicic acid as primary materials for rock.

Along the part of Chilka lake in the Utkal coast, some parts of west Godavari, Krishna and Guntur of Andhra coast, some parts of Madurai, Sattur and Ramnathapuram and major parts of Tirunelveli of Tamil Nadu coast exhibit the presence of black soil. This tropical black clay is rich in lime, magnesium and aluminium but poor in phosphorous, nitrogen and organic matters. They originate either from decomposition of basic basalt or certain sedimentary clays or decomposition of calcium and magnesium. These black soils are not as rich as Deccan Trap. The fertility of these black soils depends on self-ploughing character.

CLIMATE AND SOIL OF LAKSHADWEEP ISLANDS

The Lakshadweep group of islands along the Arabian Sea are of coral origin which developed around volcanic peaks. It seems that they first rose to the surface in the form of shallow oval basins and that under the protection of the reef, the eastern rim gradually developed towards the centre, forming the islands. This developmental phase is still going on towards the centre of the lagoon. All the islands are identical in structure and function and found raised in only 5 m above the sea.

The northern most group is collectively known as Amindivi comprising the islands of Chetlat, Kitau, Kadamath, Amin and Betra. The Lakshadweep islands comprises Androth, Kavarathi, Agathy and Kalpeni. Minicoy is situated in the extreme south. Among these islands, Minicoy is the largest with an area of 4.53 km² and all other islands are very small.

The first humus layer is very thin and below this layer is the fine coral sands which extend at the surface of all islands. Just beneath this coral sands, there is a layer of oolitic lime stone which look like coarse, finely conglomerated and associated with embedded bits of shell. Below this crust of coral stones, there is another layer of fine sand which forms the

last layer of the coral islands. In total, the width of this coral stone including sandy layer varies from 2-3 m.

The climatic conditions of these islands remain foggy due to the presence of cloud cover throughout the year. Wet-bulb temperature never falls below 23.8°C and relative humidity is above 72%. The highest temperature ranges from 35°-37°C and the lowest temperature ranges from 17°-18°C. The rainfall is very high and ranges between 2247-2550 mm.

CLIMATE AND SOIL OF BAY ISLANDS

Bay islands comprise Andaman and Nicobar groups of islands of the Bay of Bengal. They are the young fold of mountains originated from the Arkan yoma. The Andaman and Nicobar are separated by a deep sea oceanic channel known as the Ten degree channel. The Andaman group of islands comprise of 204 islands and Nicobar group of islands comprises 18 islands. The rocks of Andaman belong to Mesozoic, Tertiary and Quaternary formation with recent and sub-recent deposits along the coast. Both conglomerates and sand stone type rocks are dominant in these islands and most of the hill ranges and peaks are formed by serpentine rocks. Geological work in the Nicobar islands indicates that southern parts have sandstones and shells like that of the Port Blair series of Andamans but presence of poor lignite coal embedded in this sandstones differs from that of the Andaman series. Northern islands of Nicobar comprise of coral beds. Soil of the Andaman and Nicobar islands indicate tropical, sub-tropical, coastal saline alluvium and sandy soils. Tropical and alluvium sub-tropical soils are found along the hill ranges or in the valley but along the sea coast, soils are transported. According to the topographic diversity, the soil can be divided into various types from the sea coast to the high hill ranges. Zonation of vegetation pattern expresses the limiting extent of different soil types. Along the sea coast sandy alluvium of marine origin with shingles and coral dust are dominating, along the banks of creeks and channels mixed saline soils consisting of sands and clayloam of the valleys are found common. In the valleys and lower slopes of hills, clay-loam soils are predominant. Along the hills, stiff clay associated with dark red-loam or

black-loam are common above the underlying sandstones. Most of these sandstones are rich in mica and remain moist throughout the year.

Climate of Andaman and Nicobar islands is influenced by the surrounding warm sea and as the islands lie south of the Tropic of Cancer, they enjoy a tropical warm and humid climate. The mean maximum temperature varies from 28°C-30°C in various islands and mean minimum temperature ranges from 23°C-23.8°C. The main attraction of these islands are the rain fall and humidity. The rainfall usually continues through out the year except for 3 dry months i.e. February to April and humidity remains above 85% for those wet months. The average annual rainfall ranges from 2000 to 3000 mm over these islands.

SEA WATER

The water which is most essential for dry and wet coastal ecosystems along the sandy or rocky coasts, deltas, estuarine mudflats, coastal backwaters and salt-marshes is mainly influenced by sea water and in some areas mixture of sea and river water. Chemical composition of the sea water contains 96.6% pure water and 3.4% dissolved salts. The dissolved salts consists of chlorine, sodium, magnesium, sulphur, calcium and potassium salts. Besides these salts, some minor elements such as strontium, bromine, boron, iron and silicon are found from 1-100 ppm. Some trace elements like nickel and others are also found in the sea water and these are found to be absorbed and assimilated in the marine organisms. Some essential compounds like nitrates, bicarbonates and phosphates are also present in the sea water and at shallow depths where there is enough light, these compounds break to remove nitrogen, carbon and phosphorous by photosynthesis. In very deep water, where the light is negligible, bacterial decomposition of organic matters mix with the sea water in ionic form and these enter into the photosynthetic activities. Though the organic matters in the sea water is very low but the above process maintains the photosynthetic cycle in the sea life.

Due to continuous contact of sea water with the atmosphere, the sea water contains gases like O₂, CO₂ and N₂ and other inert gasses like Argon, Helium, Neon and Radon. (Rao, B.R., 1983).

POTENTIALITY OF INDIAN COAST, SHORE AND OFF-SHORE REGIONS

Application of the littoral zone for human activities and problems are related to the different nature of geomorphological features of coast line, shore line and off-shore lines in India. However, it would be useful to highlight separately the application of coast, shore and off-shore regions in India.

APPLICATION OF COAST ZONE

In this littoral part, all the rivers, streams and drainage systems finally terminate into the sea and physical character of the coast line in this region is related to the different structures, functions and applications. In W.Coast, where geomorphology is largely marked by steep rocky face, cliffs and scarped slope, the river systems are well-drained with flood-free hinter land and produce high hydro-electric potential. On the other hand, due to steep rocky face and cliffs this coastal zone is rather formidable for communication, trade and tourist activities from the shore and interior areas. In Gujarat coast, due to low land plain, roads, railways, inter-connected riverways and several trade centres are remarkable as in Mandavi, Kandla, Okha, Diu, Broach and Surat. Mumbai is the southern periphery of this coastal zone where these activities are confined mostly to the eastern side, far away from the shore. From Mumbai to Karwar the coastal active zone is the narrowest part in India where rocks and cliffs of the coast directly face the shore and the width of shore and coast is minimum. Here, the use of coast zone is rather very difficult for harbour, communication and accessibility between land and sea. East coastal zone of India, as a whole is marked by easier relief and greater width with major deltas. Therefore, these zone are highly productive for better cultivation, roads, railway, navigation, canals fisheries, ports and potential tourism. Economic significance of tidal forests specially mangroves along the deltas are remarkable in these zones. Due to these facilities, the eastern coastal plains are densely populated. There are some problems in these coastal zone such as tidal bores are found in greater depth and the plains become susceptible to floods during monsoon and post-

monsoon. Population in the tidal forests are unhealthy, malaria infested and people live with wild animals and insects.

APPLICATION OF SHORE ZONE

Applied aspect of shore zone in the littoral region for economic significance and human uses may be highlighted in the following features :

1. Shore marked by geometrical straightness is not helpful for construction of ports due to occurrence of high tidal bore which may cause severe collision to ships even when anchored. But this type of shore has a merit for long distance visibility and navigation facility.

2. On the other hand the shore marked by indentation is a beautiful advantage for development of harbour. They provide shelter against storm and high wind and favourable terrain in the coastal zone. Therefore, some of our important harbours like Karwar, Marmagaon and parts of Mumbai, Surat, Broach, Khambat, Bhavnagar, Diu, Port-Okha and Kandla, etc. occur along the western coast.

3. On the protected leeward side of deltaic protuberances there are harbours like Kakinada and Masulipattanam. Along deltas, shore features are highly advantageous due to availability of navigation facilities from several distributaries and estuarine mouths and bridge head point or tidal head point ports of varying significance can be developed. Construction of new Haldia Port in West Bengal and Paradeep Port in the Mahanadi delta, Orissa are recent examples.

APPLICATION OF BEACH ZONE

Besides the tourism involved in the straight, shallow beaches, development of off-shore bar, spits and bayheads act as saving clause of the shore with respect to the utility in navigation. Due to the occurrence of several off-shore bar, spits and bayheads in the Matabar coast, many lagoons, lakes and other sheltered bodies have originated and these harbour large numbers

of major, medium and minor ports on the Karnataka and Kerala beach zone like Cochin, Calicut (Kozikode) Ernakulam, Mahe, Cannanore, Kasargod, Mangalore and Alleppy, etc. In the east coast, spit formation has protected the coast, and ports like Ganjam, Kalingapattanam, Tuticorin, have developed. Other ports of the east coast as well as the south-west of Kathiawar have been protected by bars and spits formation. These types of beach features act as natural break waters and by mechanical dredging or artificial development, they can serve as highly flourishing mercantile shore. Some lakes like Chilka, Pulicat and Vembanad occur as inner shorelines and serve important wetland resources, tourism and fisheries. The lagoons, lakes, and creeks in the inner shore provide continuous navigation advantages to coastal inlands and development of fisheries. Margins of inner shore of lakes, lagoons and coastal marshes develop salt pans which are the important sites for salt industries. In Andhra Pradesh, Gujarat, Rann of Kutch, they are common.

POTENTIALITY OF SAND DUNES

Sand dunes on the shore and on the coast line are of many importance. The wind blown sands out of the beach sand, build sand hills and sand piles which are uneven, highly porous, light and arid in nature. Some interesting sand bindings and economically viable plant species are found in these zones. In some regions, these sands are cemented and consolidated by marine shells as the Millolite of south west Kathiawar or the sand rock of Gulf of Mannar shore and are used as building stones. The light, well-drained sandy back shore regions of Coromandel and North Circar littoral are famous for betel vine cultivation.

IMPORTANCE OF BEACH TERRACES

Flat, sandy seaward sediments of the shoreline which are exposed during low tide are known as beach terraces. They are very much useful for holiday excursion and are common in Coromandel and North Circars coasts.

IMPORTANCE OF LITTORAL CONCRETES

These are mostly found in Maharashtra and some parts of Kathiawar shore. They consist of continuous

grit of shingle, cemented by carbonate of lime and are generally found little above the high tide, forming well-drained, flatground off Esplanade (Mahim and the fort of Mumbai). The bank of this concrete acts as natural break water against storms during s.w. monsoon to the sites between the ridge of the concrete and the mainland. Due to the presence of this littoral concrete, the Maharashtra shore zone is free from marine erosion and due to absence of this concrete formation, the Karnataka and Kerala coasts face extensive marine erosion. Leeward sides of this concrete have calm water marshes, and due to arresting of suspending sediments they are the source of plant growth. In Henry and Kenery Islands, they help in lowland reclamation.

IMPORTANCE OF LOW LEVEL LATERITE AND TERIS

Occurrence of low level laterite both in the east and west coast is a problem for cultivation but the other uses of laterites like building stones, source of iron and many important plant resources, are no doubt an applied aspect. Formation of Red sand hills, not from the shore beaches but from the foot hill zones of the inner mountains of south India (Tirunelveli Dist.), are known as teris and act as a source of good fresh water reservoir and supply water for cultivation and other purpose. They become dry during non-rainy period but remain watered during heavy rainy period.

APPLICATION OF OFF SHORE ZONE

Most important applied side of this littoral zone are 1. Fisheries, 2. Islands resources, 3. Oil productions and Anchorage facilities.

Fisheries : The continental shelf in India covers 298,000 sq. km which is the source of maximum fish production. Fishing is generally confined within 8-10 km of the shore line but sometimes, it extends up to 30 km. The shallow and wider shelf in the Malabar coast holds maximum salt water fishing industries. Fishes like Sardine, Shark, Cat-fish, Mackerel, Pomfret, Whiting, Sale, Sea-break, Jew-fish, Indian rock-cod and Prawn have very suitable breeding ground in the continental shelf.

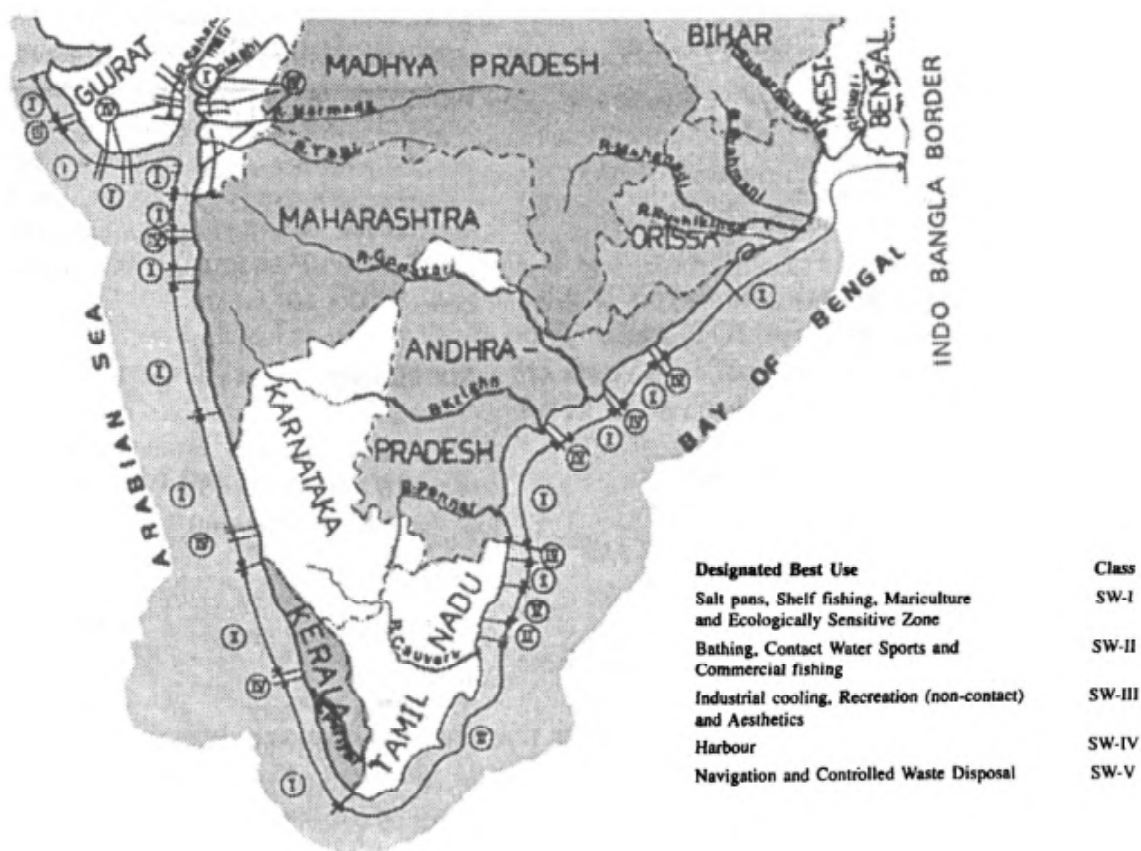
The productive pearl and clam fisheries in the Gulf of Mannar is a valuable resource of the Off-Shore zone. Submarine calcareous coral banks with rocky outcrops occur in the central tract of the Gulf of Mannar. Near about 54 banks of varying sizes are common along this region. This pearl fisheries are declining due to gastropod molluscs and tiger-fish which prey on the (pearl) oyster.

Islands : The use and commercial utilization of tropical island resources are well-known in Andaman and Nicobar Islands for forest resources, fisheries, wild life and marine resources. Lakshadweep group of islands are very useful for coconut, bread-fruits, coral fisheries and other marine resources. Some islands are very useful for tourism and habitat for coral reef.

Oil production and Anchorage : From Calicut to Cape Comorin there are mud banks on the Continental Shelf

which serve for smooth anchorage even when south west monsoon becomes forceful. During monsoon the bed of darkgreen and oily mud on the sea floor usually comes out with the water of anchorage. Near Alleppey, this mud comes out from a subterranean stream beneath the sandy beach deposits and this mud originates due to overflow of back water during monsoon. Some part of this mud flow towards the sea and other part enters to the outlet of the subterranean canal. In this process, the off-shore bank becomes muddy. Distillation of the mud samples yield oily petroliferous matter, probably the decomposed organic matters both from animals and plants.

According to the recent studies through different seminars and workshops from 1989 to 1992 by the Central Pollution Control Board the best uses of the Indian coast line have been designated as the following classes and the same classification of the sea coast and its water are shown in the map.



Designated Best Use Classes

(Source : CPCB, 1996)

HABITAT AND PLANT COMMUNITIES OF THE INDIAN COAST

Apart from the early floristic informations before 1950s, Hooker, J. D. (1875); Schimper, A.F.W. (1891); Prain, D. (1903); Blatter, E. (1905); Cooke, T. (1908); Gamble, J.S. (1920); Haines, H. (1925); Kurze, S. (1877) and (1870); Erlanson, E.W. (1936), Venkateshwaralu, W. (1944) and others, very few studies have been conducted on coastal plant communities in India, indicating the flora, ecology and vegetation of Indian coast. Though occurrence of strand plants and mangroves have been mentioned in various publications by the above workers but comprehensive flora on the entire coast land with topographic, geomorphic, edaphic and the ecological accounts on the vegetation of dry strand and wetland habitats of Indian coast have not been attempted. Schimper's work on the littoral flora of Indo-Malayan coast is mostly based on the observation of Malayan archipelago and on the findings of Kurze's studies on the shore plants of Andaman and Myanmar. Since 1950, some work has been carried out frequently on the vegetation and flora of Indian coast by the scientists of Ecology Unit, Botanical Survey of India and of other institutes such as, Arora, R.K. and K.R. Aggarwal (1960); Bharucha, F.R. (1950); Mooney, H.F. (1950); Navalkar, B.S. (1951); Lawrence, C.A. (1960); Nayar, M.P. (1959); Jain, S.K. (1968); Satyanarayana, Y. (1958); Shah, G.L. (1962); Sidhu, S.S. (1963); Sundarraj, D.D. and M. Nagrajan (1964); Thomas, K.J. (1962); Vartak, V.D. (1968); Rao, T.A. and A.K. Mukherjee (1972); and (1967); Rao, T.A., A.K. Mukherjee and L. K. Banerjee (1970); Rao, T.A. and A.R.K. Sastry (1972); Rao, T.A. and K.R. Aggarwal (1966) and Rao, T.A. and A.R.K. Sastry (1971); Rao, T.A. and A.K. Mukherjee (1963), (1964) and (1966), Rao, T.A. and P.G. Shanware (1967); More recently, Rao, T.A. (1971); Balakrishnan, N.P. (1989); Thothathri, K. (1962); Blasco, F. (1977); Chapman, V.J. (1977), Rao, T.A. and V.M. Meher-Homji (1985); Mukherjee, B.B. and J. Mukherjee (1978); Naskar, K.R. and D.N. Guha Bakshi (1983); Banerjee, L.K., A.R.K. Sastry and M.P. Nayar (1989); Banerjee, L.K. (1990); Mitra,

R.L. and L.K. Banerjee (1979); Rao, T.A. and L.K. Banerjee (1982); Banerjee, L.K. (1987 a, b); Banerjee, L.K. (1992) and (1993).

In all the studies, flora and vegetation of some regions of Indian coast are highlighted in different publications. Recently Rao, T.A. and V.M. Meher-Homji (1993) have published "Dry Coastal Ecosystem of the Indian sub-continent and islands", where they have elaborated only the strand and beach plant communities of Indian coast but a complete, consolidated account of the flora and vegetation of Indian coast would be an essential pre-requisite for a indepth knowledge of coastal ecosystem. The aim in this study is to provide a detailed knowledge of the present plant resources of coastal ecosystem with some projections for the future of the coastal zones which are under increasing pressure from expanding human population. To fill up the gap, an attempt is made in this study to publish a comprehensive work on Diversity of coastal Plant communities in India based on the survey of unexplored and under-explored areas of the coast line and on previous survey works accumulated in the Ecology Unit, Botanical Survey of India.

METHODS

Field tours were conducted by various scientists from BSI and about 4000 specimens are being housed in the Ecology Herbarium.

For quantitative studies, quadrats of 50 m by 50 m were established in different habitats, ten to fifteen quadrats constituting a stand. All trees, shrubs and herbs in each quadrat were listed by counts. Density, frequency, dominance, percentage cover of strand vegetation were calculated on the Kathiawar, Konkan, Malabar coast and Utkal coast and many others in West coast. Along the wet coastal habitat or in mangrove habitat, frequency, density, basal area cover, relative frequency, relative abundance and Importance Value Index (IVI) of the plant species were established by

line transect methods and the calculated values of F.D., R.F., R.D., R.A. and IVI for the Mahanadi wet coastal habitat are presented here.

OUTLINE OF THE PLANT ZONATION AND CLASSIFICATION OF COASTAL PLANT COMMUNITIES IN INDIA

The coastal region which comprises diverse ecosystems present very interesting aspects for ecological, physiological and phytogeographical studies. Only certain physiologically specialised and ecologically adapted plants which have evolved remarkable adaptations to survive in the saltwater conditions grow in this sensitive ecosystem.

The merit of classification of the coastal flora in India needs special attention. This unique soil-vegetation complex is classified in detail within the frame-work of Champion and Seth's (1968) classification into types and sub-types corresponding to the underlying substratum followed by respective plant groupings as indicators of a particular zone. The classification is proposed here to demonstrate the different ecofloristic zones. Although with much overlapping, it is preliminary, in particular as regards to the delimitations, but it may nevertheless serve its purpose.

The 7,500 km long coast line in India is subjected to the wave actions of the Bay of Bengal, the Arabian Sea and the Indian ocean on the east and the west coast and at the southern most end respectively. The west coast line is long and more or less straight, from Cape Comorin in the south to the 20°N and extends into the states of Gujarat, Maharashtra, Karnataka (Mysore) and Kerala. The east coast runs in wide curves changing direction from north to north-east and extends in the states of Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. In general the seaboard is wider along the east coast than in the west coast. Between the coast line and the adjacent plains lie the two major on-shore ecosystems : Sandy and rocky strands in dry coastal ecosystems and estuaries, deltas, back waters and lagoons in wet coastal ecosystem.

The climate along the coast line is relatively uniform over extensive areas and it has been classified on the basis of moisture index into the following five climatic groups : Perhumid, Humid, Subhumid, Semiarid and Arid. It is arid in the Gujarat coast in the vicinity of Kuchchh, Okha-Dwarka and Jamnagar shores. Further down, along the Veraval and Bhavnagar it is semi-arid. South western shores stretching into Surat of south Gujarat is dry. Coastal belts of Maharashtra, Karnataka and Kerala fall under humid and sub-humid zone but Kozhikode and Trivandrum represent perhumid climate. In the east, the Bengal basin, chiefly the Sunderbans region falls under humid types of climate. The Coromandel and Circar coasts experience moist sub-humid type of climate, but the Utkal coast experiences humid climate.

Despite these regional climatic variation it is generally seen that the influence of the maritime climate on the upland part of the coastal biosphere is very much affected by the combined action of precipitation and local topography and the all pervading influence of the sea is felt only in the low lying areas of the coast. Effect of the land climate is not appreciable in the low lying areas of the coast. Here, they are chiefly influenced by tides, wave action, sea winds, saline water and nature of substratum.

Zonation of plant communities on the littoral regions is an universal phenomenon, but while some species have a very wide vertical range over the coastline others are very restricted in distribution. Some species, are remarkably constant in position related to tide level and salinity conditions while others occupy different levels according to the variation of the local conditions. Similar type of species colonization may change in different regions and similar type of species distribution may recur from shore to shore. Besides the variation of topography, substrate and environmental conditions, zonation of plant communities along the coast is intimately related to tide factor, and in the littoral region, supra tidal, mid tidal and infra tidal littoral species are distinguished everywhere whatever the structure of the littoral topography consisting of strand, rock, coral or wet alluvial lands. The moist littoral region, lying as a boundary layer between the main land and the inner

most edge of the sea shore can be divided into three distinct zones on the basis of tidal relationship as follows :

1. Supra Littoral Zone

It is the upper shore region where high water of spring tide invades at least the lower part of the zone and indicates the lower limit of terrestrial vascular plant zonation. It is the belt where coastal terrestrial plants dominate.

2. Mid Littoral Zone

This is the main tidal belt of the shore tending to be covered and uncovered everyday at least in part. It is indicated by the extent of coastal wetland species, mangroves, variety of algae and seagrasses.

3. Infra Littoral Zone

It is the lowest zone of the shore, covered by sea water, uncovered only at the major low tides and sometimes only in calm water. Variety of algae and seagrasses extend from the upper limit to the lowest level, ever visible between waves.

In case of rocky shore, the mid and infra littoral zones are found covered with variety of algae, corals and seagrasses.

Determining Environmental Factors for Plant Zonation

Ecological factors responsible for determining zonation patterns of plant communities on the coastal belt along the supra tidal and mid tidal zones of the littoral regions are many, such as, wave action, wind forces, sunlight, topographic and edaphic diversities, climate and biotic factors.

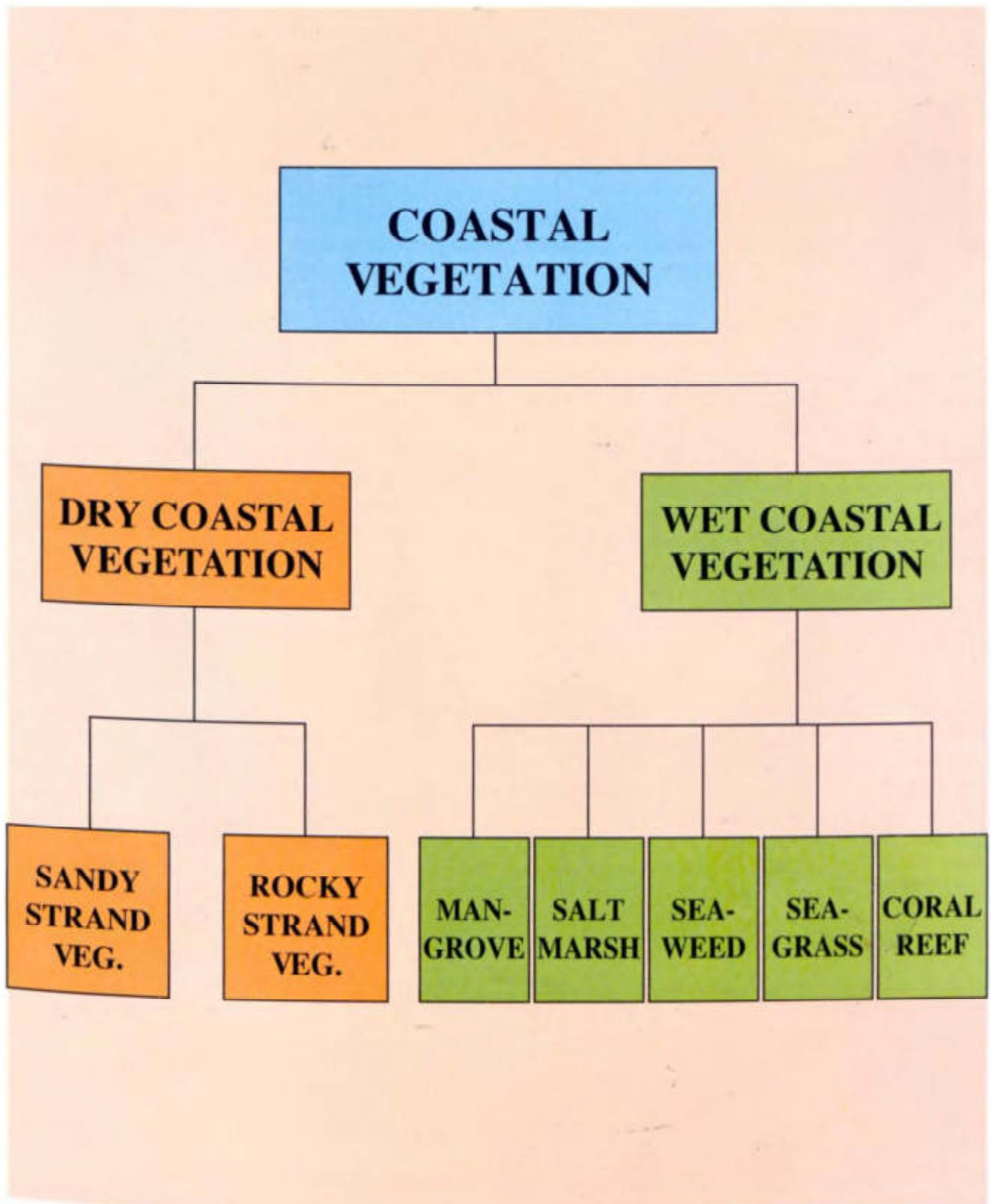
Different heights to which waves can wash and spray are usually responsible for modifying the extent of plant zonation and distribution of different plant species from shore to shore. Influence of sunlight and wind are also found to modify plant zonation patterns and colonization of different plant species from shade and calm weather condition. Thus, the lee side of sand dunes or cliffs with less sunlight and wind forces, represent different types of plant associations and different plant zonations from the front side of the dunes

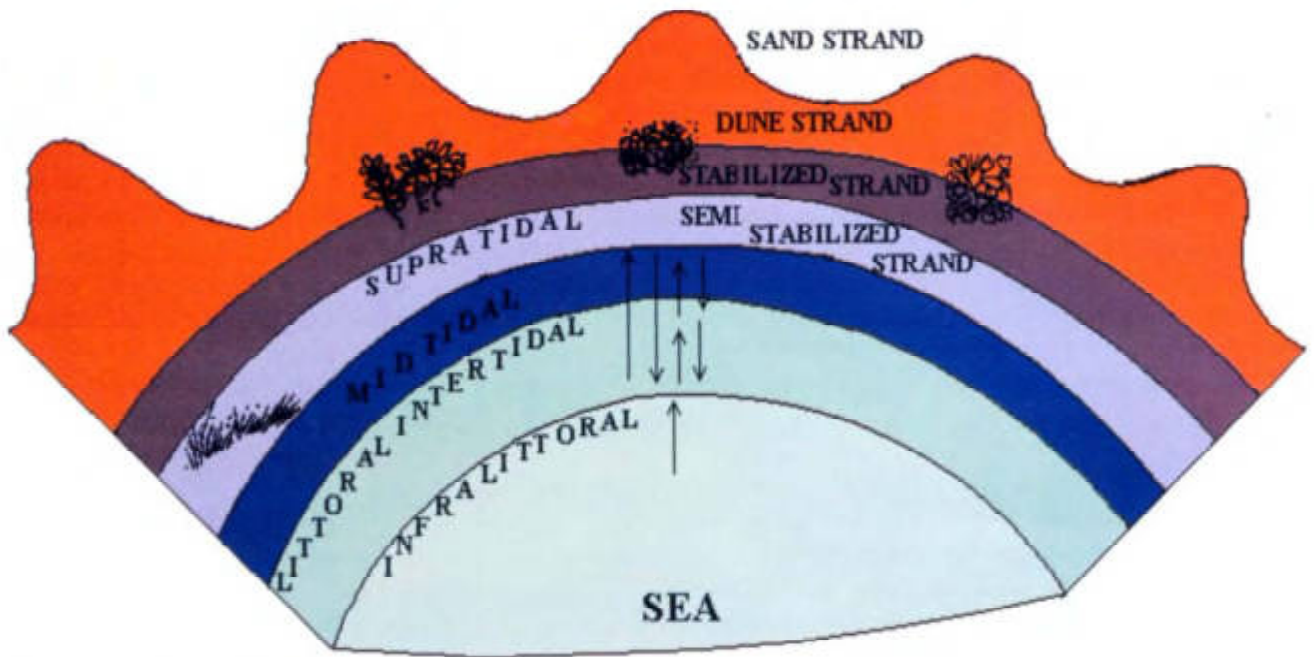
or cliffs. Forceful wind, topography and substratum conditions vary from shore to shore and play most essential factors for determining the plant zonation pattern, distribution and extent of different species. The undulating low land topography with muddy or silty substratum of the coast line may retain more water of the receding tide for longer periods, than the elevated sandy beaches, cliffs and steep slopes. These two structurally different topographic formations with the effect of different tidal flow, create two distinct coastal habitat, where zonation and distribution of plant species are completely separate, depending upon the impact of local environmental conditions.

The substratum varies from shore to shore, it may be dominated with limestones, shales, sands and smooth-laminated granite which have less water holding capacity than the muddy, clayey and silty substratum. According to these differences in soil structure, zonation, association and distribution of plant species are found different. Though climatic factors do not show any striking contrast between the East and West coast, some local micro-climatic variations on temperature, rainfall and humidity may influence the zonation and distribution of plant species from one shore to other. Changes in water salinity due to intermixing of fresh water alongwith the salt water in the estuarine regions also cause great deal in influencing the changing pattern of plant zonation and distribution.

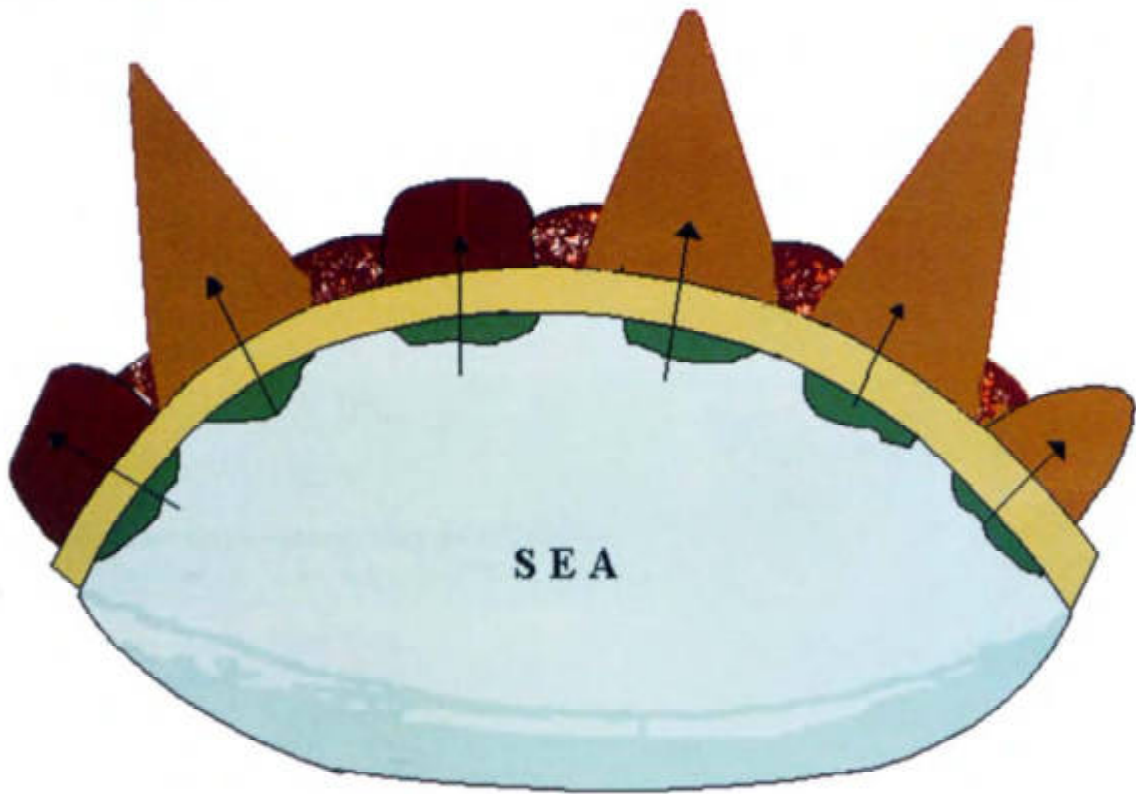
Biotic factors of different types are the most burning problems for changing the plant zonation pattern and species distribution. All technological developments, construction activities, tourist developments and indiscriminate use and utilization of rocky and sandy shores are responsible for changes and degradation of plant zonation and species distribution.

It is observed that recognition of coastal plant communities into different zonal patterns for an easy classification of coastal vegetation depending upon the various impact of the above factors is very difficult. On the other hand, the impact of a single, broad base environmental factor such as receding tide over the coastal topography may play an important criteria for dividing the coastal habitat and its plant communities into two major and distinct zonal types such as, a zone





Dry Coastal Sand Strand



- SPEET
- CLIFF
- SEAGRASS, ALGAE

Dry Coastal Rocky Strand

of dry coastal plant communities and a zone of wet coastal plant communities. Along the low, undulating topographic relief near estuaries, deltas and backwaters, rate of receding tide becomes slow and the muddy substratum remains super saturated with water, keeping the conditions wet. On the contrary, along the high elevated sand beaches, steep slopes of cliffs and spits, rate of receding tide becomes very quick and the sandy or rocky substratum remain unsaturated with water, making the conditions dry.

The wet coastal habitat with low undulating topography, consisting of silty or muddy relief is mostly found in the sheltered areas where the coast line is interrupted by the rivers to form deltas, estuarine lagoons and backwaters, the flowering plants concentrate mainly on supra littoral and mid littoral regions. But along the dry coastal habitat where high steep and slopped topography consists of sandy or rocky relief on open uninterrupted shore condition of the coast line, the flowering plants concentrate along the supra littoral regions. The infra littoral regions are mostly covered by algae and sometimes seagrasses.

CLASSIFICATION OF COASTAL PLANT COMMUNITIES

Zonation of coastal plant communities are found different in structure, function and composition along the dry and wet coastal habitat conditions and has been divided into two distinct types named as : Dry coastal plant communities and Wet coastal plant communities.

DRY COASTAL PLANT COMMUNITY

According to the impact of various maritime environmental factors such as, topography, edaphic and tidal action, the dry coastal plant communities from the mean high tide level to the end of sandy or rocky relief can be subdivided into main two types that are sandy strand and rocky strand.

Sandy strand is again divided into 4 subtypes such as :

1. Pioneer semi stabilised strand,
2. Stabilised strand,

3. Dune strand and
4. Coastal woodlands, scrubs and palm groves.

The rocky shore lines are free from sands but contain limestones or shell reefs of considerable width and their pot holes and crannies, harbour some calcium loving plants.

VEGETATION OF SANDY STRANDS

1. Pioneer Semistabilised strand type

This is the pioneer vegetation zone on supra littoral region of unstabilised or semistabilised sandy or rocky sea beaches where the dynamic action of sea waves, salt spray and wind force remain so active that no plant can grow except very few species with the development of some special adaptive features for withstanding this hostile environment. Some common and restricted plant species like *Cyperus arenarius*, *Sesuvium portulacastrum*, *Hemithria compressus*, *Cyperus pedunculatus*, *Launaea sarmentosa* with their thick, fleshy leaves, long runner and extensive nodal root system, are found to withstand this open coast environmental conditions and function as sand accumulator in this pioneer zone for bringing the coast towards the stability. Along the rocky coast this pioneer zone is found to be covered, mainly with *Artiplex stocksii*, *Polycarpea spicata*, *Fagonia indica* which can tolerate the wind and wave action with their thick leaves and runner system. However, the above plant association on rocky strand is only located along the West coast. In the East coast, this rocky zone is covered with algal communities.

2. Stabilised strand type

This zone is located little away from the former unstabilised sandy beaches and is found more or less in stable condition of sandy beaches where except for very occasional high tide, the areas remain free from the frequent impact of sea waves. Vegetation in this zone mainly consist of closed herbaceous creepers forming mat on the sandy strand. In case of rocky strand this zone is associated with different plant species and are found only on the thin mantle of deposited sands or debris in the crevices.

Dominant plant species along the sandy strand of East and West coast are : *Hydrophylax maritima*, *Ipomea pes-caprae*, *Canavalia maritima*, *Launaea sarmentosa*, *Psilostachys sericea*, *Euphorbia rosea*, *Geniosporum tenuiflorum*, *Perotis indica*, *Trachys muricata*, *Sporobolus virginicus*, *Zoysia matrella*, *Cassytha filiformis*, *Borreria articularis*, *Asparagus domosus*, *Peplidium maritimum*, *Halopyrum mucronatum*, *Enicostema hyssopifolium* and others. Distributional resume of the above plant species are responsible for different ecological conditions of the Indian coast and it will be described in a separate chapter of this text. However, the functional activities of all the species show peculiar adaptation on sand binding, baby dune formation and protecting upliftment of sands during storm. They are capable of withstanding high wind force due to mat formation and nodal root system in their habitat and also capable of withstanding salt spray because of their thick, cuticular leaves. Dominant plant species in the case of rocky strand along the East and West coast are : *Indoneesiella echioides*, *Kickxia ramossissima*, *Lindenbergia muraria*, *Portulaca pillosa*, *Portulaca quadrifida*, *Pulicaria angustifolia*, *Limonium stocksii*, *Pavonia zeylanica*, *Blepharis* sp., *Euphorbia thymifolia*, *Vernonia cinerea*, *Indigofera aspalathoides*, *Indigofera cordifolia*, and others with the main functional activities of accumulating debris and sands on the pot holes.

3. Dune Strand type

Stabilised sand strand follows immediately the dune strand of various size and shape. Various types of large dunes are commonly found along the East coast while some sand bars and small dunes are frequently found along with pocket beach formation on the West coast. Zonation of plant species on the sea face side and lee side of the dunes depend on the variation of impact of salt spray, wind forces and sunlight conditions.

Some beautiful sand binders with long horizontal runners and fleshy nodal roots are common along the lower slopes of the sand dunes for protecting the wind blown sands. Middle and upper layers of the dunes are found to be covered with bushy herbs and shrubs which

also function to check the wind blown sands. Lee side of the dune shows different picture of plant zonation and most of the associated species are similar to that of the inland formation. Common plant species associated along the lower, middle and upper parts of the dunes are: *Hydrophylax maritima*, *Spinifex littoreus*, *Launaea sarmentosa*, *Rothia trifoliata*, *Portulaca tuberosa*, *Zornia diphylla*, *Tephrosia purpuria*, *Crotalaria striata*, *Oldenlandia umbellata*, *O. stricta*, *Indigofera trifoliata*, *Borreria articularis*, *Synostemon bacciforme*, *Trianthema triquetra*, *Phyllanthus madraspatensis*, *Perotis indica*, *Bulbostylis barbata*, *Fimbristylis falcata*, *Fimbristylis diphylla*, *Aristolochia bracteolata*, *Sida cordifolia*, *Calotropis gigantea*, *Opuntia dillenii*, *Tylophora indica*, *Allmania nodiflora* var. *procumbens*, *Mollugo disticha*, *Gisekia pharnaceoides*, *Waltheria indica*, *Cleome aspera*, *Catharanthus roseus*, *Datura metel*, *Turnera ulmifolia*, *Jatropha gossypifolia* and others. The dominant species associated on sand bars and small dunes along the pocket beaches of Western coast are: *Ipomea pes-caprae*, *Launaea sarmentosa*, *Corchorus aestuans*, *Sporobolus coromandelicus*, *Psilostachyum sericeum*, *Cynodon dactylon*, *Dactyloctenium aegyptium*, *Crotalaria retusa*, *Calotropis gigantea*, *Physalis minima*, *Zoysia matrella*, *Pandanus tectorius*, *Vitex trifoliata*, *Pedaliium murex*, *Murdannia nudiflora*, *Cyanotis cristata*, *Scilla hyacinthina*, *Borreria stricta*, *Fimbristylis dichotoma*, *Amaranthus* sp., *Sida cordifolia*, *Scaevola taccada*, *Wedelia biflora*, *Tylophora indica*, *Canavalia maritima*, *Stachytarpheta urticaefolia*, *Zornia diphylla*, *Memecylon umbellatum* and others.

4. Coastal Woodland type/Palm type

This is the last part of the coastal plant zonation where the flora have less impact on maritime environment and merge gradually with the inland formation. Here plant species which extend from the sea shore towards the inland regions even sometimes up to an altitude of 200 m show preference of best development and growth in the coastal habitat under the maritime ecological conditions than the inland areas. Common species and palms in this sandy and rocky strands are :

Calophyllum inophyllum, *Acacia planiformis*, *Alangium salviolium*, *Ardisia solanacea*, *Anacardium occidentale*, *Allophylus cobbe*, *Atalantia monophylla*, *Borassus flabellifer*, *Capparis brevispina*, *Calotropis gigantea*, *Casuarina equisetifolia*, *Cerbera manghas*, *Cocos nucifera*, *Colubrina asiatica*, *Commiphora wightii*, *Cordia subcordata*, *Erythrina variegata*, *Euphorbia cordifolia*, *Euphorbia nivulia*, *Ficus benghalensis*, *Grewia tenax*, *Guettarda speciosa*, *Maytenus emarginata*, *Hernandia peltata*, *Hyphaene dichotoma*, *Ixora coccinea*, *Diospyros buxifolia*, *Memecylon umbellatum*, *Memecylon angustifolium*, *Argusia argentia*, *Pemphis acidula*, *Prosopis cineraria*, *Premna serratifolia*, *Pongamia pinnata*, *Samadera indica*, *Salvadora persica*, *Scaevola taccada*, *Scutia myrtina*, *Streblus asper*, *Thespesia populnea*, *Suriana maritima*, *Syzygium ruscifolium*, *Vitex trifolia*, *Ziziphus oenoplia* and others.

VEGETATION OF ROCKY STRAND

Mostly along the West coast starting from the south eastern Kathiawar to Trivandum including Gujarat, Konkan and Malabar coastal regions show extensive formation of rocky cliffs and ghats of various sizes and shape. Due to eroded nature of this coastal belt, in some areas, the existence of shore line and coastal belts are represented by the inland cliffs, barriers and spits. Except some pocket beaches, long extensive sandy beach and dune formation along the coast line like that in the Eastern coast are absent.

Studies on rocky dry strands along the coastal region of Kuchchh, Saurashtra, Konkan and Malabar areas reveal that the plant zonation on rocky strands can be divided into following 4 types according to the impact of maritime environment :

A. Constant wave cut rocky strand

This is the pioneer zone of rocky strand usually covered with some specially adapted species which are capable of tolerating salinity, high wave action and wind force. Common species found dominating in this zone are : *Polycarpaea spicata*, *Artriplex stocksii*, *Fagonia indica*, *Limonium stocksii*, *Thuarea involuta*, *Polygala erioptera* and others. Along the East coast, this rocky

strand in Cape Camorin and other parts are full of algal community. Growth of *Enzita superba* in Ratnagiri coastal cliff is of interest in this zone.

B. Occasional wave cut rocky strand

This is the second vegetation zone of the rocky strand where frequent sea waves during the very high tide wash the undulating rocky surfaces.

Here vegetation cover is more dominant where the crevices are covered with thin mantle of sands, lime stones and debris. Common species harboured in this zone are : *Indoneesiella echioides*, *Enicostema hyssopifolium*, *Kickxia ramosissima*, *Lindenbergia muraria*, *Portulaca quadrifida*, *Pulicaria angustifolia*, *Pemphis acidula*, *Pavonia procumbens*, *Sporobolus diander*, *Helichrysum cutchicum*, *Limonium stocksii* and others.

C. Rocky slopes above the wave action

This zone lies in between the constant wave cut region and woodland zone of the rocky strand specially situated in the middle part of the rocky slopes, cliffs and undulated rocky flats where impact of regular sea wave is not functional except the wind blown salt spray and very occasional high tide condition. Common species usually harboured in this zone is a mixture of salt tolerant coastal weeds and some inland woody species growing under the maritime influences. Some of the dominant species in this zone are :

Aerva lanata, *Tephrosia purpurea*, *Helichrysum cutchicum*, *Burleria prionitis*, *Sericostoma pauciflorum*, *Calotropis procera*, *Jatropha gossypifolia*, *Syzygium ruscifolium*, *Indoneesiella echioides*, *Toddalia asiatica*, *Capparis brevispina*, *Capparis decidua*, *Ardisia solanacea*, *Atalantia monophylla*, *Calophyllum inophyllum*, *Caesalpinia crista*, *Colubrina asiatica*, *Pisonia aculeata*, *Thespesia populnea*, *Strychnos nuxvomica*, *Anacardium occidentale*, *Ixora arborea*, *Vitex trifolia*, *Salvadora persica*, *Pandanus tectorius*, *Premna serratifolia*, *Argusia argentia*, *Psilotrichum sericeum* and many others. *Hyphaene dichotoma* and *Acacia planiformis* are found where more sands are accumulated on the rocky crevices.

D. Rocky woodland strand or Coastal rocky woodland

This formation is very interesting along the West coast where due to constant erosion, most of the coastal areas do not show distinction between the shore and back shore topography. In some regions, formation of pocket beaches are the only criteria for demarcating the shore and back shore topography, moreover, formation of many cliffs and ghats along this coast line indicates the appearance of inland flora to the coast line without the presence of shore feature. Vegetation in this type also shows that major components which could have come only from the interior woodland. Under this category, some plants extending from the sea towards the interior show varied tolerance capacity of the regular sea wave flash. Sometimes, the same plant species may attain an altitude of 200 m. A few of them have their niche breached more frequently under the maritime influence than in the inland areas. Tropical evergreen formation is remarkably concentrated along these areas extending from Goa, Konkan and Malabar coastal regions under the maritime influence. Certain common interesting woodland plants are : *Indonesiella echioides*, *Calotropis gigantea*, *Cassytha filiformis*, *Euphorbia nivulia*, *Justicia adhatoda*, *Cordia dichotoma*, *Erythrina suberosa*, *Ixora arborea*, *Morinda citrifolia*, *Symplocos cochinchinensis*, *Carallia brachiata*, *Medinilla malabarica*, *Hopea odorata*, *Strychnos nuxvomica*, *Vateria indica*, *Dipterocarpus alatus*, *Poeciloneuron indicum*, *Calophyllum inophyllum*, *Palaquium ellipticum*, *Myristica malabarica*, *Aporosa villosa*, *Schleichera oleosa*, *Terminalia paniculata*, *Mangifera indica*, *Vitex negundo*, *Syzygium samarengense*, *Artocarpus peduncularis*. Along the lower canopy *Holigarna longifolia*, *Dillenia pentagyna*, *Scolopia crenata*, *Alstonia scholaris*, *Diospyros ebenum*, *Hopea utilis* are common formation in the coastal secondary evergreen type. Along the coastal shrubs in and around plain land *Strychnos nuxvomica*, *Careya arborea*, *Carallia brachtata*, *Acacia chundra*, *Acacia sinuata*, *Ancardium occidentale*, *Randia dumatorum*, *Ixora coccinea*, etc. are common.

PLANT COMMUNITIES OF THE COASTAL STATES

Ecological investigation on the statewide Dry and Wet coastal plant communities based on the present and the past survey from the Ecology unit, BSI are as follows :

GUJARAT COAST

It extends along the peninsulas of Kuchchh and Saurashtra and includes a portion of areas south of Khambhat, up to the borders of Konkan coast. This coast is divisible under three sub types: Kuchchh, Saurashtra and Southern Gujarat.

A. Kuchchh coast

The coastal area of Kuchchh is surrounded on the south by the Gulf of Kuchchh and on the west by the Arabian sea. The coast gently rises and is fringed with mangrove swamps. In some areas it rises in rows of sandy hills or beaches or as in the north west, in broken rocky cliffs. The sandy strand is intercepted here and there by muddy coast and sometimes by rocky strand. The few publications on the flora of Kuchchh are from Blatter (1908) and others. The strand flora is similar to that of Sind (Pakistan). Further the reported occurrence of such plants like *Astragalus prolixus*, *Heliotropium renifolium*, *Spinifex littoreus*, *Scaevola taccada*, *Pegonum harmala*, *Tamarix articulata*, is of distributional interest because these plants are not recorded to occur in the adjacent peninsular coast of Saurashtra.

B. Saurashtra coast

The coast line is bounded by the Arabian sea in the south and southwest, by the Gulf of Kuchchh in the northwest and by the Gulf of Khambhat and mainland in the east. The coastal area can be divided into three sub types: The coast line from the mouth of the Gulf of Kuchchh to Okhamandal, the coast line of Okhamandal to Diu and the coastline of Diu to Gopnath, continued up to Amli. These have been studied from an ecological point of view since 1960 (Rao *et al.*, 1963a, b;



Backshore vegetation consisting of *Ipomoea pes-caprae*, *Pandanus* sp. and others in Goa

Spinifex littoreus, protecting the uplifting of sands from mature dunes



Collection of Coastal Plant specimens from a dangerous Sea facing Cliff at Ratnagiri



Pure Community of *Hydrophylax maritima*, a pioneer sand binder covering the Sand Dunes





Vegetation of Rocky Coast in Andaman

Coastal Desert Vegetation in Gujarat



Wet Coastal Mangrove Vegetation,
Sundarbans, West Bengal

Coastal Woodland Vegetation, mainly covered with Palms



1964, 1965, 1966, 1967, 1969, 1970). The coast line bordering the Gulf of Kuchchh and Khambat are muddy with limited strand conditions whereas the coast lines from Okhamandal to Diu and also from Diu to Gopnath are fringed with wind blown sand humps often intercepted by rocky cliffs. Rock strand and sand strand are frequently seen along this coast line. The recent ecological studies along this area have revealed that the north-western part of Saurashtra coast, more or less corresponding to that of arid zone is botanically similar to that of Kuchchh strand flora and the south eastern area bordering the Gulf of Khambat is corresponding to the semi arid zone to the Konkan coast. The western or Persio-Arabian elements like *Asparagus dumosus*, *Capparis brevispina*, *Helichrysum cutchicum*, *Sericostema pauciflorum*, *Limonium stocksii*, *Lotus garcinii* and *Euphorbia nivulia* are well represented in the arid coastal area. However, their frequency diminishes towards the south-eastern areas due to semi arid condition where the flora is represented by Indio-Malaysian and Polynesian coastal elements like *Ipomoea pes-caprae*, *Sesuvium portulacastrum*, *Hydrophyllax maritima*, *Borreria articularis*, *Psilostrichum sericeum*, *Launaea sarmentosa*, *Canavalia maritima* and *Hyphaena dichotoma*.

C. Southern Gujarat coast

The coast line south of Narmada up to Daman is marshy, intercepted infrequently by sandy shores of limited stretches. The recorded sand strand flora mostly correspond to the Indo-Malayan elements. The noteworthy features of strand plants are the northern limit of *Spinifex littoreus* at Daman, occurrence of *Zoysia matrella* at Daman, *Perotis indica* at Daman and the absence of *Calophyllum inophyllum* along the Gujarat coast lines. Recently the occurrence of *Spinifex littoreus* in Dholkia creek has been reported. The frequent occurrence of *Hyphaena dichotoma* in the Diu Kodinar sector of Saurashtra coast is reported along the Daman coast.

KONKAN COAST (Maharashtra State)

The coast extends from north of Goa to Daman, a distance of 500 km, and is more or less cliffy,

occasionally intercepted by sandy beaches of limited length over littoral concrete. The northern part under riverine and tidal influence becomes muddy. Otherwise the coast is of jutting headlands and often covered with a thick mantle of sand.

The information on the strand flora is inadequate and scanty. But a few publications pertaining to this area are from Bhauucha (1950), Satyanarayan (1958), Shah (1962), Navalkar (1951), Burns (1910), Cooke (1908), Blatter (1905) and Rao T.A. (2000).

The development of rich strand flora in the form of strand forest is not seen anywhere along the coast due to the paucity of extensive strand conditions. Along the sea shores of the areas, south of Daman including Mumbai and Salsette island there are innumerable marshy areas fringed with mangroves and only in raised grounds with less salinity there are saline pastures chiefly represented by *Aeluropus lagopoides*, *Paspalum distichum*, *Digitaria ciliaris*, *Sporobolus virginicus* and *Fimbristylis dichotoma*. The newly recorded occurrence *Psilostrichum sericeum* on Juhu sands near Mumbai is of interest (Shah 1962). *Cyperus rotundus*, a strand creeper has been reported at Marmagaon (Yartak, 1968) and its spread north of Goa is very much limited and not so extensive as in the coastal Karnataka and Kerala.

KARNATAKA COAST (Karnataka State)

The Karnataka coast extends about 225 km and is comparatively wider in the south than in the North and ranges from 8 km to 24 km. The coast line is sandy and rocky. The few publications which are helpful in building up the strand flora are of Arora *et al.* (1965), Cooke (1908) and Rao, T.A. (2000).

The noteworthy strand plants of this area are *Scaevola taccada*, *S. plumieri*, *Cyperus rotundus*, *Crotalaria nana*, *Euphorbia atoto*, *Indigofera aspalathoides* and *I. uniflora*. Their frequency of occurrence is more in this coast than in the Konkan coast. *Ipomoea tuba*, is of extensive occurrence along the coast (Rao *et al.*, 1964). The other plants of interest reported with precise locality are of *Aerostichum aureum*, a salt tolerant fern and *Flagellaria indica* on rock strand.

MALABAR COAST (Kerala State)

The Malabar or Kerala coast extend from the north of Kasargod to Travancore district in the south. The coast extends about 500 km with an average width of only 25 km and ranging from 10 to 30 m in elevation. This area bounds in lakes and back water systems, most of which are connected to the sea. Some of the recorded floristic accounts on this coastal area are from Hooker *et al.* (1875-1897), Gamble (1915), Erlanson (1936), Mudaliar *et al.* (1952) and Thomas (1962).

The interesting feature of the strand flora is the occurrence of *Parsonia alboflavescens*, *Wedelia biflora*, *Canavalia maritima*, and *Barringtonia racemosa* in areas ranging from 10 to 30 m in elevation, under the coastal influence. Another noteworthy plant is *Scaevola taccada*, a coral sand indicator widely represented in near by coral islands. The rare plants which are common to this coast and that of Karnataka are *Cyperus rotundus*, *Flagellaria indica*, *Calophyllum decipens* and *Acrostichum aureum* (Rao *et al.*, 1973). A fairly wide spread plant *Euphorbia rosea* of this coast has not been recorded from Karnataka coast. Similarly the strand climber *Mucuna gigantea* which occurs here is not reported in the Karnataka coastal area.

EAST COAST

The physiographic area of east coast is divisible into four distinct parts from north to south: Bengal, Utkal, Andhra and Tamil Nadu coasts corresponding to respective states.

A. Bengal coast (West Bengal State)

The West Bengal coast is divisible into two parts: Midnapur coast and the Gangetic Sundarbans with the river Hooghly forming numerous creeks and channels between them. The Sundarbans is the largest deltaic tidal swamp of the world, out of which 4,200 sq. km are in 24-Parganas where the sandy areas are limited and a few are along the sea face.

The contribution towards this coastal flora is that of Prain (1903) and Rao *et al.* (1970). Only along the limited sea face consistent dry coastal vegetation is seen.

The coastal strand flora and some other characteristic flora of Utkal coast are also present in this area. The new addition to strand flora in this region is the occurrence of *Aeluropus lagopoides* on saline strand bordering the eastern bank of the river Hooghly, at Sagar island and Junpul (Rao *et al.*, 1965).

The sandy coastal strip from Hiji towards south, to the mouth of Suvarnarekha river, forms a part of the Midnapur coast, in West Bengal. The sand strand is composed of *Spinifex littoreus*, *Launaea sarmentosa*, *Cyperus arenarius*, *Borreria articularis*, *Polycarpaea corymbosa*, *Polygala erioptera*, *Ipomoea pes-caprae*, *Sida cordifolia* and *Jatropha gossypifolia*, and many local plants are found growing towards the landward fringe of the backshore. This floristic composition is similar to that of the adjacent Utkal coast except for the absence of three widely spread Utkal strand plants: *Euphorbia rosea*, *Geniosporum tenuiflorum* and *Hydrophyllax maritima*. In this area the other newly recorded plants of strand dune habitat of Utkal coast are also recorded, *Cyperus arenarius*, *Portulaca pillosa*, *Scyzgium ruscifolium* (Mukherjee and Banerjee, 1968), *Gisekia pharnaceoides*, *Rothia indica*, *Trianthema triquetra* and *Spinifex littoreus* (Rao *et al.*, 1966, 1967).

B. Utkal coast (Orissa State)

The coast covers an area situated from a little north of Suvarnarekha river to a little south of the Rushikulya river including the Mahanadi delta and the coastal lagoon Chilka. The coast line is straightly curved; conforms more or less to Orissa State boundary, about 400 km in length and lined with many sand dunes formed due to strong wave and wind action. The strand flora is very conspicuous and sometimes strand forests are also observed at certain places. This has been accounted in the study on the flora of the Mahanadi delta (Banerjee, L.K. and Rao, T.A., 2000) and also published accounts recorded pertaining to Orissa flora Rao *et al.* (1970, and 1972); Haines (1921); Mooney (1950); Sanyal (1957); Saxena and Brahmam (1996).

The interesting components of strand flora are *Spinifex littoreus*, *Euphorbia rosea*, *Phyllanthus rotundifolius*, *Fimbristylis fatcata*, *Geniosporum*

tenuiflorum and *Hydrophylax maritima*. The newly reported *Aeluropus lagopoides* from several stations of Bengal coast is yet to be located in Utkal coast, *Enicostema hyssopifolia* is a very common plant all along the Indian coast except in Orissa and West Bengal. The other plants recorded from this coast are *Merope angulata*, *Myriostachya wightiana*, *Ipomoea tuba*, *Canavalia cathartica* and others.

C. Andhra coast (Andhra Pradesh)

The Andhra coast extends from the southern limit of the Utkal plains to the Pulicat lake and conforms more or less to Andhra Pradesh State boundary. It includes the Krishna and Godavari delta. The coast line conforms to rocky and sandy types. The few publications from this region are from Gamble (1915-36), Venkateshwaralu (1944), Venkateshwaralu *et al.* (1972), Rao (1957) and Rao *et al.* (1970, 1971, 1972), Banerjee (1998).

The interesting report is the occurrence of *Psilotrichum sericeum* at Nellore sea sands (Gamble, l.c.). This handsome herb is reported in Saurashtra coast (Rao *et al.*) and Mumbai coast near Juhu. It appears to be very much restricted in distribution and does not seem to have spread widely along similar situations. The other plants of interest are *Aeluropus lagopoides*, *Indigofera aspalathodes*, *Ipomoea tuba*, *Trianthema triquetra*, *Trachys muricata*, *Dimorphocalyx lawianus* and *Myriostachya wightiana*.

D. Tamil Nadu coast

The Tamil Nadu coast extends from the southern limit of Pulicat Lake to point Calimere and conforms to Tamil Nadu state boundary stretching about 675 km with an average width of 100 km and includes the Cauvery delta with marshy lands in the southern parts. The published papers on this coast are a few and mostly give a general picture of the vegetation (Gamble, 1915-

1932; Merlange and Meherhomji, 1965; Nayar, 1959, Lawrence, 1960; Rao *et al.*, 1973; Daniel, 1967). The noteworthy strand plants of this area are *Scaevola plumieri*, *Arenaria neelgherrensis*, *Heterostemma tanjorensis*, *Sesamum prostratum* and *Nesaea lanceolata*. *Pemphis acidula*, a coral stone indicator is reported in the southern rocky areas of the coast. *Halophyrum mucronatum*, a widely spread coastal grass reported in Karnataka coast, Saurashtra coast and Krusadi group of islands, has been reported at the southern tips of the coast. *Sesamum prostratum* occurs on sandy shore at Adyar near Chennai. Recently *Myriostachya wightiana* has been reported at Vedharanyanam along this coast (Sebastine *et al.*, 1967).

The coast line bordering the southern strip from Point Calimere to Cape Comorin including that of a few leading islands of the Gulf of Mannar like Rameswaram, Krusadi, Shingle (Rao *et al.*, 1963a, 1964), Hare and Church (Srinivasan, 1960; Sunderraj *et al.*, 1964, 1966) exhibits strand flora which is akin to that of Ceylon coast. Pure strand scrub forests of *Pemphis acidula* is characteristic of all islands except Rameswaram. The chief components of strand flora are *Pemphis acidula*, *Suriana maritima*, *Thespesia populnea*, *Halopyrum mucronatum*, *Scaevola taccada*, *S. plumieri*, *Ipomoea pes-caprae* and *Spinifex littoreus*.

The reported occurrence of *Argusia argentea* on the shores of Krusadi island (Sunderraj *et al.*, 1962) is obviously a newly invaded strand pioneer from Ceylon. This invader is a potential forest builder and if left undisturbed this may regenerate to a great extent as to become a strand forest. Among the plants of interest are the occurrence of *Polycarpaea spicata*, reported to occur only in West coast along Saurashtra coast, Lakshadweep group of islands and also in small islands in the coast of Jaffna (Ceylon). Occurrence of *Suriana maritima* and *Cordia subcordata* of Ceylon strand flora is of interest.

WET COASTAL PLANT COMMUNITY

The Wet coastal plant community can be divided into two distinct zones such as on-shore, that is mid-littoral lowlying terrestrial zone and off-shore, that is infra-littoral marine zone. About 6,740 sq. km littoral areas of the Indian sub-continent are frequently interrupted by the formation of deltas, estuaries, back water flows, lagoons and oceanic islands, under the influence of tropical humid climate in the maritime environment. These on-shore low-lying areas under the influence of regular tidal inundation are the meeting line of sub-areal and marine inter-action with the dynamic processes of erosion and deposition. The continental river system and marine process become very dynamic in these places and show differences in the rate and intensity of erosion, deposition and wave action in different geomorphological formation. The rate of receding tide of the sea is very slow in these regions due to low topography and the substratum remains super saturated keeping the condition always wet. Plant communities along these on shore wetlands, from the river mouth to the limit of saline tide water flow towards the interior, are mainly dominated by Mangroves and Salt marshes. On the contrary, plant communities along the off-shore marine wetlands are mainly dominated by Algae, Seagrasses and Coral strand resident flora.

The wet coastal ecosystem within its off-shore and on-shore limit holds most valuable and potential plant communities which serve as basic resources for human life as well as for environmental protection. Plant communities in the wet coastal ecosystem are :

- (1) Phytoplankton
- (2) Mangroves
- (3) Salt marshes
- (4) Marine coral strand
- (5) Seagrasses
- (6) Seaweeds

1. PHYTOPLANKTONS IN THE INDIAN COAST

Phytoplanktons are the microscopic floating algae in the aquatic system. In the coastal region they

are very common along the On-Shore and Off-Shore wetland system. Though phytoplanktons are microscopic they are the main primary producer of food and energy on which a large scale animal diversity is completely dependent in the marine and coastal wetland eco-system. Phytoplanktonic study in coastal zone is no doubt a very critical task but some of our phytoplanktonic collection from different estuaries, off shore zones and lagoons in the Indian coast and collection of other workers (Horrell and Nayudu, 1924; Menon, 1945; Subrahmanyam, 1946; Chacko, 1950; I. Yengar and Venkataraman, 1951) can enumerate an over all phytoplanktonic picture in the coastal belt. Marine phytoplankton are mainly under the classes Bacillariophyceae and Chlorophyceae, but some are under Cyanophyceae and Dinophyceae especially in the coastal lagoons. These are commonly known as diatoms, desmids, blue greens and dinoflagellates respectively. Some common Phytoplankton genera and species along the marine and brackish water lagoons are as follows :

CYANOPHYCEAE :

Oscillatoria sp., *Phormidium* sp., *Spirulina* sp., *Lyngbya* sp., *Anabaena* sp., *Nostoc* sp., *Microcystis* sp.

CHLOROPHYCEAE and DINOPHYCEAE :

Spirogyra sp., *Oedogonium* sp., *Cosmarium* sp., *Closterium* sp., *Dinophyses* sp., *Peridinium* sp., *Scenedesmus* sp., *Ceratium* sp.

BACILLARIOPHYCEAE :

Stephanopyxis turris, *Coccolodiscus centralis*, *Rhizosolenia* sp., *Rhizosolenia styliformis*, *Rhizosolenia robusta*, *Rhizosolenia setigera*, *Rhizosolenia imbricata*, *Rhizosolenia alata*, *Rhizosolenia calcar-avis*, *Bacteriastrium hyalinum*, *Chaetoceros lorenzianus*, *Chaetoceros compressus*, *Chaetoceros penicillatus*, *Chaetoceros eibenhii*, *Chaetoceros affinis*, *Chaetoceros curvisetus*, *Ditylum* sp., *Biddulphia mobilensis*, *Biddulphia sinensis*, *Thalassiothrix longissima*, *Thalassiothrix frauenfeldii*, *Thalassiothrix nitzschiioides*, *Asterionella japonica*, *Cocconeis placentula*, *Bacillaria paradoxa*, *Nitzschid closterium*, *Nitzschia longissima*, *Nitzschia pungens* and many others.

Status of Phytoplankton of West coast

Nitzschia,
Thalassiothrix.

GUJARAT

Ram *et al.*, 1988 reported 78 species belonging to 28 genera from Porbandar important genera of which are *Nitzschia*, *Navicula*, *Thalassionima*, *Thalassiosira*, *Coscinodiscus*, *Collithophorides*, *Cyclotella*, and *Chaetocheros*.

Bedi Area

Coscinodiscus,
Chaetoceros.

Phytoplankton Genera along the Gujarat coast

(Source : Sen Gupta, R. *et al.*, 2000)

Pirotan Area

Thalassiothrix,
Nitzschia,
Gyrosigma,
Thalassionema,
Thalassiosira.

Mundra Area

Thalassiothrix,
Thalassionema,
Nitzschia,
Navicula,
Biddulphia,
Dinophysis.

Poshitra Area

Chaetoceros,
Coscinodiscus,
Biddulphia,
Nitzschia,
Navicula.

Mundra Kandla Area

Nitzschia,
Thalassiothrix,
Navicula,
Coscinodiscus.

Okha Area

Chaetoceros,
Coscinodiscus,
Nitzschia,
Rhizosolenia,
Biddulphia,
Peridinium,
Navicula,
Pleurosigma,
Thalassiosira,
Thalassionema,
Skeletonema.

Kandla Area

Nitzschia,
Chaetoceros,
Coscinodiscus.

Vadinar Area

Coscinodiscus,
Chaetoceros,
Rhizosolenia,
Planktonella,
Biddulphia.

Mithapur Area

Coscinodiscus,
Oscillatoria,
Biddulphia,
Rhizosolenia,

Karumbhar Area

Coscinodiscus,
Navicula,

Chaetoceros,
Pleurosigma,
Thalassionema.

Dwarka Area

Biddulphia,
Coscinodiscus,
Chaetoceros,
Pleurosigma,
Peridinium,
Rhizosolenia.

Porbandar Area

Chaetoceros,
Pleurosigma,
Coscinodiscus,
Nitzschia.

Mahuv Area

Navicula,
Nitzschia.

Gopnath Area

Navicula,
Nitzschia,
Thalassiosira.

Alang Area

Coscinodiscus,
Dinophysis,
Pleurosigma.

Hazira Area

Nitzschia,
Chaetoceros,
Coscinodiscus,
Oscillatoria,
Skeletonema.

MAHARASHTRA

Ramaiah *et al.*, 1998 reported following genera and species *Thalassiosira*, *Coscinodiscus*, *Nitzschia* and *Skeletonema costatum* (93%). Tiwary and Nayar, 1998 reported total 58 genera of phytoplanktons comprising of 46 diatoms and 6 dinoflagellates and 6 others of which genus *Thalassiosira* is dominant.

Phytoplankton genera and species reported in Fresh water tanks of Maharashtra.

(Source : Goel, P.K. *et al.*, 1991)

CHLOROPHYCEAE

Ankistrodemus sp.
Chlamydomonas sp.
Chlamydomonas sp.
Elakatothrix sp.
Kirchneriella sp.
Oocystis sp.
Pediastrum duplex
Pediastrum tetras
Scenedesmus arcuatus
Scenedesmus armatus
Scenedesmus quadricauda

CYANOPHYCEAE

Anabaena sp.
Chroococcus Sp.
Microcystis aeruginosa
Oscillatoria sp.
Phormidium sp.

BACILLARIOPHYCEAE

Cyclotella sp.
Fragilaria construens
Fragilaria capunica
Melosira granulata
Navicula sp.

Nitzschia acicularis

Nitzschia mediores

Synedra acus

Synedra sp.

EUGLENOPHYCEAE

Euglena pisciformis

Euglena proxima

GOA

Estimation of phytoplankton cell from Mandavi Estuary and Zuari Estuary was reported by Devassy & Vhargava (1978).

KARNATAKA

Kusuma *et al.* (1988) reported diatom genera such as *Thallossiosira*, *Nitzschia*, *Coscinodiscus*, *Asterionella*, *Rhizosolina* and dinoflagellates such as *Noctiluca* and *Ceratium* as common.

KERALA

Estimation of phytoplankton cells from Cochin backwaters was reported by Devassy and Bhattathiri (1974).

LAKSHADWEEP

Wafar *et al.* (1991) reported phytoplanktons such as *Trichodesmium thiebautii*, *T. erthaeum*, *Gymnodinium* sp., *Nitzsia volodyrtium*, *Costinodiscus* sp., *Chaetoceros* and *Thallassiosira*.

Phytoplankton species enumerated in Lakshadweep are *Chaetoceros* sp., *Coscinodiscus* sp., *Nitzschia bilobata*, *Nitzschia closterium*, *Planktoniella sol*, *Amphora* sp., *Melosira* sp., *Rhizosolenia* sp., *Rhizosolenia stoltherfothii*, *Rhizosolenia alata*, *Pleurosigma* sp., *Biddulphia sinensis* and *Noctiluca* sp.

Status of Phytoplankton of East coast

(Source : Gouda, R. *et al.*, 1991)

CHYSOPHYTA : BACILLARIOPHYCEAE

Centrales

Bacteriastrum hyulinum Lauder

Biddulphia biddulphiana (Smith) Boyer

B. mobiliensis (Bailey) Grunow.

Hemialus sinensis Greville

Trigonium articum Brightwell

Triceratium dubium Brightwell

T. favus Ehrenberg

T. reticulum (Ehrenberg) Simonsen

Chaetoceros affinis Lauder

C. curvisetus Cleve

C. diadema (Ehrenberg) Gran

C. decipiens Cleve

C. lorentianus Grunow

Actinocyclus ingens Ratt

A. octonarius Ehrenberg

Coscinodiscus excentricus Ehrenberg

C. marginatus Ehrenberg

C. radiatus Ehrenberg

C. jonesianus (Greg) Ostenf

C. rothii (Ehrenberg) Ross

Hyalodiscus franklini (Ehrenberg) Ross

Lauderia annulata Greville

Melosira sulcata (Ehrenberg) Kuetzing

Melosira sp.

Paralia sulcata Ehrenberg

Podosira stelligera (Bail) Mann

Pyxidula minuta Grunow

Skeletonema costatum (Greville) Cleve

Stephanopyxis palmariana (Grev.) Grunow

Guinardia Flaccida (Castracane) Peragallo

Leptocyliidrus danicus Cleve

Schroederella delicatula (Peragal.) Pavillard

Rhizosolenia aloata Brightwell

R. castrone Peragallo

R. hebetata (Bailey) Gran

R. setigera Brightwell

R. styliformis Brightwell

Pennales

Cocconeis apiculata Greville

Bacillaria paradoxa (Gmelin) Grunow

Nitzschia closterium (Ehrenberg) W.Smith

N. longissima (Brebisone) Ralfs

N. seriata Cleve

N. vitrea Normann

Amphora obtusa Gregory

Asterionella glacialis Castracane
Fragilaria oceanica Cleve
Grammatophora undulata Ehrenberg
Azpeitia africana (Janisch ex Schmidt) Fryxell & Watkin
Thalassiothrix frauenfeldii Grunow
Thalassiothrix longissima Cleve & Grunow
Thalassinema nitzschoides Grunow
Amphiphora paludosa Grunow
Caloneis crass (Gregory) Ross
Gyrosigma balticum (Ehrenb.) Robernhorst
Mastogloia harvathiana Grunow
M. minuta Greville
Navicula longa (Gregory) Ralfs
N. humerosa Brebisson
N. lyra Ehrenberg
N. spectabilis Gregory
N. zostereti (Gran) Robernhorst
Pleurosima aestuarii (Breb.) W.M. Smith
P. angulatum (Quekott) W.M. Smith
P. directum Grunow
P. elongatum W.M. Smith
P. formosum W.M. Smith
P. falx Mann
P. normanii Ralfs
Perissonae pentagona Desikacharya *et al.*
Pinnularia brunii (Mayer) Hust
Surirella eximia Greville

CHOROPHYTA : CHLOROPHYCEAE

Enteromorpha compressa Greville
Spirogyra sp.

PYRROPHYTA : DINOPHYCEAE

Ceratium setaceum Jorgensen
C. furca Ehrenberg
C. tripos Muller
C. lineatum (Ehrenberg) Cleve
Dinophysis sp.
Gonyaulux polyedra Lebour

Peridinium depressum Bailey
Proto-peridinium sp.
Prorocentrum micans Lebour
Pyracystis linula Schut

CYANOPHYTA : CAYNOPHYCEAE

Anabaena sp.
Nostoc sp.
Lyugibia aestuarii Gamont
Oscillatoria sp.
Trichodesmium erythraeum Ehrenberg

List of Plankton Genera and species along Parangipettai coast

(Krishnamurthy *et al.*, 1995)

Planktonic form

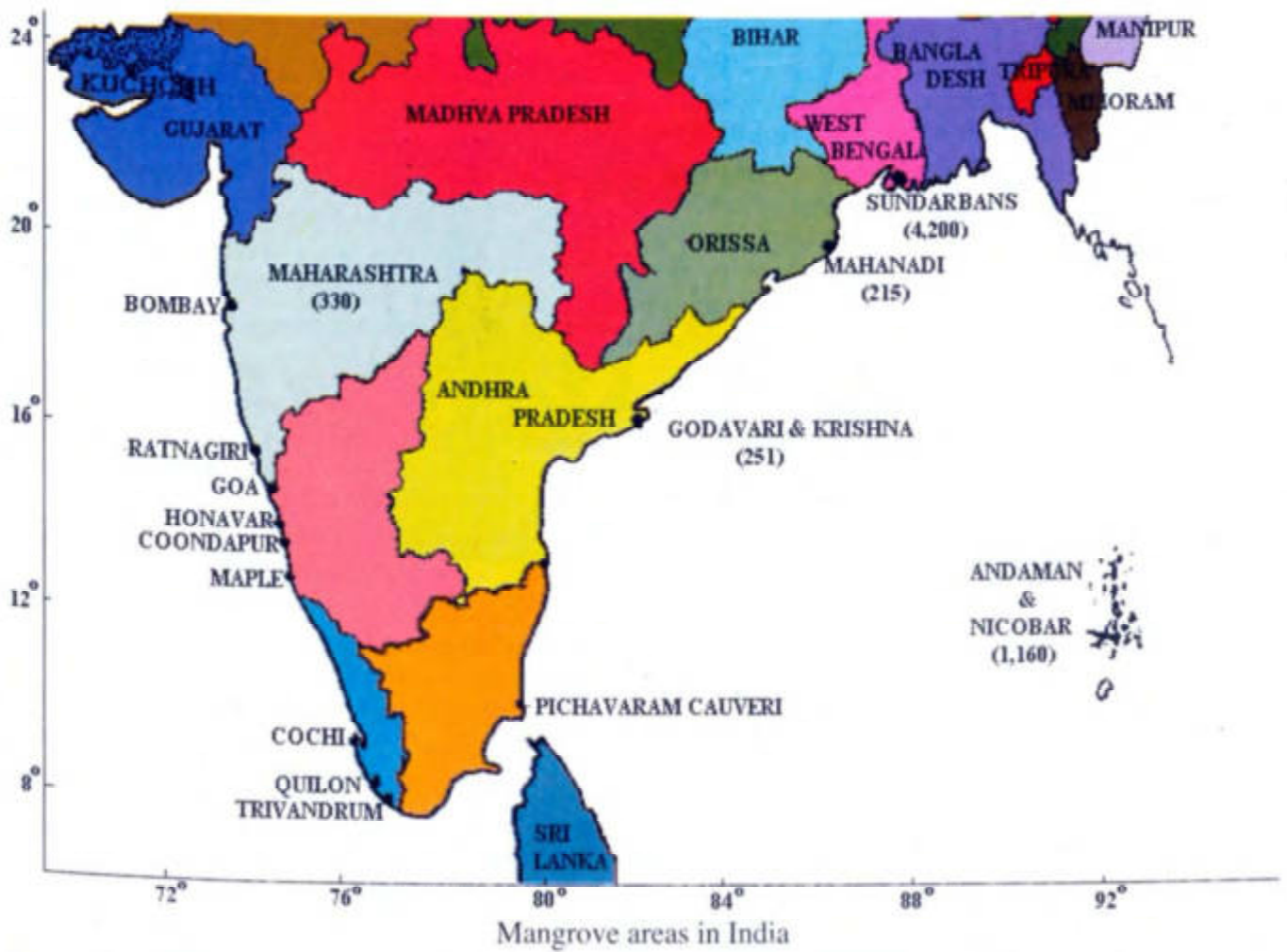
Phormidium tenue
Phormidium fragile
Gloeocapsa sp.
Cloethece sp.
Microcoleus sp.
Oscillatoria sp.
Chroococcus sp.
Microcystis sp.
Synechocystis sp.

Epiphytic form

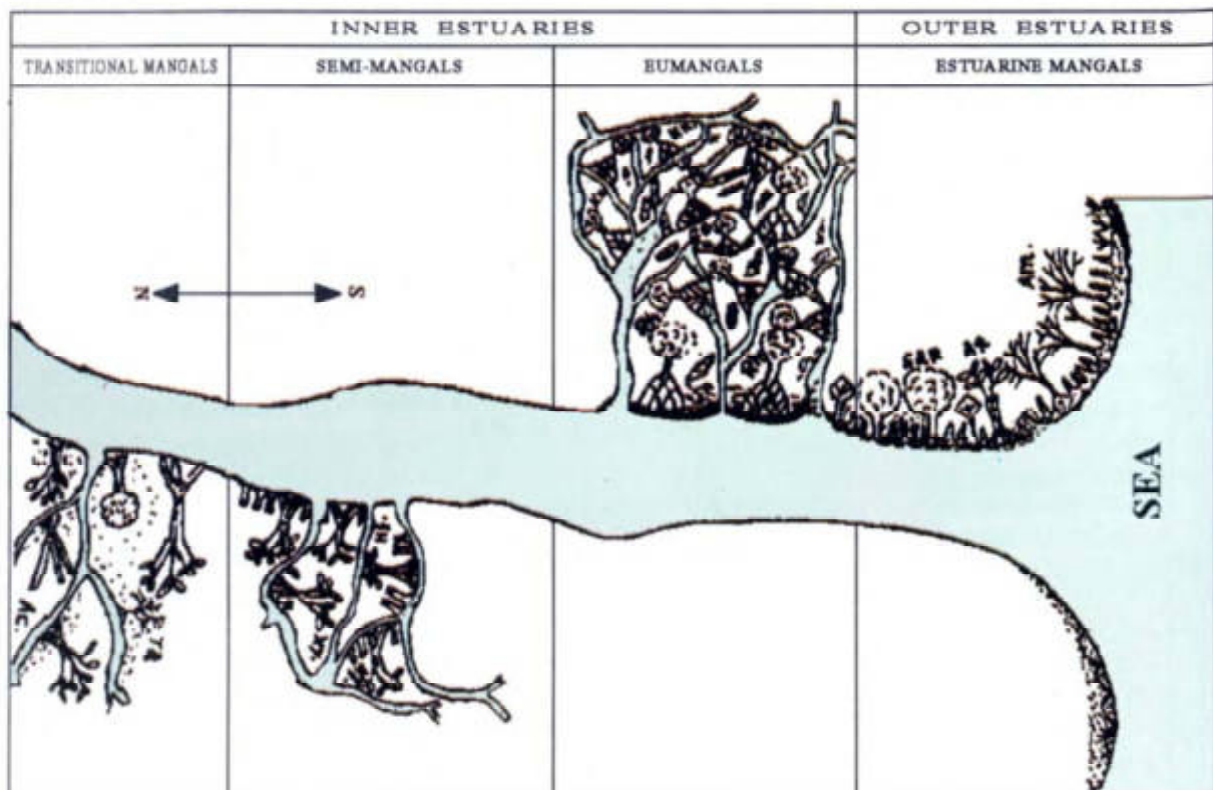
Phormidium tenue
Chroococcus sp.
Microcoleus sp.

Benthic form

Phormidium tenue
Chroococcus sp.
Microcoleus sp.
Gloeocapsa sp.
Oscillatoria sp.



West Mangrove formation Dominated by *Avicennia marina* in Gujarat (Kuchchh)



Diagrammatic Classification of Mangrove Communities in India



A view of Sundarbans Mangroves at low tide

2. MANGROVES OF INDIAN COAST

Portuguese were probably the first foreigners to visit mangrove forests along the Indian coast around 14th century and called them "Mangue". In 'Surinum' the common name of *Rhizophora mangle* is "Mangrow". In Malayan word plants growing under tidal influences and producing arched aerial roots are referred as "Mangil". Macnae (1968) asserted the term Mangrove for individual plants species and the term "Mangal" for plant community. Whatever may be the term associated with the origin of the name 'Mangroves', it can be defined as group of plant species taxonomically isolated and remarkably successful in colonizing the intertidal zone at the interface between land and the sea along the banks of estuaries, creeks and canals of deltas, shallow lagoons and backwaters.

In general mangroves are found mainly in the tropical and subtropical sheltered coastline with dark green shining foliage and negatively geotropic roots. They show maximum modification in their morphology, physiology and bio-chemical activities with superficial adaptive characters like pneumatophores, stilt roots and vivipary for withstanding partly submerged saline situation. It can only extend its spread up to the limit of saline tide water flow. Best mangrove formation are seen where the tidal regime is normal with a constant mixing of sea water and fresh water where temperature does not optimally go below 20°C and soil is mostly alluvial in nature with high salt and water contents and low oxygen and high hydrogen sulphides and rain fall remains 2000-3000 mm per year.

Mangrove ecosystem is well known for greater diversity of flora and fauna as well as a greater degree of specialization in structure and function. Though species diversity is very low in this ecosystem due to dominance of large physiological forces of saline tide water and lack of stable substrate but it commands the highest importance by virtue of their biological productivity, specialized adaptive diversity, complexity in the ecological processes and finally the importance of the bio-diversity resources which are used directly or indirectly. Other amenities provided by these bio-diversity resources for protection and conservation of the environment is so much valued that the cost could

not be evaluated with the help of monetary measure. Besides the economic significance and sustainable life support products, the mangrove ecosystem play a vital role in the environmental protection by acting as a cost free and self repairing static border security force for protecting inland vegetation and life from cyclone and floods. They help in maintaining atmospheric equilibrium, checking soil erosion, stabilizing the coastline, building new islands or areas, acting as a wind breaker to protect storms and cyclones and providing many important wild life habitat including that of Royal Bengal Tigers.

About 6740 sq. km littoral regions including deltas, estuaries, backwaters, bay islands and lagoon in India are protected by extensive cover of mangals (mangrove community) being the third largest formation of the world after Indonesia and Australia. In India distribution of mangrove diversity is found in Andaman and Nicobar group of Oceanic islands. Sundarbans in the Gangetic delta of West Bengal; Mahanadi deltaic complex of Orissa coast; Coringa, Godavari and Krishna delta of Andhra Pradesh, Cauvery delta of Tamil Nadu, specially in Pichavaram; Gulf of Khambat, Saurashtra and Gulf of Kutch in Gujarat; Mumbai, Ratnagiri, Malvan, Devgad and Vijayadurg in Maharashtra; Mandavizuari estuary of Goa; Coondapur, Honaver and Malpe in Karnataka and Kochi, Vembanad, Quilon, Trivandrum, Kananore, Kozhikode and Kottayam in Kerala state.

Studies on Indian mangrove were initiated as early as 17th century itself when van Rhee de in 1686-1703 was first to provide a scientific account on Indian ocean mangroves in "Hortus Malabaricus". Roxburgh (1814) describe the flora of Sundarbans in "Hortus Benghalensis", Clarke in 1896 provided an account of the Sundarbans in Linnaeus Society of London, Prain (1903) published Flora of Sundarbans in the Records Botanical Survey of India.

Subsequently in 20th century many workers came to lime light viz., Hooker (1872), Blatter (1905), Cook (1908), Curtis (1933), Champion (1936), Troup (1921), Griffith (1936), Cornwell (1937), Navalkar (1951), Krishnamurty *et al.* (1987), Untwale (1982, 1984), Naskar and Gehabaksi (1983) and Banerjee *et al.* (1987, 1989, 1992, 1998) and Rao T.A. (1968-2000).

GLOBAL POSITION

According to the estimate made by F.A.O./UNDP, a total area of 7.1 million hectare is covered under the mangrove formation in the world. Out of these, Indonesia ranks first, followed by Australia, Malayasia, Bangladesh and India. The Mangrove forests are Circuntropical in distribution and are chiefly found along the inter-tidal regions of the sheltered bay, lagoons and backwaters in the tropical and sub-tropical regions of the world. These forests are more extensively found in the Indo-Pacific region than African and American continent.

Mangroves occur throughout the world extending their distribution from 24° N to 38° S and covers mostly on the eastern borders of the continent. In the northern hemisphere, mangroves extend along the coasts ranging in latitude between 24° N and 32° N. Members of *Rhizophora* are found in the Ryukyus and S. Japan of Kagoshima (32° N). In Florida, it extends to 28° N and in Bermuda at 32° N but on the Pacific coast, mangroves do not extend beyond 24° N. In the southern hemisphere, it is found on the Brazillian East coast, south to the tropic of Capricorn but on the West coast it does not extend beyond 4° S. In Africa, mangroves are found to nearly 32° S on the East coast but on the West coast, it does not grow after 10° S. In Australia and New Zealand, mangroves are found as far south as 37° S. The Global extent of mangroves of the old world is from East Africa, up to the Red Sea, across the Indian ocean to Australia, northwards to the Philippines and Southern Japan and southwards to New Zealand, finally reaching the eastern limit in Samo. The new world mangroves extend essentially to the shore of America, West Indies and West coast of Africa.

Regarding the number of mangrove species throughout the world, it is estimated that old world areas contain as much as 65 number of mangrove species in contrast to only 10 species in the new world areas. The new world swamps and marshes are covered with maximum number of salt marsh species. Large mangrove formations are seen in the estuarine and deltaic areas of the rivers Zambesi and Rufiji along the East African coast where the species composition is also found somewhat rich due to mingling of Western

and Indo-Pacific elements. However, the composition of mangrove species by and large is maximum along the Indo-Pacific region.

According to the geographical distribution, the extension of mangroves can be divided into two groups :

1. New World Group including West Africa and
2. Old World Group

1. New World Group

(a) American Group :

In the North, Central and South America, mangroves are characterised by *Rhizophora mangle*, *Avicennia germinans*, *Conocarpus erectus* and *Laguncularia racemosa*. West Central America is characterised by the additional presence of *Pelliciera rhizophora*, *Rhizophora racemosa*, *R. harrisonii* and *Avicennia bicolor*, the Gulf of California is characterised by mangroves consisting of *Rhizophora mangle*, *Conocarpus erectus* and *Avicennia germinans*, the East Central American group is very similar to West Central American type except the absence of *Pelliciera* sp., West Indies and Florida known as Caribbean sub-group do not have *Rhizophora racemosa* and *R. harrisonii*, but presence of *Avicennia schaueriana* is interesting one. In the Atlantic South America, mangroves are characterised by the addition of *Rhizophora racemosa* and *Avicennia schaueriana* but complete absence of *Conocarpus erectus*.

(b) West African Group :

Mangroves are characterised by *Avicennia africana*, *Rhizophora mangle*, *Conocarpus erectus*, *Laguncularia racemosa* and the species of *Osbornia*.

2. Old World Group

This group consists of three subgroups viz. Persian gulf-Madagascar, Indo Malaysian and Australian group.

(a) Persian Gulf-Madagascar Group :

Here mangroves are characterised by dominant species of *Rhizophora mucronata*, *Avicennia marina*,

Bruguiera gymnorrhiza, *Sonneratia alba*, *Ceriops tagal* and *Xylocarpus benadirensis* (restricted to the area). Persian Gulf sub-group is characterised by *Avicennia marina* and *Rhizophora mucronata* and Madagascar sub-group also possesses the same characters.

(b) Indo-Malayan Group :

This group can be subdivided into 4 sub-groups such as: Indian sub-group where *Sonneratia apetala*, *Heritiera fomes* and *Phoenix paludosa* are main characteristic and restricted species along with other mangroves. In the Myanmar-Indonesian-Malayan sub-groups where mangroves are characterised by maximum number of species except a few which are restricted in India. In North Australian-Papuan sub-group besides the dominance of *Rhizophora apiculata*, *Bruguiera sexangula* and *Sonneratia ovata*, it is characterised by *Xylocarpus australasicus* and *Acrostichum speciosum*.

(c) Australian Group :

This group due to low winter temperature possesses maximum salt marsh community rather than mangroves and *Avicennia marina* var. *resinifera* with *Aegiceras corniculatum* are characteristic formation among the mangroves.

Mangrove plant diversity of the New World regions consist of 10 dominant species which are not found along the Old World mangrove regions. These 10 species are :

- Rhizophora mangle*
- R. harrisonii*
- R. racemosa*
- Laguncularia racemosa*
- Pelliciera rhizophora*
- Conocarpus erecta*
- Avicennia germinans*
- A. bicolor*
- A. africana*
- A. schaueriana*

In the old world mangrove plant diversity, except some one or two species, India represents as many number of species as those reported for Malaysia and Indonesia. Special significance of Indian mangrove diversity is the characteristic occurrence of *Sonneratia apetala*, *Heritiera fomes* and *Phoenix paludosa* which are mostly restricted in the Indian sub-continent.

MANGROVE VEGETATION IN INDIA

Structure of vegetation, richness of species, association and zonation of mangroves are found different in the East coast, West coast, Andaman and Nicobar islands and in the Gujarat coast. It is observed that four phases of developmental structure of mangrove vegetation such as Estuarine mangroves, Riverine true mangroves, Riverine semi mangroves and Riverine transitional mangroves are well represented in the Sundarbans and in the Mahanadi delta of the East coast. This may be due to regular supply of fresh water flow from various rivers and innumerable ramification of river system. Starting from the Godavari-Krishna delta towards the Tamil Nadu, Karnataka, Kerala, Maharashtra, Goa, and Andaman and Nicobar islands, the Riverine semi mangrove formation is completely absent. This means that mangrove vegetation has developed in three phases along these areas due to lack of some ecological factors, specially less influence of fresh water flow. Again in Gujarat coast only Jamnagar, Pirotan and Tapi river mouth are dominated by Estuarine mangrove formation with very little trace of Riverine true mangrove zone but throughout the Gulf of Khambat, and Western side of the Gulf of Kutch up to the Pakistan border the vegetation forms a climatic climax covering a single species dominance, *Avicennia marina*. Except the first type that is Estuarine mangrove formation, no other formation of the 4 developmental stages are found. Therefore it is evident that mangrove species diversity gradually tapers from the Sundarbans and Orissa and is much less along the west coast from down south in the Kerala to Saurashtra and finally ends to a single species dominated regions along the Gulf of Khambat and extreme west of the Gulf of Kutch regions.

Mangrove vegetation of the East Coast

Sundarbans is the largest deltaic complex of the world formed by the sediments deposited by the three great rivers, the Ganga, Brahmaputra and Meghna. Almost 62% of the delta falls under Bangladesh and 38% of the region lies within India. Therefore the Indian and Bangladesh part of Sundarbans together comprise the largest continuous mangrove block in the world. Vegetation in the Indian Sundarbans covering the mangrove areas of 4200 sq. km in the 24 Parganas of West Bengal is fully covered with dense growth of mangroves in the unstable substrate and saline tide water flow. Here salinity and tidal amplitude vary seasonally and according to the impact of salinity and tidal flow, association of different mangrove species are found in different zones. Along the estuarine mouth *Avicennia marina*, *Aegialitis rotundifolia*, *Bruguiera parviflora*, *Ceriops tagal*, *Sonneratia griffithii*, *Porteresia coarctata* and others are dominant. Along the Riverine true mangrove zone where the areas are associated with more number of creeks and channels, *Rhizophora apiculata*, *Rhizophora mucronata*, *Kandelia candel*, *Aegiceras corniculata*, *Bruguiera gymnorrhiza*, *Xylocarpus granatum*, *Xylocarpus mekongensis*, *Sonneratia apetala*, *Avicennia alba*, *Excoecaria agalocha*, *Ceriops decandra* are dominant. In the Riverine semi mangrove zone where soil surface is more clay dominated and influence of fresh water flow is more, *Heritiera fomes*, *Cynometra iripa*, *Cerbera manghus*, *Intsia bijuga*, *Excoecaria agalocha*, *Brownlowia teresa*, *Nypa fruticans*, *Aglaiia cucullata* and others are dominant. In the Riverine transitional mangrove zone where the areas are mainly influenced by the high spring tide, *Clerodendrum inerme*, *Dalbergia spinosa*, *Acanthus illicifolius*, *Derris trifoliata*, *D. uliginosa*, *Thespesia populnea* and others are dominant. *Phoenix paludosa*, the palm which serve as den of the Royal Bengal Tiger is present as pure stand on elevated fringes and orier border lines. The mangrove fern, *Acrostichum aureum* generally colonizes towards the back mangrove areas where soil and pH are abruptly changed. Salt marshes dominated by *Suaeda*, *Salicornia* and other species are frequently found along the degraded areas. Mangrove vegetation of the Mahanadi delta in Orissa covers an area of only

215 sq. km. Due to influence of many fresh water rivers in the Batighar, Karisardiom, Jambu, Hookitola, Bhitarkanika, Ghaurimata and Thakurdian, the structure of the vegetation develops more uniquely than that of the Sundarbans. All the four developmental phases along with all the mangrove species except *Nypa fruticans* are present within this small area. Moreover this small area harbours some interesting species such as *Heritiera littoralis*, *H. kanikensis*, *Rhizophora stylosa*, *Sonneratia alba* which are not found in the Sundarbans. Formation of salt marshes and pure stand of *Phoenix* and *Acrostichum* are also common in this delta.

Mangrove vegetation of the Godavari-Krishna delta in Andhra Pradesh covering an area of 225 sq. km shows a regression due to less fresh water influence and large scale over-exploitation and reclamation. Vegetation in this delta developed in three developmental phases, the Riverine semi mangrove stage is completely absent and therefore, the species diversity is much less in comparison with the Sundarbans and that of the Mahanadi delta. The species compositions in the 1st, 2nd and 4th developmental phases of the vegetation are the same in this delta as in the Sundarbans and the Mahanadi delta. Speciality of the vegetation structure in this delta is the occurrence of *Scyphiphora hydrophyllacea* belonging to Rubiaceae which is restricted only in Andaman Islands. *Nypa fruticans*, *Phoenix paludosa*, *Heritiera fomes*, *Heritiera littoralis*, *Brownlowia teresa*, *Aglaiia cucullata* and even *Acrostichum aureum* are not found in this delta. Due to large scale exploitation and change of some essential ecological factors, vast areas of the mangrove vegetation are transformed into salt marsh formation and species of *Suaeda*, *Salicornia*, *Arthrocnemum* and others are dominant.

Mangrove vegetation of the Cauvery delta in Tamil Nadu covers about 150 sq. km. Due to discontinuity of its topographic condition and lack of fresh water flow majority of the mangroves are shifted to the Pichavaram and Muthupet areas. Vegetation structure of these reserve forests represents the same three phase development stages as that of the Godavari-Krishna delta. All mangrove species, which are present in the Godavari-Krishna delta except *Scyphiphora hydrophyllacea*, are dominant in these delta. The main



Breathing Roots of *Avicennia officinalis* in the Sundarbans



Mangroves of Orissa



Mangroves of Godavari Delta



Mangroves of Pichavaram, Tamil Nadu

speciality of the vegetation is the luxuriant growth of *Rhizophora apiculata*, *R. mucronata* and one new hybrid species *R. annamalaica*. Recently, only 14 mangroves species from the Pichavaram areas have been estimated. Mangrove vegetation of these areas have been degraded due to several anthropogenic factors and reduced fresh water supply. Absence of wide spread species *Acrostichum aureum* and *Bruguiera gymnorhiza* is a surprising fact.

Mangrove vegetation of the West Coast

Due to absence of large deltas, less number of rivers, distributaries and less fresh water supply mangrove vegetation along the west coast mostly form a fringe mangrove formation. Only in certain estuarine and backwater parts of Maharashtra, Goa, Karnataka, Kerala and Gujarat where favourable conditions prevail, mangrove vegetation develops densely along those regions. However, the species diversity along the west coast is much less from that of the east coast formation. Mangrove vegetation of Maharashtra covers 300 sq. km area spreading along tidal river creeks and backwaters of Achara, Deogadh, Vijaydurg, Ratnagiri, Kundalica and Mumbra-diva of Mumbai region. Vegetation structure in some parts of this area is well developed with three developmental phases consisting of estuarine mangroves of *Avicennia marina*, *Lumnitzera racemosa*, *Porteresia coarctata*, riverine true mangroves with *Rhizophora apiculata*, *R. mucronata*, *Kandelia candel*, *Ceriops tagal*, *Sonneratia alba*, *Bruguiera gymnorhiza*, *B. cylindrica*, *Aegiceras corniculatum* and riverine transitional mangroves with *Excoecaria agallocha*, *Clerodendrum inerme*, *Derris heterophylla* and *Acanthus illicifolius*. Much of the areas in the Maharashtra State under mangrove vegetation have been degraded and lost due to land reclamation, overexploitation and coastal industrial pollution. Some of the species which were reported common in Bandra areas such as the species of *Lumnitzera*, *Rhizophora* and *Bruguiera* have almost disappeared and the area is now represented with very low vegetation cover of *Avicennia marina* and *Acanthus illicifolius*. Speciality of the mangrove vegetation in the Ratnagiri coast is the luxuriant growth of *Sonneratia alba*.

Mangrove vegetation of Goa

The total mangrove vegetation area along the Goa coast is estimated about 200 sq. km of which 90% mangroves occur along the Mandavi-Cumbarjua canal-Zuari estuarine complex and other parts of Galgibag, Talpona, Sal, Chapora and Terekhol river mouth. The vegetation structure is also developed in three developmental stages with *Avicennia marina* along the estuarine mouth, *Rhizophora mucronata*, *Rhizophora apiculata*, *Kandelia candel*, *Avicennia officinalis*, *Sonneratia alba*, *Aegiceras corniculatum* in the riverine true mangrove phase and *Excoecaria agallocha*, *Derris heterophylla*, *Acrostichum aureum*, *Acanthus illicifolius* along the riverine transitional phase. The mangrove flora of Goa regions comprises of 15 to 18 species.

Mangrove vegetation of Karnataka

The mangrove vegetation of Karnataka covers an area of about 90 sq. km spreading along the rivers Kalinadi-Belamdar nadi, Danga valley, Kashi, Sharavati; Karki, Haldipur, Dharieswar, Hanovar and Coondapur. The formation of mangrove vegetation is mainly of fringing type along the intertidal regions of estuaries, backwaters and other intertidal protected areas. The structure of vegetation also develops in three phases as compared to the Maharashtra and Goa. The dense vegetation of *Avicennia marina* and *Avicennia alba* along with *Lumnitzera racemosa* are dominant in the estuarine mangrove zone. *Rhizophora mucronata*, *Rhizophora apiculata*, *Kandelia candel*, *Aegiceras corniculatum*, *Sonneratia alba*, *Sonneratia caseolaris*, *Excoecaria agallocha*, *Ceriops tagal* and others are found in the riverine true mangrove zone. *Acanthus illicifolius*, *Derris uliginosa*, *Derris scandens*, *Cerbera manghas*, *Thespesia populnea* and *Acrostichum aureum* are dominant in the riverine transitional mangrove zone. Hanovar and Coondapur represent the good patches of mangrove vegetation and rich floristic diversity. Luxuriant growth of *Ceriops tagal*, *Cerbera manghas* and *Sonneratia alba* are interesting features of mangrove vegetation. The fern *Acrostichum aureum* grows densely along the back mangrove areas and along the banks of backwaters.

Mangrove vegetation of Kerala

The mangrove vegetation of Kerala covers an area of about 17 sq. km spreading the entire backwater system, lagoons and some of the intertidal areas of Cochi, Vembanad, Quilon, Trivandrum, Kannanor, Kozhikode and Kottayam. The general structures of the mangrove vegetation have been repeatedly damaged due to agriculture, coconut plantation, pisciculture and other over-exploitation activities. Some of the private ownership mangrove forest areas where the target were for over-exploitation and destruction as a result of which the total mangrove areas of Kerala State have been massively reduced. The present vegetation structure along the Cochi, Quilon, Kannanor and Kottayam reveals that it forms three developmental stages similar to that of the Karnataka State. The dominant species are *Avicennia officinalis*, *Avicennia marina*, *Bruguiera cylindrica*, *Bruguiera parviflora*, *Bruguiera gymnorhiza*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Sonneratia caseolaris*, *Ceriops tagal*, *Cerbera manghas*, *Dolichandrone spathesia*, *Acanthus illicifolius*, *Derris heterophylla* and others.

Mangroves vegetation of Lakshadweep

The Lakshadweep comprises 36 islands. Being low atolls and due to absence of clay materials the ecological conditions are not suitable for the growth of mangroves in this islands. However, a small patch of *Bruguiera parviflora* in the Minicoy islands is present.

Mangroves vegetation of Andaman and Nicobar Islands

The mangrove vegetation of the Andaman and Nicobar islands covers an area of 1190 sq. km. These oceanic islands are surrounded by sea water and the source of fresh water in these regions are mainly due to heavy rainfall and from the small rivers and streams flowing from the adjacent hill ranges. Mangrove vegetation of these islands also shows three types of developmental phases. But the structure of vegetation is completely different compared to that of the mainland mangroves. The luxuriant growth of *Rhizophora*

apiculata, *Rhizophora mucronata*, *Bruguiera parviflora*, *Bruguiera cylindrica*, *Sonneratia griffithii*, *Heritiera littoralis*, *Nypa fruticans*, *Phoenix paludosa* and *Xylocarpus granatum* are very surprising. The detailed study regarding the growth pattern and the impact of ecological factors need urgent attention. The speciality of this vegetation is the impenetrable formation of *Nypa fruticans* and *Rhizophora apiculata* along the inner side of the creeks and canals and the occurrence of *Xylocarpus moluccensis*, *Lumnitzera littorea*, *Scyphiphora hydrophyllacea*, *Heritiera littoralis*, *Acanthus ebracteatus* and *Acrostichum speciosum* which are not common in the inland mangrove vegetation.

Mangroves vegetation of Gujarat coast

The mangrove vegetation in Gujarat coast covers an area of disputed estimation. According to Forest Survey of India (1997) the total area of mangrove vegetation is 991sq. km. But in recent survey it is estimated as 1324 sq. km (Singh, 1999), though large areas within the notified forest regions are not suitable for mangrove vegetation. According to this estimate the area cover of the mangrove vegetation in Gujarat stands second position after the Sundarbans. The large part of the mangrove vegetation along the Gulf of Kutch and the Gulf of Khambhat are in a different ecological situation compared to the other mangrove vegetation areas of the country. Climatically the area is influenced by open coastal environment with the formation of coastal desert or arid open mudflats. Restricted flow of the rivers and construction of several dams inhibit the flow of freshwater to the mangrove vegetation. Majorities of the old forest areas are massively destroyed due to several anthropogenic factors. Areas like Jamnagar, Pirotan island, Tapi river mouth are dominated by estuarine mangrove formation with very little trace of riverine true mangrove type but throughout the Gulf of Khambhat and western side of the Gulf of Kutch up to Pakistan border (Kori creek) the vegetation forms a climatic climax and except the estuarine mangrove formation dominated by a single species, *Avicennia marina*, no other formation of the four developmental phases of the mangrove vegetation are found. The Gulf

of Khambhat and western side of the Gulf of Kuchchh are dominated by *Avicennia marina* and its varieties with the association of *Urochondra setulosa*, a grass, forms pure community along the tidal creeks and shallow mud flats. Besides this pure formation of *Avicennia marina*, some upland areas are completely covered with salt marshes dominated by *Artiplex stocksii*, *Salicornia brachiata*, *Suaeda fruticosa*, *Tamarix troupitii* and others. Along Jamnagar, Tapi river mouth, and eastern part of the Gulf of Kuchchh are dominated by *Avicennia marina* along with sparse distribution of *Avicennia officinalis*, *Rhizophora apiculata*, *Aegiceras corniculatum*, *Sonneratia apetala*, *Acanthus illicifolius* and others.

GEOGRAPHICAL DISTRIBUTION, AREA AND SPECIES DIVERSITY

Distribution

Mangrove forests are circumtropical in distribution and are found along the intertidal regions of the tropical and sub-tropical areas of the world extending from 24° N to 38° S. Geographical extension of mangroves can be divided into two groups: 1) New World Group which includes mangroves of North, Central and South America and West Africa, 2) Old World Group which includes mangroves of Persian Gulf, Madagascar group, Indo-Malaysian group and Australian group.

The New World mangroves extend essentially to the shore of America, West Indies and West coast of Africa. The Old World mangroves extend from East Africa up to the Red Sea, across the Indian Ocean to Australia, northwards to the Philippines and southern Japan and southwards to New Zealand. The New World mangroves are dominated by only 10 species, which have no affinities with the Old World mangroves. Not a single species of the New World mangroves is found in the Old World group. The Old World mangroves are dominated by 69 species and the composition, by and large is found maximum along the Indo-Pacific region. The number of species found in India have significant affinity with those reported for Malaysia and Indonesia.

Presence of *Rhizophora apiculata*, *Bruguiera sexangula* and *Aegiceras corniculatum* show affinity to the flora with that of the Australian and Papuan group.

Mangroves in India are typical of the Malay Peninsula, Polynesia, Indo-China, Australia, Ethiopia, Sri Lanka and of other Old World's Indo-pacific elements. Mangrove area in India is so called as extension from the Persian Gulf around the coast of India, Pakistan and Sri Lanka to Myanmar (Burma) including Andaman and Nicobar Islands.

The major mangrove areas along the East coast of India are found in the Gangetic Sundarbans regions in West Bengal, the Mahanadi deltaic complex in Orissa, the Godavari-Krishna deltaic system in Andhra Pradesh and Cauvery estuarine complex in Tamil Nadu. These east coastal mangrove areas are considered to be the best habitat and commonly harbour about 63 mangrove species out of the total 68 species in India. The associated mangrove flora in the area belong to the so-called "Indo-Pacific" origin from Malaysia, Australia and East Africa, and the biodiversity is appreciably more rich and diversified than that of 'Australia' or 'Atlantic' region.

Along the West coast, no major deltas are found except the small estuaries of the Narmada and the Tapi river and a few other hyper saline shallow estuaries in Saurashtra, Gulf of Khambhat and Gulf of Kuchchh. Mangroves are found confined here towards the small pockets of backwater system such as Mandavi-Zuaria estuaries in Goa, along the intertidal creeks and canals of Kalinadi in Karwar, Coondapur, Hanover and Malpe in Karnataka, 8 minor lakes, Cochi, Vembanad, Qilon, Trivandrum, Cannanore, Kozhikode, Kottayam in Kerala and along some creeks and estuaries in Maharashtra.

Approximate Mangrove Areas

Total Mangrove area in different parts of the world is not properly known. However, it is estimated from various publications that the total mangrove area of the world is approximately 17109000 ha or 171090 sq. km.

Table - 7: APPROXIMATE MANGROVE AREAS IN VARIOUS COUNTRIES

ASIA	Area (ha)	AFRICA	Area (ha)	AMERICA	Area (ha)
Australia	1162,000	Angola	50,000	Belize	75,000
Bangladesh	410,000	Benin	3,000	Brazil	2,500,000
Brunei	7,000	Cameroon	273,000	Colombia	307,000
Fiji	20,000	Gabon	250,000	Costa Rica	19,000
India	675,000	Guinea	260,000	Cuba	448,000
Indonesia	2,500,000	Guinea Bissau	243,000	Dominican Republic	9,000
Kampuchea	10,000	Gambia	60,000	El Salvador	36,000
Malaysia	674,000	Kenya	45,000	Ecuador	196,000
Myanmar	817,000	Liberia	40,000	French Guiana	55,000
Pakistan	345,000	Mauritania	Few ha	Guadeloupe	3,000
Papua New Guinea	553,000	Madagascar	320,000	Guatemala	50,000
Philippines	240,000	Mozambique	85,000	Guiana	150,000
Sri Lanka	4,000	Senegal	440,000	Haiti	18,000
Thailand	288,000	Sierra Leone	100,000	Honduras	145,000
Vietnam	320,000	Nigeria	973,000	Jamaica	7,000
		Tanzania	96,000	Martinique	2,000
		Zaire	20,000	Mexico	660,000
				Nicaragua	60,000
				Panama	486,000
				Peru	28,000
				Surinam	115,000
				Trinidad & Tobago	4,000
				U.S.A (Florida & P. Rico)	178,000
				Venezuela	260,000
	8,020,000		3,258,000		5,831,000
GRAND TOTAL : 17,109,000 ha or 1,71,090 Sq. km					

Major areas of mangrove forests in different states in India have been estimated by the Government of India in the Status Report, Dec., 1987 published by the Ministry of Environment & Forests, estimated areas of mangroves with the help of Indian Remote Sensing data

and also the Forest Survey of India published in the State Forest Report, 1997 regarding the areas of mangrove forests of different states. All these data regarding the areas of mangrove in India (sq. km) is shown in Table 8.

Table - 8 : AREA WISE DISTRIBUTION OF MANGROVES IN INDIA

Sl. No.	State/Union Territory	Area*	Area**	Area***
1.	West Bengal (Sundarbans)	4200	1619	2123
2.	Andaman & Nicobar Islands	1190	770	966
3.	Maharashtra	330	138	124
4.	Gujarat	260	1166	991
5.	Andhra Pradesh	200	480	383
6.	Tamil Nadu	150	90	21
7.	Orissa	150	187	211
8.	Karnataka	60	19	3
9.	Goa	200	5	3
10.	Kerala	16	16	17
	Total	6756	4490	4844

Note : The value of area has been rounded to the nearest 10 sq. km.

Sources :

* Status reports on mangroves in India, Government of India, Ministry of Environment & Forests, December 1987.

** Indian Remote Sensing Data (Nayak, 1993)

*** State of Forest Report, 1997; Forest Survey of India, Government of India.

Percentage of total survey work done on the above mangrove areas in India are as follows :

	Areas	% of Survey
1.	Sundarbans—West Bengal	70%
2.	Mahanadi Delta—Orissa	80%
3.	Godavari-Krishna Delta—Andhra Pradesh	80%
4.	Cauvery Delta—Tamil Nadu	50%
5.	Backwaters of Kerala and Cochi	55%
6.	Karnataka Mangroves	80%
7.	Mangroves of Goa	80%
8.	Mangroves of Maharashtra	65%
9.	Mangroves of Gujarat	62%
10.	Mangroves of Andaman & Nicobar Islands	60%

Mangrove Areas need attention for further study :

1. Some islands of Sundarbans
2. Mahanadi Delta proper (Kujang Division)
3. Coringa Bay
4. Krishna Delta—Nuchgunta areas
5. Cochi, Vembanad, Quilon
6. Coondapur, Hanover
7. Narmada and Tapi mouth
8. Kuchchh, Khambat and Saurashtra
9. Nicobar Island

SPECIES DIVERSITY

Except one fern genus *Acrustichum* all the trees, shrubs and herbs in this group belong to the families of Angiosperm. They exhibit a similar physiognomy with dark green shining foliage, mostly with negative geotropic roots, much aerenchymatous tissues and viviparous germination, almost absence of epiphytes, general scarcity of parasites and less under growth. Localised occurrence of climber and lianas are characteristic biodiversity features of the mangrove ecosystems. Among the climbers, species of *Derris*, *Finlaysonia*, *Tylophora*, *Mucuna*, *Sarcolobus* and *Flagellaria* are locally common.

Distribution of 30 families, 43 genera and 69 species excluding salt marshes and some orchids available in mangrove habitat, is an interesting feature in Indian mangroves. The species diversity in Indian mangrove is related to its available ecological conditions from the Sundarbans towards the Gujarat. The richness of the species decreases from the East coast towards the West coast and finally form monotypic strand in the western part of the Gulf of Kuchchh. In the East coast there are 30 families 43 genera and 63 species excluding salt marshes and Orchids. On the West coast there are 23 families 25 genera and 35 species excluding salt marshes and Orchids and in Andaman and Nicobar island there are 25 families 32 genera and 45 species excluding salt marshes and Orchids. There are about 28 mangrove species, which show restricted distribution only along East coast, and they have not extended their distribution along the west coast. Similarly, there are 1 or 2 mangrove species, which have been reported only from West coast and not extended their distribution along the West coast. In the Andaman and Nicobar islands there are atleast 6 species restricted in the oceanic mangrove environment and are not extended either in East coast or West coast. Similarly, 22 species which occur in the East coast have not been found extended in the Andaman and Nicobar islands.

Table - 9 : DIVERSITY OF FAMILY, GENERA & SPECIES (Excluding salt marshes and Orchids)

	India	East Coast	West Coast	Andaman & Nicobar Islands
Families	30	30	23	25
Genera	43	43	25	25
Species	69	63	35	45



Mangroves of Goa



Backwater Mangroves of Kerala



Mangrove formation near Kori Creek in Kutchh, Gujarat



Mangroves of Andaman Islands

Ten dominant mangrove family in India along with the number of species distributed in East Coast, West Coast and Andaman & Nicobar islands are given in Table 10.

Table - 10 : TEN DOMINANT FAMILIES

Family	No. of Species		
	East Coast	West Coast	Andaman & Nicobar Islands
Rhizophoraceae	10	6	9
Avicenniaceae	3 + 1(var.)	3+1(var.)	3
Sonneratiaceae	4	2	1
Meliaceae	3	2	2
Stereuliaceae	3	—	1
Arecaceae	2	—	2
Papilionaceae	5	2	4
Caesalpinjiaceae	5	2	4
Asclepiadaceae	5	—	3
Poaceae	2	3	—

Mangrove diversity depends on the habitat where inter-mixture of fresh and salt water is maximum. The case is very evident in the Mahanadi delta in Orissa where mangrove area is too small, about 215 sq. km but influence of fresh water and opportunity of intermixing the fresh and salt water is ample, specially along the Bhitarkanika reserve forests. Probably due to the above factor, Mahanadi delta possesses maximum number of mangrove species (63) concentration in India with one new mangrove species and several new records. Sundarbans with 4,200 sq. km mangrove land have 61

mangrove species out of 69 numbers in India. The Godavari, Krishna, Cauvery delta and the West coastal mangroves show less number of mangrove species and the species which can only thrive with the influence of more fresh and saline water mixture are totally absent among these areas.

Diversity of mangrove flora is represented by several families, genera, species and varieties. Diversity in families, genera, species and varieties of mangroves in the Indian subcontinent along with distribution is presented in the Table 11.

Table - 11 : MANGROVE SPECIES ALONG THE EAST COAST, WEST COASTS AND ANDAMAN & NICOBAR ISLANDS

Name of Species	East Coast	West Coast	Andaman & Nicobar Islands
<i>Acanthus ebracteatus</i> Vahl	-	-	+
<i>A. ilicifolius</i> L.	+	+	+
<i>A. volubilis</i> Wall.	+	-	+
<i>Acrostichum aureum</i> L.	+	+	+
<i>A. speciosum</i> Willd.	-	-	+
<i>Aegialitis rotundifolia</i> Roxb.	+	-	-
<i>Aegiceras corniculatum</i> (L.) Blanco	+	+	+
<i>Aglaia cucullata</i> (Roxb.) Pellegrin	+	-	-

Name of Species	East Coast	West Coast	Andaman & Nicobar Islands
<i>Avicennia alba</i> Blume	+	+	+
<i>A. marina</i> (Forsk.) Vierh.	+	+	+
<i>A. marina</i> var. <i>acutissima</i> Stapf. & Mold.	+	+	-
<i>A. officinalis</i> L.	+	+	+
<i>Brownlowia tersa</i> (L.) Kosterm	+	-	+
<i>Bruquieria cylindrica</i> (L.) Bl.	+	+	+
<i>B. gymnorhiza</i> (L.) Lamk.	+	+	+
<i>B. parviflora</i> Wight & Arn. ex Griff.	+	-	+
<i>B. sexangula</i> (Lour.) Poir	+	+	+
<i>Caesalpinia bonduc</i> (L.) Roxb	+	+	+
<i>C. crista</i> L.	+	+	-
<i>Cerbera manghus</i> L.	+	+	+
<i>Ceriops decandra</i> (Griff.) Ding Hou	+	+	+
<i>C. tagul</i> (Perr.) Rob.	+	+	+
<i>Clerodendron inerme</i> Gaertn.	+	+	+
<i>Cryptocoryne ciliata</i> (Roxb.) Schott.	+	-	-
<i>Cynometra tripa</i> Kostel	+	-	+
<i>Cynometra ramiflora</i> L.	+	-	+
<i>Dalbergia spinosa</i> Roxb.	+	-	+
<i>Derris scandens</i> (Roxb.) Benth.	+	+	+
<i>D. heterophylla</i> (Willd.) Back. & Bakh.	+	+	+
<i>Dolichandrone spathacea</i> (L.f.) K. Schum	+	+	+
<i>Excoecaria agallocha</i> L.	+	+	+
<i>Fimbristylis ferruginea</i> (L.) Vahl.	+	+	+
<i>Finlaysonia obovata</i> Wall.	+	-	+
<i>Flagellaria indica</i> L.	+	+	+
<i>Heritiera fomes</i> Buch. Ham	+	-	-
<i>H. littoralis</i> Dryand.	+	+	+
<i>H. kanikensis</i> Mj. et Ban.	+	-	-
<i>Hibiscus tiliaceus</i> L.	+	+	+
<i>Hoya parviflora</i> (Roxb.) Wall.	+	-	+
<i>Intsia bijuga</i> (Colebr.) O. Kunt.	+	-	+
<i>Ipomoea tuba</i> (Schl.) G. Don	+	+	-
<i>Kandelia candel</i> (L.) Druce	+	+	-
<i>Lumnitzera littorea</i> (Jack.) Voigt.	-	-	+
<i>L. racemosa</i> Willd.	+	+	+
<i>Merope angulata</i> (Willd.) Swingle	+	-	-

Diversity of Coastal Plant Communities in India

Name of Species	East Coast	West Coast	Andaman & Nicobar Islands
<i>Mucuna gigantea</i> (Willd.) DC.	+	+	+
<i>Myriostachya wightiana</i> (Nees ex Steud.) Hook. f.	+	-	+
<i>Nypa fruticans</i> (Thunb.) Wurm.	+	-	+
<i>Phoenix paludosa</i> Roxb.	+	-	+
<i>Porteresia coarctata</i> (Roxb.) Tateoka	+	+	-
<i>Rhizophora apiculata</i> Bl.	+	+	+
<i>R. mucronata</i> Lamk.	+	+	+
<i>R. stylosa</i> Griff.	+	-	-
<i>Salvadora persica</i> L.	+	-	-
<i>Sarcobolus carinatus</i> Wal.	+	-	+
<i>S. globosus</i> Wal.	+	-	-
<i>Scirpus littoralis</i> Schrad.	+	-	-
<i>Scyphiphora hydrophyllacea</i> Gaertn. f.	+	-	+
<i>Sonneratia alba</i> J. Smith	-	+	-
<i>S. apetala</i> Buch.-Ham.	+	+	-
<i>S. caseolaris</i> (L.) Engl.	+	+	+
<i>S. griffithii</i> Kurz	+	-	+
<i>Thespesia populnea</i> (L.) Sol. ex Correa	+	+	+
<i>T. populneoides</i> (Roxb.) Kntel	+	-	-
<i>Tylophora tenuis</i> Bl.	+	-	+
<i>Urochondra setulosa</i> C. E. Hubb.	-	+	-
<i>Xylocarpus granatum</i> König	+	-	+
<i>X. mekongensis</i> Pierre	+	-	+
<i>X. moluccensis</i> (Lamk.) Roem	-	-	+

Following members of Asclepiadaceae and Orchidaceae are found only in Andaman & Nicobar Islands :

Name of Species	East Coast	West Coast	Andaman & Nicobar
<i>Cymbidium madidum</i> var. <i>lerove</i> (St. Cloud) Menniger	-	-	+
<i>Dischidia benghalensis</i> Coleb.	-	-	+
<i>D. nummularia</i> Br.	-	-	+
<i>Dendrobium crumenetum</i> Rchb. f.	-	-	+
<i>D. teretifolium</i> var. <i>fasciculatum</i> Rupp.	-	-	+
<i>D. discolor</i> Ldl.	-	-	+
<i>D. grande</i> Hk. f.	-	-	+
<i>Eria pudica</i> Lindl.	-	-	+
<i>Pholidota imbricata</i> Londl.	-	-	+

The following Salt marshes/Halophytes are also found associated along the degraded part of blanks/salt pans in the mangrove forests

Name of Species	East Coast	West Coast	Andaman & Nicobar Islands
<i>Aeluropus lagopoides</i>	+	+	-
<i>Arthrocnemum indicum</i> (Willd.) Moq.	+	+	-
<i>Cressa cretica</i> L.	+	+	-
<i>Heliotropium curassivicum</i> L.	+	+	-
<i>Salicornia brachiata</i> Roxb.	+	+	-
<i>Sesuvium portulacastrum</i> L.	+	+	-
<i>Suaeda fruticosa</i> (L.) Forsk.	+	+	-
<i>S. maritima</i> (L.) Dumort.	+	+	-
<i>S. monoica</i> Forsk. ex Gmel.	+	+	-
<i>S. nudiflora</i> (Willd.) Moq.	+	+	-
<i>Tamarix troupitii</i> Hole	+	+	-
<i>Salsola kali</i> L.	-	+	-

Endemic mangrove species in India :

Very few mangrove species are found endemic in Indian subcontinent. From the World distribution records and extensive survey from different parts of India the following mangrove species are seem to be endemic:

Acanthus ebracteatus Vahl.

Acanthus volubilis Wall.

Browntonia tersa (L.) Kost.

Dalbergia spinosa Roxb.

Fintaysonia obovata Wall.

Heritiera fomes Mj. et Ban.

Thespesia populnea (Roxb.) Kostel

Phoenix paludosa Roxb.

Sonneratia apetala Buch.-Ham.

Urochondra setulosa C.E. Hubb.

STRUCTURE, CLASSIFICATION AND FUNCTION OF MANGROVE VEGETATION IN INDIA

In India, study of mangrove zonation was proposed in a consolidated account by Champion &

Seth (1968). However, between 1936 and 1957 isolated attempts have been made by many authors, as evident in the papers submitted at the Mangrove Symposium (1957). During recent years, Rao & Sastry (1974), Blasco (1975), Raju (1968), Meher-Homji (1973), Blasco & Caratini (1973), Caratini *et al.* (1973), Chapman (1976), Mukherjee & Mukherjee (1978), Banerjee (1987, 1989) and others have studied mangrove vegetation, classification and zonation based on regional settings, correlating with the localized environmental factor. The present study has been conducted mainly on the role of salinity in the mangrove plant communities and how the changes of the salinities affect the zonation pattern of mangrove vegetation through out the Indian sub-continent. Other ecological factors and the morphological adaptation of species are also briefly highlighted here in support of the mangrove zonation pattern.

The mangrove areas in India experience a tropical humid climate. A hot season is followed by rainy season which extends from June to October with annual rainfall ranging from 2500-3000 mm. The areas are subjected to cyclonic disturbances, especially during the months of October and November. Maximum temperature varies from 25-35°C and the minimum from 12-24°C. The areas receive a seasonal variation of tidal inundation according to the distance

from river mouth towards the inland areas, the major characteristics of which are summarized in Table - 12.

The tidal level varies from the estuarine mouth towards the inland areas, and is subjected to wide seasonal variation. The maximum height observed is 6.0 m during July-August near the river mouth and 2.5 m towards inland areas from the tide datum. The minimum is found to be 3.5 and 1.0 m during February-March.

The physical characteristics of soils indicate silty clay as the dominant texture. Soil are saline and dominated mostly by sodium chloride. The soil reaction is slightly acidic to neutral, and is subjected to wide seasonal variations. The salinity ranges from EC 30-12 mmhos/cm in the outer estuarine belt, and EC 24-1 mmhos/cm in the inner estuarine belt. Mineral montmorillonite in association with halloysite and illite are common in the deltaic region. The salinity of river-water varies seasonally and decreases from the river mouth to the inland areas. Seasonal salinity ranges at a depth of 30 cm indicate that maximum salinity is EC 33 mmhos/cm at the estuarine mouth during January-March, decreasing gradually to EC 18 mmhos/cm towards the inland tidal creeks. The minimum ranges from EC 2-10 mmhos/cm in the transitional or hinterland areas.

In the present work, salinity characteristics, topographic diversity and species composition have been used as a basis to classify the mangrove community, which has been divided into two major types: **outer estuarine mangals** and **inner estuarine mangals**. Considerable changes in the zonation of mangrove vegetation extending from mouth of estuaries up to the influence of saline tidal water flow to the inner riverine system are recognized in the sequence of plant zonation and influence of interacting salinity conditions from the river mouth to the inner riverine system. Under this pattern, the efficiency with which each mangrove species tolerates salinity and tidal conditions largely determines its intertidal position and the nature of its morphological adaptations. Outer estuarine regions with great ecological stress are influenced by the open coastal environment having the same salinity conditions, as that of the sea water and produce a restricted zone on this open coastal environment. Outer estuarine banks under an open coastal environment experience high salinity, high tidal flow and silt deposition. Some mangroves which are adapted by means of salt excretory glands are more common and are restricted to this habitat. This type has been named as Estuarine Mangals.

Table - 12 :

Areas	Salinity EC mmhos/cm depth 30 cm				Tide level from tide datum in metre			
	J M	A J	J-S	O-D	J M	A-J	J-S	O-D
Outer estuaries	33	29	18	26	3.5	4.5	6.0	3.5
Inner estuaries								
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/ hinterland areas	10	8	2	9	1.0	2.0	2.5	1.0

Table - 13 : Analysis of soil particles; data represent average values of 10 samples from each type

Areas	Particle size distribution, depth 10-20 cm				pH	Organic matter %	EC range (mmhos/cm)
	Clay %	Silt %	Fine sand %	Coarse sand %			
Outer estuaries	31	44	19	7	6.8	2.5	33-18
Inner estuaries							
1. Creeks at lower elevation	42	30	22	3	6.9	3.0	25-11
2. Creeks at higher elevation	50	29	17	2	7.1	3.5	20-06
3. Transitional/hinterland areas	25	03	40	24	6.3	4.8	10-02

Table - 14 : Distribution of mangrove species and salinity conditions from the outer estuary towards the riverine system up to the limit of saline tide water flow

Tidal flat	Characteristics of tidal flats	Salinity EC (mmhos/cm)	Plant association	Adaptation	Proposed classification type
1. Outer estuarine or open shore	Near the sea, minimum number of creeks and channels, influence of shore environment	18-33	<i>Avicennia marina</i> , <i>Aegialitis</i> , <i>Luonnitzera</i> - <i>Sonneratia</i> association	Presence of salt excretory glands and salt water storage mechanism	Outer estuarine mangroves or Estuarine Mangals
2. Inner estuarine or sheltered coast					
a) Upper part of the inner estuary	Situated in sheltered coast line, away from the sea. Maximum number of creeks and channels, at lower elevation, high tidal velocity and influence of fresh water flow	11-25	<i>Rhizophora-Kandelia-Ceriops</i> and <i>Aegiceras</i> association	Presence of stilt roots and vivipary	True mangrove
b) Middle part of the inner estuary	Lesser number of creeks and channels at higher elevation, influence of more fresh water flow	6-20	<i>Heritiera fomes</i> - <i>Xylocarpus-Cynometra</i> - <i>Cerbera-Irsia</i> and <i>Phoenix</i> association	Presence of woody pycnomorphores	Semi-mangrove
c) Lower part of the inner estuary	Lesser number of creeks and channels which are suddenly shut-off due to formation of sand bars. The higher relief is influenced by monsoonal or abnormal tides	02-10	<i>Dalbergia spinosa</i> , <i>Derria-Plourenia</i> - <i>Acanthia</i> association	Usually possess no adaptive features like above	Transitional mangroves

By contrast, the inner estuarine regions or the inner riverine landscape just behind the river mouth are associated with several creeks, channels and islets and develop a gradation of salinity conditions due to increased fresh water flow. These regions harbour many interesting mangrove species with different adaptive mechanisms and form a distinct zone in these regions.

Depending on the influence of small scale variation of salinity conditions and different edaphic and tidal variations, adaptive modification of taxa grouped under different tidal flats provide very interesting key points which are helpful in subdividing plant communities again into three zones: Typical mangrove zones or true Mangroves communities, Less pronounced mangrove zones or semi mangroves communities and transitional or hinterland mangrove zones or Transitional Mangroves communities.

Members of Rhizophoraceae with stilt roots (except, *Bruguiera gymnorhiza* with knee roots) and viviparous habit spread over a tidal relief of considerable depth with high tidal velocity along the creeks and channels. These conditions, perhaps show a true picture of the mangrove community or true Mangals.

Again, *Sonneratia*, with peculiar association of *Aglaia*, *Cynometra* and *Xylocarpus* species, possess woody many pneumatophores and buttresses and spreads over a tidal relief of shallow depth along the higher banks of creeks and channels. The disappearance of plant communities with stilt roots and viviparous habit but appearance of different plant communities with woody pneumatophores, probably indicate changed habitat conditions and give an incomplete picture of a Mangrove community or semi mangals. Lastly, hinterland flora includes such taxa that do not produce the above adaptive features and spread over a relatively higher relief, where only monsoonal and abnormal spring tide keep the conditions transient. Plant communities in this zone can extend from saline habitat to relatively less salt conditions known as Transitional Mangals.

The typical mangrove zone is the same as the 'True mangroves' of Stamp (1926) and 'Typical mangroves' of Chatterjee (1957). The less pronounced mangrove zone is the same as the 'Semi-mangroves' of Transley and Fortisch (1905), and the hinterland flora

is the same as the 'Transitional mangroves' of Chapman (1977). In an arid climate, as salinity increases landwards, this zonation is found to be restricted to a narrow band on the coast line. The presence of more channels and creeks, the higher velocity of tidal waves, moderate salinity conditions, the absence of stranded beach ridges and the presence of *Rhizophora* species usually delimit the inner estuarine tidal flats from the outer estuarine flats.

Outer estuarine zones :

Mangals along the broadest regions of river estuaries are influenced by the open shore environment. The lower units of these tidal flats are mainly dominated by *Avicennia marina* (Forsk.) Vierh. excluding the newly exposed areas covered with saline grass *Porteresia coarctata* (Roxb.) Tateoka, and the upper units are mostly covered with *Sonneratia griffithii* Kuez, *Bruguiera cylindrica* (L.) Bl., *B. parviflora* Wt. & Arn. ex Gill., *Sonneratia alba* J. Sm., *Avicennia alba* Blume, *Lumnitzera racemosa* Willd., *Ceriops tagal* (Perr.) Rob., *Aegialitis rotundifolia* Roxb. and sometimes *Phoenix pabudosa* Roxb. The presence of salt excretory glands in the petioles and leaves of *Avicennia marina* and the increased water storage mechanism in the leaves of *Sonneratia*, *Lumnitzera* and *Aegialitis* species (Chapman 1976) are the adaptive mechanism for withstanding the high salinity conditions of the open shore environment.

Inner estuarine zones :

The inner estuarine or riverine landscape associated with several creeks, channels, islets and fringes provides a favourable habitat for many mangroves and the flora becomes richer and diversified. Compared to that of the open shore type, the vigour of the sea surf is broken as a result of several outlying creeks and channels. Strong wind action and continuous salt spray are not effective due to the sheltered situation of these locations. Field observation revealed that plant groupings with the characteristic adaptive features change in relations to different elevation of terrain, nature of tidal flows, salinity conditions, influence of fresh water and sediment types.

Tidal flats which are associated with a maximum number of creeks and channels along the upper part of the inner estuarine zones, where the topography is sloped to an elevation of less than 5 m above the mean sea level and most frequently traversed by every tide, are characteristic of a typical mangrove zone. Here the influence of fresh water supply is comparatively more, but the tidal velocity is higher due to the presence of numerous creeks. The distribution and zonation of different species along these tidal flats depend upon two landforms arranged more or less parallel to the waterline. The lower units, or low tidal zones, which are exposed only during low tide, are mainly dominated by *Rhizophora apiculata*, *R. mucronata*, *Kandelia candel*, *Aegiceras corniculatum* associated with *Xylocarpus granatum*, *Excoecaria agallocha* and *Bruguiera gymnorrhiza*. A very low step gradually separates the lower unit from the higher unit which is characterized by a dense cover of mangroves associated with some climbers, undershrubs and parasites. This is mainly colonized by *Ceriops decandra*, *Bruguiera gymnorrhiza*, *Xylocarpus mekongensis*, *Avicennia officinalis*, *Phoenix paludosa*, associated with *Acanthus ilicifolius*, *Merope angulata*, *Dalbergia horrida*, some climbers like *Finlaysonia obovata*, *Derris scandens*, *Tylophora tenuis*, *Hoya parasitica* and others.

Rhizophora, *Kandelia* and *Aegiceras* adapted with their stilt roots and viviparous habit develop magnificently along the lower intertidal regions, perhaps to give full protection against the high velocity of tidal current to the next higher unit. *Avicennia officinalis* and *Excoecaria* usually occur behind the *Rhizophora* community, whereas *Bruguiera gymnorrhiza* does not show any preference for a particular zone, but is found mixed with other species.

Tidal flats along the middle part of the inner estuarine or riverine areas are away from the Bay and more nearer to fresh water sources where the topography is gently sloped to an elevation of more than 5 m but less than 10 m above the mean sea level. These zones are also influenced by several creeks and channels, but at higher elevation. Salinity is lower due to the greater influence of fresh water flow. Lower intertidal units of the region are frequently covered with *Sonneratia*

apetala Buch.-Ham., *S. caseolaris* (L.) Engl., *Aegiceras corniculatum* (L.) Blanco, and *Avicennia alba* Bl., but the middle and upper units are largely colonized by dominant *Heritiera fomes* Buch.-Ham., in association with *Brownlowia tersa* (L.) Kosterm., *Cynometra iripa* Kostel., *Aglaiia cucullata* Pellegrin, *Cerbera manghas* L., *Intsia bijuga* Kuntz., *Bruguiera sexangula* (Lour.) Poir., *Xylocarpus mekongensis* and sometimes *Bruguiera gymnorrhiza*. Most of the species in this habitat show adaptations like knee roots, peg-like pneumatophores, blind root suckers and buttresses, probably for withstanding less aerated conditions of the mud and for supporting the massive bole. This morphological adaptation give a distinct stamp to the topography, distinguishing this type from the previous one.

Brownlowia tersa, *Dalbergia spinosa*, *Acanthus ilicifolius* and scattered growth of *Phoenix paludosa* form a shrubby layer. *Crimum asiaticum*, *C. defixum*, *Myriostachya wightiana* and *Fimbristylis ferruginea* form the common herbaceous layer. The climbers, *Derris heterophylla*, *Mucuna gigantea*, *Flagellaria indica* and *Acanthus volubilis* are common in this type. Along the western coast, where the tidal flats are mainly inundated with sea water flow, this zone is either absent or seems to be very limited.

Flood plains along the transitional areas of hinterlands of the inner estuaries, where creeks and channels are suddenly shut off due to the formation of natural sand bars, are usually devoid of regular tidal flow, and the one-way flow of tidal current, mostly during abnormal spring tide, keeps the conditions transient. These zone are mainly dominated by *Heritiera littoralis*, *Thespesia populnea*, *Acanthus ilicifolius*, *Pongamia pinnata*, *Clerodendrum inerme* and *Caesalpinia bonduc* associated with some fresh water riverine elements like *Syzygium ruscifolium*, *Carissa spinarum*, *Ochna obtusata*, *Alphanso ventricosa*, *Manilkara hexandra*, *Diospyros cordifolia*, *D. buxifolia* and others.

Most of the species in these zones possess no adaptive features like stilt roots, pneumatophores or knee roots. Further increase in elevation, deposition of sand and the accumulation of more organic matter change the habitat unfavourably for any type of formation



A view of Andaman Mangroves



Mangroves of North Andaman



Mangroves of South Andaman



Bird's permanent nest in Andaman Mangroves

mentioned above and the fern, *Acrostichum aureum*, in association with *Tamarix troupiti*, *Salvadora persica* and others commonly dominate over the region. Thus three zonal structures have been classified and named in the inner estuarine region as follows :

(a) a zonal structure of typical mangrove habitat or true mangals with the members of Rhizophoraceae adapted by means of vivipary and stilt roots.

(b) a zonal structure of less pronounced mangrove habitat or semi-mangals associated with different groupings of taxa adapted by means of pneumatophores and buttresses.

(c) a zonal structure of transitional or hinterland mangrove area with the mingling of the upland flora due to sudden change of habitat, known as transitional mangals.

Function of Mangroves :

The uses and values of mangroves and the mangrove ecosystem are many. People along the coast are constantly depending on the products of mangroves directly or from the amenities provided by the resources. Majority of the people inhabiting in and around the mangrove woods, are using the species of *Avicennia* due to its high calorific value as fire wood even in green conditions. In addition, mangroves are potential source of good charcoal and alcohol. Production of alcohol from *Nypa fruticans* can be used as transport fuel. Many species of mangroves produce good timbers and plywoods for furniture and several construction works like boat and ship building, heavy construction work like bridges, mining pits, beam, pools, etc. Almost all the members of Rhizophoraceae produces heavy tannins, adhesives and glues. Species of *Heritiera* produces synthetic fibres (rayon) and durable flooring and panelling materials for ship. Species of *Aglaia* and *Xylocarpus* produces beautiful household articles and furniture. Decoction from the fruits of *Xylocarpus* is said to give good remedy for breast cancer. Species of *Excoecaria* and *Sonneratia* produce paper pulp and various types of soft wood. Besides the production of sugar, alcohol, vinegar and fermented drinks, *Nypa* leaves provide very long lasting thatching materials and

matting articles due to presence of waxy coating. It is observed that roof thatched from *Nypa* leaves could last for 10 years or more. Many species of mangroves are producing several medicinal and other usable products such as, decoction of bark of *Rhizophora* produce medicines for diarrhoea, dysentery, stops bleeding, neck inflammation and leprosy. Bark and sap of *Cerbera* are purgative, its fruit and seeds produce medicinal oil for rheumatism.

Pneumatophores of *Bruguiera* produce scent. Leaves of *Avicennia* are good fodder of domestic buffaloes and increase their milk production. Leaves of *Sonneratia* are good fodder of deer and fruits are used for vegetable, jam and jelly preparation. Fruits of *Avicennia* and *Sonneratia* are good fish food. Value of the mangrove ecosystem components for several natural wildlife products are also interesting. Many natural products like marine fishes, crustaceans, shellfish, honey, wax, skin of reptile, birds, amphibians insects and mammals are associated in the mangrove ecosystem. Gross production of phytoplankton, the primary producer in the mangrove ecosystem is found higher than the nearshore water. The main contribution of mangrove plants in this ecosystem is the litter fall and the consequent as detrites for supplying productive nutrition in the ecosystem.

Environmentally and ecologically, the major amenities provided by the value of mangrove communities is not possible to evaluate with the help of monetary value. Mangroves serve as a natural border security forces for reducing coastal erosion, to dampen storm surges, cyclonic floods and wind velocity. Along the river banks and estuarine mouth, lining of mangroves with their stilt root system functions as tide-breaker to prevent the high speed of saline tide water flow and winds for protecting adjacent inland vegetation and properties. They help in soil formation by trapping debris, protect rich organic soil washed down through river system to the sea and provide rich nursery ground for many marine fishes, invertebrates, molluscs, birds, reptiles and crustaceans. Endangered Royal Bengal Tiger, Proboscis monkey of Borneo and Olive Ridley turtles of Orissa are found only in the Mangrove habitat.

In the estuarine ecosystem, mangroves create sea-river interphase and buffer high salinity, regulate rich organic-laden water flow, stabilize the alluvial soils brought from the rivers and fix the sediments of the sea with the detrites. Thus it produces one of the richest productive ecosystem for supporting valuable sustenance of the marine and estuarine biodiversity. Besides the high commercial value of mangroves in the field of fish production, edible crabs, tiger prawns, reptile skin, oysters, honey, fire-woods, timbers, poles and ship building materials, thousands of tourists visit every year to enjoy its wild life scenario, curious and adaptive nature of plants, endangered Royal Bengal Tigers, Reptiles, migratory birds and honey collection processes. These are, no doubt, important commercial source from mangrove ecosystem. Since mangroves are found in the fragile ecosystem, their scientific values rank among the most prioritised biodiversity research areas. The capacity of withstanding high saline water in the salt stress environment, production of stilt roots, woody and spongy breathing roots and viviparous germination of the seedlings to avoid unnecessary delay in dispersal mechanism are the most critical scientific values for research. Scientific research on the behaviour of wildlife in this dynamic ecosystem is an important field of investigation. Bacterio-fungal decomposers thriving to convert mangrove litters into consumable protein which are used by fish population and ultimately end up with the foodchain of tigers and crocodiles in this system is an interesting and valuable scientific research item. The Sundarban's Royal Bengal Tiger (*Panthera tigris tigris*) roam unabated as a top predator in the mangrove land forming the largest tiger colony on globe. The development of its unique trait of drinking saline water and taking aquatic food as part of its menu, is the most valued of scientific research. The principle terrestrial prey of tiger are Chital or spotted deer which show remarkable adaptation of excreting salts through lacrymal secretion is also of scientific value. Young hatchlings of Olive Ridley turtles (*Lepidochelys olivacea*) has shown remarkable development even up to 8 months in the mangrove water way and probably

use mangrove detrites in their food chain. Scientific value of this research will also be of much interesting. A new field of scientific value of mangroves is seen when mangroves are found to function as a buffer against the oil-slicks washed down from the sea and in some areas mangroves are seen to grow faster when they are bathed in tidal waters enriched with sewage effluents. In Machilipattanam and Nizampattanam (Andhra Pradesh) and the old Salt Lake system of Kolkata, mangroves are found well developed alongside solid and liquid waste disposal under the regular tidal flow. Thus the capacity of mitigating water pollution by the mangrove species will be of great scientific value. In India, most of the human settlements are located along the coastal belts and density of the population is more towards the estuarine and deltaic complexes where the complex and diverse mangrove systems develop a traditional interaction between the mangroves and human livelihood. The mangrove forests are traditionally being used for firewood, charcoal, tannin, house and boat building materials, for fish, crabs, oysters, shellfish, honey, wax and others natural resources, which are very important substance of commercial value. The direct uses may sustain communities whose economy is based on harvesting other minor products. Thus, viability of this mangrove ecosystem for minimum requirement of the people's livelihood depend on the management and protection of the natural resources in a sustainable way and therefore, humanity must be related for giving special care for preservation of mangroves.

Status of Indian Mangroves

The mangrove ecosystem is itself vulnerable and fragile. There are many species, which are restricted to some localized areas due to some special ecological factors or some species, which are largely threatened due to excessive demographic pressure, over utilization, over exploitation and loss of habitat. Some of the rare and threatened species of Indian mangrove are represented in the following Table - 15 :

Table - 15 : STATUS OF MANGROVES IN INDIA

Name of the Species	Distribution	Status
<i>Acanthus volubilis</i> Wall.	Only in one population in Sundarban.	Rare due to loss of habitat
<i>Aegialitis rotundifolia</i> Roxb.	Restricted only in East Coast up to Krishna Delta.	Threatened due to over utilization.
<i>Brownlowia tersa</i> (L.) Kosterm	Restricted in Sundarbans, Orissa and Andaman.	Threatened due to over exploitation.
<i>Bruguiera sexangula</i> (Lour.) Poir.	Restricted only in Sundarbans, Orissa and Goa.	Rare due to lack of ecological condition.
<i>Cryptocoryne ciliata</i> (Roxb.) Schott.	Restricted in Sundarbans and Orissa.	Rare due to over-exploitation.
<i>Cynometra iripa</i> Kostel	Only one or two plants are localized in Sundarbans, Orissa and Andaman.	Rare due to over exploitation.
<i>Dolichandrone spathacea</i> (L. f.) K. Schum.	Restricted in Orissa and Andaman	Rare due to over exploitation.
<i>Finlaysonia obovata</i> Wall.	Monotypic, only in Sundarbans, Orissa and Andaman	Rare due to loss of habitat.
<i>Heritiera fomes</i> Buch.-Ham.	Restricted only in Sundarbans and Orissa.	Threatened due to changed habitat conditions and over exploitation.
<i>Heritiera kanikensis</i> Mj. et Ban.	Restricted only in Orissa (New Species).	Threatened due to over exploitation.
<i>Intsia bijuga</i> (Colebr.) O. Kunt.	Restricted only in Orissa and Andaman. Previously reported from Sundarbans.	Rare due to loss of habitat.
<i>Lumnitzera littorea</i> (Jack.) Voigt.	Restricted only in Andaman.	Rare due to loss of ecological condition
<i>Kandelia candel</i>	East and West coast	Has become very rare.

Name of the Species	Distribution	Status
<i>Merupe angulata</i> (Willd.) Swingle	Though recorded from Sundarbans but collected only from Orissa.	Threatened due to over exploitation
<i>Mucuna gigantea</i> (Willd.) DC.	Reported only in Orissa and Kerala.	Rare due to loss of habitat.
<i>Nypa fruticans</i> (Thunb.) Wurm.	Restricted only in Sundarban and Andaman & Nicobar Is.	Threatened due to changed ecological condition and over utilization.
<i>Phoenix paludosa</i> Roxb.	Restricted only in Sundarban, Orissa and Andaman.	Threatened due to excessive demographic pressure for over utilization
<i>Rhizophora stylosa</i> Griff.	Only recorded from Orissa and Andaman.	Rare due to loss of habitat.
<i>Sarcobatus carinatus</i> Wall.	West Bengal, Orissa, Godavari delta and Andaman.	Rare due to over exploitation.
<i>Scyphiphora hydrophyllacea</i> Gaertn. f.	Restricted only in Godavari mouth and Andaman.	Rare due to over exploitation.
<i>Sonneratia alba</i> J. Smith	Restricted only in the West coast and one population in Orissa.	Threatened due to over exploitation.
<i>Thespesia populneoides</i> (Roxb.) Kostel	Restricted only in Sundarbans and Orissa.	Rare due to lack of special ecological condition.
<i>Tylophora tenuis</i> Bl.	Only found in Orissa, though reputed from Sundarbans but not collected.	Very rare due to changed ecological condition.
<i>Xylocarpus granatum</i> Koenig	Restricted in Sundarbans, Orissa and up to Godavari Delta and Andaman.	Threatened due to over utilization.
<i>Xylocarpus mekongensis</i> Pierre	Restricted only in Sundarbans, Orissa and Andaman.	Threatened due to over utilization

Table - 16 : WORLD DISTRIBUTION OF MANGROVE SPECIES

Family	Genus	Species	Habit	Geographical Regions	
				New World	Old World Indian Region
Acanthaceae	<i>Acanthus</i>	<i>ebRACTEATUS</i>	Shrub	-	10
		<i>ilicifolius</i>	Shrub	-	1,2,3,4,5,6,7,8,9,10
		<i>volubilis</i>	Climber	-	1,2,10
Apocynaceae	<i>Cerbera</i>	<i>manghas</i>	Tree	-	1,2,5,6,10
Areaceae	<i>Nypa</i>	<i>fruticans</i>	Shrub	-	1,10
	<i>Phoenix</i>	<i>paludosa</i>	Tree	-	1,2,10
Asclepiadaceae	<i>Finlaysonia</i>	<i>obovata</i>	Climber	-	1,2,10
	<i>Sarcobolus</i>	<i>globosus</i>	Climber	-	1,2,3,10
		<i>carinatus</i>	Climber	-	1,2,3,10
	<i>Tylophora</i>	<i>tenuis</i>	Climber	-	2,10
Avicenniaceae	<i>Avicennia</i>	<i>alba</i>	Tree	-	1,2,3,6,7,8,10
		<i>bicolor</i>	Tree	+	-
		<i>germinans</i>	Tree	+	-
		<i>integra</i>	Tree	+	-
		<i>marina</i>	Tree	+	1,2,3,4,5,6,7,8,9,10
		var. <i>australasia</i>	Tree	+	-
		var. <i>eucalyptifolia</i>	Tree	+	-
		<i>officinalis</i>	Tree	-	1,2,3,4,5,6,7,8,9,10
		<i>rumphiana</i>	Tree	-	-
		<i>schaueriana</i>	Tree	+	-
Bignoniaceae	<i>Dolichandrone</i>	<i>spathacea</i>	Tree	-	1,2,5,10
Bombacaceae	<i>Comptostemon</i>	<i>philippinensis</i>	Tree	-	-
		<i>schultzei</i>	Tree	-	-
Caesalpinaceae	<i>Caesalpinia</i>	<i>bonduc</i>	Tree	-	1,2,3,10
		<i>crinata</i>	Tree	-	1,2,3,10
	<i>Cynometra</i>	<i>iripa</i>	Tree	-	1,2,10
		<i>ramiflora</i>	Tree	-	1,2,5
	<i>Intsia</i>	<i>bijuga</i>	Tree	-	1,2,10
Combretaceae	<i>Conocarpus</i>	<i>erectus</i>	Tree	+	-
	<i>Laguncularia</i>	<i>racemosa</i>	Tree	+	-
	<i>Lumnitzera</i>	<i>littorea</i>	Tree	-	10
		<i>racemosa</i>	Tree	-	1,2,3,4,6,8,9,10
Convolvulaceae	<i>Ipomoea</i>	<i>tuba</i>	Climber	-	1,2,3

Family	Genus	Species	Habit	Geographical Regions	
				New World	Old World Indian Region
Cyperaceae	<i>Fimbristylis</i>	<i>ferruginea</i>	Herb	-	1,2,3
	<i>Scirpus</i>	<i>litoralis</i>	Herb	-	1,2,3,6
Euphorbiaceae	<i>Euclea</i>	<i>agallocha</i>	Tree	-	1,2,3,4,5,6,7,8,10
		<i>indica</i>	Tree	-	-
		<i>ovata</i>	Tree	-	-
Flagellariaceae	<i>Flagellaria</i>	<i>indica</i>	Climber	-	1,2,5,10
Lythraceae	<i>Pennisetum</i>	<i>acidula</i>	Tree	-	5,10
Malvaceae	<i>Hibiscus</i>	<i>tiliaceus</i>	Shrub	-	1,2,3,4,5,6,7,8,10
		<i>Thespesia</i>	Tree	-	1,2
		<i>populnea</i>	Tree	-	1,2,3,4,5,6,7,8,9,10
Meliaceae	<i>Albizia</i>	<i>cucullata</i>	Tree	-	1,2
		<i>granatum</i>	Tree	-	1,2,3,4,5,10
		<i>mekongensis</i>	Tree	-	1,2,10
		<i>malaccensis</i>	Tree	-	10
Myrsinaceae	<i>Acycos</i>	<i>corniculatum</i>	Shrub	-	1,2,3,5,6,7,8,9,10
		<i>floridum</i>	Shrub	-	-
Myrtaceae	<i>Osbornia</i>	<i>octodonta</i>	Shrub	-	-
Papilionaceae	<i>Dalbergia</i>	<i>spinosa</i>	Tree	-	1,2,3,10
		<i>scandens</i>	Tree	-	1,2,3,5,6,7,8,10
		<i>heterophylla</i>	Tree	-	1,2,3,5,6,7,8,10
	<i>Mucuna</i>	<i>gigantia</i>	Tree	-	1,2,5
Pelticaceae	<i>Pelticera</i>	<i>rhizophorae</i>	Tree	+	-
Plumbaginaceae	<i>Aegialitis</i>	<i>rotundifolia</i>	Tree	-	1,2,3
		<i>annulata</i>	Tree	-	-
Poaceae	<i>Myriostachya</i>	<i>wightiana</i>	Herb	-	1,2,3,5
		<i>Porteriana</i>	Herb	-	1,2,3,4,5,6,7,8
		<i>Urochorda</i>	Herb	-	9
Pteridaceae	<i>Acrostichum</i>	<i>aureum</i>	Herb	-	1,2,7,8,10
		<i>danceifolium</i>	Herb	-	-
		<i>speciosum</i>	Herb	-	10
Rhizophoraceae	<i>Bruguiera</i>	<i>cylindrica</i>	Tree	-	1,2,3,4,6,7,8,10
		<i>exaristata</i>	Tree	-	-
		<i>gymnorhiza</i>	Tree	-	1,2,3,4,5,6,7,8,10
		<i>hainestii</i>	Tree	-	-

Diversity of Coastal Plant Communities in India

Family	Genus	Species	Habit	Geographical Regions	
				New World	Old World Indian Region
		<i>parviflora</i>	Tree	-	1,2,6,10
		<i>sexangula</i>	Tree	-	1,2,10
	<i>Ceriops</i>	<i>australis</i>	Tree	-	-
		<i>decandra</i>	Tree	-	12,3,4,10
		<i>tagal</i>	Tree	-	1,2,5,7,8,9,10
	<i>Kandelia</i>	<i>candel</i>	Tree	-	1,2,3,5,6,7,8,10
	<i>Rhizophora</i>	<i>apiculata</i>	Tree	-	1,2,3,4,5,6,7,8,10
		<i>harrisonii</i>	Tree	+	-
		<i>mangle</i>	Tree	+	-
		<i>macronata</i>	Tree	-	1,2,3,4,5,6,7,8,9,10
		<i>racemosa</i>	Tree	+	-
		<i>samoensis</i>	Tree	-	-
		<i>stylosa</i>	Tree	-	2,10
Rubiaceae	<i>Scyphiphora</i>	<i>hydrophyllacea</i>	Shrub	-	3,10
Rutaceae	<i>Merope</i>	<i>angulata</i>	Shrub	-	1,2
Soneratiaceae	<i>Sonneratia</i>	<i>alba</i>	Tree	-	2,4,5,6,7,8
		<i>apetala</i>	Tree	-	1,2,3,4,7,8,9
		<i>caseolaris</i>	Tree	-	1,2,5,6,7,8,10
		<i>griffithii</i>	Tree	-	1,2,10
		<i>lanceolata</i>	Tree	-	-
		<i>ovata</i>	Tree	-	-
		<i>x gulgai</i>	Tree	-	-
		<i>x uramu</i>	Tree	-	-
Sterculiaceae	<i>Heritiera</i>	<i>fomes</i>	Tree	-	1,2
		<i>globosa</i>	Tree	-	-
		<i>kanikensis</i>	Tree	-	2
		<i>litoralis</i>	Tree	-	2,4,6,10
Tiliaceae	<i>Brownlowia</i>	<i>tersa</i>	Shrub	-	1,2,10
Verbenaceae	<i>Clerodendrum</i>	<i>inermis</i>	Shrub	-	1,2,3,4,5,6,7,8,10
31	48	96			

1 Sunderban (West Bengal), 2 Orissa, 3 Andhra Pradesh, 4 Tamil Nadu, 5 Kerala, 6 Karnataka, 7 Goa, 8 - Maharashtra, 9 - Gujarat, 10 - Andaman & Nicobar islands.

CONSERVATION AND MANAGEMENT OF MANGROVE ECOSYSTEM

Mangroves are considered as Static Border Security Forces against the cyclone, flood and storms to protect inland life and properties. Its ecosystem is providing highest importance by virtue of its biological productivity and sustainable life support to the people living in and around the coastal belt. It helps to maintain coastal atmospheric equilibrium, soil stabilization, building of new islands and extending the coastal lands through accretion. Global threat regarding the rise of temperature due to Green House drift and the sea level rise which may submerge the low lying areas along the coast such as Bangladesh and Eastern India can be overcome through suitable management of the mangrove vegetation, which help to increase the level of lands of those particular areas.

During the past, mangrove forests were exploited by the traditional users for firewood, domestic fuel, charcoals, fodder, etc. and for that many of the mangrove forests were destroyed in different parts of India. Subsequently other uses like timber, plywood, paper pulps, conversion of mangrove forest areas into other land use pattern and construction of railway lines were the serious problems for conservation of mangrove forests.

In the present day the problems of conservation have become more serious due to increased population pressure, political division of the country, encroachment of land for rehabilitation, development of different industries, thermal and hydroelectric power projects, diversion and blockage of natural canals and creeks, resettlement, aquaculture and agricultural activities, construction of new ports and conversion of mangrove land to urban development schemes along the coastal belts. Increased population pressure and exploitation over the last hundred years have led to noteworthy reduction of both floristic components as well as the areas of mangrove cover in India. The Kerala back water system was once supported by luxuriant growth of mangrove formation but now very few mangroves are seen in the midst of coconut plantation. During the last 2-3 centuries the mangrove forest areas in Sundarbans have been seriously reduced due to agricultural and aquacultural practices. The remote

sensing study indicates a reduction of 20 sq. km of area of mangrove forests during last 10 years in Orissa. In Saurashtra, Gulf of Kutch and Gulf of Khambhat, significant reduction of mangrove forests were seen due to constant pressure for fodder, fuel and camel grazing. Mangroves in Maharashtra, Andaman and Nicobar islands and Sundarbans are facing major problems for more land required in Urban Development Scheme and for agricultural practices. All the above destructive activities on the mangrove forests have given the chances to realize the practical value of the mangrove ecosystem in India by several ways. However, before the early 1980's it was not possible to check the malady for destruction of mangrove area in India.

Now the significance of mangrove ecosystem has been realized throughout the world. Many countries like Australia, Thailand, Malaysia, Vietnam, Indonesia, Pakistan, Bangladesh, USA, Cuba, Colombia, Panama and others have developed their own conservation and management plans considering the localized problems. Some of the International organization viz. International Society for Mangrove Ecosystem (ISME) based at Okinawa, Japan, Food and Agricultural Organization (FAO) United Nation, Head Quarter at Rome, Italy and Mangrove Action Plan (MAP) in Western United States have also come up to promote and coordinate the conservation and management activities of mangrove ecosystem.

In India, Ministry of Environment & Forests has set up the National Mangrove Committee with the help of scientists, forest personnels, researchers and administrators for considering various problems on conservation and management of mangrove ecosystems. This Committee recommended some vital points for researchs development and conservation of mangrove in India such as mapping of mangrove areas, quantitative and qualitative survey alongwith the climatic and other environmental parameters, selection of reserve forests, large scale afforestation programmes and research on flora, fauna and microbial organisms of the mangrove ecosystem. On the basis of the National Mangrove Committee, 15 mangrove areas in India were selected for giving proper management and conservation. These 15 areas are Sundarbans, Bhitarkanika, Mahanadi Delta, Krishna Delta, Ratnagiri, Kundapur, Goa, Vembanad,

Point Calimere, Pichavaram, North Andaman, Nicobar island, Gulf of Kuchchh, Gulf of Khambat and Jamnagar.

For the management and conservation of the above mangrove areas the Ministry of Environment & Forests has notified all mangrove areas in India in first priority list of Coastal Regulation Zone (CRZ) and also established different Biosphere Reserves, National Parks and Sanctuaries.

The conservation and management activities of the Sundarbans Forests have received much attention and good number of national and international organisations and some NGOs are involved in these activities. Some of the organisations such as Sundarbans Development Board and Forest Department, Government of West Bengal, Department of Science and Technology, New Delhi, various institutions of ICAR, different Universities of West Bengal, Bose Research Institute, Kolkata, Botanical Survey of India, Zoological Survey of India under Ministry of Environment & Forests, Indian Statistical Institute, Bidhan Chandra Krishi Viswavidyalaya, Ramakrishna Ashram, Nimpith, Tagore Society, Rangabelia, Lok Siksha Parisad-Ramakrishna Mission Ashram, Narendrapur, etc. Moreover the major areas of Sundarban Forest is under the control of Project Tiger, Crocodile Breeding and Rearing Project and also under the Man and Biosphere Project.

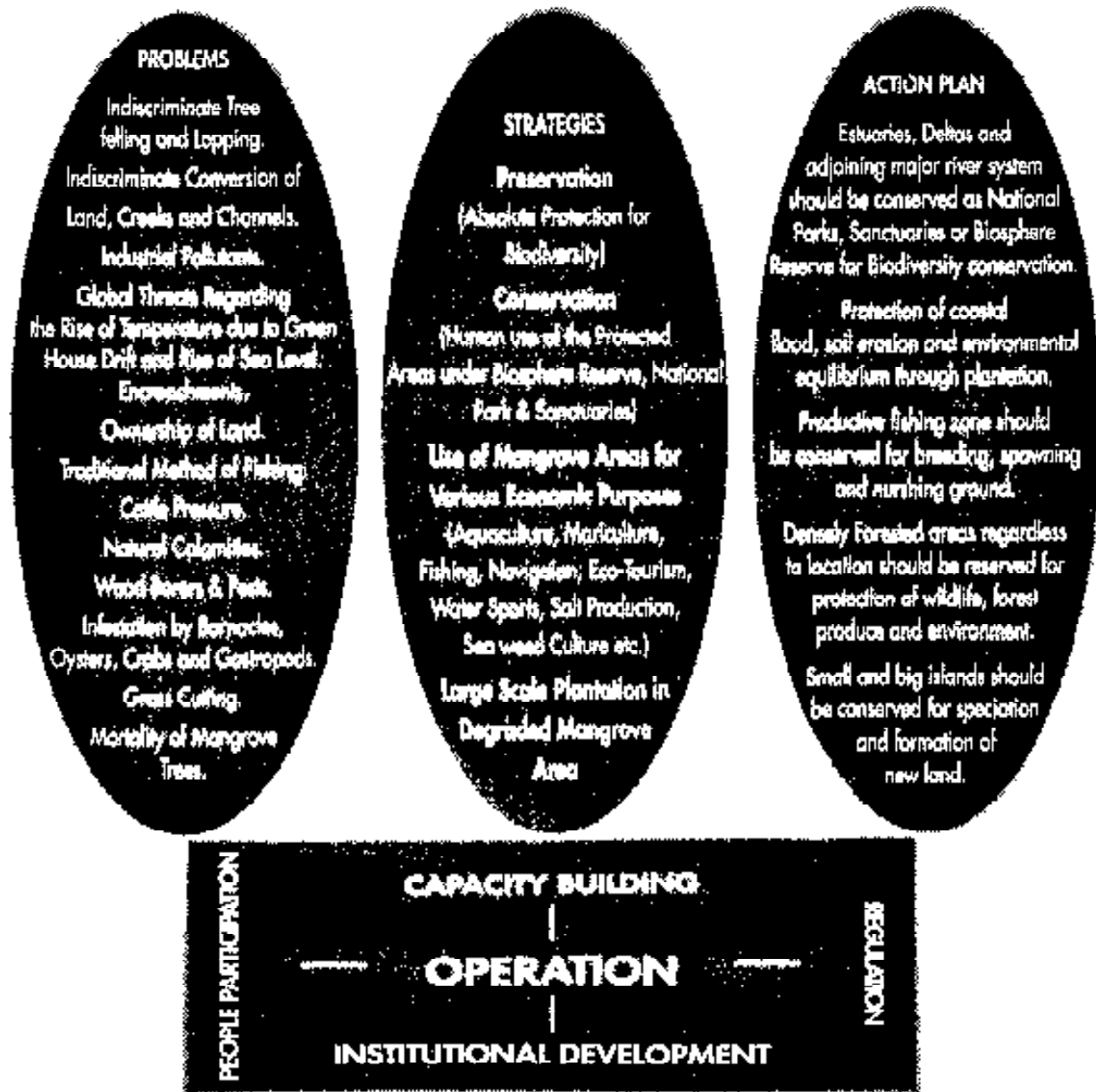
In the Sundarban Biosphere Reserve the best activity in the management perspective is the increase of tiger population from 135 to 264 (1988 census) besides the significant increase of the population of fishing cats, estuarine crocodiles and Olive Ridley Turtles. Except the population of *Heritiera fomes*, which has been diminished due to lack of fresh water flow, other mangrove genus viz., *Avicennia*, *Excoecaria*, *Phoenix* etc., are extending successfully in natural conditions. In the Bhitarkanika mangrove Sanctuary it has been reported that natural population of *Heritiera*, *Excoecaria*, *Avicennia* and *Sonneratia* has been steadily extended. Increased population of Open Billed Storks from 1000-30000, Olive Ridley Turtles from 1 Lakh to 2 Lakhs and Crocodiles from 100 to 350 are very successful output due to proper management programme in this state.

In the Godavari Krishna estuary, 'Coringa' Mangrove Reserve has been successfully covered with many mangroves due to large-scale afforestation. In the Pichavaram Mangrove Reserve 80% of the natural mangroves have been restored. In the Ratnagiri, Vembanad and Kundapur areas, Eco-restoration, development of mangrove nurseries and afforestation programme has been successfully developed. In Gujarat coastal mudflat, waste mangroves of the Gulf of Kuchchh and mangroves in the Marine National Park of Jamnagar have been successfully protected and restored.

FUTURE DIRECTION FOR CONSERVATION AND MANAGEMENT OF MANGROVE ECOSYSTEM

Ever-ending demand for enhancing the socio-economic structure associated with changing environmental conditions have led the planners to think for some future recommendation regarding the conservation and management of the mangrove ecosystem. In 1998, Government of India realized to reform the National Forest Policy involving people as a partner in the development, protection and management of forest resources. In 1990, Ministry of Environment & Forests issued a guideline regarding the involvement of village communities and voluntary agencies in the protection and development of degraded forest areas on the basis of taking a share of benefit from the areas that they agree to protect and develop. These Joint Forest Management Practices have become very much accepted and its model for managing the mangrove ecosystem is very successful. However, considering a dramatic changes in the present day due to high biotechnological activities, information technology, large demand on forest resources due to population pressure and side by side development of new regimes like Intellectual Property Right (IPR), General Agreement on Trade and Tariff (GATT) and Convention on Biological Diversity (CBD), a new approach for Joint Forest Management for sustainable utilization, conservation and protection of forest resources should be our future aims and objectives.

Local people and forest environment have to find their due places in a holistic approach, man's need has to be taken care keeping in mind the requirements for



sustainable development. The processes by which loss of biodiversity, genetic resources and ecological habitats occur are not known by most of the forest managers who make decision regarding the forest management. Therefore, the management of forest ecosystem based on biological components and genetic resources must have to be more people oriented scheme for obtaining more supported documents in regard to management and conservation activities. Experts commonly lack in depth of knowledge and experiences regarding the local society, ethnic culture, use of biodiversity resources, traditional management practices and different micro environmental conditions which may inevitably bring a recipe for failure of a successful model for management of mangrove forest ecosystem. It is possible with the help of Joint Forest Management Programme when the management plans are owned and understood by all the relevant local groups of protagonists including District, Mouzas, Panchayat, Administrators and even the Private enterprises.

3. SALT MARSHES OF THE INDIAN COAST

Salt marshes are formed in coastal environment starting from sea wards edge, newly formed estuarine mud flats up to a limit of extreme high water tide mark. There are two distinct types of salt marshes ; Inland salt marshes and maritime salt marshes. The maritime salt marshes are essentially confined to the temperate regions of the coast where physical conditions usually afford areas of shallow and sheltered water. Salt marsh also occur in the tropics, especially in arid or monsoonal regions and in such cases it is to be found generally either within the mangrove zone or landward regions of the mangrove belt. Though it is obvious that in the tropics both mangals and salt marshes are found in the same condition but there are significant differences between the two types. Salt marsh vegetation usually occur in changed environmental situation within the tidal ecosystem. The plant communities hardly attain height up to 2 m. Whereas mangrove vegetation does not occur well in this changed situation and plants attain up to 50 m height.

Salt marsh formation in the tropical deltas are usually limited in extent due to competition with mangrove species. They occur in three different

environmental situations : (1) as a pioneer formation covering recently formed mud flats along the open coast, inner region of estuarine islands or recently formed elevated regions along the estuaries or lagoon system. (2) as halophytic community occupying saline soil on the inner edge or within the mangrove swamps. (3) as a secondary formation on cut over or degraded areas within the mangrove woodlands. The first situation is found in few places on the Gujarat coast and on the Bay of Bengal coast, at Coringa, Kakinada, Sanjay nagar beach near Kothapalem, Nalimundi beach near the Krishna estuary and in Sarlagunta beach near the estuary of Light house Meru of the river Krishna. The situation depend on the presence of higher level tidal mud flats having less chances of inundation by tidal water. These flats are exposed at least once in a week to tidal inundation, as a result the areas remain physiologically dry with high percentage of salinity concentration. *Sesuvium portulacastrum* L., forms pioneer marsh along the most outer limit of the mud flats and *Aeluropus lagopoides* Trin. on sandy-saline flats. Other halophytes which are mainly dominant over these regions are *Salicornia brachiata* Roxb., *Arthrocnemum indicum* Moq., *Suaeda maritima* Dumort., *S. fruticosa* L., *S. nudiflora* Moq., *Cressa critica*. They alongwith some grasses are found on bunds and on elevated muds. The second situation is the most common for marsh formation in dry and slightly higher areas within the mangrove swamps or on the landward margins of the tidal mangrove forests. At Coringa, Kandikuppa, Sarlagunta, Nachgunta, Ellichitladibba, Lankavanidibba (Muthyakalava), Kothapalem, Dindipalem, Moriagunta and many other places of Andhra Pradesh the development of salt marsh situation can be explained as follows : the high tide in each places brings with it abundant fine sediments, fragments of vegetation and other materials in suspension, at the turn of the tide, the speed of the receding tide becomes much lower due to shallow topography of the areas and there is a short period of minimum, or even no motion and some of these loads are deposited especially near the margins of the flats and also on the slightly higher part of the flat. In the long run, deposition increases and the level of the flat especially near its margins and in other places gradually rises. Gradual accumulation of salt water in

gently sloping and shallower places together with high evaporation rate causes the soils to become more saline in comparison to that of the adjoining mangrove areas. During this period seeds of halophytes including mangrove hypocotyles are carried in by the tide but only those species which are capable of withstanding the unusual situation in this high saline soil condition begin to take root. The vegetation in this formation depends to a considerable extent on the substratum. Plants such as *Salicornia* and *Arthrocnemum* may begin to grow on more or less fine sand. As they trap more and more of the sediment brought in by the tide, the substratum become gradually silty or muddy. At this stage *Suaeda maritima* in association with *S. nudiflora* and *S. fruticosa* form a dominant component. In the early stages, tidal flow and ebbs form a sheet and drop some of its load there. As time goes on, these areas expand and a time comes when the tidal flow and ebbs become restricted. Such areas are usually inundated only during the spring tides and during the long dry season, high rate of evaporation induces strong capillarity and increased salt concentration on the surface. Under this condition *Aeluropus lagopoides*, *Cressa critica*, *Sesuvium portulacastrum*, *Heliotropium curassavicum* and others form dominant community in association with *Suaeda fruticosa* and *Salicornia brachiata*. Third situation involves the invasion of salt marshes to the cut over or degraded mangrove forest areas. When the relief towards the degraded or cut over mangrove forest area become elevated due to many abiotic and biotic factors, the forest areas are cut off from daily inundation of saline waterflow. Plant communities within the areas slowly die out due to soil compaction and increasing acidity. At this stage along the Sundarbans and in the Mahandi deltaic areas, the mangrove fern, *Acrostichum aureum* in association with other salt marshes are found dominant. But along the Godavari-Krishna deltaic areas the salt marsh species like *Hemitheria*, *Aeluropus* along with species of *Cressa*, *Suaeda* and *Salicornia* dominate to form a permanent structure due to degraded conditions.

4. MARINE CORAL STRAND OF THE INDIAN COAST

Along the Palk Bay, Gulf of Mannar, Malvan, Goa, Gulf of Kuchchh as well as oceanic islands of

Lakshadweep, Maldivic and some parts of Andaman & Nicobar Islands formation of coral reefs are very prominent. Coral reefs command the greatest importance by virtue of their biological productivity, the largest diversity of resident fauna and flora, complexity of trophic organization and finally the resources, both organic and inorganic, that are of direct economic importance. Aesthetically, they are the most beautiful, and constitute the only environment that is colourful and attractive to a common man.

CORAL REEF FORMATION IN INDIAN WATERS

(Wafar, 1992)

(a) **Palk Bay** : The reef here is of the fringing type and extends from 79°08' to 79°20' E along 9°17' N. This is one of the few Indian reefs where detailed studies on coral and associated fauna and flora, productivity and ecological structure have been carried out. Coral fauna comprises of 63 species under 21 genera. Resources exploited from this reefs are shells and souvenir corals, particularly of the ramose type.

(b) **Gulf of Mannar** : Fringing reefs occur around a chain of 20 islands from Tuticorin (8°48' N; 78°9' E) to Shingle island (9°14' N; 79°14' E). Only few of the northern most and southern most islands have been subjected to detailed studies. Coral fauna from 4 northern islands belong to 88 species under 26 genera. Systematic of coral from other reefs are not known. Exploited resources are principally coral blocks and coral debris. Trap and drift-net fishing is also carried out near the islands. Chank and pearl fishing are important activities near the Tuticorin region. Holothurians, marine algae and molluscan shells are harvested in large quantities, almost throughout the year.

(c) **Gulf of Kuchchh** : Reef formation are fringing or patchy around a chain of islands from Okhu to Jodhya. Coral diversity is lowest of all Indian reefs, with only 26 species under 20 genera. Ramose corals are totally absent. Exploited resources are mainly coral stands dredged for use in cement factory, with an estimated 0.6 to 1 million tonnes removed annually. No other resource appear to be intensively exploited.

(d) **Lakshadweep islands** : Reef formation (8-12° N; 71-74° E) are mainly atolls, with a low-lying island on the east, a broad, well developed reef on the west, with a lagoon in between, connected to the open ocean by

one or several channels. In addition, 3 reefs, the top of which lie just below mean sea level, and 5 submerged banks (mean depth 40 m) also have living coral cover. The number of coral species in all islands together may be much higher. No single resource is exploited intensively. However, collection and trade in souvenir corals was a main activity of resource exploitation in Kavaratti atoll until recently. Efforts to develop harvesting of ornamental fishes on a commercial scale are now on.

(e) **Andaman island** : Reef formation are of fringing type around these islands ($10^{\circ}30'$ - 14° N; 92 - 93° E).

About 70 species of coral under 25 genera are known from these reefs. Exploited resources are principally molluscan shells (*Trochus*, *Turbo*) for use in handicrafts, and ramose corals for souvenir collections.

(f) **Nicobar islands** : These island ($6^{\circ}30'$ N; 94 - 96° E) also have vast fringing reefs. A total of 42 coral genera are known from these reefs. As with Andaman reefs, molluscan shells are the main exploited resources.

Isolated occurrences of corals are known from central west coast of Indian and the submerged banks in the Arabian Sea but these do not sustain any resource that can be exploited commercially.

Table - 17 : Assesment of major coral reefs, coverage areas and diversity of genera, fish yield, exploited parts and present status

Geographic area (km ²)	Reef area coral genera and sub-genera	Number of known yield (million tons per year)	Potential fish resources	Exploited state of the reefs	Present
Gulf of Mannar	100	26+4	0.001-0.0015	Coral blocks, debris, algae, shells	Over-exploited
Gulf of Kuchchh	1000	20+1	0.01-0.015	Coral sands and degraded	Over-exploited
Lakshadweep	4200	28+9	0.04-0.06	Coral collection	Under-utilized
Andaman	11000	25+8	0.11-0.17	Shell collection	-do-
Nicobar	2700	42+9	0.03-3.04	-do-	-do-

VEGETATION ON CORAL STRAND

Raised consolidated ridges of the coral strand also show different type of vegetation zones depending on the nature of soil types, stability of the strand and impact of sea wave action. Accordingly, classification of the coral strand vegetation can be made into 4 vegetation zones :

1. Open pioneer zone of coral strand where the topography is regularly inundated due to sea wave action and the areas are covered with some specialised

plant groups such as : *Cyperus pachyrrhizus*, *Cyperus pedunculatus*, *Thuarea involuta*, which are found creeping on the moist sands with the help of runner system.

2. Raised ridges of coral strand which are occasionally inundated during the high tide are found associated with *Spinifex littoreus*, *Salmonia cantonensis*, *Wedelia biflora*, *Euphorbia atoto* and others.

3. Stable coral strand above the usual wave action zone is usually associated with some plant species of special interest and very few of them can be located

towards the other sandy or rocky coast lines in India. The common species in this zone are: *Pemphis acidula*, *Scaevola plumeri*, *Argusia argentea*, *Suriana maritima*, *Lepturus repens*, *Lepturus radicans*, *Guettarda speciosa*, *Hernandia peltata*, *Cordia subcordata*, *Halopyrum mucronatum*, *Cymbopogon caesiis*, *Sporobolus spicatum* and others.

4. Woodland zone of the coral strand is the backshore formation of ever green and semi-evergreen types and the vegetation in this zone is more or less similar to that of the West Coastal rocky woodland formation associated with the occurrence of some restricted littoral tree species of interest. Most dominant plants are : *Cynometra ramiflora*, *Heritiera littoralis*, *Ochrosia oppositifolia*, *Thespesia populnea*, *Pongamia pinnata*, *Calophyllum inophyllum*, *Terminalia catappa*, *Cycas rumphii*, *Manilkara littoralis*, *Barringtonia asiatica* and others.

5. SEAGRASSES OF THE INDIAN COAST

Seagrasses inhabit the infratidal and midtidal zones of shallow and sheltered localities of sea, gulfs, bays, backwaters, lagoons and estuaries. They usually prefer to grow on muddy, sandy, clayey and coral rubble bottoms but also on rocks and its crevices under water. They are found to grow either homogeneously or heterogeneously in mixed populations forming thick and dense meadows.

Seagrasses are marine plants belong to three monocotyledonous families Hydrocharitaceae, Ruppiaceae and Potamogetonaceae, being the only submerged marine angiosperms to have very successfully adapted to survive in the saline environment, these form a very fascinating group of plants. They are distinct from the members of the grass family Poaceae.

As per our present knowledge (Srinivasan, 1969; Ramamurthy *et al.*, 1992) there are 13 genera and about 52 species distributed throughout the world. Of the 52 species of seagrasses available in both tropical and temperate waters around the world, 14 species are found along the Coromandel coast extending to a length of about 2000 km.

The increasing interest on seagrasses has also reflected the recognition of their unique ecological importance in the preservation of marine ecosystems.

Arber (1920) have put forth certain salient properties for seagrass community to adopt and to withstand marine environment as follows :

- (a) ability to grow in saline medium.
- (b) ability to grow when completely submerged.
- (c) must possess well developed anchoring below ground system.
- (d) ability to compete with other marine organisms.
- (e) completion of life cycle when completely submerged.
- (f) must have the capacity for hydrophilous pollination.

Seagrasses are well distributed in India extending from the lake Chilka in Orissa, Chinnaganjam back water in Andhra Pradesh, Palk Bay comprising Katunavadi, Mimisal, Manora, Adirampahinam, Malli Pattinam, and Manamelkudi regions. The Gulf of Mannar, Rameswaram, Pamban, Mandapam and Krusadi group of islands harbour maximum number of Seagrass species. It is also found vigorous along Andaman and Nicobar island.

Enumeration and distribution of Seagrasses :

(1) *Cymodocea rotundata* Ehrenb. & Hempr. ex Asch. (Potamogetonaceae)

Local Name : Alai vaari.

Cymodocea rotundata is a submerged marine herb, dioecious, creeping on seabed with branched, monopodial rhizome. It grows in sheltered and shallow regions of infra littoral zone in sandy, muddy or coral strands. It is found growing in association with *Cymodocea serrulata*, *Enhalus acoroides*, *Halophila stipulacea*, *Halodule uninervis*, *H. pinifolia* and *Thalassia hemprichii*. It forms an extensive meadow on the sea bed of 1-2 m depth. It is distributed along the Tamil Nadu coast in Chennai, Chengalpattu, Tanjavur, Nellai, Pandhukkottai and Ramanathapuram. Thick meadow on sea bed forms a rich habitat for many marine fauna.

Flowering and Fruiting : The plants are seen in vegetative condition only.

(2) *Cymodocea serrulata* (R. Br.) Asch. & Magnus (Potamogetonaceae)

Local name : Alai vaari.

It differs from *C. rotundata* in having open ringed leaf scars and broad lamina distinctly serrulate at

apex. It is distributed in 1 m deep sea water along the sandy, muddy or rocky and coral substratum of Tiruchendur, Manappadu, Uvari and Idinthakarai coastal regions of Tamil Nadu, associated with *Enhalus acoroides*, *Syringodium isoetifolium* and *Cymodocea rotundata*.

In the Gulf of Mannar, it forms vast submerged beds which is a good habitat for a number of marine Fauna. *Cymodocea serrulata* is widely distributed along the coast of Tamil Nadu and totally absent in Andhra Pradesh coast.

Flowering & Fruiting : March-April and September-October.

(3) *Enhalus acoroides* (L.f) Royle (Hydrocharitaceae)
Local name : Alai vaari.

This giant seagrass is a perennial, submerged, robust herb, creeping with very stout rhizomes in 2-3 m deep sea bed. Both roots and rhizomes penetrate deep into the crevices of coral flats to provide strong support for withstanding tidal waves. It is usually found in sheltered marine areas in shallow water associated with sandy mud and coral strand. It harbours a wide range of dense micro-epiphytic flora and fauna on the leaf surface. It forms thick underground meadows and provide good habitat to various marine fauna like Sepia, Sea-lotus, Dugong, Sea horse, Scorpion fishes, Sea cucumber, Marine snakes, Molluscs, etc.

The distribution of *Enhalus acoroides* along the Coromandel coast is very much restricted in Puddhukkottai and Ramanathapuram districts of Tamil Nadu (Ramamurthy *et al.*, 1992). Whereas, washed ashore materials were collected in plenty form Chengalpattu and Thanjavur districts. This species is totally absent along Andhra Pradesh coast.

Uses :

The seeds are edible and eaten by local people at Pamban and it tastes like ground nuts. The fibre from leaves are used for fishing nets. The plants are used as manure for coconut and tobacco plantations (Wealth of India, 1952).

Flowering & Fruiting : Periodical throughout the year.

(4) *Halodule pinifolia* (Miki) Hartog
(Potamogetonaceae)

Local Name : Kadal karumbu.

Halodule pinifolia is a dioecious herb with moniliferous creeping rhizomes and 2-3 linear leaves

from scaly, branched stem. It is commonly found in all habitats starting from infralittoral regions to the estuaries, tidal forests, backwaters and lagoons. It grows on coarse and fine sands, muddy soils, rocks and coral strand. This species is found growing luxuriantly in backwaters, estuaries, bays and gulfs in sheltered localities, associated with *Halodule uninervis* (narrow-leaved forms), *Halophila ovalis*, *H. ovata*, *H. beccarii* on muddy bottoms. It is distributed throughout the Coromandel coastal regions such as Tuticorin, Krusadi, Rameswaram, Cuddalore, Kaliveli, Pulicat, Pamban, Pondicherry, Gulf of Mannar, Palar estuary and others. Along the Andhra coast it is found in Chinnaganjuru, Gunnamola, Karedu, Kavali, Utukuru, Krishna Patnam areas. It is reported also from Chilka lake in Orissa. In the submerged beds numerous marine fauna take shelter and food from this population.

Flowering & Fruiting : February July.

(5) *Halodule uninervis* (Forsk.) Asch.
(Potamogetonaceae)

Local name : Kadal karambu.

A common Seagrass distributed along the entire Coromandal coast. It occurs in open seas, sheltered localities of bays, gulfs, backwaters, estuaries and the margins of mangrove creeks. Generally this species is predominant in tidal and subtidal zones. The substratum is mostly fine sand to coarse sand, black mud, rock and coral rubbles. (Ramamurthy *et al.*, 1992).

Flowering & Fruiting : June July.

This species generally forms a vast stretch of submerged meadows in sheltered localities and backwaters, it is commonly interspersed with *Halodule pinifolia*, *Halophila ovalis*, *H. ovata*, *H. beccarii* but sometimes as separate patches adjacently. It has been also found associated with *Cymodocea rotundata*, *Cymodocea serrulata*, *Syringodium isoetifolium*, *Thalassia hemprichii* in Krusadi island, Rameswaram and Tuticorin regions of Gulf of Mannar. (Ramamurthy *et al.*, 1992)

Various marine fauna such as eel, fish, prawn, crabs, etc. live in these submerged beds for breeding and shelter.

(6) *Halodule wrightii* Asch. (Potamogetonaceae)

Local Name : Korai paasi.

Halodule wrightii is now known from the Coromandel coast along the back waters and lagoons

near the sea. It is found frequently in open sea near Rameshwaram and in Palk Bay, and along mangrove creeks. It generally grows from 25 cm to 2 m deep, and sometimes exposed during low tides.

The substratum ranges from fine sand to black mud and coral platform. Generally it is found growing in association with *Halodule uninervis* and *H. pinifolia*.
Flowering and Fruiting : March - July.

(7) *Halophila beccarii* Asch. (Hydrocharitaceae)

Local Name : Kodai paasi.

Halophila beccarii is a monoecious herb creeping with rhizomes. Leaves 4-6 mm, oblong-lanceolate with 7-10 mm long petioles. Flowers solitary, axillary. It is common in shallow sheltered localities of bays, estuaries, backwater and in the undergrowth of mangrove swamps, but absent in open sea. It is found in a depth of 0.5 to 2 m in coarse sand to muddy and clayey substratum. It is distributed along the coast of Tamil Nadu, Andhra Pradesh and Orissa from sandy bottom at Cuddalore in Tamil Nadu and Kakinada port in Andhra Pradesh and Chilka lake in Orissa.

It is found associated with other seagrasses like *Halophila ovata*, *H. ovalis* and *Halodule uninervis* and *H. pinifolia*. Sometimes found to grow in pure formation. Micro algae and several marine fauna like molluscs, juvenile crabs, prawn and shrimps inhabit the beds of *Halophila beccarii*. In the Chilka lake prawn culture is usually found along the population of this seagrass.

(8) *Halophila decipiens* Ostenf. (Hydrocharitaceae)

Local name : Kadal paasi.

Halophila decipiens is a marine form, pantropical in distribution. In India, it is restricted to Tuticorin coast of Tamil Nadu. It is found on soft muddy sand to fine coarse sand, to a depth of 3 - 5 m. It is usually associated with algae like *Caulerpa scalpelliformis* and *Ulva reticulata*. It is reported that the seagrass is very much disturbed due to coastal pollution and it is often found uprooted near the harbour of Tuticorin.

Flowering & Fruiting : January to March.

(9) *Halophila ovalis* (R. Br.) Hook. f. (Hydrocharitaceae)

Local Name : Aathu korai.

Halophila ovalis is the most common seagrass found abundantly along the entire Coromandel coast, Chinnaganjam and Chilka lake. This species grows in various ecological conditions from marine infratidal zone towards the margins of estuaries, back waters, lakes and lagoons. Wide range of morphological variation, specially, in the shape and size of leaves are very prominent in different habitat conditions. The marine forms along the Palk-Bay and Gulf of Mannar show ovate or obovate leaves, truncate at base, and grow commonly on sandy, muddy or coral debris associated with other marine seagrass species. The other forms which are usually found along the estuaries, tidal forests, coastal lagoons and lakes show oblong or elliptic oblong leaves narrowed at the base. It usually forms a pure strand under water extending as dense meadows on loose muddy soil or on coarse sandy substratum. This form is very common in the Chilka lake near Ramva.

Uses : Leaf paste mixed with turmeric is applied to cure various skin diseases, burns, boils, etc. by local fishermen. Occasionally plants are used as manure in coconut and other plantations. (Wealth of India, 1959)

Flowering & Fruiting : Throughout the year.

(10) *Halophila ovalis* (R. Br.) Hook. f. subsp. *ramamurthiana* Ravikumar & Ganesan. (Hydrocharitaceae)

Local Name : Elais paasi; Aaku naasi.

This subspecies is apparently restricted to the Coromandel coast as reported by Ramamurthy *et al.*, 1992. It is locally abundant and forms several isolated patches of pure stands in the backwaters of Marakkanam, on soft black mud. It is closely allied to *Halophila ovalis* and *H. stipulacea* and can be distinguished from them in having oblong-elliptic leaves, acute at apex and cuneate at base. The subspecies is reported only from the margin of backwaters not from the sea.

Flowering & Fruiting : Almost throughout the year.

(11) *Halophila ovata* Gaud. (Hydrocharitaceae)

Local Name : Elai paasi; Aaku naasi.

Halophila ovata is usually common on sheltered bay, open sea beds with less tidal waves, backwaters, estuaries and lagoons. It grows on sandy,

muddy and coral substrate at very shallow depth. It some times, grows along with other seagrasses like *Halodule pinifolia*, *H. uninervis* (narrow leaf form), *Halophila ovalis* and rarely with *Cymodocea rotundata* and *Thalassia hemprichii*.

Its distribution is recorded from Krusadi, Ramenwaram, Hare island, Cuddalore, Pulicat, Mandapam and Tuticorin of Coromandel coast, Chinnaganjuni, West Tuticorin of Coromandel coast and Chilka lake in Orissa.

Flowering & Fruiting : Throughout the year.

(12) *Halophila stipulacea* (Forsk.) Asch. (Hydrocharitaceae)

Halophila stipulacea is a marine form and usually not recorded from back water and lagoons. It grows in sheltered localities as isolated patches either as pure formations or mixed with *Halophila ovalis* and *H. Ovata* in sandy mud or on coral rubbles. Recently it is reported from the Chilka lake near Rambha.

Flowering & Fruiting : February to April.

(13) *Syringodium isoetifolium* (Asch.) Dandy (Potamogetonaceae)

Local Name : Kodai korai; Korai paasi.

Syringodium isoetifolium is a dioecious, slender much branched fleshy herbs, creeping with rhizomes. It is a pure marine form and is not found in backwaters, estuaries, lakes and lagoons. It usually grows in coral strands and sometimes on sandy or muddy beds and on rocks. It is always found associated with *Cymodocea serrulata*, *Thalassia hemprichii*, *Enhalus acoroides*, *Halophila ovalis*, *Halodule pinifolia* and *H. uninervis*. It is distributed mostly along the Palk strait, Palk Bay, Gulf of Mannar and Lakshadweep islands.

Flowering & Fruiting : Throughout the year.

(14) *Thalassia hemprichii* (Ehrenb.) Asch. (Hydrocharitaceae)

Local Name: Alai vaari; Kattai korai.

The distribution of *Thalassia hemprichii* in Tamil Nadu coast is almost continuous in all districts except south Arcot and Kanya Kumari. In the entire Andhra Pradesh coast, this species is completely absent and not even washed ashore specimens were noted. (Ramamurthy *et al.*, 1992)

It occurs in purely marine habitat and is not found in estuaries, back waters and lagoons. Extensive growth of rhizomes form a thick, inter woven mat on sea bed and serve as rich habitat for many marine fauna. The interwoven rhizomatous mat on coral reefs is very helpful for soil binding and holding many suspended organic matters.

SEAGRASS ECOSYSTEM IN THE GULF OF MANNAR

[Ref : Thangarajou *et al.* (1998)]

The seagrass ecosystem in the tropics and particularly in India has always been given a low priority by scientific communities and environmentalists in their studies (Jagtap 1996). Kannan (1998) have stated that the Gulf of Mannar Biosphere Reserve stands first in India for its higher species diversity and density of seagrasses followed by the Palk Bay, Andaman and Nicobar islands and the Lakshadweep islands. From our latest survey in the various islands of the Gulf of Mannar, 13 species of seagrasses have been recorded out of 14 species of seagrasses recorded in India.

Rao (1973) has estimated the mean density of seagrasses in Mandapam area as 558 tonnes / sq. km, while recently Jagtap (1996) has stated that the entire Gulf of Mannar and Palk Bay could be expected to have a seagrass cover of 30 km² and a standing crop of 7000 metric tons. Thus the extent and biomass of seagrasses along the southeast coast are about 25 and 10 times greater respectively than the other major seagrass regions in India. However, much more seagrass cover may be there which is not at all explored fully. In general, *Cymodocea serrulata*, *Halodule* sp., *Syringodium isoetifolium* (Jagtap, 1996), *Thalassia hemprichii* and *Enhalus acoroides* (Kannan, 1998) are the major contributors towards the total seagrass biomass and productivity.

There is no work on primary productivity of the seagrasses of the Gulf of Mannar except that of Ganesan (1992), who recently has conducted a study under the Department of Ocean Development, Government of India, sponsored research programme on "Conservation of Seagrass Ecosystem of the Gulf of Mannar Biosphere Reserve-Monitoring Seagrass Ecosystem Characteristics and Experimental Transplantation Studies" and recorded the diversity, productivity, biomass, etc. of the seagrasses in the Gulf of Mannar.

This Marine Biosphere Reserve is the first of its kind in India and south east Asia and it is situated between latitude $8^{\circ}35' - 9^{\circ}25' N$ and longitude $78^{\circ}8' - 79^{\circ}30' E$. The Gulf of Mannar Biosphere Reserve is well known for its biotic wealth and higher productivity ($7.3 \text{ g cm}^{-2} \text{ d}^{-1}$). Nearly 5000-7000 tons of dry seaweeds and seagrasses are harvested and exported from here to other regions of Tamil Nadu as raw material of various industries. It has also been recorded that the marine fishery production of 102,897 tons (1996) with a production rate of 14 tons per km^2 from this area is very high when compared to the national average of 9 tons per km^2 (Devaraj, 1998).

It is considered to be the hot spot of marine biodiversity based on its higher species diversity and density. The floral components comprise 126 species of phytoplankton (Kannan, 1998), 160 species of seaweeds (MoEF, 1987), 13 species of seagrasses (Kannan, 1998), 13 species of mangroves (Perichiappan *et al.*, 1995) and 78 species of other flowering plants. The faunal components comprise 91 species of zooplankton, 108 species of sponges, 14 species of gorgonids, 119 species of polychaetes, 79 species of crustaceans, 4 species of sea turtles, 10 species of mammals (Devaraj, 1998) and 117 species of coral (Gopinatha Pillai, 1971). Above all 450 species of fin fishes (Dorasaj, 1998) make the Gulf of Mannar a fertile ground for fishery resources. Such impressive species diversity and abundance of multifarious species is mainly due to the organic carbon production from the wide spread seagrass meadows in this in the Gulf of Mannar area.

IMPORTANCE OF THE SEAGRASS ECOSYSTEM

Seagrasses provide food and shelter to a variety of organism and hence the seagrass meadows act as "nursery ground". They baffle currents, provide shade and concomitant temperature modification for the hiding organisms. Seagrasses serve as sediment traps and stabilize the bottom sediments which in turn improve the water clarity.

Seagrasses also provide substrata for attachment of epiphytes. It has been estimated that over 150 species of microalgae (mostly diatoms), 450 species of macroalgae and 180 species of invertebrates are found on the seagrass blades. These epiphytes also function as primary producers and are the potential food sources

for a variety of marine organisms. The skeletal remains of epiphytic crustose coralline algae serve as an important source of CaCO_3 . Even though the effect of shading, damage and nutrient filtering by the epiflora and epifauna of seagrasses could limit the photosynthetic efficiency of the seagrasses, they can be still efficient in stripping nutrients from sea water and sediments.

THREATS TO THE SEAGRASS ECOSYSTEM OF THE GULF OF MANNAR

Rapid industrialization and urbanization pose serious threats to the seagrasses of the world. Decline of seagrass meadows has been documented in many parts of the world as a result of coastline development. Rajeshwari Mahalingam and Kamala Gopinath (1987a) stated that apart from the human activities on the shore, the seagrasses undergo major environmental stress due to salinity, light penetration, nutrient enrichment, mechanical disturbance, etc. They reported that the decline in the submerged seagrass beds in the Gulf of Mannar and elsewhere in India is mostly due to improper management of coastal area. Rajeshwari Mahalingam and Kamala Gopinath (1987b) also reported that thermal discharge from the power station adversely affects the seagrass ecosystem of Tuticorin. It has been noted that the seagrasses do not grow near the thermal power station for about 5-10 km along the coast in the shallow waters. Apart from these, fishing activities over the seagrass beds, man-made engineering works, pollution and coral mining are all the other factors which adversely affect the seagrasses of the Gulf of Mannar. In general, international trade, inadequate legislation, linear approach in resource utilization, tourism and over-exploitation of natural resources are leading to the seagrass habitat destruction.

CONSERVATION STRATEGIES FOR SEAGRASS ECOSYSTEM OF THE GULF OF MANNAR

From the above observation on the seagrasses of the Gulf of Mannar, it is evident that the Biosphere Reserve has a high species diversity and density when compared to the other coastal areas of India. Active implementation of Biosphere Reserve concept and proper management of the Gulf of Mannar Biosphere Reserve are to be carried out to conserve the seagrasses in this biosphere area. Regularizing the fishing activity and prohibition of fishing on seagrass meadows will help to protect the seagrasses. Mapping of seagrasses

Table - 18 : Seagrasses recorded from various coastal states of India

(Jagtap, 2000)

Seagrass sp.	States										
	West						East				
	GJ	MH	G	KA	KL	LD	WB	OR	AP	TN	A&N
<i>Cymodocea rotundata</i> (Ehrenb.) Hempr. et Aschers	-	-	-	-	-	+++	-	-	-	++	-
<i>C. serrulata</i> (R. Brown) Aschers. et Magns	-	-	-	-	-	+	-	-	-	++	-
<i>Enhalus acoroides</i> (Linn. f) Royle	-	-	-	-	+	+	-	-	-	+	++
<i>Halodule pinifolia</i> (Miki) Hartog	-	-	-	-	-	-	+	-	+	++	++
<i>Halodule uninervis</i> (Forssk.) Aschers.	+	-	-	-	-	++	+	-	+	++	+
<i>H. wrightii</i> Aschers.	-	-	-	-	-	-	+	-	+	+	-
<i>Halophila beccarii</i> Aschers.	++	++	++	++	-	-	++	++	++	++	-
<i>H. decipiens</i> Ostenfield	-	(+)	-	-	-	-	-	-	-	+	-
<i>H. ovalis</i> (R. Brown) Hook	+	-	+	-	+	++	+	+	+	++	++
<i>H. ovalis</i> var. <i>ramamurthiana</i> (R. Brown) Ramamurthy	-	-	-	-	-	-	-	-	-	-	-
<i>H. ovata</i> Gaud	+	-	-	-	-	++	+	+	+	++	++
<i>H. stipulaceae</i> (Forssk.) Aschers.	-	-	-	-	-	-	-	-	-	(+)	-
<i>Syringodium isoetifolium</i> (Aschers.) Dandy	-	-	-	-	-	++	-	-	-	++	+
<i>Thalassia hemprichii</i> (Ehrenb.) Aschers.	-	-	-	-	-	+++	-	-	-	++	++
<i>Ruppia maritima</i> L.	-	-	-	+	-	-	-	++	-	++	-
Total no. of species	4	2	2	2	2	8	6	4	6	14	7

GJ -Gujarat, MH - Maharashtra, G -Goa, KA - Karnataka, KL - Kerala, LD -Lakshadweep islands, WB - West Bengal, OR - Orissa, AP - Andhra Pradesh, TN - Tamil Nadu, A &N - Andaman and Nicobar Islands

% FO= Percentage frequency of occurrence,

- = Absent, (+) = Very rare, (FO = < 5%), + = Rare (5-20%), ++ = common (FO = 40-70%),

+++ = Dominant (FO = > 70%)

of the Gulf of Mannar using satellite remote sensing techniques so as to get a clear picture about the seagrass cover in the Gulf of Mannar is very necessary. This will largely help to monitor and identify the areas for any seagrass denudation. Legal action initiated against the industries which are polluting the seagrass areas will be helpful to conserve this fragile ecosystem. Besides these, effective seagrass transplantations should be done in order to retrieve and compensate the denuded seagrass beds. Creating awareness among all ocean users and conducting research programmes on seagrass conservation are urgently required.

6. SEAWEEDS OF THE INDIAN COAST

A purely sandy beach harbours practically no algal community. A rocky coast supports quite an innumerable variety of algal vegetation. In such situations when the wave action is strong and is attended with swell and swift currents bathing the hard substrata, different kinds of algae grow in profusion. If the coast happens to be somewhat flat and extensive and gradually sloping towards the sea with marked tidal effect of complete submergence during high-tides and successive exposure during low-tides, that offers the best and most favourable habitat for many variety of algal population. Its distribution extends from the open shore formations to inter tidal lagoons, bays, rock pools and puddles, or in creeks and inlets, beyond the low tide mark and in the infra-littoral regions of the coast. Deep water forms are seen to flourish even descending down to several fathoms. Great many of the sea-weeds are susceptible to turbidity and pollution of sea water. The sea-weeds, however attain their luxuriance, both in growth and number where the sea water is very clear and penetration of sun-light is to greater depths. Seasonal changes have also a marked effect on the growth of several species, particularly those flourishing on the upper limits of the littoral belts. The cool water months around December or January support a climax of infra littoral algal vegetation in many places under different situations. Their abundance, density, diversity and distribution pattern surpasses by imagination while the hot summer months of March - May, inhibit the growth of several species, resulting in a remarkable or complete depletion and disappearance of most of the forms.

The important factors influencing the growth of seaweeds are :

- (1) The nature of the substratum
- (2) Effect of tides
- (3) Surf of wave action
- (4) Clarity of sea water
- (5) Biotic and seasonal changes

Considering various uses and utilization of the seaweeds in the field of food and shelter of marine fauna, as fertilizer, iodine, potash, stock food, poultry food, human food, in the industries of glue, agar, algin, vitamin, antibiotic, mannitol and others. Indian research on seaweeds needs to be more increasing and critical survey and assessment of marine algal resources are very essential to solve different problems of extracting valuable marine algal products for commercial export.

ECOLOGICAL NOTES ON COASTAL SEAWEEDS IN INDIA

Dr. K. Srinivasan in the year 1969 studied the coastal algal communities from the Botanical Survey of India. His specimens, colour drawing and photographs are carefully preserved in the Industrial Section, Indian Museum. During recent study we have verified his published work from "Phytologia Indica"

A. CYANOPHYTA

PLEUROCAPSALES :

1. *Hyella capitosa* Born. et Flahs.

It is endolithic, boring into hard shells of *Balanus tintinnabulum* and other shells of Molluscs, etc.

Distribution : Mahabalipuram, near Chennai. It also occurs in various shells, throughout Indian coasts.

B. CHLOROPHYTA

ULVALES :

2. *Enteromorpha compressa* (L.) Grv.

It grows on rocks and coralline substrates, at and near the water mark.

Distribution:-Krusadi Island; Hare Island; Chennai harbour.; Mahabalipuram; Cape Comorin and in many localities.

3. *Enteromorpha intestinalis* (L.) Link. f. var. *cornucopiae* (Lyngb.) T. Agardh.

It grows in brackish waters, in littoral zones between tide-marks and in wide ranges. Abundantly

growing on buoys in harbour areas, in very shallow brackish water lagoons and lakes on mud banks or bottoms with sand or rocks.

Distribution : Chilka lake, Orissa; Chennai harbour; and many places of India.

4. *Ulva fasciata* Delile.

It grows on rock pools, deeply submerged under water.

Distribution : MulDwarka, in many harbours.

5. *Ulva lactuca* L.

It is epiphytic on other algae or growing on small coralline rocks, stones, and wood-works at artificial substrata in wharfs, wooden posts etc. on exposed tide marks nearer low tide level along sheltered localities in shallow waters near shore and in rock-pools.

Distribution : Okha, Krusadi Island, Cape Comorin, Chilka and many other places along the Indian coast.

6. *Ulva reticulata* Forsk.

This is not very common in Indian shores. During stormy weather this algae sometimes come ashore with huge mass of other algae.

Distribution : Okha port; Mumbai.

CHAETOPHORALES :

7. *Phaeophila dendroides* (Crouan) Batters

It is endophytic in *Rozenvingea intricata* (J. Agardh.) Boergs.

Distribution : Chilka lake, Arkha kudu sector, Orissa; Pamban; Gulf of Mannar.

DASYCLADALES :

8. *Acetabularia crenulata* Lam. var. *monodisca* Boergs.

It grows in the intertidal belts on flat coralline bed, exposed to open sea.

Distribution : Andaman.

SIPHONOCLADALES :

9. *Dictyosphaeria cavernosa* (Forsk.) Boergs.

It grows in shallow waters on often exposed coasts and on coral reefs which are washed by waves and also in deeper waters.

Distribution : Krusadi Island; Shingle Island; Okha; Dwarka; Lakshadweep Island.

10. *Valoniopsis pachynema* (Martens) Boergs.

These are attached to rocks between tide marks, and the upper littoral zones where sea-water is inundated.

Distribution : Krusadi Islands.; Okha; Dwarka.

11. *Boergesenia forbsii* (Harv.) Feldm.

It occurs in reefs and coralline substrata heavily silted with fine and smooth sand or mud and which get frequently exposed during low tides. It frequently occurs inside shallow lagoons and tranquil bays, near the upper limits of tide mark.

Distribution : Krusadi; Rameswaram; Pamban; Tuticorin; Hare Island; Andaman Islands and Car Nicobar.

12. *Chamaedoris auriculata* Boergs.

It occurs in exposed localities in littoral zone with other algae in dense tufts on rocky substratum and also in comparatively protected places in intertidal rock pools submerged and below water level.

Distribution : Dwarka.

13. *Chaetomorpha media* (Agardh.) Kuitg.

It occurs in very exposed localities on rocks dashed by strong waves. Besides rocks, it is seen growing on large Barnacles.

Distribution : Mahabalipuram, Chennai, Okha port.

SIPHONALES :

14. *Pseudobryopsis mucronata* Boergs.

This alga grow well in shallow water of intertidal rocks and pools

Distribution : Mumbai, Dwarka, Okha, MulDwarka.

15. *Bryopsis plumosa* (Hids.) C. Agardh. var. *pinnata* (Lam.) Boergs.

It grows on rocks and stones on exposed sheltered areas, in intertidal rock-pools, between mid-to-low water mark and also found covered by other larger seaweeds.

Distribution : MulDwarka.

16. *Caulerpa corynephora* Montagne

It is found along the intertidal rocks and coral strand, creeping with stolon and roots.

Distribution : Tuticorin, MulDwarka, Okha.

17. *Caulerpa cupressiodes* (Vahl) Weber van Bosse.

It grows well in exposed coasts, behind coral strand, sheltered areas in lagoon and also in muddy shallow waters as well as in deeper waters.

Distribution : Krusadi; Pamban and Tuticorin.

18. *Caulerpa paltata* (Jurn.) Lamour.

It occurs in shallow rock pools on silt covered stones and coralline hard substrates, abundant in low tide pools, on rocky shores, on rocks near low tide marks.

Distribution : Krusadi Island; Shingle Island; Tuticorin and Hare Island; Cape Comorin, Quilon, Mumbai, Dwarka, Okha, Andaman Island, Lakshadweep Island and many other places of Indian coasts.

19. *Caulerpa racemosa* (Forsk.) Waber-van-Bosse

This is frequent in shallow rock-pools and lagoons protected by coral reefs, on rocks between tide marks in exposed regions, in infra-littoral belts, on sandy or muddy floors.

Distribution : Cape Comorin, Krusadi Island, Pamban Island, Tuticorin, Kovalam, Quilon, Karwar, Mumbai, Okha, Dwarka, Andhra coasts, Andaman Islands, Lakshadweep Islands, Chilka lake and in many localities.

20. *Caulerpa taxifolia* (Vahl.) Agardh.

This alga grows in shallow waters, in lagoons or in exposed localities or even in deeper water.

Distribution : Pamban, Krusadi, Okha port.

21. *Caulerpa verticillata* J. Agardh. f. var. *verticillata*

This alga is an interesting member, found along the mangrove belts, where it is seen attached to the mangrove roots.

Distribution : Tuticorin, Okha port in Post reef and Adithra reef.

22. *Caulerpa crassifolia* (C. Agardh.) J. Agardh.

This is seen in moderate to somewhat deeper water in depressions in the intertidal lagoons, bays and at low water marks where the bottom is sandy and with broken pieces of corals and dead shells.

Distribution : Hare Island, Tuticorin.

23. *Caulerpa scalpelliformis* (R. Br.) Waber van Bosse.

It grows in littoral zones, on low lying flat depressions and in rock pools, lagoons and bays covering the sandy bottom of sea floors. It also grows on rocks, wharfs, wooden and iron pillars or jetties, etc.

Distribution : Cape Comorin, Kovalam, Tuticorin, Hare Island, Krusadi Island, Shingle Island, Rameswaram Island, Pamban, Dwarka, Okha, Veraval, MulDwarka, Karwar, Mumbai and Vishakhapatnam.

24. *Caulerpa serrulata* (Forsk.) J. Agardh.

It is frequently found in sandy to silty bottom of shallow lagoons with sprinkling of corals and dead shells.

Distribution : Krusadi Island.

25. *Caulerpa sertularioides* (Gmelin) Howe

This is common in surface of the sea to a few meters depth. It grows both in exposed condition as well as relatively sheltered condition of the bay. It is also found in sandy bottoms of shallow lagoons.

Distribution : Krusadi, Pamban, Rameswaram, Shingle, Tuticorin Island, Hare Island, Church Island, Cape Comorin, Mumbai, Dwarka, Okha, Chilka, Andaman and Lakshadweep Islands.

26. *Avrainvillea erecta* (Berkel.) Gepp.

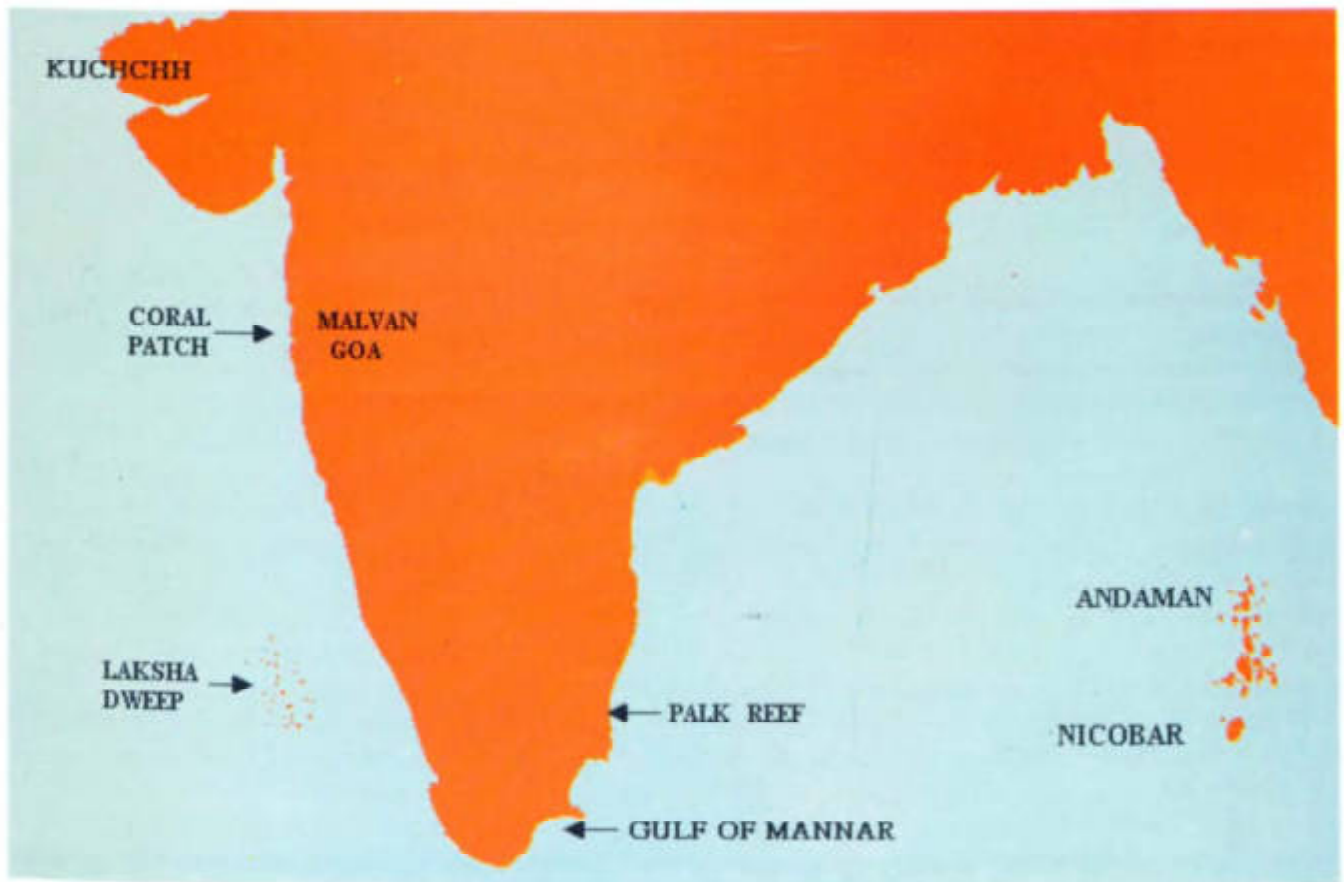
It is found in surroundings which are built of coralline reef with interesting depressions silted and muddy, at the intertidal belts and extending to low water mark. The greater part of the alga is buried in the sand or mud.

Distribution : Krusadi Island, Shingle Island, Hare Island, Tuticorin, Church Island and Andamans.

27. *Codium elongatum* C. Agardh.

It occurs in deep rock pools. It is more common towards the lower limits of low water mark.

Distribution : Dwarka, Okha Port.



Location of Coral Reefs in India



Branch Coral Thickets (*Acropora* sp.)



Distribution of Seagrass in India



Halophila beccarii Asch. (individual plant)

28. *Tydemania expeditionis* Weber van Bosse.

It is grown in restricted locality on rocks which was constantly washed by waves.

Distribution : Nancowry Island, Bay of Bengal.

29. *Codium dwarkense* Boergs.

It grows in intertidal pools and along the deeper clefts in the rocky coast (Okha) and for greater part of the low tides also.

Distribution : Okha Port.

30. *Codium iyengarii* Boergs.

It especially grows in intertidal belts where the plant gets exposed during low tides. They are also found to grow in small rock-pools and puddles at their sides and more towards the upper limits. The plants harbour a number of epiphytes, such as *Ceramium*, *Polysiphonia*, etc.

Distribution : Okha, Dwarka.

31. *Codium tomentosum* (Hudson) Stack.

This alga are often brought forth and ejected by the sea on the beach along with the huge masses of *Caulerpa racemosa*. It is also found attached to rocks which are exposed and washed by waves. They are also noted in intertidal pools.

Distribution : Krusadai, Tuticorin, Cape Comorin and many other places along Indian coasts.

32. *Halimeda macroloba* Decsne.

They grow on somewhat slushy and muddy bottom of exposed coasts. They are generally seen in shallow lagoon.

Distribution : Andaman Island, Nicobar Island, Nancowry Island.

33. *Halimeda opuntia* (L) Lamour.

It frequently occurs in lagoons and is also washed ashore in quantities. It is also found in intertidal belts.

Distribution : Gulf of Mannar, Krusadi, Rameswaram, Pamban, Cape Comorin, Kerala coasts, Mumbai, Okha, Dwarka and Andamans.

34. *Halimeda tuna* (Ell. & Sol.) Lamour.

This is found attached to rocks in shallow waters, also in deeper waters, on sandy shallow pools and coral banks.

Distribution : Krusadi, Shingle, Tuticorin, Cape Comorin, Okha, Dwarka and several other areas.

35. *Udotea flabellum* (Ell. & Sol.) Howe.

It grows in shallow intertidal, heavily silted lagoons and also found in deeper waters up to 40 m on loose sandy bottoms.

Distribution : Hare Islands, Tuticorin.

36. *Udotea indica* A. & E. S. Gepp.

This alga grows in somewhat flat open situations with considerable tidal effects. It is very common in reef beds of corals associated with sand and silt. It is also found in shallow lagoon.

Distribution : Krusadi, Tuticorin, Okha, Dwarka.

C. PHAEOPHYTA

ECTOCARCARPALES :

37. *Ectocarpus breviarticulatus* J. Agardh.

It grows on very exposed situations on hard rocks which are beaten by violent waves or sprayed by sea water.

Distribution : Chennai harbour, Mahabalipuram,

DICTYOTALES :

38. *Dictyota atomaria* Hauck.

It generally grows in rockpools near or below low water mark.

Distribution : Okha port, Dwarka, Mumbai.

39. *Dictyota bartayresiana* Lamour.

It grows in shallow pools or lagoon on sandy bottom, in partially sheltered localities, often lying loose and covering sandy bottoms of lagoons behind coral reefs at intertidal belts and also in somewhat deeper waters.

Distribution : Krusadi, Pamban, Tuticorin, Cape Comorin, Chennai, Mahabalipuram, Mumbai, Dwarka, Okha.

40. *Dictyota ciliata* J. Agardh.

It grows in the intertidal belts in lagoons with heavy muddy bottoms, admist with coralline reefs and various other larger brown and green seaweeds.

Distribution : Krusadi, Tuticorin, Hare Island.

41. *Dictyota dichotoma* (Huds.) Lamour. f. var. *implexa* (Lamour.) J. Agardh.

It grows on rocks along the intertidal belt.

Distribution : Tuticorin, Hare Islands, Dwarka, Okha.

42. *Dictyopteris australis* Sonder.

It grows on rocks along the intertidal belt.

Distribution : Dwarka, Okha port.

43. *Dictyopteris woodwardii* (Br.) J. Agardh.

It grows in deep rock-pools in well submerged condition. It is also developed on open intertidal zone and in shallow lagoons.

Distribution : Krusadi Islands, Okha port, MulDwarka, Malvan.

44. *Padina tetrastomatica* Hauck.

It grows well in sheltered as well as in much exposed localities near low water mark and below, in intertidal lagoons, rock pools, and at mid-tide levels.

Distribution : Mumbai, Karwar, Mahabalipuram, Chennai, Krusadi, Pamban, Tuticorin, Cape Comorin, etc.

45. *Padina commersonii* Bory.

It grows in low lying rock pools and lagoons in littoral zones and on somewhat exposed shores and also in rocks.

Distribution : Krusadi, Okha, Dwarka, MulDwarka.

46. *Padina parvula* (L.) Lamour.

It develops at mid-tide levels, and lagoons with fine sand and silt, on dead corals and also on rocky surfaces washed by waves.

Distribution : Cape Comorin, Kovalam, Quilon, Mahabalipuram, Krusadi, Rameswaram, Shingle Island, Tuticorin, Mumbai, Waltair, Dwarka, Okha, Chilka and in many places of Indian coast.

47. *Zonaria latissima* Kütz.

It grows in many islands and in lagoons along the intertidal belts on rocks and corals.

Distribution : Krusadi, Shingle Island,

48. *Spathoglossum asperum* J. Agardh.

This alga is often seen detached from its original place of growth and carried by waves and currents and stranded on the shore on rock-pools.

Distribution : Krusadi, Pamban, Tuticorin, Hare Island, Church Island, Cape Comorin, Mumbai, Karwar, Okha port, Dwarka, etc.

49. *Stoechospermum marginatum* (Agardh.) Kütz.

It grows luxuriently in somewhat quiet rock pools in open situation and at the lower limits of the intertidal belts.

Distribution : Mumbai, Dwarka, Okha, Tuticorin, Krusadi and Karwar.

CHORDARIALES :

50. *Myriogloea seturus* (Harv.) Kütz.

This alga grows together on hard rocky faces, boulders and stones which are exposed to strong and direct wave action.

Distribution : Dwarka, Okha Port, Cape Comorin.

51. *Nemacystus decipiens* (Sw.) Kütz.

This alga grows on rocks and stones from which they are loosely hanging in exposed to direct wave action.

Distribution : Dwarka.

DITYOSIPHONALES :

52. *Chonospora fastigiata* J. Agardh. var. *pacifica* J. Agardh.

It grows on rocks, in intertidal belts on exposed surfaces, in crevices and even in exposed localities.

Distribution : Cape Comorin

53. *Colpomenia sinuosa* (Roth.) Derbes & Solier.

It grows on exposed shores or sometimes in sheltered and not much exposed situations in tide pools, on rocks, reefs and branches of *Sargassum*, *Hormophysa*

and other larger brown sea weeds in intertidal lagoons near high water mark.

Distribution : Krusadi, Pamban and Rameswaram Islands, Tuticorin and Hare Island, Mumbai, Dwarka, Okha, Vishakhapattanam coast, Cape Comorin, etc.

54. *Hydroclathrus clathratus* (Bory) Howe.

It is commonly seen in shallow waters, in intertidal lagoons on exposed situations and on reefs.

Distribution : Krusadi, Pamban, Rameswaram Islands, Shingle Island, Tuticorin, Hare Island and Dwarka.

55. *Rosenyngia intricata* (J. Agardh.) Boergs.

It is very common along the estuarine areas very close to the sea, with the effect of the tidal waters. In the intertidal zones it grows in comparatively quieter waters of shallow bays and lagoons, on gravel or coarse sand or on broken shells.

Distribution : Chilka lake, Dwarka, Okha, Tuticorin, Hare Island, Adyar (Chennai) salt marsh.

FUCALES :

56. *Cystophyllum muricatum* (Turn.) J. Agardh.

This alga grows in the shallow lagoons at intertidal belts and in heavily silted and sandy covered seafloors with broken coralline pieces of larger or smaller sizes.

Distribution : Tuticorin, Hare, Pamban, Krusadi Islands, Dwarka, Okha.

57. *Hormophysa triquetra* (C. Agardh.) Kutz.

The alga grows in shallow bays and lagoons in the intertidal belts.

Distribution : Krusadi, Pamban Islands.

58. *Sargassum duplicatum* J. Agardh.

It grows in patches on rocks.

Distribution : Port Blair, Andamans; Minicoy and Lakshadweep.

59. *Sargassum polycystum* C. Agardh.

This alga grows in lagoons and on the rocks in sub-littoral belts.

Distribution : Pamban, Krusadi, Shingle Islands and Rameswaram.

60. *Sargassum swartzii* (Turn.) C. Agardh.

It is abundant on rocks dashed by sea waves.

Distribution : Cape Comorin, Krusadi, Pamban Islands, Andaman and Nicobar Island.

61. *Sargassum wightii* Grev.

This alga occurs in open situations on rocks which are washed by waves or on coral-rocks exposed to severe wave action.

Distribution : Krusadi, Pamban Islands, Cape Comorin, Quilon, Andaman Islands and many places along Indian coasts.

62. *Turbinaria ornata* J. Agardh.

This species grows on rocks and coralline rocks and boulders and in intertidal belts near low water mark or during monsoons in deep water.

Distribution : Krusadi, Pamban and Andaman Islands.

D. RHODOPHYTA

BANGIALES :

63. *Porphyra tenera* Kjellm

This species grows on isolated rocks and boulders constantly bathed by waves or submerged and also between the tide marks. They show remarkable adaptation to withstand desiccation.

Distribution : Cape Comorin, Chennai harbour.

NEMALIONALES :

64. *Dermonema frapperi* (Mont. ex Millard) Boergs.

It grows on rocks exposed to strong waves.

Distribution : Cape Comorin.

65. *Helminthocladia clavadosii* (Lamour.) Setch. f. var. *indica* Desikachary.

This alga grows luxuriantly, attached to hard rocks facing the open sea. It has high wave withstanding capacity. It harbours many epiphytes like *Polysiphonia* sp. and *Ceramium* sp.

Distribution : Okha Port.

66. *Liagora erecta* Zeh.

This alga grows on large boulders near the shore which are exposed to very strong and direct surf action.

Distribution : Chennai beach, Mahabalipuram.

67. *Scinaia furcellata* (Turn.) Bivonia

This species grows the lower littoral regions and deeper waters.

Distribution : Okha port.

68. *Scinaia hatei* Boergs.

It grows in rock pools near low water mark and casts ashore.

Distribution : Dwarka, Okha port.

69. *Scinaia indica* Boergs.

This species grows below low water mark in comparatively deeper waters attached to rocks and coral strand. It also frequently casts ashore.

Distribution : Dwarka, Okha.

70. *Asparagopsis taxiformis* (Delile) Collins & Harvey.

The alga grows in sublittoral belt. It prefers somewhat a sandy bottom and also in the water which is turbid to certain extent.

Distribution : Okha port, Dwarka.

CRYPTOMENIALES :

71. *Corynomorpha prismatica* (J. Agardh.) J. Agardh.

The alga grows luxuriantly on rocks which are exposed to violent wave action and below the water level in swift current and swell of the waves.

This also occurs at the sides of long, narrow shallow creeks at intertidal belt and in comparatively sheltered places.

Distribution : Cape Comorin, Okha port.

72. *Halymenia ceylanica* Harv.

It grows on rocks. During monsoons the specimen is washed ashore generally in southern coasts.

Distribution : Tuticorin, Rameswaram, Dhanushkodi, Andaman and Nicobar Island.

73. *Halymenia floresia* (Clem.) Agardh.

It grows in deeper water and during stormy months it is washed ashore.

Distribution : Chank Fisheries, Rameswaram, Pearlbeds, Tuticorin, Hare Island, Dhanushkodi, Pamban, etc.

74. *Halymenia porphyroides* Boergs.

The alga grows below low water mark on rocks, stones and dead shells.

Distribution : Okha port, Dwarka, MulDwarka.

75. *Halymenia venusta* Boergs.

It grows in exposed coasts in low lying rock pools near water mark, on submerged portions of rocky faces and huge boulders.

Distribution : Dwarka, Okha port, MulDwarka.

76. *Grateloupia comorini* Boergs.

The alga grows luxuriantly at the interstices of huge rocks and also attached to rock sides, through the gaps in which sea water passes with high current. It is also washed ashore.

Distribution : Cape Comorin.

77. *Grateloupia filicina* (Wulfen) C. Agardh.

The alga grows on rocks and boulders with vertical faces, exposed to strong waves, also in shallow waters and between tide marks.

Distribution : Chilka, Chennai harbour, Mahabalipuram, Mumbai.

78. *Grateloupia indica* Boergs.

This red alga grows perhaps in deep water. It is often brought by the waves with other algae and cast ashore.

Distribution : Okha port.

79. *Grateloupia lithophila* Boergs.

It grows on rocks, boulders and stones which are exposed to direct surf action. It also grows luxuriantly on artificial rocky substrata facing the sea.

Distribution : Mahabalipuram.

80. *Sebdenia polydactyla* (Boergs.) Balakrishnan

It grows in deeper waters and detached portion of the plants, sometimes large species are carried out by the high tide waves.

Distribution : Okha port, Dwarka.

81. *Desmia hornemanni* Lyngb.

It grows on rocks, between tide marks, nearer to low water mark, in very clear and deep lagoons where the bed is purely sandy.

Distribution : Cape Comorin, Pamban, Krusadi, Tuticorin, Hare Islands, Okha, Dwarka, Shingle Islands, Lakshadweep.



Salt Marsh formation at Elichit Dibba, Andhra Pradesh

Halophila Community under water in Chilka Lake



Halophila and *Chaetomorpha* sp. in Chilka Lake

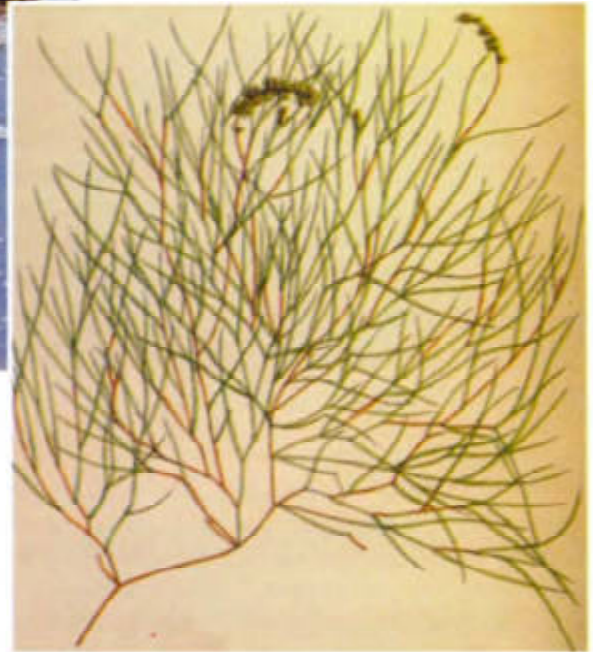
Salt Marsh formation at Lankavani Dibba, Andhra Pradesh





Enteromorpha Community in Chilka Lake

Potamogeton pectinatus



Algal Mat formation in Chilka Lake

Halophila Community in Chilka Lake



82. *Amphiroa anceps* (Lamk.) Deesne.

It grows between tidal levels and deeper waters. It is abundant along the shores, in lagoons, on reefs and sheltered locations also.

Distribution : Cape Comorin, Krusadi, Mumbai, Okha, Dwarka.

GIGARTINALES :

83. *Solieria robusta* (Grev.)

The alga generally occurs in deep water and number of specimens are washed ashore during high tide and stormy weather.

Distribution : Tuticorin pearl beds, Dwarka, Okha port.

84. *Gracilaria corticata* J. Agardh.

This algal community is found in the intertidal zones as well as on rocky faces constantly washed by violent breakers.

Distribution : Cape Comorin, Kovalam, Quilon, Tuticorin, Hare Island, Chennai harbour, Mahabalipuram, Karwar, Malabar hill, Kolaba, Back bay, Bandra in Mumbai.

85. *Gracilaria fergusonii* J. Agardh.

The species generally grows in exposed condition. Sometimes they washed ashore along with other algae during high tide.

Distribution : Tuticorin, Cape Comorin, Krusadi Island, Shingle Island.

86. *Gracilaria pygmaea* Boergs.

It grows in intertidal lagoons and reef-faces and also attached to coralline substratas.

Distribution : Krusadi Island.

87. *Gracilaria verrucosa* (Huds.) Papenfuss.

This species grows in shallow water lagoon, on rocks, stones and shells.

Distribution : Krusadi Island; Tuticorin; places in Pathara, Rhamba, Kalijai in Chilka lake, Orissa; Knolikote, Parikud, Kalijageswar and Nairi.

RHODYMENIALES :

88. *Botryocladia leptopoda* (J. Agardh.) Kylin.

The alga grows in the lowest littoral zone or

sublittoral zone, intertidal rock-pools, towards the bottom region and they are also noted at the sides of the rock dashed by violent waves.

Distribution : Dwarka, Dhanuskodi, Pamban coast, Cape Comorin.

89. *Botryocladia skottsbergii* (Boergs.) Levr.

It grows in small patches firmly attached to substratum which is rocky and is found to prefer situations which are not directly exposed to the sun, usually it is found on the underside of rocky out crops.

Distribution : Kavarathy Island, Lakshadweep.

90. *Coelarthrum opuntia* (J. Agardh.) Boergs.

The alga grows in deep water and they sometimes also cast ashore during high tide.

Distribution : Tuticorin, Dhanushkodi, Krusadi Island, Okha port and Dwarka.

91. *Rhodymenia australis* Sonder.

It grows in the larger and deeper rock pools on the rocky faces hidden from general view and cut off from light.

Distribution : Okha port, Dwarka, Mumbai.

92. *Rhodymenia plumata* Grev.

The alga grows at the upper limits of high water mark and along the coast with sand grains and plenty of shells.

Distribution : Cape Comorin.

93. *Champia indica* Boergs.

The alga grows luxuriantly in deep intertidal rock-pools at the bottom region and quite submerged under water.

Distribution : Dwarka, Okha.

94. *Gastroclonium iyengarii* Srinivasan

It grows on rocks below low water mark and on coralline substrata.

Distribution : Okha port.

95. *Griffithsia flabelliformis* Harv.

The alga grows on rock pools.

Distribution : Dwarka, Okha port, Dhanushkodi.

96. *Hypoglossum spathulatum* Kutz

The species grows on coral pieces or as clumps. It frequently comes ashore.

Distribution : Okha port.

97. *Dictyurus purpurascens* Bory.

The alga occurs in clumps, several plants growing together attached to the hard substratum (boulders) which are exposed to surf action. They also grow on shells and stones.

Distribution : Cape Comorin, Tuticorin, Hare Island.

98. *Neurymenia fraxinifolia* (Mert.) J. Agardh.

It occurs in deeper water which is well protected from the direct wave action and sunlight. It also grows below in surface level on the vertical faces or inward by scooped out portions of rocks which are strongly affected by the swell and swift current.

Distribution : Tuticorin, Hare Island, Cape Comorin, Krusadi and Shingle Island.

99. *Acanthophora delilei* Lamour.

It grows below low water mark in the intertidal belt of the coast and also in exposed and sheltered places.

Distribution : Okha, Dwarka, Mumbai, Tuticorin, Hare Island, Pamban.

100. *Enantiocladia prolifera* (Grev.) Falkenb.

It grows on hard rock which is not exposed directly to sun light at all. It also grows in deeper waters.

Distribution : Cape Comorin, Tuticorin, Dhanushkodi.

101. *Laurencia pedicularioides* Boergs.

It grows in low water mark.

Distribution : Dwarka.

102. *Lophocladia lallemandi* (Mont.) Schmitz

It grows on broken pieces of rock buried under coarse-grained sand and also near high tide mark.

Distribution : Hare Island, Tuticorin pearl bed, Pamban.

103. *Polysiphonia variegata* (Agardh.) Zan.

It grows on mud covered rocks, in marine and estuarine regions and on other marine plants, in lagoons and in dirty water.

Distribution : Krusadi, Okha, Dwarka.

104. *Heterosiphonia muelleri* (Sond.) De Toni.

It grows in low lying rock-pools and lagoons, on the exposed coast. It also casts ashore during the high tide.

Distribution: Dwarka, Okha port, Hare Island.

(Source : Srinivasan, 1969)

UTILISATIONS OF SEaweEDS

Seaweeds are one of the most common beneficial coastal resources which are variously used as edible and industrial materials by the mankind and as different habits and food for wild marine fauna. Following algae are very useful directly as edible and industrial raw materials (Chennubhotla *et al.*, 1981, 1987).

1. *Ulva latuca*
2. *U. fasciata*
3. *U. rigida*
4. *U. reticulata*
5. *Enteromorpha compressa*
6. *Chaetomorpha antennina*
7. *Caulerpa racemosa*
8. *C. sertularioides*
9. *C. taxifolia*
10. *Codium adharens*
11. *C. decorticatum*
12. *C. timentosum*
13. *Dictyota dichotoma*
14. *Padina commersoni*
15. *P. gymnospora*
16. *P. tetrastrumatica*
17. *Colpomenia sinuosa*

18. *Hydroclathrus clathratus*
19. *Rosenvingea intricata*
20. *Chnoospora minima*
21. *Cystoseira trinodis*
22. *Hormophysa triquetra*
23. *Sargassum johnstonii*
24. *S. myriocystum*
25. *S. swartzii*
26. *S. tenerrimum*
27. *S. wightii*
28. *Turbinaria conoides*
29. *T. ornata*
30. *Porphyra vietnamensis*
31. *Gelidiella acerosa*
32. *Halymenia floresia*
33. *Grateloupia filicina*
34. *G. lithophila*
35. *Gracilaria corticata*
36. *G. crassa*
37. *G. foliifera*
38. *G. edulis*
39. *G. verrucosa*
40. *Sarconema furcellatum*
41. *Hypnea musciformis*
42. *Gigartina acicularis*
43. *Rhodomenia dissecta*
44. *Centroceras clavulatum*
45. *Spyridia filamentosa*
46. *S. fusiformis*
47. *Acanthophora spicifera*
48. *Laurencia papillosa*
49. *L. obtusa*

At present *Gelidiella acerosa* and *Gracilaria edulis* are used as a raw material for the production of Agar-agar in India. Species of *Hypnea*, *Gigartina*, *Spyridia*, *Sarconema*, *Acanthophora* and *Laurencia* give gel like extracts known as agaroids. Species of *Sargassum*, *Turbinaria*, *Cystoseria*, *Hormophysa*, *Dictyota* and *Padina* yield alginic acid and iodine. In India sodium alginate is extracted by the seaweed industries using species of *Sargassum* and *Turbinaria* as raw material. Species of *Ulva*, *Enteromorpha*, *Chaetomorpha*, *Caulerpa*, *Codium*, *Hydroclathrus*, *Rosenvingea*, *Chnoospora*, *Prophyra*, *Halymenia*, *Grateloupia*, *Gracilaria*, *Hypnea*, *Rhodomenia*, *Centroceras*, *Acanthophora* and *Laurencia* are being utilized as human food in Japan, China, Korea, Indonesia, Philippines, U.S.A. and many other countries, but in India the seaweed as food is yet to be popularised.

SEAWEED CULTIVATION (Ganesan *et al.*, 1998)

Along the Indian coast line thousands of acres of coastal waters ideal for seaweed cultivation are available, which include the Gulf of Mannar, Gulf of Kutchh, Minicoy, Lakshadweep and Andaman and Nicobar islands. However, production of seaweeds in India is only 0.5% of the world. This is because Indian use of seaweeds is mainly restricted to the use of phyco-colloids (agar and algin) in some industries and to a very limited degree as food or fertilisers.

Seaweed culture is very profitable due to the following facts :

1. Capital investment is lesser in seaweed cultivation than in other species.
2. Seaweed culture does not lead to any input which is potentially harmful to the environment.
3. Seaweed farm are not labour intensive.
4. Market for seaweed products such as agar-agar, algin and carrageenan is diversified viz. food, pharmaceutical and other industrial sectors.
5. Seaweed culture preserves the ecological balance of the coastal waters.

COMMON TECHNIQUES FOR SEAWEED CULTIVATION

1. The fixed off-bottom monoline or bottom line method : Wooden anchors (like mangrove branches) are stacked at the substratum and nylon ropes are tied. Distance between the rows of stacks is 1 m. The nylon line is 0.3-0.5 m above the bottom depending on water level during low tide. Sporelings or thallus cuttings are inserted into the nylon rope at 20-25 cm intervals. Harvest will be made after 2-3 months. This method is commonly adopted for *Kappaphycus*.

2. Single Raft Floating Technique : This is somewhat cheaper than the monoline method of culturing seaweeds. Ten meter horizontal rope is tied on both sides with anchors or rocks. One meter vertical ropes are tied at an interval of 10-15 cm. Sporelings or cuttings are inserted into the vertical rope with 5-10 cm intervals. This method is commonly used for *Porphyra* and *Gracilaria* cultivation.

Agar rich seaweeds viz. *Gracilaria* sp. can be cultured in ponds, canals and tanks. Polyculture of seaweeds with fishes is also possible to get additional income.

Strategies for promoting seaweed cultivation in India

1. Banning of collection of seaweeds by the industries from the natural beds.
2. Formation of fishermen co-operative societies in all the coastal villages.
3. Nationalised banks should readily come forward to provide loans to fishermen co-operative societies for procurement of ropes for seaweed cultivation.
4. Government should encourage village level agar, algin and carrageenan production through subsidies and loans.
5. Awareness must be created among the people about the importance of seaweeds, especially their food value. This will increase the demand for seaweeds.
6. Simple technologies must be developed for preparation of delicious food items from seaweeds.

DISTRIBUTION OF ALGAL FLORA ALONG THE INDIAN COAST

A total of 680 species of marine algae have been recorded from India of which near about 400 species from the East coast and 280 species from the West coast. From the analyses of survey work and survey of different scientist such as Srinivasan, K. (1969); Krishnamurthy, V. S. and Chennubhotla (1998); Sengupta *et al.* (1999); Untwale & Wafar (1986); Jagtap (1987), I., K. Banerjee & A. Roy (1999) and Naskar (1999) the distribution of algal flora along the different coastal areas in India is as follows :

Location in coastal states	No. of Species
Gujarat	150
Maharashtra	91
Goa	77
Karnataka	41
Kerala	43
Tamil Nadu	299
Andhra Pradesh	89
Chilka, Orissa	45
Andaman & Nicobar	91
Lakshadweep	79

STATUS OF ALGAE OF THE WEST COAST

Sengupta *et al.* 1999 studied intensively the algal species occurring along the Gujarat coast. They reported total 210 species of which 39 species belong to Rhodophyceae, 25 species to Chlorophyceae, 21 species to Phaeophyceae and 3 species to Cyanophyceae.

Table - 19 : CHECK LIST OF MARINE ALGAE OF GUJARAT COAST

(Pilo, B. *et al.*, 1996, R. Sengupta, 1999)

Family, Genera and Species	1969	1999	Locality
CHLOROPHYTA			
CHLOROPHYCEAE			
Ulvaceae			
<i>Enteromorpha clathrata</i> (Roth) J. Ag.	-	+	Porbandar, Gulf of Kuchchh
<i>Enteromorpha compressa</i> (L.) Grev.	+	-	
<i>Enteromorpha flexuosa</i> (Wulf.) J. Ag.	-	+	Dwarka, Gulf of Kuchchh
<i>Enteromorpha gujaratensis</i> Kale	-	+	Porbandar
<i>Enteromorpha plumosa</i> Kuetz	-	+	Porbandar
<i>Enteromorpha instestinalis</i> (L.) Link	+	+	Veraval, Gulf of Kuchchh
<i>Ulva beytensis</i> Thivy & Sharma			Beyt island
<i>Ulva faciata</i> Dolile	+	+	Veraval, Gulf of Kuchchh
<i>Ulva lactuca</i> L.	+	+	Okha, Porbandar, Veraval, Gulf of Kuchchh
<i>Ulva reticulata</i> Forssk.	+	+	Gulf of Kuchchh
<i>Ulva rigida</i> C. Ag.	-	+	Gulf of Kuchchh
CLADOPHORALES			
Cladophoraceae			
<i>Chaetomorpha antennina</i> (Bory) Kuetz.	-	+	Okha, Dwarka
<i>Chaetomorpha dendroides</i> (Crouan) Batters	+	-	
<i>Chaetomorpha indica</i> Kuetz	-	+	Gulf of Kuchchh
<i>Chaetomorpha linoides</i> (Ag.) Kuetz	-	+	Veraval
<i>Chaetomorpha crystallina</i> (Roth) Kuetz	-	+	Porbandar
<i>Cladophora expansa</i> (Mertens) Kuetz	-	+	Porbandar
<i>Cladophora prolifera</i> (Rot.) Kuetz	-	+	Gulf of Kuchchh
<i>Spongomorpha indica</i> Thivy & Vis	-	+	Okha, Veraval, Gulf of Kachchh
<i>Willeella ordinata</i> Boergs	-	+	Okha
CHAETOPHORALES			
Chaetophoraceae			
<i>Ectochaete leptochaete</i> (Huber) Wille	-	+	Dwarka
<i>Phaeophila dendroides</i> (Crouan) Batters	+	-	Dwarka
SIPHONALES			
Protosiphonoaceae			
<i>Bryopsis hynoides</i> Lamour.	-	+	Okha
<i>Bryopsis indica</i> A. & E.S. Gepp	-	+	Okha
<i>Bryopsis plumosa</i> (Huds.) Ag.	-	+	Okha, Veraval, Gulf of Kuchchh
<i>Bryopsis plumosa</i> (Huds.) Ag. var. <i>pinnata</i> (Lam.) Boergs	+	-	
<i>Bryopsis ramulosa</i> Montagne	-	+	Veraval, Gulf of Kuchchh
<i>Pseudobryopsis mucronata</i> Boergs	+	+	Gulf of Kuchchh

Family, Genera and Species	1969	1999	Locality
Caulerpaceae			
<i>Caulerpa corynephora</i> Montagne	+	-	
<i>Caulerpa crassifolia</i> (Ag.) J. Ag.	+	+	Veraval, Gulf of Kuchchh
<i>Caulerpa cupressoides</i> (Vahl.) Ag.	+	+	Veraval, Gulf of Kuchchh
<i>Caulerpa fastigiata</i> Mont.	-	+	Okha
<i>Caulerpa peltata</i> Lamour.	+	+	Dwarka
<i>Caulerpa racemosa</i> (Forssk.) Weber v. Boose	+	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Caulerpa sculpelliformis</i> (R. Dr.) Web. v. Boose	+	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Caulerpa serrulata</i> (Forsk.) J. Ag.	+	-	
<i>Caulerpa serularioides</i> (Gmel.) Howe	+	+	Dwarka, Gulf of Kuchchh
<i>Caulerpa taxifolia</i> (Vahl.) Ag.	+	+	Veraval, Gulf of Kuchchh
<i>Caulerpa veravalensis</i> Thivy & Chauhan	-	+	Veraval
<i>Caulerpa verticillata</i> J. Ag.	+	+	Okha, Gulf of Kuchchh
Dasycladaceae			
<i>Acetabularia calyculus</i> Quoit et Guimard	-	+	Okha
<i>Acetabularia crenulata</i> Lam. var. <i>monodisca</i> Boergrs	+	-	
<i>Boergesenia forbsii</i> (Harv.) Feldm.	+	-	
Codiaceae			
<i>Codium decorticatum</i> (Woodw.) Harvey	-	+	Veraval, Gulf of Kuchchh
<i>Codium dwarkense</i> Boergrs.	+	+	Dwarka, Okha, Veraval
<i>Codium elongatum</i> C. Ag.	+	+	Gulf of Kuchchh
<i>Codium iyengarii</i> Boergrs.	+	+	Dwarka, Okha
<i>Codium tomentosum</i> (Hudson) Stack.	+	-	
<i>Halimeda macrotoba</i> Decsne	+	-	
<i>Halimeda opuntia</i> (L.) Lamour.	+	-	
<i>Halimeda tuna</i> (Eil. et Sol.) Lamour.	+	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Tydemania expeditionis</i> Weber	+	-	
<i>Udotea flabellum</i> (Eil. & Sol.) Howe	+	-	
<i>Udotea indica</i> A. & E.S. Gepp	+	+	Okha, Dwarka, Veraval, Gulf of Kuchchh
Valoniaceae			
<i>Boodlea composita</i> (Harv. et Hook. f.) Brand	-	+	Okha, Dwarka, Veraval, Gulf of Kuchchh
<i>Chaetomorpha media</i> (Agardh) Kurtz.	+	-	
<i>Chamaedoris auriculata</i> Boergrs.	+	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Cladopharopsis sundanensis</i> Reinh.	-	+	Dwarka
<i>Dictyosphaeria cavernosa</i> (Forssk.) Boergrs	+	+	Okha, Veraval, Gulf of Kuchchh
<i>Valoniopsis pachynema</i> (Martens) Boergrs	+	+	Okha, Dwarka, Veraval, Gulf of Kuchchh
<i>Valonia utricularis</i> (Roth) Ag.	-	+	Okha, Dwarka, Veraval, Gulf of Kuchchh
Phyllosporonaceae			
<i>Ostroebium reineckei</i> Bornet	-	+	Okha

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Family, Genera and Species	1969	1999	Locality
CHRYSTOPHYTA			
XANTHOPHYCEAE			
HETEROSIPHONALES			
Vaucheriaceae			
<i>Vaucheria piloboloides</i> Thur.	-	+	Dwarka
PHAEOPHYTA			
PHAEOPHYCEAE			
ECTOCARPALES			
Ectocarpaceae			
<i>Ectocarpus arabicus</i> Fig. et DeNot	-	+	Dwarka, Veraval, Porbandar
<i>Ectocarpus battersii</i> Bornet	-	+	Dwarka
<i>Ectocarpus breviarticulatus</i> J. Ag.	+	-	
<i>Ectocarpus columellaris</i> Boergs.	-	+	Porbandar
<i>Ectocarpus elachistaeformis</i> Heydrich	-	+	Porbandar
<i>Ectocarpus ovalis</i> Kjellm.	-	+	Dwarka
<i>Ectocarpus rhodochoortonoides</i>	-	+	Dwarka
<i>Giffordia conifera</i> (Boergs.) Taylor	-	+	Dwarka, Okha
<i>Giffordia mitchellae</i> (Harv.) Hamel.	-	+	Dwarka, Okha, Porbandar, Veraval, Gulf of Kuchchh
<i>Giffordia sandriana</i> (Zanardini) Hamel.	-	+	Dwarka
<i>Myriogloea sciurus</i> (Harv.) Kuck.	-	+	Gulf of Kuchchh
<i>Streblonema turmale</i> Boergs.	-	+	Porbandar
SPHACELARIALEA			
Sphacelariaceae			
<i>Sphacelaria furcigera</i> Kuetz.	-	+	Dwarka
<i>Sphacelaria tribuloides</i> Meneghini	-	+	Dwarka
DICTYOTALES			
Dictyotaceae			
<i>Dictyopteris acrostichoides</i> (J. Ag.)	-	+	Okha, Veraval
<i>Dictyopteris australis</i> Sonder	+	+	Dwarka, Okha, Veraval
<i>Dictyopteris woodwardii</i> (Brown) J. Ag.	+	+	Gulf of Kuchchh
<i>Dictyota atomaria</i> Hauck.	+	+	Gulf of Kuchchh
<i>Dictyota bartayresiana</i> Lamour.	+	+	Veraval, Gulf of Kuchchh
<i>Dictyota cervicornis</i> Kuetz.	-	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Dictyota ciliolata</i> J.G. Agardh	+	+	Gulf of Kuchchh
<i>Dictyota dichotoma</i> (Huds.) Lamour.	+	+	Gulf of Kuchchh, Dwarka, Okha, Veraval
<i>Dictyota divaricata</i> Lamour.	-	+	Gulf of Kuchchh, Dwarka, Okha, Veraval
<i>Dictyota pinnatifida</i> Kuetz.	-	+	Veraval, Porbandar, Okha
<i>Dilophus fasciola</i> (Roth) Howe	-	+	Okha, Dwarka
<i>Padina boryana</i> (Bory) Thivy ex Taylor	-	+	Dwarka
<i>Padina commersonii</i> Bory.	+	-	
<i>Padina gymnospora</i> (Kuetz.) Vickers.	-	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Padina pavonia</i> (L.) Lamour	+	-	
<i>Padina pavonica</i> (L.) Thivy ex Taylor	-	+	Dwarka

Family, Genera and Species	1969	1999	Locality
<i>Padina tetrastrumata</i> Hauck.	+	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Pocockiella variegata</i> (Lamour.) Papenfuss	-	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Spathoglossum asperum</i> J. Ag.	+	-	
<i>Spathoglossum variabile</i> Fig. et DeNot	-	+	Okha, Veraval, Gulf of Kuchchh
<i>Stoechospermum marginatum</i> (Ag.) Kuetz.	+	+	Veraval, Gulf of Kuchchh
<i>Zonaria latissima</i> Kuetz.	+	-	
CHORDARIALES			
Myrionemataceae			
<i>Ascocyclus orbicularis</i> (J. Ag.) Magnus.	-	+	Dwarka, Veraval, Porbandar
<i>Composnema gracile</i> A.Kuckuck	-	+	Porbandar
<i>Hecatonema sargassicola</i> Boergs.	-	+	Porbanda, Okha
<i>Hecatonema terminalis</i> (Kuetz.) Kylin	-	+	Dwarka
<i>Myrionema sirangulans</i> Greville	-	+	Okha, Veraval
Corynophlacaceae			
<i>Myricatula arabica</i> (Kuetz.) Feldman	-	+	Dwarka, Okha
Chordariaceae			
<i>Levringia boergensenii</i> Kylin	-	+	Dwarka, Veraval
Spermatochnaceae			
<i>Myrioglossa sciurus</i> (Sond.) Kuck.	+	-	
<i>Nemacystus decipiens</i> (Sond.) Kuck.	+	+	Dwarka, Veraval, Gulf of Kuchchh
DICTYOSIPHONALES			
Punctariaceae			
<i>Chnoospora fastigiata</i> J. Ag. var. <i>pacifica</i> J. Ag.	+	-	
<i>Colpomenia sinuosa</i> Derb. et Sol.	+	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Hydroclathrus clathratus</i> C. Ag.	+	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Iyengaria stellata</i> (Boergs.) Boergs			Dwarka, Veraval, Gulf of Kuchchh
<i>Roesenvingea intricata</i> (J. Ag.) Boergs	+	+	Dwarka, Okha
<i>Rosenvingea orientalis</i> J. Ag.			Gulf of Kuchchh
FUCALES			
Cystoseiraceae			
<i>Cystophyllum muricatum</i> (Turn.) J. Ag.	+	-	
<i>Cystoseira trinodis</i> (Frossk.) C. Ag.	-	+	Dwarka
<i>Cystoseira indica</i> (Thivy et Doshi) Mairh	-	+	Okha, Veraval, Gulf of Kuchchh
<i>Hormophysa triquetra</i> (L.) Kuetz.	+	+	Veraval, Gulf of Kuchchh
Sargassaceae			
<i>Porphyra tenera</i> Kjellum	+	-	
<i>Sargassum carpophyllum</i> J. Ag.	-	+	Okha, Veraval
<i>Sargassum cinctum</i> J. Ag.	-	+	Porbandar
<i>Sargassum cinereum</i> J. Ag.	-	+	Veraval, Okha
<i>Sargassum duplicatum</i> J. Ag.	+	-	
<i>Sargassum ilicifolium</i> (Turn.) J. Ag.	-	+	Dwarka

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Family, Genera and Species	1969	1999	Locality
<i>Sargassum johnstonii</i> Setchell & Gardner	-	+	Okha, Veraval, Gulf of Kuchchh
<i>Sargassum polycystum</i> C. Ag.	+	-	
<i>Sargassum plagiophyllum</i> (Mert.) Agardh	-	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Sargassum prismaticum</i> Chauhan	-	+	Porbandar
<i>Sargassum swartzii</i> (Turn.) C. Ag.	+	+	Veraval, Gulf of Kuchchh
<i>Sargassum tenerrimum</i> J. Ag.	-	+	Okha, Dwarka, Veraval
<i>Sargassum vulgare</i> C. Ag.	-	+	Porbandar
<i>Sargassum wightii</i> Greville	+	+	Veraval, Gulf of Kuchchh
<i>Turbinaria ornata</i> J. Ag.	+	+	Gulf of Kuchchh
RHODOPHYTA			
BANGIOPHYCEAE			
GONIOTRICHALES			
Goniotrichaceae			
<i>Goniotrichum elegans</i> (Chauv.) Lejolis	-	+	Dwarka
FIORIDEOPHYCEAE			
NEMALIONALES			
Chantransiaceae			
<i>Acrochaetium carnea</i> J. Ag.	-	+	Okha
<i>Acrochaetium crassipes</i> Boergs.	-	+	Dwarka
<i>Acrochaetium erectum</i> Boergs.	-	+	Dwarka
<i>Darmonema frapperi</i> (Mont. ex Millard) Boergs.	+	-	
Helminthocliadiaceae			
<i>Helminthocladia australis</i> Harvey	-	+	Okha
<i>Helminthocladia calyadosii</i> (Lamour.) Setchell f. var. <i>indica</i> Desik	+	+	Okha, Veraval, Gulf of Kuchchh
<i>Liagora ceranoides</i> Lamour.	-	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Liagora erecta</i> Zch.	+	-	
Chaetangiaceae			
<i>Actinotrichia fragilis</i> (Forsk.) Boergs.	-	+	Dwarka, Okha
<i>Galaxaura oblongata</i> (Lamour.) Setchell f. <i>indica</i> Desik.	-	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Liagora ceranoides</i> Lamour.	-	+	Dwarka, Veraval, Gulf of Kuchchh
Chaetangiaceae			
<i>Actinotrichia fragilis</i> (Forsk.) Boergs.	-	+	Dwarka, Okha
<i>Galaxaura oblongata</i> Lamour	-	+	Dwarka, Veraval, Gulf of Kuchchh
<i>Pseudogloiophloeus fascicularis</i> (Boergs.)	-	+	Desik, Okha port, Dwarka
<i>Scinaia fucellae</i> Turner	-	+	Veraval, Gulf of Kuchchh
<i>Scinaia furcellata</i> (Turn.) Bivonia	+	-	
<i>Scinaia hatei</i> Boergs.	+	+	Dwarka, Okha
<i>Scinaia indica</i> Boergs.	+	+	Dwarka, Okha, Veraval, Gulf of Kuchchh

Family, Genera and Species	1969	1999	Locality
Bonnemaisoniaceae			
<i>Asparagopsis sandfordiana</i> Harvey	-	+	Dwarka
<i>Asparagopsis taxiformis</i> (Delile) Collins et Harvey	+	+	Veraval, Gulf of Kuchchh
GELIDIALES			
Gelidiaceae			
<i>Gelidium pusillum</i> (Stackh.) Lejolis	-	+	Dwarka Veraval, Gulf of Kuchchh
Gelidiellaceae			
<i>Gelidiella acerosa</i> (Forks.) Feldman et Hauck	-	+	Dwarka, Veraval, Gulf of Kuchchh
CRYPTONEMIALES			
Corallinaceae			
<i>Amphiroa anceps</i> (Lamk.) Decsne.	-	+	Okha, Dwarka
<i>Amphiroa fragillissima</i> (L.) Lamour.	-	+	Veraval, Gulf of Kuchchh
<i>Arthrocardia capensis</i> (Leach) Areschoug	-	+	Dwarka
<i>Jania rubens</i> (L.) Lamour.	-	+	Dwarka
Grateloupiaceae			
<i>Cryptonema undulata</i> Sonder	-	+	Okha, Dwarka
<i>Grateloupia comorini</i> Boergs.	+	-	
<i>Grateloupia filicina</i> (Wulf.) Ag.	+	+	Veraval, Gulf of Kuchchh
<i>Grateloupia indica</i> Boergs.	+	+	
<i>Grateloupia lithophilla</i> Boergs.	+	-	
<i>Halymenia ceylanica</i> Harv.	+	-	
<i>Halymenia floresia</i> (Clem.) Ag.	+	+	Gulf of Kuchchh
<i>Halymenia porphyroides</i> Boergs.	+	+	Okha, Dwarka Veraval, Gulf of Kuchchh
<i>Halymenia venusta</i> Boergs.	+	+	Dwarka Veraval, Gulf of Kuchchh
Corynomorphaceae			
<i>Corynomorpha prismatica</i> J. Ag.	+	+	Gulf of Kuchchh
GIGARTINALES			
Sebdeniaceae			
<i>Sebdenia polydactyla</i> (Boergs.) Balak.	+	+	Okha, Dwarka Veraval, Gulf of Kuchchh
Gracilariaceae			
<i>Corallopsis cacalia</i> J. Ag.	-	+	Okha,
<i>Gracilaria corticata</i> J. Ag.	+	+	Dwarka, Veraval,
<i>Gracilaria fergusonii</i> J. Ag.	+	-	
<i>Gelidiopsis gracilis</i> (Kuetz.) Vickers.	-	+	Gulf of Kuchchh
<i>Gracilaria pygmaea</i> Boergs.	+	+	Veraval, Gulf of Kuchchh
<i>Gracilaria verrucosa</i> (Hunds) Papenfuss	+	+	Veraval, Gulf of Kuchchh

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Family, Genera and Species	1969	1999	Locality
Solieraiaceae			
<i>Agardhiella robusta</i> (Grev.) Boers.	-	+	Dwarka
<i>Eucheuema spinosum</i> J. Ag.	-	+	Okha
<i>Meristotheca papulosa</i> (Mont.) J. Ag.	-	+	Dwarka
<i>Solieria robusta</i> (Grev.) Kylin	+	+	Gulf of Kuchchh
Rhabdoniaceae			
<i>Catenella repens</i> (Light f.) Batt.	-	+	All over Gujarat
Rhizophyllaceae			
<i>Amphiroa anceps</i> (Lamk.) Decsne	+	-	
<i>Desmania hornemanni</i> Lyngb.	+	+	Gulf of Kuchchh
Hypneaceae			
<i>Hypnea cervicornis</i> J. Ag.	-	+	Gulf of Kuchchh
<i>Hypnea musciformis</i> (Wulf.) Lamur	-	+	Okha, Veraval
Gigartiniaceae			
<i>Gigartinia</i> sp. Stackhouse	-	+	Gulf of Kuchchh
RHODYMENIALES			
Rhodymeniaceae			
<i>Botrycladia leptopoda</i> (J. Ag.) Kylin f. var. <i>luxurians</i> Boergs	+	+	Dwarka Veraval, Gulf of Kuchchh
<i>Botrycladia skottsbergii</i> (Boergs.) Levr.	+	-	
<i>Coelarthrum opuntia</i> (J. Ag.) Boergs	+	+	Veraval, Gulf of Kuchchh
<i>Rhodymenia australis</i> Sonder	+	+	Okha, Veraval, Gulf of Kuchchh
<i>Rhodymenia palmata</i> Grev.	+	+	Gulf of Kuchchh
Lomentariaceae			
<i>Champia indica</i> Boergs	+	+	Okha, Veraval, Gulf of Kuchchh
<i>Champia parvula</i> (Ag.) Harvey	-	+	Okha
<i>Champia somalensis</i> Hauck	-	+	Dwarka
<i>Gastroclonium iyengarii</i> Srinivasan	+	+	Okha, Gulf of Kuchchh
CERMIALES			
Ceramiaceae			
<i>Callithamnion byssoides</i> Arn.	-	+	Okha
<i>Centroceras clavavulatum</i> (Ag.) Mont	-	+	Dwarka
<i>Ceramium</i> sp. Roth.	-	+	Gulf of Kuchchh
<i>Griffithsia flabeliformis</i> Harv.	+	-	
<i>Griffithsia rhizophora</i> (Gruenow) Web. van Bosse	-	+	Porbandar, Dwarka, Okha
<i>Haploplegma duperreyi</i> Mont.	-	+	Okha, Veraval, Gulf of Kuchchh
<i>Spyridia aculeata</i> J. Ag.	-	+	Dwarka
<i>Spyridia alternans</i> Boergs	-	+	Veraval, Gulf of Kuchchh

Family, Genera and Species	1969	1999	Locality
Delesseriaceae			
<i>Caloglossa bombayensis</i> Boergs	-	+	Veraval, Gulf of Kuchchh
<i>Cryptopleura</i> sp. Kuetz	-	+	Gulf of Kuchchh
<i>Enantiocladiaprolifera</i> (Grev.) Falkinia	+	-	
<i>Hypoglossum spatulatum</i> Kuetz.	-	+	Okha, Veraval, Gulf of Kuchchh
<i>Membranoptera murrayi</i> Boergs	-	+	Okha
<i>Myriogramme bombayensis</i> Boergs	-	+	Okha
<i>Myriogramme okhaensis</i> Boergs	-	+	Okha
<i>Platysiphonia miniata</i> (Ag.) Boergs	-	+	Okha
<i>Taenioma perpusillum</i> J. Ag.	-	+	Dwarka
Rhodomelaceae			
<i>Acanthophora delilei</i> Lamour.	+	+	Okha, Veraval, Gulf of Kuchchh
<i>Acanthophora dendroides</i> Harvey	-	+	Dwarka
<i>Acanthophora spicifera</i> (Vahl.) Boergs	-	+	Veraval, Gulf of Kuchchh
<i>Chondria armata</i> (Kuetz.) Okamura var. <i>plumaris</i> Boergs	-	+	Okha, Dwarka,
<i>Chondria cornuta</i> Boergs.	-	+	Veraval,
<i>Chondria dasphylla</i> Agardh	-	+	Veraval, Dwarka, Gulf of Kuchchh
<i>Dictyurus purpurascens</i> Hory.	+		
<i>Herposiphonia tenella</i> Nagl.	-	+	Dwarka
<i>Laurencia cruciata</i> Harvey	-	+	Dwarka
<i>Laurencia obtusa</i> (Huds.) Lamour.	-	+	Dwarka
<i>Laurencia pannosa</i> Zan.	-	+	Dwarka
<i>Laurencia papillosa</i> (Forsk.) Creville	-	+	Veraval, Gulf of Kuchchh
<i>Laurencia pedicularioides</i> Boergs	+	+	Dwarka, Gulf of Kuchchh
<i>Leveillea jungermannioides</i> (Mart. et Hering.) Harvey	-	+	Dwarka
<i>Lophocladia lallemandi</i> (Mont.) Schmitz.	+	+	Okha, Veraval, Gulf of Kuchchh
<i>Lynkiella karvalensis</i> Varma	+	+	Okha,
<i>Neurymenia fraxinifolia</i> (Mert.) J. Ag.	-	+	Veraval, Gulf of Kuchchh
<i>Polysiphonia acuminata</i> N.L. Gard.	-	+	Okha
<i>Polysiphonia bharadwajae</i> sp. nov.	-	+	Okha
<i>Polysiphonia coarcta</i> Tseng	-	+	Okha
<i>Polysiphonia ferulacea</i> Suhr.	-	+	Okha, Dwarka,
<i>Polysiphonia gopnathensis</i> Thivy et Rao	-	+	Gopnath
<i>Polysiphonia kappannia</i> Rao	-	+	Okha
<i>Polysiphonia parthasarathyae</i> Rao	-	+	Okha
<i>Polysiphonia tuiticorinensis</i> Boergs	-	+	Okha
<i>Polysiphonia unguiformis</i> Boergs	-	+	Dwarka,
<i>Polysiphonia variegata</i> (Ag.) Zanardini	+	+	Okha, Veraval, Dwarka, Porbandar

Diversity of Coastal Plant Communities in India

Family, Genera and Species	1969	1999	Locality
<i>Oschera condensata</i> Web. van Bosse	-	+	Okha
<i>Roschera glomerulata</i> (C. Ag.) Web. van Bosse	-	+	Okha, Dwarka
Dasyaceae			
<i>Dasya flagelliformis</i> Boergs	-	+	Okha, Gulf of Kuchchh
<i>Heterosiphonia muelleri</i> (Sond.) Detoni	+	+	Okha, Veraval
<i>Heterosiphonia wurdemanni</i> (Baill.) Falkb.	-	+	Okha
CYANOPHYTA			
Pleurocapsales			
<i>Hyella caspitosa</i> Born. et Flash	+	-	

MAHARASHTRA

Altogether 91 marine algal species are reported from Maharashtra : Malvan-69 species, Colaba-64 species and Ratnagiri-51 species. Genera like *Monostroma*, *Gelidium*, *Gracilaria*, *Sargassum* are economically very important. Some species of *Acetabularia* and *Caulerpa verticillata* are rare and restricted to this coast.

List of Marine Algae along the coast of Maharashtra :

Monostroma axyspermum
Ulva sp.- 3 species
Enteromorpha 4 species
Chaetomorpha 2 species
Cladophora fascicularis
Caulerpa 2 species
Bryopsis 2 species
Emodesmis verticillata
Averenvillea sp.
Valonia aegagrophila
Microdictyon tenuis
Struvea anastomosans
Acetabularia sp.
Ectocarpus conigera
Giffordia mitchelli
Sphacelaria furcigera
Dilophus fasciola

Dictyota dichotoma
Dictyopteris sp.
Padina sp. 2 species
Lobophora variagata
Ralfsia expansa
Stoechospermum marginatum
Spatoglossum asperum
Colpomenia sinusa
Sargassum sp.- 5 species
Rhodochorton sp.
Erthrocladia sp
Bangia fuscopurpurea
Porphyra vietnamensis
Galaxaura sp.
Scinaia hetai
Gratelopia lithophila
G. indica
Melobasia farinosa
Amphiroa fragilissima
Jania adherens
Cheilosporum spectabile
Lithophyllum
Gelidium pusillum
G. micropterium
Geliopsis variabilis
Caulocanthus sp.
Halymenia sp.

<i>Sarcotema filiformae</i>	<i>Chondria</i> sp. 2 species
<i>Saliera robusta</i>	<i>Bacrychia tenella</i>
<i>Gracilaria</i> sp. 3 species	<i>Rhodymenia palmata</i>
<i>Hypnea</i> sp. 2 species	<i>Potysiphonia</i> sp. 2 species
<i>Ceramium</i> 2 species	<i>P. variegata</i>
<i>Ahnfeltia plicata</i>	<i>Acanthophora spiciphora</i>
<i>Champia parvula</i>	<i>Centroceras clavulatum</i>
<i>Gastroclonium</i> sp.	<i>Martensia</i>
<i>Spyridoa fusiformis</i>	<i>Dasya</i> sp.
<i>Laurencia</i> sp. 3 species	<i>Catnella repens</i>
<i>Laurentia obtusa</i>	<i>Caloglossa leprieurii</i>

GOA

Untwale and Dhargalkar (1975) studied algal communities from Goa coast and reported 77 spp. belonging to 37 genera from Terakhol, Chapora, Donapaula and Cabo de Rama localities are as follows :

Name of the species	LOCALITIES			
	Terakhol	Chapora	Donapaula	Cabo de Rama
<i>Acanthophora spicifera</i>	+		+	+
<i>Asparagopsis</i> sp.	+			
<i>Avrainvillea</i> sp.			+	
<i>Bryopsis plumosa</i>			+	+
<i>Chaetomorpha media</i>	+	+		+
<i>Caloglossa leprieurii</i>	+	+	+	+
<i>Centroceras clavulatum</i>	+	+		
<i>Ceramium fastigiatum</i>	+	+		+
<i>Cladophora</i> sp.	+		+	+
<i>Chaetomorpha linum</i>		+		
<i>Chaetomorpha</i> sp.			+	
<i>Colapomenia sinuosa</i>			+	
<i>Caulerpa</i> sp.		+	+	
<i>Cardium dwarkense</i>			+	+
<i>Dictyota bartayresiana</i>	+			
<i>D. dichotoma</i>	+			
<i>Dictyota</i> sp.			+	+
<i>Enteromorpha clathrata</i>	+	+		
<i>E. compressa</i>	+			

Diversity of Coastal Plant Communities in India

Name of the species	LOCALITIES			
	Terakhol	Chapora	Donapaula	Cabo de Rama
<i>E. intestinalis</i>		+		
<i>Emeromorpha</i> sp.			+	+
<i>Gelidium pusillum</i>	+			+
<i>Gelidiopsis variabilis</i>				+
<i>Grateloupia filicine</i>	+			+
<i>Gracillaria</i> sp.	+	+		+
<i>Hydrocoleus lynchbyaceus</i>			+	+
<i>Hypnea</i> sp.	+	+		+
<i>Laurencia papillosa</i>			+	+
<i>Martensia fragilis</i>			+	+
<i>Microdictyon</i> sp.				+
<i>Oscillatoria</i> sp.				+
<i>Padidna</i> sp.	+	+	+	+
<i>P. tetrastromatica</i>			+	+
<i>Palmaria palmata</i>				+
<i>Porphyra vietnamensis</i>	+	+		+
<i>Polysiphonia microcarpa</i>			+	+
<i>P. variegata</i>			+	+
<i>Rhizoclonium</i> sp.	+			
<i>Rosenvingea orientalis</i>	+			
<i>Spathoglossum asperum</i>	+			
<i>Spathoglossum</i> sp.			+	
<i>Stoechosperum marginatum</i>	+		+	+
<i>Schizothrix creswelli</i>			+	+
<i>Schizothrix</i> sp.	+	+		
<i>Sargassum</i> sp.	+	+	+	+
<i>Ulva</i> sp.	+	+	+	+
<i>Pocockiella variegata</i>			+	
<i>Plectonema battersii</i>			+	+

KARNATAKA

Untawale & Wafar (1985) studied algal communities from Karnataka coast and reported 25 spp. belonging to 17 genera from different localities are as follows—

Name of the Species	LOCALITIES									
	Kawar	Betokevi	Kurita	Houavar	Bhatkal	Gangoli	Majpu	Siratkal	Ha Ningshe En	Sineswar
<i>Ayruvillea erecta</i>	+									
<i>Bryopsis plumosa</i>								+		
<i>Caulerpa scapelliformis</i>	+		+							
<i>C. pettara</i>					+					
<i>Caulerpa</i> sp.				+						
<i>Cladophora</i> sp.										+
<i>Chaetomorpha</i> sp.				+						
<i>Chaetomorpha media</i>			+	+	+		+	+	+	+
<i>Dictyota</i> sp.				+						
<i>Dictyota babariayresiana</i>					+		+			
<i>Dictyopteria australis</i>	+			+			+			
<i>Enteromorpha flexuosa</i>		+	+			+	+	+	+	+
<i>Enteromorpha intestinalis</i>				+						
<i>Monostroma</i> sp.				+						
<i>Microdictyon</i> sp.			+							+
<i>Padina</i> sp.				+	+					
<i>Padina tetrastrumatica</i>	+						+			
<i>Prackiella varigata</i>	+			+						
<i>Sphaecelaria fundigera</i>	+		+	+	+				+	
<i>Spathoglossum asperum</i>	+			+						
<i>Sargassum ilicifolium</i>	+			+	+		+	+		
<i>Sargassum tenerrimum</i>	+			+			+			
<i>Stoehospermum marginatum</i>				+			+			
<i>Ulva fasciata</i>		+	+		+		+	+		+
<i>Ulva</i> sp.				+						

KERALA

Sobha and Nair (1983) reported 34 sp. of algae of which Rhodophyta-20, Chlorophyta-10 and Phaeophyta-4 from Kerala. Krishnamurty & Joshi (1970) reported total 49 sp. from Cape Comorin.

LIST OF MARINE ALGAE OF LAKSHADWEEP ISLANDS

(Source : Jagtap, 1987)

CYANOPHYTA

- Aphanocapsa* sp.
- Oscillatoria* sp.
- Phormidium* sp.
- Lyngbya majescula* Harv. ex Gomont
- Gardnerula tenuissima* Tseng et Hua

CHLOROPHYTA

- Ulva fasciata* Dellile
- Enteromorpha tubulosa* Kuetz
- E. linza* (L.) J. Ag.
- Rhizoclonium hookeri* Kuetz
- Chaetomorpha linum* (Muell) Kuetz
- Cladophora fascicularis* (Mertens.) Kuetz
- Cladophoropsis zollingeri* (Kuetz) Boerg
- Bryopsis plumosa* (Hud.) Ag.
- B. hypnoides* Lamour
- Caulerpa sertularioides* (Gmel.) Howe
- C. serrulata* (Forssk.) J. Ag. emend Boerg
- C. racemosa* var. *clavifera* (Turner) Web. van Bosse
- C. racemosa* (Forssk.) Web. van Bosse
- C. cupressoides* (Vahl) Ag.
- C. fastigata* Mont
- Codium adhaerens* Anderson
- Halimeda gracilis* Harv. et J. Ag.
- H. opuntia* Lamour
- Boodlea composita* Harv. et Hook f. Brand
- Dictyosphaeria cavernosa* (Forssk.) Boerg
- Boergesina forbesii* (Harv.) Feldm.
- Struvea anastamosans* Harv. Picon

PHAEOPHYTA

- Hydroclathrus clathratus* C. Ag.
- Dictyopteris deliculata* Lamour
- D. australis* Sonder.
- Dictyota dichotoma* (Huds.) Lamour
- Padina tetrastomatica* Hauck
- Pocockiella variegata* (Lamour) Papen.
- Sargassum duplicatum* Ag.
- Turbinaria ornata* J. Ag.
- T. conoides* Kuetz

RHODOPHYTA

- Acrochaetum* sp.
- Galaxaura* sp.
- Asparagopsis taxiformis* (Delile) Coll et Harv.
- Gelidium pusillum* (Stackh.) Le Jollis
- Gelidiella acerosa* Forssk. et Feld
- Jania adhaerens* Lamour
- Melobesia* sp.
- Halymenia venusta* Boerg.
- Hypnea valentiae* (Turn.) Mont.
- Gracilaria crassa* Harv.
- G. edulis* (Gmel.) Silva
- Gelidiopsis intricata* (Ag.) Vickers
- Ceratodictyon spongiosum* Zanard.
- Champia parvula*
- Callithamnion* sp.
- Centroceras clavulatum* (Ag.) Mont
- Ceramium moryae* Verb V. Bosse
- C. tenuissimum* J. Ag.
- Spyridia aculeata* J. Ag.
- Wrangelia* sp.
- Chondria dasyphylla* Ag.
- Laurencia obtusa* (Huds.) Lamour
- L. pedicularioides* Boerg
- L. cruciata* Harv.
- L. papillosa* (Forssk.) Gravel
- Herposiphonia* sp.
- Acanthophora muscoides* (L.) Boerg
- A. spicifera* (Vahl.) Boerg
- Tolipocladia glomerulata* (C. Ag.) Web. van Bosse
- Chondrococcus hornemanii* Mart.
- Leveillea jungermannioides* (Mart et Hering) Harv.
- Dictyurus purpurescens* Boerg

LIST OF ALGAE FROM EAST COAST

CYANOPHYTA

Family : Oscillatoriaceae

Phormidium fragile (Meneghini) Gomont
Lyngbya lutea (Ag.) Gomont
Lyngbya hieronymusii Lemm.
Lyngbya confervoides C. Ag. ex Gomont
Lyngbya martesianu Menegh. ex Gomont
Lyngbya semiplena (C. Ag.) J. Ag. ex Gomont
Microcoleus chthonoplastes Turon ex Gomont
Hydrocoleum lyngbyaceum Kuetz. ex Gomont
Schizothrix lamyi Gomont
Oscillatoria jasorvensis Vouk.
Oscillatoria subbrevis Schomidle.
Oscillatoria tenuis Ag.

Family : Hyellaceae

Xenococcus chaetomorphae Setchell et Gardner
Xenococcus cladophorae (Tilden) Setchell et Gardner

Family : Nostocaceae

Anabaena variabilis Kg.
Anabaena oryzae Fritsch.

CHRYSOPHYTA

Family : Vaucheriaceae

Vaucheria erythrospora Christensen.
Vaucheria prescottii Islam.
Vaucheria mayanadensis Brady.
Vaucheria pronosperma Islam.

CHLOROPHYTA

Family : Ulvoaceae

Enteromorpha clathrata (Roth) Grev.
Enteromorpha intestinalis (L.) Link. f.
Enteromorpha prolifera (Muciller) J. Ag.
Enteromorpha compressa (L.) Grev.
Ulva patengensis L.
Ulva lactuca L.
Ulva fasciata Delile.

Family : Cladophoraceae

Lola implexa (Harv.) Hamel.

Lola capillaris (Kg.) Hamel
Lola tortuosa (Dillw.) Chapman.
Cladophora echinus (Bias.) Kuetz.
Cladophora patentiramea (Mont.) Kuetz.
Cladophora sundarbanensis Islam.
Rhizoclonium riparium (Ruth) Harvey.
Rhizoclonium hookeri Kuetz.
Chaetomorpha linum (Muell.) Kuetz.
Chaetomorpha area (Dillw.) Kg.
Chaetomorpha gracilis Kg.
Chaetomorpha brachygona Harvey

Family : Codiaceae

Boodleopsis sundarbanensis Islam.

Family : Zygnemataceae

Spirogyra sp.

Family : Dictyosiphonaceae

Rosenvingea intricata Boergs.

RHODOPHYTA

Family : Rhabdoniaceae

Catenella impudica (Mont.) J. Ag.
Catenella repens (Light Foot) Batters.
Catenella nipae Zanardini.

Family : Rhodomelaceae

Pterosiphonia pennata (Roth) Falkenberg.
Bostrychia radicans (Mont.) Montagne
Bostrychia tenella (Vahl.) J. Ag.
Acanthophora specifera (Vahl.) Boerg.
Polysiphonia denudata (Dillwyn) Kuetz.
Polysiphonia mollis Hooker & Harvey.
Polysiphonia sertularioides J. Ag
Polysiphonia subtilissima Mont.

Family : Cryptomeniaceae

Grateloupia filicina Ag.

Family : Gigartiniaceae

Gracilaria verrucosa (Huds.) Pap.

SEASONAL SUCCESSION IN ALGAL COMMUNITY IN SALT MARSHES

(Krishnamurthy, 1998)

In tropical marshes, brown algae are rarely found, except for the solitary occurrence of *Rosenvingea intricata* (Krishnamurthy, 1950, 1954). On the other hand, green algae including species of *Enteromorpha*, *Cladophora*, *Spyridia*, *Polysiphonia*, *Acanthophora*, *Bostrychia* and sometimes *Caloglossa* have been recorded. *Vaucheria* species has been recorded from some estuarine mud flats. Seasonal succession of algal communities in a salt marsh was studied by Krishnamurthy (1954). He recognized six algal communities in the salt marsh connected with the estuary of river Adyar in Chennai. These were :

- (1) *Chaetomorpha-Gracilaria* community,
- (2) *Acanthophora-Hypnea* community,
- (3) *Polysiphonia platycarpa* community,
- (4) *Rosenvingea intricata* community,
- (5) *Enteromorpha-Cladophora* community
- (6) Diatom and blue-green algal community.

Of these, the *Chaetomorpha-Gracilaria* community and the *Acanthophora-Hypnea* community persisted throughout the year and the dominant members of these communities were quite abundant. The *Polysiphonia* community and the *Rosenvingea* community occurred twice a year with intervening period when vegetative thalli of these genera were not seen. The *Enteromorpha-Cladophora* community and the diatom and blue-green algal community were found only in some part of the year.

Gracilaria and *Acanthophora* showed reproductive stages, during the postmonsoon period. *Polysiphonia platycarpa* showed all stages of life history, although it was not found throughout the year. Severed fragments of *Polysiphonia* showed characteristic regeneration from the axial siphon of short thick stumps. The other algae were mostly in vegetative condition only and their probable mode of reproduction was by fragmentation.

The *Enteromorpha-Cladophora* community was present in the marsh only during July to February and composed of *E. lingulata* (*E. compressa* var. *lingulata*), *E. prolifera* var. *tubulosa* and a species of *Cladophora* (unnamed by Krishnamurthy 1954), *C. expansa*. Of these *E. lingulata* was dominant from July to December and from December onwards, this species showed

decreased abundance and *Cladophora expansa* increased and became dominant and in February, the entire community "disappeared" from the marsh. It is suspected that these might be restricted to very small areas during February to June.

The algal community consisting of Diatoms and blue-greens were abundant from August to December. The members of this community i.e. 14 taxa of diatoms and six taxa of blue-green algae were first found to form a golden green film at the drying margins of the water in the marsh. *Cocconeis littoralis* was also epiphytic on various larger algae, especially *Polysiphonia platycarpa* and *Gracilaria verrucosa*. This species along with *Nitzschia closterium*, *Oscillatoria nigrovirides* and *Anabaena* sp. were dominant in August-October. In November, these species dwindled and their place was taken over by *Pleurosigma* which dominated the community from November to February of the next year.

One interesting phenomenon noticed in this community is the seasonal succession between the benthic and epiphytic members of both groups. From July to August, epiphytic blue-green algae and epiphytic diatoms were abundant; benthic blue-green algae were abundant for a short while and the benthic diatoms were rather scarce. Later in the season, benthic and epiphytic diatoms became dominant, benthic blue-green algae became scarce and epiphytic blue green, totally absent (Krishnamurthy, 1981).

Work on the algal floral of salt marshes in India, especially on their productivity are limited and this is a field which deserves attention in future.

CONSERVATION OF MARINE ALGAE

The economically important marine algae such as *Gelidiella acerosa*, *Gracilaria edulis*, *G. corticata*, *G. foliifera*, *G. arcuata*, *G. verrucosa*, *G. crassa* and species of *Sargassum* and *Turbinaria* are exploited along Tamil Nadu coast for supply to seaweed based industries.

India possesses rich and varied biodiversity of marine algae due to its locational advantage north of the equator with a latitudinal spread, which gives a wide range of climatic conditions from torrid to cold. The seaweed resources in the coastal waters are heavily exploited affecting natural resources and biodiversity. Losses of marine biodiversity are largely the result of conflicting uses of, in particular, coastal habitats, which lead to

degradation, fragmentation and loss of habitats. The needs of growing population for housing, disposal of human and industrial wastes, fisheries, development of harbours, industrial sites and tourist complexes are combined with effects from activities such as forestry or mining, up water sheds of hundred kilometres away, to degrade and destroy coastal habitats. It is habitat alteration, fragmentation and destruction in the coastal zone that are the main factors leading to loss of marine biodiversity (Gray, 1997). Therefore there is a need for conservation of resources by preventing indiscriminate harvesting by seaweed collectors and adopting culture practices. Pollution of coastal waters, aquaculture activities in coastal zone and heavy exploitation of coral reefs also affect the algal resources. The destruction of biodiversity, besides its ethical and aesthetic implications, has severe economic affect. Therefore it is very essential to protect the biodiversity and conserve the resources by all concerned agencies.

FUNGAL FLORA OF INDIAN COAST

Fungi include majority of non-flowering plants and constitute a group of heterotrophic organisms subsisting as parasites or as saprophytes on other organisms or their residues, respectively.

In India it numbers more than 2300 genera and approximately 14,500 species. No special attention has so far been given for survey of fungal flora specially restricted to the coastal belt. Some common species, which have been collected from the coastal plants, are as follows :

Amylosporium campbellii
Corticiopsis telfrii
C. floccosa
C. aspera
C. caperata
C. sanguinaria
C. strumosa
Cystostiptoporus violaceo-cinerascens
Earliella scabra
Funalia leonina
Grammothele delicatula
G. fuligo
Hexagonia tenuis
H. aptaria
Loweporus tephroporus
Nigrofomes melanoporus,

Nigroporus vinosus
N. durus
Pachykytospora Papyracea
Pseudofavolus miquelii
Tinctoporellus epimiltinus
Antrodiella semisupina
A. minutispora
A. tunua
A. liebmanii
A. straminea
Bjerkendera adusta
B. famosa
Boodanzewia berkeleyi
Ceriporia viridans
C. mellea
C. purpurea
C. xylostromatoides
Daedalea incana
D. andamani
D. sulcata
D. sprucei
Datronia mollis
Dichmitus leucoplacus
Favolus brasiliensis
F. spathulatus
Fomitopsis dochmitis
F. feei
F. palustris
F. rosea
F. scutellata
Gloeophyllum abietinum
G. sepium
G. subferrugineum
G. trabeum
Gloeoporus dichrous
Incrustoporia carneola
Irpex lacteus
Junghunia nitida
J. collabens
Laetiporus sulphureus
Lenzites acuta
L. betulina
L. elegans

L. vespacea
Lignosus sacer
Microporus affinis
M. xanthopus
Oxyporus spiculifer
O. ravidia
O. populinus
O. latiniarginata
Perenniporia fulviseda
P. medulla-panis
P. ochroleuca
P. tenuis
Polyporus varius
P. tricholoma
P. squamosus
P. grammacephalus
P. arcularis
P. brumalis
Pycnoporus cinnabarinus
P. sanguineus
Pyrofomes albomarginatus
Rigidoporus lineatus
R. microporus
R. ulmarius
R. vineta
Schizopora paradoxa
S. flavipora
Trametes cingulata
T. cotonea
T. gibbosa
T. hirsuta
T. lactenea
T. tephroleuca
T. varians
Trichaptium byssogenus
T. biformis
T. abietinum
Tyroniyces chioneus
Writoporia lenta

(Source : Sharma, J. R., 1997)

NOTES ON MARINE FUNGI

True marine fungi like Phycomycetes and

Ascomycetes are most frequently found in marine environment, though some imperfect fungi also occur. The Phycomycetes or Hemiascomycetes include the yeasts, which have numerous marine representations. Many of the fungal species have been isolated from mangroves, seagrasses, seaweeds, macroscopic algae and submerged wooden structures or driftwood. In a study of lignicolous marine fungi from India, twelve Ascomycetes and six Fungi Imperfecti from driftwood and wood submerged in the sea were recorded (Raghukumar, 1973)

Venkatesan (1981) carried out the first systematic seasonal study on the occurrence and distribution of higher fungi in Pichavaram mangroves near Portonovo which is dominated by species of *Rhizophora* and *Avicennia*—Maximum number of fungi were recorded during monsoon months when the salinity was low (4.9×10^{-3}). Their number reduces during summer when the salinity was high (25.83×10^{-3}). The mangrove water harbours a sparse fungal population compared to mud, rhizosphere and rhizoplane. Altogether 80 species belonging to 47 genera were isolated in one-year period of study. Twelve species of typical marine fungi were found to colonize only the litter of *Avicennia* and *Rhizophora*. *Aspergillus* was the most dominant in all biotopes followed by *Penicillium* and *Cladosporium*. Phycomycetes were very rare in water, mud and rhizosphere. The study of litter fungi of *A. officinalis* and *R. mucronata*, employing moist chamber incubation revealed the presence of 12 species of typical marine lignicolous fungi : *Leptasphaeria australiensis*, *L. contecta*, *Lignicola laevis*, *Lutworthia medusa*, *Massariella martina*, *Camarosporium quaternatum*, *Cirrenalis pygmaea*, *Culcitaina achrospora*, *Humicola alopallonella*, *Periconia prolifica*, *Speria pelagica* and *Zalerion varium*. The roots and twigs harboured a richer mycoflora than the leaf litter.

Deuteromycetes forming bulk of the mangrove fungi were found to be the most active cellulose decomposers. The rhizospheres examined, revealed the preponderance of Deuteromycetes. The mangrove swamp, especially rhizosphere is a potential habitat for fungal inhabitation. The rhizosphere soils were found to favour the establishment of fungal community, irrespective of varying salinity levels, perhaps due to the pronounced rhizosphere effect.

Thraustochytriales or Oomycetes are known to occur in seawater and sediment. Even though they have been isolated from several parts of the world, including

Antarctic waters, only little is known on their ecology in a marine environment and their role. Very recently considerable work has been carried out on their ecology in Indian waters. One estimation showed that their number ranged from 1 to 69 l⁻¹ in the oceanic water samples (Arabian sea) and up to 11,000 l⁻¹ in sample from the lagoons of Lakshadweep coral islands (Raghukumar, 1985). The species isolated were, *Labyrinthuloides yorkensis* and *Ukenia amoeboides*. Later, one species which was consistently isolated in great number from the coral reef lagoons of the Lakshadweep Islands was identified as a new protist, *Corallochytrium limaensisporum* gen. et sp. nov. (Raghukumar, 1987). These thraustochytrids may possibly play a major role in the biodegradation of organic matter and turnover of nutrients in the sea. Many of the diatoms collected from Arabian Sea were found to harbour thraustochytrid fungi on them (Raghukumar, 1986a). The fungus was identified as *Ukenia visurgensis*. The green alga, *Cladophora* collected from the beaches of Goa and Lakshadweep Islands showed the presence of three fungal pathogens viz. *Strobidium bryopsidis*, *Olpidium rostriferum* and *Labyrinthula* Sp. A species of Coenomyces was found to be associated with *Cladophora repens* and *Rhizoclonium*. Except *Labyrinthula*, the other fungi could not be cultured on artificial media and most of them were host specific. Fungi are also known to be important causal agents of 'shell diseases' in marine bivalves (Raghukumar & Lande, 1988). They may also significantly contribute to the degradation of calcareous substrate including shells in the marine environment.

Yeasts constitute a significant portion of the mycoflora of the tropical marine ecosystem. 14 species of yeasts were isolated (De Souza, 1978). They belong to the genera *Candida*, *Geotrichum*, *Trichosporon*, *Dipodascus*, *Pichia* and *Torulopsis*. Among these, *Candida tropicalis*, *Geotrichum penicillatum* and *Trichosporon cutaneum* were the dominant species. These yeasts are known to reduce C : N ratio of detritus in mangroves and they also showed a positive correlation with phosphorus. *Torulopsis glabrata* was found to be the best phosphorus solubilizer.

A systematic study on the seasonal occurrence and distribution of Actinomycetes in the sediments of coastal environment of Portonovo, South India was conducted by Lakshminarasimhan (1978). Maximum number of the actinomycetes could be recorded in estuarine and

mangrove biotopes. Among the genera of actinomycetes encountered (*Streptomyces*, *Micromonospora* and *Nocardia*). *Streptomyces* constituted nearly 85 per cent of the population. In general, the Grey and White colour series were encountered most frequently. These groups were followed by members of Red and Yellow colour series.

A subsequent study conducted by Vanaja Kumar (1979) indicated the predominance of antagonistic strains among the members of Streptomycetes isolated from marine molluscs. The seasonal changes occurring in the Streptomycete populations of shell surface, mantle and gut of five molluscs—three bivalves (*Crassostrea madrasensis*, *Meretrix casta*, *Anadara rhombea*) and two gastropods (*Telescopium telescopium*, *Bullia vittata*) from estuarine, backwater and marine regions of Portonovo coast over a period of one year were noted. Actinomycetes strains could be isolated from all the regions of the molluscs. While the Actinomycetes population on the shell surface exhibited significant positive correlation with some of the environmental factors, those of the mantle and gut regions did not exhibit any such correlation. Unlike sediments, only two genera viz. *Streptomyces* and *Actinomyces* were encountered.

LICHEN FLORA OF COASTAL INDIA

Singh, Ajay (1964); Awasthi (1963); Awasthi & Singh, K. P. (1973a & 1973b); Prain (1905); Roychowdhury, K. N. (1985) and many authors have studied Lichens of Indian Flora but very few attempt has been initiated to concentrate on the Lichen flora from the coastal region. Present authors have surveyed only the Lichen flora of Sundarbans mangroves and from the Andaman Islands which have been identified from the collections of BSI and NBGRI. 86 species are reported from the East coastal regions and Andaman Islands.

LICHENS FROM MANGROVES, EAST COAST

Trypethelium eluerae Sprengl.

Trypethelium tropicum (Ach.) Muell.-Arg.

Laurera madreporiformis (Eschw.) Riddle apud Howe

Arthonia antillarum Nyl.

Arthonia cinnabarina (Dec.) Wallr.

Arthonia subgyrosa Nyl.

Arthonia subvelata Nyl.

Arthothelium arnorme (Ach.) Muell.-Arg.

Opegrapha bonplandiae (Mass.) Fee

Opegrapha martii Nyl.

Opegrapha vulgata (Ach.) Ach.

Melaspilia insitiva Strit.

Graphina leuconephala (Nyl.) Zahlbr.

Chiodecton micrographum (Nyl.) Zahlbr.

Lecanactis premnea Arn. var. *melargyra* (Nyl.) Zahlbr.

Schismatomma kurzii (Krmph.) Zahlbr.

Schismatomma glaucumoides (Nyl.) Zahlbr.

Lecidea granifera (Ach.) Vain.

Caloplaca encephalarti (Krmphbr.) Zahlbr.

Buellia lauri-cassiae (Fee) Muell.-Arg.

Rinodina colobina (Ach.) Th.

Rinodina intrusa (Nyl.) Malme

Dirinaria consimilosis (Strit.) Awas.

LICHENS FROM COASTAL ANDAMANS

Microthelia conothelena (Nyl.) Zahlbr.

Microthelia dissepta A. L. Smith

Microthelia micula Korb.

Anthracotheccium andamanicum (Nyl.) Muell.

A. interponens (Nyl.) Muell.

Arthonia catenatula Nyl.

Arthopyrenia alboatra (Kremppch.)

Arthopyrenia cinefaciens (Nyl.) Zahlbr.

Arthopyrenia conformis (Nyl.) Herre

Arthopyrenia majuscula (Nyl.) Zahlbr.

Arthopyrenia planorbella (Nyl.) Zahlbr.

Arthopyrenia terminata (Nyl.) Muell.-Arg.

Arthopyrenia subnexa (Nyl.) Mull.

Arthothelium bessale (Nyl.) Zahlbr.

Porina interstes (Nyl.) Harm

Pyrenula aspitea (Afz.) Ach.

Pyrenula nitida (Weigh) Ach.

Pyrenula subnitidella (Nyl.) Muell.-Arg.

Anthracotheccium parvinucleum (G. Meyer & Flotow) Zahlbr.

Graphina luceocarpoides (Nyl.) Zahlbr.

Graphina perstriatula (Nyl.) Zahlbr.

Graphina subotecta (Nyl.) Zahlbr.

Graphina incondita (Nyl.) Zahlbr.

Graphina particeps (Nyl.) Muell.

Graphina subtorquens (Nyl.) Nyl.

Graphina subotecta (Nyl.) Zahlbr.

Chiodecton intermissum Nyl.

Thlotrema albidopallens Nyl.

Lecidea caliginosa Stirt.

Pertusaria velata (Turn.) Nyl.

Caloplaca kurzii (Krempeh.) Sant.

Chiodecton intermissum Nyl.

Chiodecton kurzii Kempt.

Clathroporina duplicascens (Nyl.) Zahlbr.

Graphis subdisserpens Nyl.

Lecanactis concordens (Nyl.) Zahlbr.

Graphis subdisserpens Nyl.

Lecanactis concordens (Nyl.) Zahlbr.

Leptotrema andamanicum (Nyl.) A. L. Sm.

Leptotrema reculsum (Krempeh.) Zahlbr.

Mazosia phyllosems (Nyl.) Zahlbr.

Microthelia conothelena (Nyl.) Zahlbr.

Microthelia conothelena var. *errans* (Nyl.) Zahlbr.

Ocellularia allosporoides (Nyl.) Patw. & Kulk.

Ocellularia allosporiza (Nyl.) Zahlbr.

Ocellularia leucotylia (Nyl.) Muell.

Ocellularia terebrans (Nyl.) Zahlbr.

Opegrapha longula Nyl.

Paramelia ecoronata Nyl.

Parmeliella pannosa (Sw.) Muell.

Physica confluens (Fr.) Nyl.

Porina internigrans (Nyl.) Muell.

Porina interspersa (Nyl.) Zahlbr.

Porina interstes (Nyl.) Harm.

Porina subinterstes (Nyl.) Muell.

Pyrenula mastophora (Nyl.) Zahlbr.

Pyrenula subnitidella (Nyl.) Muell.

Schismatomma flavisedellum (Nyl.) Zahlbr.

Schismatomma kurzii (Krempeh.) Zahlbr.

Thlotrema albidopallens Nyl.

Thlotrema colobicum Nyl.

Thlotrema rugatulum Nyl.

Thlotrema subcalvescens Nyl.

SOME OF THE IMPORTANT HABITATS IN THE WET COASTAL SYSTEM

LAKSHADWEEP ISLANDS

Lakshadweep Islands consisting of a group of coral atolls, lagoons, submerged islands, reefs and banks in the Arabian Sea are situated between the latitude 8°-12° N and longitude 71°-74° E. It covers 36 islands, 12 atolls, 3 reefs and 5 submerged coral banks. All islands are geometrically similar in shape, relatively wider at North and narrowing down towards South except Androth. All the islands are small in size ranging from 0.1 - 4.4 sq. km in area, and are encircled by fringing reefs with the formation of lagoon on western sides. The total land area of Lakshadweep is 32 sq. km and the total extent of lagoon is about 420 sq. km (Chandramohan *et al.*, 1993). The earliest records of the flora and fauna of the Lakshadweep islands are those of Gardiner (1905) and Ellis (1924).

The tides at the Lakshadweep islands region are of semi diurnal type, with the spring tidal range of about 1.2 m and the neap tidal range of about 0.3 m. The maximum wave heights range from 5 m to 8.95 m (Ramachandran & Ajay Kumar Varma, 1997).

Rainfall is slightly more in South than in North showing an average of about 1640 mm for Minicoy and 1504 mm for Amini. The maximum temperature ranges from 35° to 17° C (Jones, 1986).

Coral Distribution

A total of 104 scleractinian corals belonging to 37 genera are reported from this region (Gopinadha Pillai & Jasmine, 1990). A comparative study of the coral fauna of southeast coast of India and the Minicoy shows that *Acropora* is the common genus at both the places, but the species occurring at the sites are markedly different. Minicoy shows a closer affinity to those of Maldives but the south-east coast shows a close affinity with Malaysian region (Gopinadha Pillai, 1971). A notable feature of the coral fauna of Lakshadweep is the absence of foliaceous forms such as *Montipora foliosa* and *Echinopora lamellosa*. The massive coral species such as *Porites solida*, *P. lutea* and *Diploastrea* sp. are very common in Minicoy (Gopinadha Pillai, 1986).

The production of particulate organic carbon (POC)

by the reef community is about 20% of its gross production, which is equivalent to about 95% of coral respiration as determined from the flow studies at night (respiration 0.100gC/m²/hr). (Qasim & Sankaranarayanan, 1970).

Due to shallowness of the lagoon, it is supporting rich growth of macrophytes. The benthic algae present in the lagoon are playing a significant role in the biogeochemical processes of the waters. The magnitude of photosynthetic activity of the algae and phytoplankton population can be seen from the diurnal changes in the oxygen, where it varies from 1.73 to 8.83 ml/l.

The most striking feature in the distribution of zooplankton in Lakshadweep waters is the higher abundance of zooplankton in the adjoining sea as compared to the lagoon.

Copepods constitute an important component in the demersal zooplankton, which hide in the coral sediments or crevices during daytime but emerge at night for feeding (Goswami and Usha Goswami, 1990).

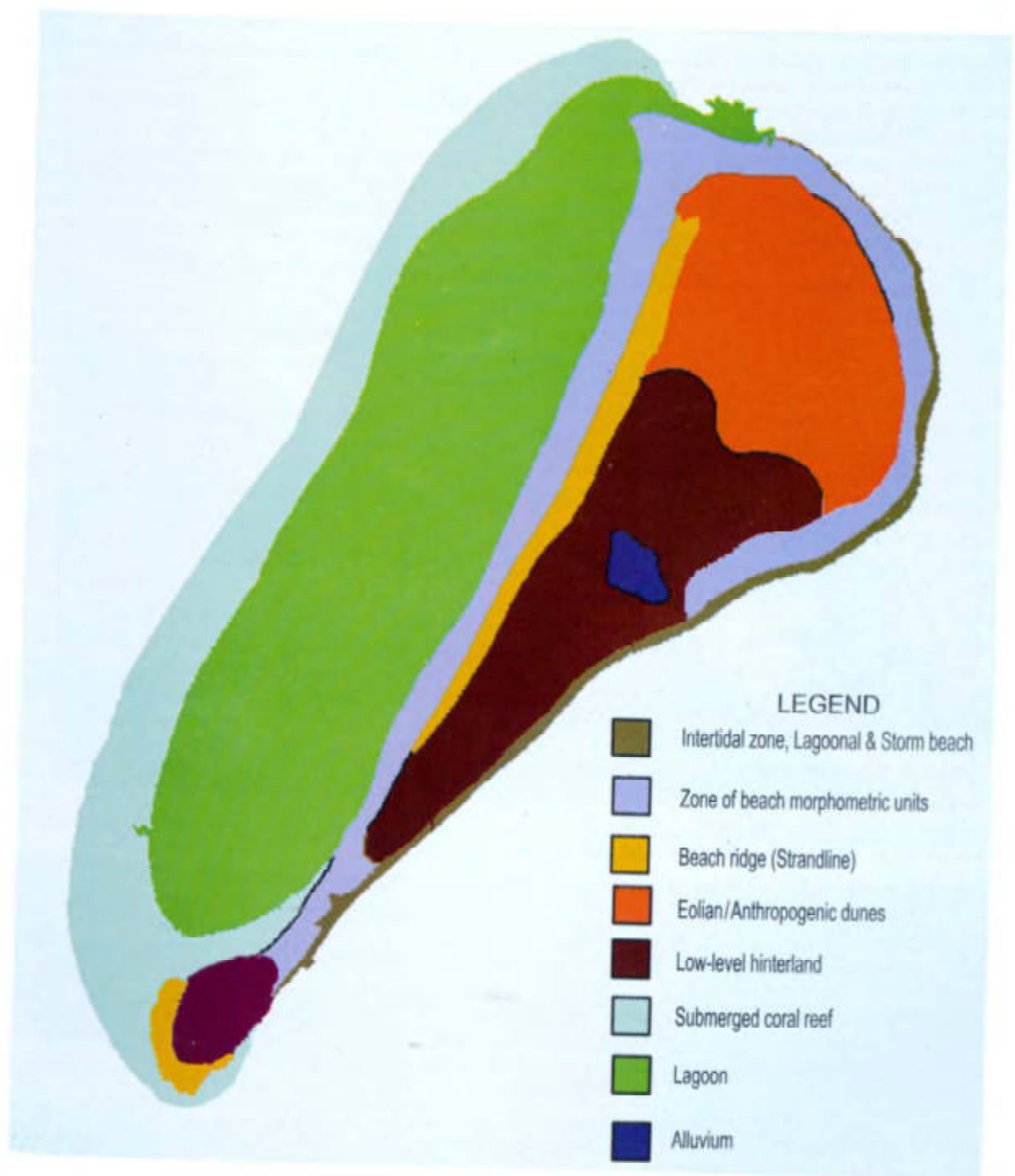
Secondary production values for the surface zooplankton samples are low during the day time in the lagoon due to higher incident illumination and temperature which force the plankton to hide in the thick growth of sea grasses, *Thalassia hemprichii* and *Cymodocea isoetifolia*.

Bhaskar (1984) has reported four species of turtles viz. *Eretmochelys imbricata* (Hawksbill), *Lepidochelys olivacea* (Olive Ridley), *Chelonia mydas* (Green turtle) and *Dermochelys coriacea* (Leather back).

Cheap and very expensive ornamental fishes are also available in huge quantities. Varieties of ornamental fishes of the genus *Abudedefduf*, *Amphiprion*, *Apogon*, *Coris*, *Balistes*, *Platax* and several other coral fishes are common in Lakshadweep (George *et al.*, 1986).

Annual fishery potential of the Lakshadweep sea has been estimated as 90,000 tonnes but the yield as per 1984 statistics is only about 5,000 tonnes / year (Jones, 1986). *Chromis caeruleus* and *Daeyllus aruanus* are predominant among the coral fishes that coexist with the racemose corals.

As per latest figures, annual fisheries yield of Lakshadweep is around 9,000 tonnes, of which tunas alone



Geology and Geomorphological Map of Kavaratti Islands, Lakshadweep

(Source : GSI, 1995)



Coastal Lagoon—Chilka Lake



A view of Chilka Lake

constitute 7,000 tonnes. Steady increase in landings and decrease in mean length of yellow fin tuna are matters of great concern over the dwindling tuna populations of this area. Vegetation of this island can be divided into four types. Open pioneer zone of the coral strand where the area is regularly inundated due to high wave action is found to be covered with some special type of coral-sand binders such as *Cyperus pachyrhizus*, *Cyperus pedunculatus*, *Thuarea involuta* alongwith some algae, species of *Dictyosphaeria*, *Caulerpa*, *Botryocladia* and *Nostoc*.

Raised ridges of coral strand which are occasionally inundated during high tide are found associated with *Sesuvium portulacastrum*, *Spinifex littoreus*, *Canavalia maritima*, *Ipomoea pescaprae*, *Euphorbia atoto*, *Wedelia biflora*, *Tylophora asthmatica*, *Pisonia aculeata*, *Leptadenia reticulata*, *Apluda mutica* and others.

Stable coral strand situated above the usual wave action zone is associated with some species of special interest, as very few of them can be located towards the other coastal zone in India. The common associated species are *Pemphis acidula*, *Scaevola plumeri*, *Messerschmidia argentea*, *Suriana maritima*, *Guettardia speciosa*, *Hernandia ovigera*, *Halophyrum mucronatum*, *Vitis quadrangularis*, *Clerodendron inerme*, *Cassytha filiformis* and others.

Back shore of the coral strands form very interesting evergreen and semi-evergreen woodland formation where the vegetation is more or less similar with that of the wet coastal rocky woodland type. Occurrence of some restricted littoral tree species is remarkable in this zone. Most dominant plants are *Thespesia populnea*, *Calophyllum inophyllum*, *Terminalia catappa*, *Ochrosia borbontca*, *Premna integrifolia*, *Morinda tinctoria*, *Pavetta indica*, *Pleurostyliia oppositifolia*.

Most of the species concentrated in this vegetation zone represents very restricted habitat in respect of their distribution and ecological niche.

COASTAL LAGOON - LAKE CHILKA

Chilka (19°28' to 19°54' N and 85°06' to 85°35' E) the largest brackish water lake or the coastal lagoon in Asia spreading an area of 1100 sq. km spans in the

districts of Puri and Ganjam in Orissa. This pear shaped lagoon is connected to the Bay of Bengal through a narrow mouth and separated from the sea by a spit of about 60 km long and about 150 meters width. It forms a part of the Mahanadi Delta and is fed by tributaries of Daya, Bhargavi and Nuna from the north and the Rushikulya from the south. It receives salt water tide from the Bay of Bengal and fresh water flow from the connecting tributaries towards north. The shallow expanses of brackish water body is the source of innumerable biological diversities depending upon the hydrology, water salinity, wave action and sedimentation pattern. It harbours varieties of micro and macro algal communities, seagrasses and many macrophytes. It provides an optimum habitat of rich variety of aquatic fauna. It serves as one of the most attractive habitats of thousands of migratory and resident birds and consequently it has been placed under Ramsar Convention of Wetlands of International Importance.

The lake is bounded by Eastern Ghats in the west, district Puri in the east, Bay of Bengal in the south and some tributaries of the river Mahanadi in the north. Several rivers and rivulets open into the lagoon contributing to large scale siltation in the catchment areas. During Summer, water level becomes lowest and during Rainy season, it becomes highest. However, the depth of water level is found different in different regions of the lake. The southern sector and central sector of the lake water remain quite deep compared to that of the northern sector due to high siltation process. The bed sediments of the lake consist of deltaic alluvium clay, sand mud, silt and shell with rich organic matters. The rock types mainly consist of khondalities, charnockites, laterites, granites and gneisses.

The climate of the lake falls under the tropical humid belt with high range of temperature, heavy rainfall and forcible wind. Mean annual temperature ranges from 26-37°C during March-April and 16-20°C in December-January. Mean annual rainfall varies from 1160 mm to 1600 mm. The average wind speed ranges from 15-25 km/hr, with more forceful wind towards the adjacent coastal area. The normal annual evaporation in the basin ranges from 180-240 cm. During Summer, it varies from 60-80 cm. During the months of May-December, the mouth of the lake is affected with severe cyclonic storms. General characteristics of the lake water is

brackish (0.3-3 gm/l). It's salinity, pH, DO, free CO₂ and suspended particles changes from season to season and varies from region to region depending on the influence of rain, evaporation pattern, tidal effect and temperature.

The detailed literature survey pertaining to the work on Chilka Lake reveals that many scientists have studied in different fields of this important brackish water lake ecosystem. Some of the studies are no doubt very helpful for evaluating the holistic status of the lake in the line of lake resources for enhancing social economy, some major problems affecting salinity condition, siltation and weed infestation, strategies of conservation and sustainable development, but they do not throw comprehensive base line data on the total plant resources, taxonomy, quantitative ecological status and the mechanism by which it differs in the distribution pattern of the various available plant species, their importance in the food chain of different fishes and birds and their effective role in protecting the soil erosion and purifying water quality. In view of the above a project on Ecological investigation on the Plant Resources of the Lake Chilka have been undertaken from the Ecology Unit, Botanical Survey of India to study the various types of phytoplankton, algae and seagrasses which are tolerating wide range of salinity, tide and wave action in submerged or emerged condition of the lake along with the systematic information and distribution of microphytes and macrophytes and other terrestrial plant communities around the lake.

Some of the most important phytoplankton, seaweeds, seagrasses and aquatic macrophytes are enlisted for preliminary information of the lake :

Phytoplankton

Anabaena sp., *Oscillatoria princeps*, *Oscillatoria chilensis*, *Lyngbya aestuarii*, *Lyngbya confervoides*, *Phormidium* sp., *Microcystis* sp., *Closterium* sp., *Cosmarium* sp., *Spirogyra* sp., *Oedogonium* sp., *Pertidium* sp., *Biddulphia* sp., *Synedra* sp., *Cocconeis* sp., *Navicula* sp., *Cymbella* sp., *Rhizosolenia* sp., *Asterionella* sp., *Nitzschia* sp. and others.

Common seaweeds

Enteromorpha intestinalis (L.) Link. f., *Gracilaria verrucosa* (Huds.) Pap., *Rosenvingea intricata* (J. Ag.) Boergs., *Polysiphonia sertularioides* (Grat.) J. Ag., *Polysiphonia subtilissima* Mont., *Grateloupia filicina* (Wulf.) Ag.

Common seagrasses

Halophila beccarii Asch., *Halophila minor* (Zoll.) Hattog.

Common aquatic macrophytes and marshy plants :

Potamogeton pectinatus L., *Potamogeton natans* L., *Vallisneria spiralis* L., *Najas indica* (Willd.) Cham., *Ceratophyllum demersum* L., *Nymphaea rubra* Roxb. ex Andrews, *Lemna paucicostata* Roth., *Hydrilla verticillata* (L.f.) Royle, *Eichhornia crassipes* (Mart.) Solms., *Typha angustata* Aory & Chams., *Scirpus articulatus* L., *S. maritimus* (L.) Lye, *Cyperus rotundus* L., *Phragmites karka* (Retz.) Trin., *Alternanthera philoxeroides* (Mart.) Griseb., *Azolla pinnata* R. Br., *Marsilea minuta* L., *Arundo donax* L. and others. A Ph. D. thesis has been awarded with full details from the Ecology Unit by Anirban Ray under the guidance of L. K. Banerjee & P. K. Mukherjee to Calcutta University 2001.

RANN OF KUCHCHH - A COASTAL DESERT

Rann of Kuchchh located at the extreme north west part of the Gujarat state extends from 22°-25° N and 68°-73° E. In the north it is connected with Pakistan, in the south with Rajkot and Surendra Nagar, in the east with Banaskanta and Mahesana district and in the west surrounded by Arabian Sea.

The important rivers draining into Rann of Kuchchh are the Luni, the Hakbari, the Bhukhi, the Banas, the Nachhu and the Demi. The river Luni has a well defined delta starting from Chitulwana to Ruthora covering a distance of 6.5 km. All these rivers have originated from the Aravalli hills. The mainland of Kuchchh is isolated on the north by Great Rann and on the south east by Little Rann. The Central part forms a table land slopping on all side resembling a structure like that of a tortoise, hence the name Rann of Kuchchh.

The western part of great Rann of Kuchchh falls under the category of coastal desert ecosystem. Due to its low lying nature, the marine water encroaches and spreads over a fairly vast area. Consequently the water and soil of that particular areas become extremely saline due to prolonged evaporation and form a marshy land. The area covering about more than 600 sq. km is influenced by a low rainfall and high temperature with a wide diurnal variation. Slightly elevated plains from which salt is periodically leached, support good growth

of fodder grasses. The land use pattern is also changing in this area from the grazing land to rain-fed farming and cultivation of marginal land by the local people. This has resulted in the reduction of grazing potential.

Special ecological significance of this area is the admixture of saline, marshy and coastal desert intermingling topography which is probably the only unique feature in this part of the Indian subcontinent. The region seems to be under the ocean during pleistocene era as it is evident from the highly fossiliferous soil formation such as sandy strands, rocky-sandy strand and soft-marsh consisting of black clay.

Due to diverse habitat conditions and specialised ecological environment, Rann of Kuchchh harbours different biological components in its ecosphere. The region exhibits a spectacular plant diversity because of its evolutionary history, geographical location and ecological specialization of forming the salt desert condition. Vegetation of the coastal desert can be divided into three major types namely coastal dry sand strand, mangroves and salt marsh. It contains one of the most fascinating areas of coastal and marine communities of both plant and animal. The elevated islands or Betts of the Rann of Kuchchh show interesting growth of many salt marshes associated with grasses and sedges. West part of the Rann of Kuchchh which extends up to the Arabian Sea, harbours a variety of marine life such as Hippocampus, Sea turtles, Dolphin, Whales, Dungos, etc. The coastal regions in this part is also a favourite spot for the breeding ground of Sea turtles, Olive Ridley turtles and Green sea turtles. It is a high potential area for lobsters and prawn harvesting. Along the Gulf of Kuchchh near Novalakhi and Okha the presence of living corals and pearl oysters are very interesting. In the Little Rann of Kuchchh one of the rarest surviving animals, the sub species of Indian Wild Ass (*Equus hemionus* Khur.) is very interesting and deserves every measure of protection. In many cases it is found that the area sustains some of the isolated populations of certain plants and animals which are extremely important from evolutionary stand point. The value of the salt desert ecosystem needs special protection due to its unique fragile nature and special ecological conditions.

Some of the interesting plant communities which are essential for ecological security of the coastal desert ecosystem are mentioned as follows :

Coastal sandy strand dominated by *Cyperus arenarius*, *Halopyrum mucronatum*, *Asparagus racemosus*, *Heliotropium bacciferum* var. *suberosa*, *Indigofera argentea*, *Lotus gracini*, *Leptadenia pyrotechnica*, *Sericostoma pauciflorum*, *Ipomoea pescaprae*, *Launaea sarmentosa*, *Borreria articularis* and many others.

The mangrove communities have formed here, a climatic climax and dominated by a monotypic form, *Avicennia marina* var. *acutissima*. Except along the west mangrove zone towards the Pakistan boarder, all other areas are covered with uniform growth of 0.5-1 m tall *Avicennia marina* var. *acutissima*. The salt marsh communities are mainly dominated by *Juncus maritima*, *Salicornia brachiata*, *Suaeda nudiflora*, *Suaeda fruticosa*, *Clerodendrum multiflorum*, *Aeluropus lagopoides*, *Cressa cretica*, *Sesuvium portulacastrum*, *Urochondra setulosa*, *Fimbristylis ferruginea*, *Fimbristylis cymosa*, *Scirpus maritima*, *Tamarix troupii* along with some grasses such as *Cenchrus ciliaris*, *Chloris virgata*, *Cynodon dactylon*, *Eragrostis ciliaris*, *Eriochloa procera*, *Sporobolus coromandelianus*, *Sporobolus marginatus* and others.

Some of the dominant thorny Scrubs which are found bordering the saline areas of the Rann are *Prosopis juliflora*, *Acacia nilotica* sub. sp. *indica*, *Acacia senegal*, *Prosopis cineraria*, *Balanites egyptica*, *Fagonia cretica*, *Commiphora wightii*, *Salvadora oltoides*, *Capparis decidua*, *Euphorbia nerifolia*, *Astragalus prolixus*, *Zygophyllum simplex* and others.

OCEANIC GROUPS OF ISLANDS - ANDAMAN AND NICOBAR

The oceanic islands of Andaman & Nicobar groups in the Bay of Bengal extending between 6°-14° N and 92°-94° E, faces Myanmar in the north and Sumatra in the south. The islands are highly undulating with different slopes. It is known that the group of islands form a narrow broken chain that are the remnants of two vast mountain ranges which once stretched from Arakan in Myanmar to Achin in Indonesia (Saldanha, 1989). Total number of islands in Andaman is 325, covering 6408 sq. km. The coast line of Andaman extends up to 1926 km. Geomorphologically the Andaman group of islands is divided into North Andaman, Middle Andaman, South Andaman (including

Ritchie's Archipelago) and Little Andaman. Topographically the coast line consists of rocky shore, sandy beaches, coral reefs, bays, lagoons, several creeks and canals. Most of the undulating terrain has the main ridges running north-south, falling stiffly and irregularly on both sides of the Bay of Bengal and the Andaman Sea. The continental slope is narrow and slopes rapidly to a greater depth. The narrow shelf is compensated by forming numerous bays, lagoons, creeks and canals. The indented coastline is irregularly broken in several places to form backwater creeks, channels and well-sheltered natural harbours. The islands are exposed to both southwest and northeast monsoon with an average rainfall of more than 3000 mm. Due to proximity of the equator, the climate is warm humid tropical. The temperature varies from 18°C to 32°C and average relative humidity ranges from 70-80%. Soil particle sizes show considerable changes from heavy clay to clay loams, gravelly loams, sandy loams, silty loams and sands. Deep alluvial deposits are often found along the lower reaches of the creeks and the banks of channels. Soil organic compounds are continuously leached out by heavy rainfall. The littoral zone is continuously inundated by tidal saltwater from the sea. The source of freshwater flow for admixturing with that of saltwater in the creeks and channels are the different small rain-fed streams from the hilly terrain. As the islands of Andaman fall under different slope groups starting 1-10% and 10-20% slopes, the volume of freshwater during rain mixing with the saltwater is generally high at the lower sloped terrain than the higher sloped terrain. This freshwater flow has high potential for the luxuriant growth and development of mangrove formation along wet coastal regions of the island.

The soil of Nicobar group seems to be little bit immature, loose in texture, poor in drainage and low in moisture capacity. It is mainly composed of micaceous sandstone with silt and clay beds. The coralline alluvium on the beach along the coastal fringes supports tree vegetation. The grey brown and red soil derived from the calcareous sandstone also support tropical forest vegetation.

The tropical oceanic island ecosystem of the Andaman extends up to the upper tidal limit of the supra littoral zone to the continental shelf. It is well known for biological productivity, species diversity richness and for

its higher endemism than the continental coastal ecosystem.

It is the most remarkable habitat for plant diversity and speciation, within the total area of 8300 sq. km near about 86% is densely covered with various forest types. The flora is very rich and diverse having several indigenous and extra Indian plant species. Most of the flora have the affinity with the flora of Myanmar, Indonesia, Malaysia and Thailand.

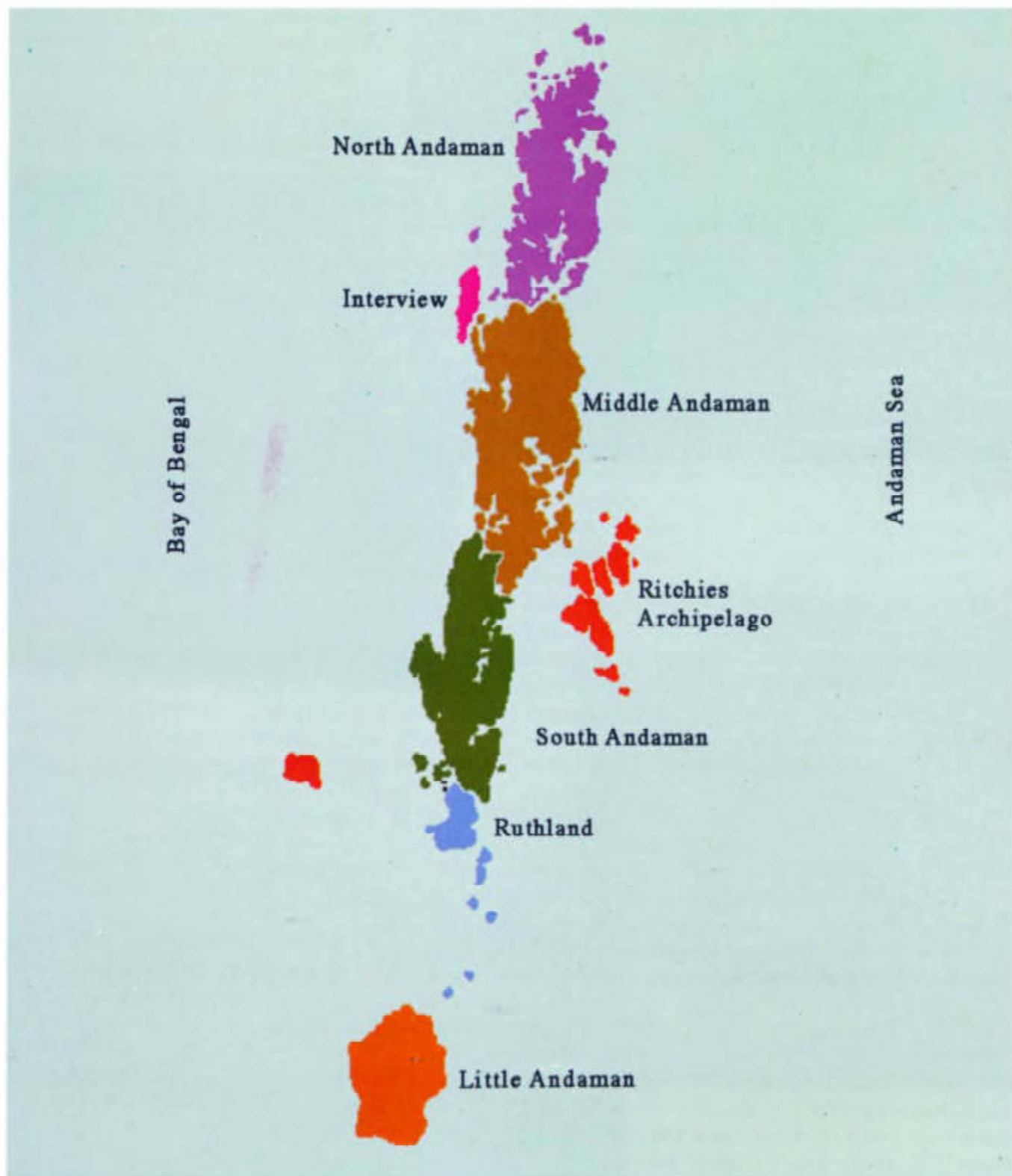
Distributional type of several plant communities depends mainly on the topographical changes of the island system. The study of littoral areas in different aspects on these islands have already been carried out by several authors such as, Singh *et al.* (1990), Sahni (1958), Balachandra (1988), Mall *et al.* (1985), Dagar *et al.* (1991), Rao, T.A. & S. Chakraborty (1987), Ellis, J.L. (1989), Balakrishnan, N.P. (1989), Vasudev Rao, M.K. (1986), Banerjee, L. K. (1999), Hajra *et al.* (1999), Sinha (1999) and many others.

The coastal plant diversity of the Andaman group of islands is very rich and productive with a good many number of angiosperms, the luxuriant growth of endemic *Cycas*, pure formation of *Nypa* palm, salt tolerant mangrove ferns and many interesting seaweeds and seagrasses.

The patterns of plant diversity as well as the functional implications of those patterns in the coastal ecosystem are very interesting in comparison with that of the terrestrial ecosystem. The members of the functional group respond differently to different environmental changes with the help of their adaptive characters. Plant communities of this group of islands represent vegetation on the rocky shore lines along the supra littoral zone, sandy strand vegetation and beach forests along the on-shore littoral zone, muddy intertidal swamp vegetation on the midlittoral zone, seaweeds, seagrasses and coral strand vegetation on the infra-littoral zone. This infra-littoral zone encompasses the exclusive economic zones of the island systems.

Classification of these coastal island plant communities can be made broadly as : Dry Coastal Plant Communities and Wet Coastal Plant Communities.

DRY COASTAL PLANT COMMUNITIES OF ANDAMAN ISLANDS : The dry coastal communities again can be divided into two distinct types : 1) The



Oceanic Islands of Andaman



Birds of Chilka Lake

Wild Ass in Rann of Kuchchh, Gujarat



Prawn Culture in Chilka Lake

Tropical Evergreen Forest of Andaman



Littoral Beach Forest, which occurs along the supra tidal zones on rocky or sandy terrain and 2) The Strand Vegetation on the sandy coastal beaches.

(1) **The Littoral Beach Forest** : This is one of the most attractive and pristine formation of the oceanic island system. Such luxuriant growth and development of the tree species along the coast line are probably the unique formation of the Andaman Coastal Ecosystem and this type is not generally found anywhere along the Indian coast. The dominant trees in this type are *Manilkara littoralis*, *Heritiera littoralis*, *Barringtonia racemosa*, *B. asiatica*, *Hernandia peltata*, *Syzigium samarangense*, *Thespesia populnea*, *Cynometra ramiflora*, *Sophora tomentosa*, *Glochidion calocarpum*, *Calophyllum inophyllum*, *Cerbera manghas*, *Ficus retusa*, *F. altissima*, *Ochrosia oppositifolia*, *Erythrina fusca*, *E. variegata*, *Cycas rumphii*, *Terminalia bialata*, *Pongamia pinnata*. Among the shrubs and herbs *Atlantia monophylla*, *Triphasia trifolia*, *Paramignya andamanica*, *Glycosmis mauritiana*, *Glycosmis arborea*, *Ardisia solanacea*, *Vitex diversifolia*, *Randia pulcherrima*, *Canthium glabrum*, *Euphorbia hirta*, *Centotheca latifolia*, *Ophiorrhiza mungos*, *Aerva lanata*, *Olax imbricata*, *Ischaemum muticum*, *Cyperus kyllinga*, *Dischidia bengalensis* and some of the common epiphytes like *Dendrobium crumenatum*, *Cymbidium aloefolium*, *Polypodium phymatodes* and species of *Drymoglossum*, *Depisorus*, *Asplenium* and the peculiar epiphytic plant like *Hydnophytum formicarium*. Along the coast on old coral stand the communities of *Guettarda speciosa*, *Pemphis acidula*, *Messerschmidia argentea*, *Vitex trifoliata*, *Scaevola sericea* and species of *Pandanus* are found common.

(2) **The Strand Vegetation** : The formation of large sandy beaches or the continuous occurrence of sand dunes like that of the east coastal regions are absent in this island ecosystem. However some small pocket beaches and crescent type of sandbars along the bay heads are prominent. The dominant plant communities along this sand strand are : *Ipomea pes-caprae*, *Desmodium umbellatum*, *Spinifex littoreus*, *Vigna marina*, *Phyla nodiflora*, *Thuarea involuta*, *Breynia racemosa*, *Carissa sp.*, *Morinda citrifolia*, *Pluchea indica*, *Dodonea viscosa*, *Wedelia biflora*, *Stachytarpheta urticaefolia*, *Cycas rumphii*, *Alysicarpus vaginalis* and others.

WET COASTAL PLANT COMMUNITIES OF ANDAMAN ISLANDS : Wet coastal communities along the oceanic island system represent the best development of mangrove communities throughout India with high floristic richness and biomass production. The diversity of seagrasses, seaweeds and coral reefs is also more attractive compared to that of the continental wet coastal system. The wet coastal communities can be divided into two sub types : 1) The Mangrove Communities and 2) Seagrasses and Seaweeds communities.

(1) **The Mangrove Communities** : About 1100 sq. km area, along the bays, lagoons, banks of creeks and canals of Andaman islands are extensively covered with mangrove vegetation. Near about 13% of the forest area of Andaman Islands is represented by mangrove communities. It is observed that the Andaman group of islands represent one of the best habitats for better quality of mangrove communities throughout India. The complete absence of salt marsh formation dominated by the species of the families Chenopodiaceae and Tamaricaceae is a unique feature of this wet coastal ecosystem. Dagar *et al.* (1991) and Mall *et al.* (1991) have made detailed study regarding the standing crop biomass, distribution and growth pattern, litter production and other ecological factors of the Andaman mangroves. But detailed information regarding the floristic richness, the total number of mangrove species in these islands and distribution of several mangrove species in context to Indian scenario have not been given properly.

Andaman mangroves are mainly distributed in three tier system depending upon the water salinity condition, tide level, admixture of fresh water flows from the hilly streams and the nature of substrate. The common species which are able to withstand high tidal amplitude, maximum water salinity and muddy substrate, with the peculiar morphological adaptation of stilt roots and vivipary are: *Rhizophora mucronata*, *Rhizophora apiculata*, *Rhizophora stylosa*, *Bruguiera gymnorhiza*, *Bruguiera parviflora*, *Bruguiera cylindrica*, *Aegiceras corniculatum*, *Avicennia alba*, *Ceriops tagal*. These communities are known as true mangrove community. Behind this true mangrove community, the habitat condition changes due to lack of tidal amplitude, less water salinity, poor aeration of soil. The common mangrove species with the adaptive features like knee roots,

pneumatophores and snake roots are : *Avicennia officinalis*, *Bruguiera gymnorrhiza*, *Excoecaria agallocha*, *Lumnitzera littorea*, *Xylocarpus mekongensis*, *Xylocarpus molluccensis*, *Sonneratia griffithii* and sometimes *Phoenix paludosa*.

Towards more interior parts the habitat is much more akin to the hinterland areas and impact of water salinity and tidal amplitude are very less due to very occasional tidal flow during maximum high tide condition. The common mangrove species which are found here usually do not show any morphological adaptive features and they can even transit to fresh water regions are *Nypa fruticans*, *Acanthus ilicifolius*, *Acanthus ebracteatus*, *Phoenix paludosa*, *Heritiera littoralis*, *Lumnitzera racemosa*, *Xylocarpus granatum*, *Intsia bijuga*, *Clerodendrum inerme*, *Dolichandrone spathacea*, *Derris trifoliata*, *Flagellaria indica*, *Caesalpinia crista*, *Finlaysonia obovata*, *Fimbristylis ferruginea*, *Sarcobolus globosus*, *Scyphiphora hydrophyllacea*, some epiphytic orchid species of the genera *Dendrobium*, *Bulbophyllum*, *Eria*, *Cymbidium*, etc. and the beautiful climbers like *Entada phaseoloides*, *Hoya parasitica*, *Dischidia bengalensis*. The degraded mangrove areas are fully covered with mangrove fern *Acrostichum aureum*. The growth of *Nypa* palms is always restricted towards the upper end of creeks and canals where the admixture of salt and freshwater is very high. In Andaman Islands, the pure formation of this palm is found along Dhanikhari, Dhaninala, R.K. Nala and other places.

(2) Seagrass and Seaweed Communities : As the coast line of the Andaman group of islands is irregularly broken by the numerous small and large indentation, the geomorphic features also vary accordingly with the formation of intertidal mudflats, shallow sandy bays, shallow open coast consisting of indented rocky bolds and sands and extensive rocky reef flats. These are the preferable habitat for the development of seagrasses and seaweeds. The most dominant size of seagrasses are located in Paschimvihar, North reef, Interview island and Kalighat in North Andaman, Inghish, Henry Lawrence

and Havelock islands in Ritchies Archipelago in Middle Andaman, Wandoor, Chidiyatapu and Chinque in South Andaman. The common species which are dominating in the Andaman group of islands are *Cymodocea roundata*, *Cymodocea serrulata*, *Enhalus acoroides*, *Halophila ovata*, *Halodule spinifolia*, *Halodule uninervis*, *Syringodium isoetifolium*, *Thalassia hemprichii* (H.S. Das, 1996)

The sheltered zones with substratum consisting of sand, rocks, dead corals and extensive rocky reef flats seem to be ideal for higher growth of seaweeds. The most common seaweeds so far identified from this group of islands are *Helymenia ceylonica*, *Sargassum swartzii*, *Sargassum wightii*, *Sargassum duplicatum*, *Turbinaria ornata*, *Halimeda macroloba*, *Halimeda opuntia*, *Caulerpa peltata*, *Caulerpa racemosa*, *Caulerpa sertularioides*, *Acetabularia crenulata*, *Avrainvillea erecta*, *Enteromorpha compressa*, *Ulva lactuca*, *Codium tomentosum*, *Padina pavonia*, *Dictyosphaeria cavernosa* and others.

INLAND FLORA OF ANDAMAN ISLANDS

The inland flora of these islands is only the last bit of tropical evergreen formation endowed with several potential and endemic species. Out of the 2000 species of angiosperm so far known from these islands about 220 are endemic of which *Dillenia andamanica*, *Pterocarpus dalbergioides*, *Mimocylon andamanica*, *Manilkara littoralis*, *Knema andamanica*, *Bentinckia nicobarica*, *Uraria andamanica*, *Neolitsea andamanica*, *Barringtonia racemosa*, *Barringtonia asiatica*, *Artocarpus peduncularis*, *Calophyllum soulattri* and many others are growing luxuriantly indicating the true picture of tropical evergreen forest.

Reckless development and deforestation have caused heavy damages to this island forest ecosystem and the pristine plant diversity of these oceanic islands and more than 15 tree species, many herbs, shrubs, orchids and climbers have become rare and endangered from these regions. (Balakrishnan, 1989)

ASSESSMENT OF PLANT COMMUNITIES IN DIFFERENT COASTAL ZONES

MAIN PLANT COMMUNITIES OF GUJARAT COAST

Okhamandal to Diu coastal area between latitudes 22°29' and 20°43'N and about 256 km long and adjacent portions within the semi-arid coastal plain of Gujarat have been studied from the Ecology Unit. Botanical Survey of India (Rao, T.A & K.R. Agarwal, 1966). Some of the important places in the Gujarat coast such as Okha, Dwarka, Porbandar, Mangrol, Veraval (Somnath) and Diu were covered.

The zonation of vegetation along the Gujarat coastal plain has been divided into three main community types such as : 1. Strand community, 2. Salt marsh community, and 3. Semi-arid coastal plant community.

1. STRAND COMMUNITY : The strand habitat is found on the land immediately adjacent and parallel to the seashore under the direct influence of salt spray. Strand communities can be studied under two subheads: (A) Pure Sand Strand, and (B) Rocky Sand Strand.

A) PURE SAND STRAND : The sand strand habitat either at the top of the beach ridges or on rocks with a thick mantle of sand above tide level has many interesting plant communities.

Under the sand strand formation five subdivision of community types have been recognized: (i) *Cyperus conglomeratus*, (ii) *Halopyrum mucronatum*, (iii) *Hydrophylax maritima*, (iv) *Ipomoea pes-caprae*, (v) *Leptadenia pyrotechnica*.

(i) ***Cyperus conglomeratus* community :**

This is the pioneer plant, growing along the unstabilised sands frequently inundated with sea water tide. It forms tufts with long runners and fleshy nodal roots and are very helpful for accumulation of sand grains. Towards the upper limit it is often found forming

gregarious patches with *Cyperus arenarius*, *Cyperus aristatus* and *Sporobolus tremulus*.

(ii) ***Halopyrum mucronatum* community :**

This community forms large clumps along the semi stabilised sand strand where it is very occasionally inundated by high sea water tide. Along the coast of Dwarka, Porbandar, Somnath and Diu, it is found either in pure form or associated with *Cyperus conglomeratus* and *Sporobolus tremulus*. Towards the upper limit of the adjacent plains *Leptadenia reticulata*, a common climber is associated.

(iii) ***Hydrophylax maritima* community :**

It is found commonly along the intermediate baby dune formation between the semi-stabilised and stabilised sand strand in Veraval and Porbandar areas. The long runner, fleshy nodal roots and thick leaves of the population help to accumulate sand grains into a small dune. It is found either in pure form or frequently associated with *Launaea sarmentosa*, *Cyperus aristatus*, *Sporobolus marginatus*. In between the depressions of the baby dunes and larger dunes, occurrence of *Psilotrichum sericeum* and *Dactyloctenium aegyptium* are of special interest in this coast.

(iv) ***Ipomoea pes-caprae* community :**

It is found very common along the stabilised sand strand of Dwarka, Okha, Somnath, and Porbandar areas forming excellent sand binder either in pure form or associated with *Cyperus conglomeratus*, *Asparagus dumosus*, *Sporobolus marginatus*, *Melanocentris abyssinica*. On transported sands, it is found associated with *Psilotrichum sericeum*.

(v) ***Leptadenia pyrotechnica* community :**

This community is abundant in sand dunes and inner sand ridges in association with *Boerhaavia diffusa*, *Convolvulus arvensis*, *Evolvulus alsinoides*, *Sida*

cordifolia, *Cynodon dactylon*, *Melanocenthris abyssinica*, *Cyperus rotundus* and *Spinifex littoreus* mostly restricted along the southern coast.

A major proportion of these sands at Okha, Dwarka and Veraval are of marine origin, composed of the shells of the marine microfauna, molluscs and coral fragments and is very rich in CaCO₃. Other quartz derived sands are also highly calcareous and contain small proportions of felspar and heavy mineral particles.

B) ROCKY SAND STRAND : The rocky strand along the foreshore is composed of limestone reef of considerable width. The pot-holes and crannies developed in the limestone reef are filled up with sand and thin mantle of soil. The rocky form is represented by the following types of plant communities : (i) *Capparis brevispina*, (ii) *Fagonia indica*, (iii) *Indigofera cordifolia*, (iv) *Kickxia ramosissima*, (v) *Lepidagathis trinervis*, (vi) *Sericostoma pauciflorum*.

(i) **Community of *Capparis brevispina* :** This is the significant community in the rocky sand localities. Under protection, it grows well and dominates the habitat. The associated plants are mostly local species distributed between the ground areas supporting larger bushes. They are chiefly represented by *Kickxia ramosissima*, *Heliotropium crispum*, *Echinops echinatus*, *Limonium stocksii* and *Sclemocarpus africanus*. These plants are present to the extent of 60% or more. The other significant associates are *Sericostoma pauciflorum*, *Lepidagathis cristata*, *Indigofera cordifolia*, *Convolvulus glomeratus*, *Pulicaria angustifolia*, *Alysicarpus monilifer*, *Capparis decidua*, *Cleome gynandra* and *Polygala erioptera*, *Fagonia indica*, *Celosia argentea*, *Trianthema* sp. and *Blumea amplexans* are other species which are often recorded in this community type.

(ii) **Community of *Fagonia indica* :** This widespread community extends all along the coast. Its chief associates are *Sericostoma pauciflorum*, *Heliotropium crispum*, *Kickxia ramosissima*, *Trianthema* sp. and *Capparis decidua*. Another frequent associate is the woody *Limonium stocksii*, which is present to the extent of 80 per cent in Dwarka/Okha coastal area. The remaining associates of this community type are the

local plants already recorded under the community of *Capparis brevispina*.

(iii) **Community of *Indigofera cordifolia* :** This community type could be seen frequently stretching to considerable distances in pure strands. It is present up to 80 per cent under the protective shade of *Capparis brevispina*. *Enticostema hyssopifolium*, *Fagonia indica*, *Sida ovata* and some local plants are the chief associates.

(iv) **Community of *Kickxia ramosissima* :** This community type is often distributed all over the habitat, forming extensive patches in pure strands. A flat rocky habitat with a very thin layer of sand is ideal for this community, and its frequency decreases towards pure sandy situations. *Pulicaria angustifolia*, *Limonium stocksii*, *Blumea obliqua*, *Alysicarpus monilifer* and *Pavonia patens* are other members of this community.

(v) **Community of *Lepidagathis trinervis* :** This woody stunted plant is found growing more in isolation than in extensive patches. Other associates are represented by *Sericostoma pauciflorum*, *Indigofera cordifolia*, *Pulicaria angustifolia*, *Echinops echinatus* and *Capparis decidua*.

(vi) **Community of *Sericostoma pauciflorum* :** This community type is found on the inland margins of pure sandy-rocky situations, forming conspicuous hemispherical mounds all along the coast. This community exhibits a scattered disposition on the habitat and is sometimes found mixed up with *Limonium stocksii* and *Lepidagathis cristata*. Presence of branched palm, *Hyphaene dichotoma* along the sandy coast of Diu and Daman areas, occurrence of *Acacia planiformis* along the Porbandar regions are of interest in these coastal plant communities.

2. SALT MARSH COMMUNITY : The river deltas, the creeks and the backwater shallow areas inundated by tidal waters on sea coasts usually contain a light to dense growth of a few salt marsh species. Muddy sea shores, quiet bays and shallow inlets are the habitats for mangroves. The various components of the salt marsh and mangrove flora can be studied under the following community types : Community of (i) *Avicennia marina*, (ii) *Suaeda nudiflora*, (iii) *Aeluropus*

lagopoides, (iv) *Fimbristylis cymosa*, (v) *Scirpus maritimus*, (vi) *Urochondra setulosa*.

(i) **Community of *Avicennia marina*** : Its presence is noted not near the coast line but in the interior sheltered muddy areas. Due to intense biotic activity, this community is fast disappearing and its characteristic thicket forming feature is seldom observed. With the change in the level of water and dryness, the occurrence of sedges like *Fimbristylis cymosa* and *Scirpus maritimus* is noticed. Further away and especially on dry ridges *Tamarix indica* is occasionally seen.

(ii) **Community of *Suaeda nudiflora*** : This plant community forms an impressive mat all along the fringes of inland creeks and shallow muddy areas. It often forms extensive pure strands but is some times found mixed with *Suaeda maritima*, *Suaeda fruticosa*, *Aeluropus lagopoides* and *Urochondra setulosa*. A slight change in the water level of the area towards inland forms a congenial habitat for the growth of *Atriplex stoksii* and *Tamarix indica*.

(iii) **Community of *Aeluropus lagopoides*** : This community type is characteristic of saline areas, where it forms green meadows and tolerates some inundation of sea-water. This plant is sometimes found in association with *Fimbristylis cymosa*, *Urochondra setulosa* and *Suaeda nudiflora*.

(iv) **Community of *Fimbristylis cymosa*** : This community becomes dominant towards the interior, frequently associated with *Aeluropus lagopoides* but sometimes it is found growing with *Scirpus maritimus* and *Urochondra setulosa*.

(v) **Community of *Scirpus maritimus*** : This type is found in pure strands, or occasionally mixed with *Fimbristylis cymosa* closely followed by *Aeluropus lagopoides*.

(vi) **Community of *Urochondra setulosa*** : *Urochondra setulosa*, a tidal mud flat plant, is a good sandbinder, sometimes found growing in association with *Aeluropus lagopoides* and *Fimbristylis cymosa*. Its occurrence and sociability increases towards open mud flats and alone banks of creeks and channels.

3. SEMI-ARID COASTAL PLANT COMMUNITY

A. COASTAL SLACK : Slacks are depressions or low-lying moist lands, which may go dry during the dry season. They fringe the shore line and provide interesting plants and habitat. Normally they are not connected directly with the sea despite their proximity, and they support a characteristic vegetation of their own, independent of the salt marshes. Several slacks were examined at different localities and found that they harbour an admixture of local plants with a few characteristic plants of this habitat. Slacks at Dwarka are represented by *Portulaca pillosa*, *P. quadrifida* and *Hylandia latebrosa*. Next come species like *Alternanthera sessilis*, *Bacopa monnieri*, *Eclipta prostrata*, *Phyllanthus fraternus*, *Eragrostis ciliaris*, *Bracharia ramosa*, *Sporobolus marginatus* and *Digitaria ciliaris* recording a presence value of 40 per cent or more. Other components with a presence value of 20 per cent or more are represented by *Cyperus rotundus*, *Cymbopogon caesius*, *Chenopodium murale*, *Euphorbia hypericifolia* and *Vitex negundo*.

The flora of Okha coastal slacks are composed chiefly of *Taverniera cuneifolia*, *Phyla nodiflora* and *Hylandia latebrosa*. They constitute 60 per cent or more of the total plant cover. Other plants of this habitat are: *Polycarpaea corymbosa*, *Corchorus depressus*, *Bacopa monnieri*, *Justicia procumbens*, *Eclipta prostrata*, *Portulaca quadrifida* and *Cyperus rotundus*. Further plants which constitute 20 per cent of the vegetational cover are represented by *Bergia suffruticosa*, *Tephrosia villosa*, *Digera muricata*, *Justicia procumbens*, *Alternanthera sessilis*, *Leucas urticaefolia*, *Crotalaria medicaginea*, *Eragrostis pilosa*, *Setaria verticillata* and *Sporobolus marginatus*. However, near Veraval coast, 60 per cent of the plant cover is composed of *Polycarpaea corymbosa* and *Bacopa monnieri*. Other plants of this area are : *Corchorus depressus*, *Phyla nodiflora*, *Digera muricata*, *Alternanthera sessilis*, *Eclipta prostrata*, *Hylandia latebrosa*, *Bergia suffruticosa*, *Ammannia baccifera*, *Ammannia multiflora*, *Andropogon* sp. and *Setaria verticillata*. At no stage dominance of a single community is seen, at best, certain

communities may form 40-60 per cent of the vegetational cover.

B, SEMI-ARID COASTAL PLAIN : This region lies behind the strand habitat or salt marsh, slacks and mud formations in some localized patches with an average width of 2-3 km. The thickness of the sand layer over the underlying calcareous conglomerate rock or calcareous sandstone rock varies from a few cm to a few meters. This plain is at a comparatively elevated level and is free from inundation with sea-water. The vegetal cover is a mixture of different inland open communities forming scrub forests. The pattern of distribution is not zonal and the existing flora is a clear example of biotic interference. A range of plant communities are however, recognized on the basis of edaphic factors. Another feature of this belt is the presence of a number of strand climbers frequently found encircling the shrubby communities. Their presence value up to 60 per cent is recorded in certain communities in this region. This form is represented by the following six community types : (i) *Euphorbia nivulia*, (ii) *Ziziphus nummularia*, (iii) *Calotropis procera*, (iv) *Butea monosperma*, (v) *Solanum surattense*, (vi) *Hyphaene dichotoma*.

(i) **Community of *Euphorbia nivulia* :** The clumps of this community are significant along the coastal plain lying between Okha and Porbandar. The three plants of more than 80 per cent occurrence are *Ziziphus nummularia*, *Barleria prionitis* and *Cassia tora*. They are often found near the main clumps of *Euphorbia nivulia* community. Other associates of 60 per cent value are *Capparis decidua*, *Commiphora wightii*, *Mimosa hamata* and *Vernonia antheimintica*. The above plants are often found intermingled with the *Euphorbia* clumps. Sometimes one may find plants such as *Calotropis procera*, *Indigofera tinifolia*, *Amaranthus grecizans*, *Pupalia lappacea*, *Eragrostis ciliaris* and

Flaveria australasica distributed between the clumps of *Euphorbia*. The disturbed areas are composed of *Eragrostis ciliaris*, *Achyranthus aspera*, *Tribulus terrestris* and *Aerva javanica*.

(ii) **Community of *Ziziphus nummularia* :** This type forms a pure strand only in certain localities far from the strand belt. Its main associates are *Cassia tora*, *Boerhaavia verticillata* and *Pupalia lappacea* with other associates as found in the *Euphorbia nivulia* community.

(iii) **Community of *Calotropis procera* :** This type inhabits dry sandy localities, and attains a good form. Its chief associates are *Capparis decidua*, *Euphorbia nivulia* and other local plants which can endure this habitat.

(iv) **Community of *Butea monosperma* :** This type may be noted at several localities from Porbandar to Delvada coastal plain belt. Though not thick, it is found scattered all along the plain, increasing in density from inland towards the sea. Other plants like *Hyphaene dichotoma*, *Capparis decidua*, *Boerhaavia diffusa* and *Eragrostis ciliaris* often appear with this community.

(v) **Community of *Solanum surattense* :** This shrubby community is recorded along the Delvada and Somnath coastal plains. This community is spreading fast in the coastal plains of Veraval-Somnath area. Its chief associates are local plants like *Vernonia cinerea*, *Capparis decidua*, *Blepharis indica*, *Boerhaavia verticillata*, *Ziziphus nummularia* and others of minor significance.

(vi) **Community of *Hyphaene dichotoma* :** The community of this tall branching palm is significant along the coastal plain of Kodinar, Delvada, Gogla and Porbandar. Sometimes it is so dense as to exclude other plants growing in its shade. *Euphorbia nivulia*, *Butea monosperma* and *Cassia tora* are its chief associates.

ASSESSMENT OF PLANT COMMUNITIES IN GUJARAT COAST

In the Gujarat coast, quantitative ecological studies were conducted on the sand strand, rocky strand, salt marshes and semi-arid coast plain habitats covering the places like Okha, Dwarka, Porbandar, Mangrol, Veraval and Diu Islands for assessment of dominant plant cover percentage from the above 4 types.

Table - 20 : SPECIES COMPOSITION OF GUJARAT COASTAL SAND STRAND (BEACH & DUNES)

SPECIES	COMMUNITY					
	1	2	3	4	5	6
1. <i>Cyperus conglomeratus</i>	C					
2. <i>Cyperus arenarius</i>	VF					
3. <i>Sporobolus tremulus</i>	F					
4. <i>Cyperus aristatus</i>	R					
5. <i>Halopyrum mucronatum</i>		C				
6. <i>Cyperus conglomeratus</i>		R				
7. <i>Sporobolus tremulus</i>		VF				
8. <i>Leptadenia reticulata</i>		F				
9. <i>Hydrophylax maritima</i>			C			
10. <i>Launaea sarmentosa</i>			R			
11. <i>Cyperus aristata</i>			F			
12. <i>Sporobolus marginatus</i>			VF			
13. <i>Psilotrichum sericeum</i>			VF			
14. <i>Dactyloctenium aegyptium</i>			F			
15. <i>Ipomoea pes-caprae</i>				C		
16. <i>Asparagus dumosus</i>				R		
17. <i>Sporobolus marginatus</i>				F		
18. <i>Melanocenchris abyssinica</i>				VF		
19. <i>Psilotrichum sericeum</i>				R		
20. <i>Leptadenia pyrotechnica</i>					D	
21. <i>Boerhaavia diffusa</i>					F	
22. <i>Convolvulus arvensis</i>					C	
23. <i>Evolvulus alsinoides</i>					C	
24. <i>Sida cordifolia</i>					F	
25. <i>Cyanodon dactylon</i>					C	

R = Less than 20%, VF = 20%-40%, F = 40%-60%, C = 60%-80%, D = More than 80%,

Table - 21 : SPECIES COMPOSITION OF GUJARAT COASTAL ROCKY STRAND

SPECIES	COMMUNITY					
	1	2	3	4	5	6
1. <i>Capparis brevispina</i>	C					
2. <i>Kickxia ramosissima</i>	F					
3. <i>Heliotropium crispum</i>	F					
4. <i>Echinops echinatus</i>	VF					
5. <i>Limonium stocksii</i>	D					
6. <i>Sclerocarpus africanus</i>	R					
7. <i>Sericostoma pauciflorum</i>	VF					
8. <i>Lepidagathis cristata</i>	F					
9. <i>Indigofera cordifolia</i>	VF					
10. <i>Convolvulus glomeratus</i>	F					
11. <i>Pultcaria angustifolia</i>	VF					
12. <i>Alysicarpus montifer</i>	VF					
13. <i>Capparis decidua</i>	F					
14. <i>Cleome gynandra</i>	VF					
15. <i>Polygala eriopetra</i>	R					
16. <i>Fagonia indica</i>	F					
17. <i>Celostia argentea</i>	R					
18. <i>Trianthema sp.</i>	VF					
19. <i>Pultcaria angustifolia</i>	F					
20. <i>Blumea amplexans</i>	R					
21. <i>Fagonia indica</i>		D				
22. <i>Capparis decidua</i>		VF				
23. <i>Sericostoma pauciflorum</i>		F				
24. <i>Heliotropium crispum</i>		VF				
25. <i>Kickxia ramosissima</i>		C				
26. <i>Trianthema sp.</i>		F				
27. <i>Indigofera cordifolia</i>			D			
28. <i>Capparis brevispina</i>			VF			
29. <i>Encostema hyssopifolium</i>			C			
30. <i>Fagonia indica</i>			F			
31. <i>Sida ovata</i>			VF			
32. <i>Kickxia ramosissima</i>				D		
33. <i>Pultcaria angustifolia</i>				F		
34. <i>Limonium stocksii</i>				C		
35. <i>Blumea obliqua</i>				F		
36. <i>Alysicarpus montifer</i>				VF		
37. <i>Pavonia putens</i>				VF		
38. <i>Lepidagathis cristata</i>				C		
39. <i>Sericostoma pauciflorum</i>				F		
40. <i>Indigofera cordifolia</i>				F		
41. <i>Pultcaria angustifolia</i>				VF		
42. <i>Echinops echinatus</i>				F		
43. <i>Capparis decidua</i>				R		
44. <i>Sericostoma pauciflorum</i>						
45. <i>Limonium stocksii</i>					D	
46. <i>Hyphaene dichotoma</i>					C	
47. <i>Acacia planiformis</i>					F	
					R	

R = Less than 20%, VF = 20%-40%, F = 40%-60%, C = 60%-80%, D = More than 80%,

Table - 22 : SPECIES COMPOSITION OF GUJARAT COASTAL SEMI-ARID COASTAL PLAIN

SPECIES	COMMUNITY					
	1	2	3	4	5	6
1. <i>Euphorbia nivulia</i>	D					
2. <i>Ziziphus nummularia</i>	C					
3. <i>Barleria prionitis</i>	F					
4. <i>Cassia tora</i>	C					
5. <i>Capparis decidua</i>	F					
6. <i>Commiphora wightii</i>	VF					
7. <i>Mimosa hamata</i>	R					
8. <i>Vernonia anthelmintica</i>	VF					
9. <i>Calotropis procera</i>	VF					
10. <i>Amaranthus gretzans</i>	F					
11. <i>Pupalia lappacea</i>	VF					
12. <i>Eragrostis ciliaris</i>	F					
13. <i>Flaveria trinervia</i>	R					
14. <i>Achyranthus aspera</i>	R					
15. <i>Tribulus terrestris</i>	F					
16. <i>Aerva javanica</i>	VF					
17. <i>Ziziphus nummularia</i>		C				
18. <i>Cassia tora</i>		F				
19. <i>Boerhaavia verticillata</i>		F				
20. <i>Pupalia lappacea</i>		VF				
21. <i>Euphorbia nivulia</i>		R				
22. <i>Calotropis procera</i>			C			
23. <i>Capparis decidua</i>			VF			
24. <i>Euphorbia nivulia</i>			F			
25. <i>Butea monosperma</i>				F		
26. <i>Hyphaene dichotoma</i>				VF		
27. <i>Capparis decidua</i>				R		
28. <i>Boerhaavia diffusa</i>				VF		
29. <i>Eragrostis ciliaris</i>				R		
30. <i>Solanum surattense</i>				C		
31. <i>Vernonia cinera</i>					F	
32. <i>Capparis decidua</i>					R	
33. <i>Blepharis indica</i>					VF	
34. <i>Boerhaavia verticillata</i>					F	
35. <i>Ziziphus nummularia</i>					VF	
36. <i>Hyphaene dichotoma</i>						C
37. <i>Euphorbia nivulia</i>						F
38. <i>Butea monosperma</i>						VF
39. <i>Cassia tora</i>						R

R = Less than 20%, VF = 20%-40%, F = 40%-60%, C = 60%-80%, D = More than 80%.

Table - 23 : SPECIES COMPOSITION OF GUJARAT COASTAL SALT MARSH

SPECIES	COMMUNITY					
	1	2	3	4	5	6
1. <i>Avicennia marina</i>	U					
2. <i>Fimbristylis cymosa</i>	F					
3. <i>Bulboschoenus maritimus</i>	VF					
4. <i>Tamarix indica</i>	R					
5. <i>Suaeda nudiflora</i>		D				
6. <i>Suaeda maritima</i>		C				
7. <i>Suaeda fruticosa</i>		F				
8. <i>Aeluropus lagopoides</i>		F				
9. <i>Urochondra setulosa</i>		VF				
10. <i>Atriplex stocksii</i>		R				
11. <i>Tamarix indica</i>		R				
12. <i>Aeluropus lagopoides</i>			D			
13. <i>Fimbristylis cymosa</i>			C			
14. <i>Urochondra setulosa</i>			F			
15. <i>Suaeda nudiflora</i>			VF			
16. <i>Fimbristylis cymosa</i>				D		
17. <i>Aeluropus lagopoides</i>				C		
18. <i>Bulboschoenus maritimus</i>				F		
19. <i>Urochondra setulosa</i>				VF		
20. <i>Bulboschoenus maritimus</i>					C	
21. <i>Fimbristylis cymosa</i>					F	
22. <i>Aeluropus lagopoides</i>					VF	
23. <i>Urochondra setulosa</i>						C
24. <i>Aeluropus lagopoides</i>						F
25. <i>Fimbristylis cymosa</i>						VF

R = Less than 20%, VF = 20%-40%, F = 40%-60%, C = 60%-80%, D = More than 80%,

SAND STRAND PLANT COMMUNITIES OF KONKAN COAST

The Konkan coast extends from south of the river Narmada, to the north of Mangalore, comprising the coast line of Mumbai, Karwar, Ratnagiri, Goa and Mangalore. General topographic configuration of this coast consists of jutting head lands or dentate rocky heads, cliffs, crescent shaped or pocket shaped beach formation in between the hill slopes and tidal mud flats along the mouth of rivers and backwaters. Quantitative ecological investigation on the Konkan coastal strand vegetation along the areas of Juhu beach, Karwar beach and dunes, Ratnagiri, Jaygarh, Hanovar, Kamta, Coondapur and Malpe have been studied and six main strand plant communities and their associations are recognised as follows :

1. *Cyperus pedunculatus*

It forms the pioneer zone on sandy beaches as a dominant plant in association with *Fimbristylis dichotoma*, *Sporobolus coromandelicus*, *Zoysia matrella*, *Perotis indica*, *Dactyloctenium aegyptium* within 20-30 m length from the intertidal zone.

2. *Ipomoea pes-caprae*

It forms dominant component, specially along the strands of Karwar, Honavar and Malpe coastal beaches within the range of 35-40 m length of intertidal zone. This is more or less semistabilised sand strand and towards the mature zone, it is associated with *Canavalia maritima*, *C. lineata*, *Alysicarpus vaginalis*, *Borreria stricta*, *Leucas aspera*, *Indigofera cordifolia*, *Tridax procumbens*, *Drimeia indica*, *Portulaca oleracea*.

3. *Psilotrichum sericeum*

It forms dominant patches along the Mumbai seashore and *Chlorophytum tuberosum* forms common

associate during the monsoon. Association of *Pedaliium murex*, *Paspalam orbiculare*, *Phyllanthus amarus*, etc. are commonly found beyond 45-55 m length of the intertidal zones of Juhu, Mumbai, Ratnagiri and Joygarh strands.

4. *Spinifex littoreus*

It is dominant largely towards the permanent and mature beach formation beyond 65-75 m length from the intertidal zone in association with *Launaea sarmentosa*, *Boerhaavia diffusa*, *Sida cordifolia*, *Cyperus rotundus*, *Aerva lanata*.

5. *Calotropis gigantea*

It indicates more or less transition to the inland vegetation in association with *Tephrosia purpurea* which is considered to be a single characteristic species co-dominant within 80-90 m length from intertidal region. The affinity with other inland communities is indicated by species of *Atangium salvifolium*, *Waltheria indica*, *Wedelia biflora*, *Eragrostis ciliaris*, *Corchorus aestuans*, *Lindernia ciliata* and *Vitex negundo*.

6. *Pandanus tectorius*

It is generally dominant towards the inland shrub or wood land zone either associated with *Vitex trifolia*, *Allophylus cobbe*, *Memecylon umbellatum*, *Calophyllum inophyllum*, *Streblus asper* or with salt tolerant species like *Clerodendrum inerme*, *Sesuvium portulacastrum*, *Fimbristylis ferruginea* and others beyond 85-100 m length from the intertidal zone. Composition of species on sand beaches and dunes along the Konkan coast showing percentage of distribution is represented in Table 24.

Table - 24 : SPECIES COMPOSITION OF INDIAN WEST COAST BEACH & SAND DUNES (KONKAN COAST)

SPECIES	COMMUNITY					
	1	2	3	4	5	6
1. <i>Cyperus pedunculatus</i>	D	VF	R	-	-	-
2. <i>Fimbristylis dichotoma</i>	F	C	-	R	-	-
3. <i>Sporobolus carandelicus</i>	VF	-	R	R	-	-
4. <i>Zizania matrella</i>	R	-	C	-	-	-
5. <i>Pennisetum indicum</i>	R	F	VF	-	-	-
6. <i>Dactyloctenium aegyptium</i>	VF	-	R	-	-	-
7. <i>Ipomoea pes-caprae</i>	-	D	VF	-	-	-
8. <i>Canavalia maritima</i>	-	C	F	-	-	-
9. <i>Alysicarpus vaginalis</i>	-	F	VF	-	-	-
10. <i>Borreria striata</i>	-	VF	R	-	-	-
11. <i>Leucas aspera</i>	-	R	R	-	-	-
12. <i>Indigofera cordifolia</i>	-	VF	R	-	-	-
13. <i>Tridax procumbens</i>	-	VF	R	-	-	-
14. <i>Drosera indica</i>	-	R	-	-	-	-
15. <i>Portulaca oleracea</i>	-	R	-	-	-	-
16. <i>Psilotrichum sericeum</i>	-	-	C	R	-	-
17. <i>Chlorophytum tuberosum</i>	-	-	VF	-	-	-
18. <i>Pedatum murex</i>	-	-	F	-	R	-
19. <i>Paspalum orbiculare</i>	-	-	R	-	-	-
20. <i>Phyllanthus amarus</i>	-	-	F	R	-	-
21. <i>Spinifex littoreus</i>	-	-	-	D	R	-
22. <i>Lantana sarmentosa</i>	-	-	-	C	VF	R
23. <i>Boerhaavia diffusa</i>	-	-	-	VF	R	-
24. <i>Sida cordifolia</i>	-	-	-	VF	R	-
25. <i>Cyperus rotundus</i>	-	-	-	R	-	-
26. <i>Aerva lanata</i>	-	-	-	VF	R	-
27. <i>Calotropis gigantea</i>	-	-	-	-	C	R
28. <i>Tephrosia purpurea</i>	-	-	-	-	D	VF
29. <i>Alangium salvifolium</i>	-	-	-	-	R	-
30. <i>Waltheria indica</i>	-	-	-	-	R	R
31. <i>Wedelia biflora</i>	-	-	-	-	R	R
32. <i>Eragrostis ciliaris</i>	-	-	-	-	R	-
33. <i>Corchorus aestuans</i>	-	-	-	-	R	-
34. <i>Lindernia ciliata</i>	-	-	-	-	R	-
35. <i>Vitex negundo</i>	-	-	-	-	R	R
36. <i>Pandanus tectorius</i>	-	-	-	-	-	C
37. <i>Vitex trifolia</i>	-	-	-	-	-	R
38. <i>Altophyllus cobbe</i>	-	-	-	-	-	R
39. <i>Momordica umbellata</i>	-	-	-	-	-	R
40. <i>Calophyllum inophyllum</i>	-	-	-	-	-	VF
41. <i>Strobilus asper</i>	-	-	-	-	-	R
42. <i>Clerodendrum inerme</i>	-	-	-	-	-	VF
43. <i>Sesuvium portulacastrum</i>	-	-	-	-	-	F
44. <i>Fimbristylis ferruginea</i>	-	-	-	-	-	VF

R = Less than 20%, VF = 20%-40%, F = 40%-60%, C = 60%-80%, D = More than 80%.

SAND STRAND PLANT COMMUNITIES OF MALABAR COAST

The Malabar coast extends from the north of Mangalore to Kanya Kumari including the coast line of Kasargod, Cannanore, Tellicherry, Kozhikode, Cochin, Quilon and Trivandrum. This coast is about 550 km long and 20-100 km wide, narrower in the north and south but wider in the middle, specially in the valley of Ponnani, the Periyar and Pamban. It shows prograding face from broader to the narrow ending of rocky projection near Kanya Kumari. Sand dunes of various forms are found all along the Kerala coast except to the south of Kovalam where rocky projection ends right up to the sea. These sand dunes of pleistocene and of recent origin have helped to form numerous shallow lagoons and back water flows. Besides these, there are some erosion platforms and lateritic cliffs near Kozhikode district. The gneissic hill lies in further inland areas. Quantitative ecological investigation along the areas of Kasargod, Kozhikode, Cochin, Aroor, Aurthangal, Cherthela, Maradi, Quilon and Varkala have been studied and six main strand plant communities are divided as follows :

1. *Ipomoea pes-caprae*

It is dominant on sandy beaches along the Karnataka part of the Malabar coast in association with *Canavalia maritima*, *Cyperus pedunculatus*, *Acrocephalus hispidus*, *Cyperus arinerius*, *Borreria stricta* within 15-26 m length from the intertidal zone of the sea.

2. *Spinifex littoriosis*

It is dominant beyond the semistabilised strand, where sand slope decreases to provide a fairly stable ground within 30-35 m length from the intertidal belt, in association with many herbaceous species like *Launaea sarmentosa*, *Tylophora asthmatica*, *Zoysia matrella*, *Fimbristylis barbata*, *Polycarpaea corymbosa*, *Crotalaria nana*, *Perotis indica*.

3. *Sida cordifolia*

It is dominant towards more stable sand strands just beyond the *Spinifex-Ipomoea* communities along the Kerala and Karnataka part of Malabar coast within 35-40 m length from the intertidal zone in association with *Fimbristylis junciformis*, *Wedelia biflora*, *Euphorbia atoto*, *Zornia gibbosa*, *Indigofera aspalathoides*, *Euphorbia rosea*, *Indigofera uniflora*, *Desmodium trifolium*.

4. *Pandanus tectorius*

It is more or less dominant towards the transition of herbaceous communities on very mature sand strand beyond the length of 42 m from the intertidal zone in association with *Asystasia gangetica*, *Stachytarpheta jamaicensis*, *Scaevola taccada*, *Premna serratifolia*, *Aerva lanata*, *Morinda citrifolia*, *Clerodendrum inerme*.

5. *Petalium murex*

Further towards the inland where soil particle size gradually changes from sand to loamy sand with moderate alkalinity and higher organic matter contents, appears the *Petalium murex* associated with some common herbs and typical coastal tree species like *Evolvulus alsinoides*, *Cyanotis axillaris*, *Thespesia populnea*, *Cerbera manghus*, *Erythrina suberosa*.

6. *Cocos nucifera*

It is found commonly cultivated in most of the Malabar regions towards the woodland zone of the lost coastal characteristics. In Alleppey and Shertalia even this plantation stands from the intertidal belt. However, in some areas where the coast line remain undisturbed some plant association like *Calotropis procera*, *Catharanthus roseus*, *Barringtonia racemosa*, *Calophyllum inophyllum* and *Scaevola plumieri* are found common.

Table - 25 : SPECIES COMPOSITION OF INDIAN WEST COAST BEACH & SAND DUNES (MALABAR COAST)

SPECIES	COMMUNITY					
	1	2	3	4	5	6
1. <i>Cyperus pedunculatus</i>	VF	-	-	-	-	-
2. <i>Cyperus arenarius</i>	R	-	-	-	-	-
3. <i>Ipomoea pes-caprae</i>	D	-	-	-	-	-
4. <i>Canavalia maritima</i>	C	-	-	-	-	-
5. <i>Acrocephalus indicus</i>	F	-	-	-	-	-
6. <i>Spinifex littoreus</i>	-	D	-	-	-	-
7. <i>Launaea sarmentosa</i>	-	F	-	-	-	-
8. <i>Tylophora indica</i>	-	R	-	-	-	-
9. <i>Zoysia matrella</i>	-	VF	-	-	-	-
10. <i>Bulbostylis barbata</i>	-	F	-	-	-	-
11. <i>Polycarpaea corymbosa</i>	-	R	-	-	-	-
12. <i>Crotalaria nana</i>	-	R	-	-	-	-
13. <i>Perotis indica</i>	-	F	-	-	-	-
14. <i>Sida cordifolia</i>	-	-	C	-	-	-
15. <i>Fimbristylis falcata</i>	-	-	VF	-	-	-
16. <i>Wedelia biflora</i>	-	-	R	-	-	-
17. <i>Euphorbia atoto</i>	-	-	R	-	-	-
18. <i>Zornia gibbosa</i>	-	-	R	-	-	-
19. <i>Indigofera aspalathoides</i>	-	-	R	-	-	-
20. <i>Euphorbia rosea</i>	-	-	VF	-	-	-
21. <i>Indigofera unifolia</i>	-	-	R	-	-	-
22. <i>Desmodium trifolium</i>	-	-	R	-	-	-
23. <i>Axystasia gangetica</i>	-	-	-	VF	-	-
24. <i>Stachytarpheta jamaicensis</i>	-	-	-	R	-	-
25. <i>Scaevola taccada</i>	-	-	-	C	-	-
26. <i>Premna serratifolia</i>	-	-	-	VF	-	-
27. <i>Aerva lanata</i>	-	-	-	R	-	-
28. <i>Morinda citrifolia</i>	-	-	-	R	-	-
29. <i>Clerodendrum inerme</i>	-	-	-	R	-	-
30. <i>Pandanus tectorius</i>	-	-	-	VF	-	-
31. <i>Pedaliium Murex</i>	-	-	-	-	D	-
32. <i>Evolvulus ulsinoides</i>	-	-	-	C	-	-
33. <i>Cyanotis axillaris</i>	-	-	-	-	R	-
34. <i>Thespesia populnea</i>	-	-	-	-	VF	-
35. <i>Cerbera manghus</i>	-	-	-	-	VF	-
36. <i>Erythrina suberosa</i>	-	-	-	-	R	-
37. <i>Calotropis procera</i>	-	-	-	-	-	F
38. <i>Catharanthus roseus</i>	-	-	-	-	-	VF
39. <i>Rarringtonia racemosa</i>	-	-	-	-	-	R
40. <i>Calophyllum inophyllum</i>	-	-	-	-	-	R
41. <i>Scaevola phaneris</i>	-	-	-	-	-	R
42. <i>Cocos nucifera</i>	-	-	-	-	-	-

R = Less than 20%, VF = 20%-40%, F = 40%-60%, C = 60%-80%, D = More than 80%.

SAND STRAND PLANT COMMUNITIES OF COROMANDEL-CIRCAR COAST

This coast extends from Midnapore of West Bengal to the Kanya Kumari east including the vast sandy coast line of Bengal, Orissa, Andhra Pradesh and Tamil Nadu. Except the large river inlets, all unsheltered sea shores of the Coromandel-Circar region are composed of broad sandy beaches, raised sand bars and sand dunes of various types. Plant communities are characteristically zoned according to the physical characteristic of the soil, tidal impact, deposition of organic matter and wind action.

The zonation pattern along the sand strand vegetation have been studied in this coast by Rao, T. A., *et al.* (1971-79), Marlange and Meher-Homji (1965), Sebastine and Ellis (1967). However, the present investigation from Ecology Unit, Botanical Survey of India shows that the sand strand vegetation can be classified into six distinct groups throughout the Bengal, Orissa, Andhra Pradesh and Tamil Nadu coastal areas :

1. Unstabilised sand strand.
2. Semistabilised sand strand.
3. Stabilised sand strand.
4. Dune sand strand.
5. Slacks and Lee-side sand-flats.
6. Woodland back-sand strand.

Plant communities on these sand strands show more or less uniform zonation pattern all along the eastern coast and can be divided into six main types as follows :

i. *Cyperus arenarius* community :

It is dominant on sandy beaches as a pioneer plant in pure form or sometimes associated with *Sesuvium portulacastrum*. Throughout Bengal, Orissa, Andhra Pradesh and Tamil Nadu it is found common along the upper limit of unstabilized zone to the semistabilized sandy strand. Towards the muddy areas *Hemithria compressus* associated with *Fimbristylis falcata* is found dominant.

ii. *Hydrophylax maritima* community :

It is dominant on sandy beaches, baby dunes and seaface dune sides, little away from the above semistabilized sandy areas. It is a closed herbaceous creeper forming dense mat on sandy strand protecting the frequent uplift of the sand grains by the wind force. It is commonly associated with *Launaea sarmentosa*, *Sporobolus virginicus*, *Zoysia matrella*, *Halopyrum*

mucronatum, *Enicostema hyssopifolium*, *Cyperus esculentus*, *Perotis indica*, *Geniosporum tenuiflorum* and others.

iii. *Ipomoea pes-caprae* community :

It is dominant towards the more stable sandy strand as well as the base of sand dunes throughout Coromandal Circar coastal region. This community is found associated with *Canavalia maritima*, *Psilotrichum sericeum*, *Euphorbia rosea*, *Trachys muricata*, *Peplidium maritimum*, *Borreria articularis*, *Phyllanthus rotundifolius*, *Rothia indica*, *Portulaca pillosa*, *Gisekia pharnaceoides*, *Trianthema triquetra* and others.

iv. *Spinifex littorius* community :

It is dominant mostly on lower slope of the sand dunes, sand ridges and sand bars along the supra tidal region with long horizontal runners and fleshy nodal roots. This community is commonly associated with *Zornia diphylla*, *Tephrosia purpurea*, *Crotalaria juncea*, *Oldenlandia stricta*, *Indigofera trifoliata*, *Sauropus bacciformis*, *Syzygium ruscifolium*, *Bulbostylis barbata*, *Fimbristylis diphylla*, *Polycarpaea corymbosa* and others.

v. *Sida cordifolia* community :

It is dominant towards the upper slope of sand dunes, sand bars and sand ridges commonly associated with *Calotropis procera*, *Allmania nodiflora*, *Mollugo distica*, *Canscora diffusa*, *Leucus stricta*, *Waltheria indica*, *Polycarpaea corymbosa*, *Tephrosia purpurea*, *Bulbostylis barbata*, *Opuntia dillenii*, *Tylophora indica*, *Cleome aspera*, *Catharanthus roseus*, *Datura metel*, *Jatropha gossypifolia*, *Aristolochia bracteolata* and others.

vi. *Casuarina equisetifolia* community :

It is found commonly cultivated in most of the Coromandel-Circar regions towards the woodland zones. However in some areas where the coast line remains undisturbed the following species are found associated in the natural habitat. *Calophyllum inophyllum*, *Acacia planiformis*, *Alangium salvifolium*, *Ardisia solanacea*, *Anacardium occidentale*, *Atalantia monophylla*, *Capparis brevispina*, *Colubrina asiatica*, *Commifora wightii*, *Cordia subcordata*, *Euphorbia nivulia*, *Grewia tenax*, *Guettarda speciosa*, *Maytenus emerginata*, *Hernandia peltata*, *Ixora coccinea*, *Diospyros buxifolia*, *Memecylon angustifolium*, *Argusia argentia*, *Pemphis acidula*, *Pongamia pinnata*, *Thespesia populnea*, *Suriana maritima*, *Ziziphus oenoplia*, *Vitex trifolia*, *Salvadora persica* and others.

Table - 26 : SPECIES COMPOSITION OF INDIAN EAST COAST BEACH & SAND DUNES (COROMANDEL- CIRCAR COAST)

SPECIES	COMMUNITY					
	1	2	3	4	5	6
1. <i>Cyperus arenarius</i>	C	-	-	-	-	-
2. <i>Sesuvium portulacastrum</i>	VF	-	-	-	-	-
3. <i>Hemihtria compressus</i>	VF	-	-	-	-	-
4. <i>Fimbristylis falcata</i>	R	-	-	-	-	-
5. <i>Hydrophylax maritima</i>	-	D	-	-	-	-
6. <i>Launaea sarmentosa</i>	-	C	-	-	-	-
7. <i>Sporobolus virginicus</i>	-	F	-	-	-	-
8. <i>Zoysia matrella</i>	-	F	-	-	-	-
9. <i>Hulopyrum mauritanicum</i>	-	VF	-	-	-	-
10. <i>Ericosstema hysopifolium</i>	-	VF	-	-	-	-
11. <i>Cyperus esculentus</i>	-	F	-	-	-	-
12. <i>Pennisetis indica</i>	-	R	-	-	-	-
13. <i>Geniosporum tenuiflorum</i>	-	F	-	-	-	-
14. <i>Ipomoea pes-caprae</i>	-	-	D	-	-	-
15. <i>Canavalia maritima</i>	-	-	C	-	-	-
16. <i>Psilotrichum sericeum</i>	-	-	F	-	-	-
17. <i>Euphorbia rosea</i>	-	-	F	-	-	-
18. <i>Trachys muricata</i>	-	-	VF	-	-	-
19. <i>Peplidium maritimum</i>	-	-	F	-	-	-
20. <i>Borreria articulata</i>	-	-	F	-	-	-
21. <i>Phyllanthus rotundifolius</i>	-	-	R	-	-	-
22. <i>Rottia indica</i>	-	-	R	-	-	-
23. <i>Portulaca pillosa</i>	-	-	P	-	-	-
24. <i>Ciselia pharnaceoides</i>	-	-	R	-	-	-
25. <i>Trianthema triquetra</i>	-	-	R	-	-	-
26. <i>Spinifex litorius</i>	-	-	-	D	-	-
27. <i>Zornia diphylla</i>	-	-	-	VF	-	-
28. <i>Tephrosia purpurea</i>	-	-	-	C	-	-
29. <i>Crotalaria juncea</i>	-	-	-	F	-	-
30. <i>Oldenlandia stricta</i>	-	-	-	R	-	-
31. <i>Indigofera trifoliata</i>	-	-	-	VF	-	-
32. <i>Scaevola hacciformis</i>	-	-	-	F	-	-
33. <i>Syzygium ruscifolium</i>	-	-	-	F	-	-
34. <i>Bulbostylis barbata</i>	-	-	-	VF	-	-
35. <i>Fimbristylis diphylla</i>	-	-	-	R	-	-
36. <i>Polycarpaea corymbosa</i>	-	-	-	F	-	-
37. <i>Sida cordifolia</i>	-	-	-	-	D	-
38. <i>Calotropis procera</i>	-	-	-	-	C	-
39. <i>Althemia nodiflora</i>	-	-	-	-	F	-
40. <i>Mollugo disticha</i>	-	-	-	-	VF	-

Diversity of Coastal Plant Communities in India

SPECIES	COMMUNITY					
	1	2	3	4	5	6
41. <i>Canscora diffusa</i>	-	-	-	-	F	-
42. <i>Leucas stricta</i>	-	-	-	-	F	-
43. <i>Waltheria indica</i>	-	-	-	-	F	-
44. <i>Polycarpaea corymbosa</i>	-	-	-	-	VF	-
45. <i>Tephrosia purpurea</i>	-	-	-	-	F	-
46. <i>Bulbostylis barbata</i>	-	-	-	-	VF	-
47. <i>Opuntia dillenii</i>	-	-	-	-	R	-
48. <i>Tylophora indica</i>	-	-	-	-	R	-
49. <i>Cleome aspera</i>	-	-	-	-	F	-
50. <i>Catharanthus roseus</i>	-	-	-	-	VF	-
51. <i>Datura metel</i>	-	-	-	-	R	-
52. <i>Turnera ulmifolia</i>	-	-	-	-	R	-
53. <i>Jatropha gossypifolia</i>	-	-	-	-	R	-
54. <i>Aristolochia brachiata</i>	-	-	-	-	F	-
55. <i>Casuarina equisetifolia</i>	-	-	-	-	-	D
56. <i>Calophyllum inophyllum</i>	-	-	-	-	-	C
57. <i>Acacia planiformis</i>	-	-	-	-	-	VF
58. <i>Alangium salvifolium</i>	-	-	-	-	-	VF
59. <i>Ardisia solanacea</i>	-	-	-	-	-	R
60. <i>Anacardium occidentale</i>	-	-	-	-	-	C
61. <i>Atalantia monophylla</i>	-	-	-	-	-	F
62. <i>Capparis brevispina</i>	-	-	-	-	-	R
63. <i>Colubrina asiatica</i>	-	-	-	-	-	R
64. <i>Commiphora wightii</i>	-	-	-	-	-	R
65. <i>Cordia subcordata</i>	-	-	-	-	-	F
66. <i>Euphorbia nivulia</i>	-	-	-	-	-	R
67. <i>Grewia tenax</i>	-	-	-	-	-	R
68. <i>Guettarda speciosa</i>	-	-	-	-	-	F
69. <i>Maytenus emerginata</i>	-	-	-	-	-	VF
70. <i>Hernandia peltata</i>	-	-	-	-	-	R
71. <i>Ixora coccinea</i>	-	-	-	-	-	R
72. <i>Diospyros buxifolia</i>	-	-	-	-	-	F
73. <i>Memecylon angustifolium</i>	-	-	-	-	-	R
74. <i>Argusia argentea</i>	-	-	-	-	-	R
75. <i>Pemphis acidula</i>	-	-	-	-	-	R
76. <i>Pongamia pinnata</i>	-	-	-	-	-	F
77. <i>Thespesia populnea</i>	-	-	-	-	-	VF
78. <i>Suriana maritima</i>	-	-	-	-	-	R
79. <i>Ziziphus oenoplia</i>	-	-	-	-	-	VP
80. <i>Vitex trifolia</i>	-	-	-	-	-	F
82. <i>Salvadora persica</i>	-	-	-	-	-	F

R = Less than 20%, VF = 20%-40%, F = 40%-60%, C = 60%-80%, D = More than 80%

PLANT COMMUNITIES ON ROCKY STRAND

Rocky strands are mostly dominant along the west coast, southern Kathiawar and Gujarat coast lines. Along the west coast, from the north of Narmada to Thiruvananthapuram, formation of cliffs, ghats and indented rocky slopes and hills of various types are very prominent. In this coast line, due to high erosion rate, most of the coastal areas do not possess any distinction between the shore and back shore topography. In some regions, formation of pocket beaches in between the two cliffs or hill slopes is the only distinguishing mark for determining the shore and back shore topography. Except some specialised salt water tolerant herbaceous communities, other plant communities on these cliffs, ghats and hill slopes appear from the inland flora showing no distinct habitat preferences like shore, back shore or inland conditions. Majority of tree species along the coast have their niche breadth same as in inland formations.

Tropical evergreen formation is the main type along these cliffs, ghats and hill slopes extending to the south Konkan hill, Ratnagiri, Goa, Karwar, Mangalore and Malabar coastal regions. Plant communities can be divided into five types as follows.

i. *Atriplex stocksii* community :

It is dominant in the pioneer zone of rocky strand and are capable of withstanding high salinity, wind and wave action of the sea. Some of the common associates which are also capable to tolerate the conditions are *Polycarpha spicata*, *Fagonia indica*, *Ensete superba*, *Limonium stocksii*, *Thuarea involuta*, *Polygala erioptera*.

ii. *Enicostema hyssopifolium* community :

It forms communities dominant on rocky crevices where frequent sea waves during high tide wash the rocky surfaces. Common associates in these strands are *Indoneesiella echioides*, *Kickxia ramosissima*, *Lindenbergia muraria*, *Portulaca quadrifida*, *Pulicaria*

angustifolia, *Pemphis acidula*, *Pavonia procumbens*, *Sporobolus diander*, *Helichrysum cutchicum*.

iii. *Tephrosia purpurea* community :

It is dominant on rocky slopes, cliffs and hill slopes above the wave action zones where except the wind blown salt spray and very high tide conditions, vegetation is not affected by the sea waves.

Tephrosia purpurea, *Calotropis procera* and *Jatropha gossypifolia* form dominant association with *Aerva lanata*, *Barleria prionites*, *Sericostoma pauciflorum*, *Indoneesiella echioides*, *Syzygium ruscifolium*, *Psilotrichum sericeum*.

iv. Mixed plant communities :

Towards the interior regions, this herbaceous zone mix up with coastal scrubs and woodland zones. Some common inland plants form dominant association over these regions such as *Toddalia asiatica*, *Capparis brevispina*, *Capparis decidua*, *Ardisia solanacea*, *Colubrina asiatica*, *Caesalpinia crista*, *Atalantia monophylla*, *Pisonia aculeata*, *Calophyllum inophyllum*, *Thespesia populnea*, *Strychnos nuxvomica*, *Anacardium occidentale*, *Pandanus tectorius*, *Vitex trifolia*, *Salvadora persica* and others are found where rocky crevices are covered with huge sand dunes.

v. *Vateria indica* - *Hopea parviflora* and *Poeciloneuron indicum* community :

They are dominant along the coastal hill slopes and ghats along Goa, South and North Kanara and Malabar regions in association with *Euphorbia nivulla*, *Cordia dichotoma*, *Erythrina suberosa*, *Ixora arborea*, *Morinda citrifolia*, *Symplocos cochlnensis*, *Carallia brachiata*, *Medinilla malabarica*, *Diospyros ebenum*, *Dipterocarpus alatus*, *Palaquium ellipticum*, *Aporosa villosa*, *Terminalia paniculata*, *Mangifera indica*, *Artocarpus hirsuta*, *Vitex trifolia* and others.

Table - 27 : SPECIES COMPOSITION OF INDIAN WEST COASTAL ROCKY STRAND

SPECIES	COMMUNITY					
	1	2	3	4	5	6
1. <i>Atriplex stocksii</i>	D	-	-	-	-	-
2. <i>Polycarpha spicata</i>	C	-	-	-	-	-
3. <i>Fagonia cretica</i>	VF	-	-	-	-	-
4. <i>Enseta superba</i>	F	-	-	-	-	-
5. <i>Limonium stocksii</i>	R	-	-	-	-	-
6. <i>Thuarea involuta</i>	C	-	-	-	-	-
7. <i>Polygala erioptera</i>	VF	-	-	-	-	-
8. <i>Enicostema hyssopifolium</i>	-	D	-	-	-	-
9. <i>Indoneesiella echioides</i>	-	C	-	-	-	-
10. <i>Kickxia ramosissima</i>	-	VF	-	-	-	-
11. <i>Lindenbergia muraria</i>	-	VF	-	-	-	-
12. <i>Portulaca quadrifida</i>	-	F	-	-	-	-
13. <i>Pulicaria angustifolia</i>	-	F	-	-	-	-
14. <i>Pemphis acidula</i>	-	R	-	-	-	-
15. <i>Pavonia procumbens</i>	-	R	-	-	-	-
16. <i>Sporobolus diander</i>	-	VF	-	-	-	-
17. <i>Helichrysum cutchicum</i>	-	C	-	-	-	-
18. <i>Tephrosia purpurea</i>	-	-	D	-	-	-
19. <i>Calotropis procera</i>	-	-	C	-	-	-
20. <i>Jatropha gossypifolia</i>	-	-	C	-	-	-
21. <i>Aerva lanata</i>	-	-	VF	-	-	-
22. <i>Barleria prionites</i>	-	-	VF	-	-	-
23. <i>Sericostoma pauciflorum</i>	-	-	VF	-	-	-
24. <i>Indoneesiella echioides</i>	-	-	F	-	-	-
25. <i>Syzygium ruscifolium</i>	-	-	R	-	-	-
26. <i>Psilotrichum sericeum</i>	-	-	R	-	-	-
27. <i>Toddalia asiatica</i>	-	-	R	-	-	-
28. <i>Capparis brevispina</i>	-	-	R	-	-	-
29. <i>C. decidua</i>	-	-	R	-	-	-
30. <i>Ardisia solanacea</i>	-	-	R	-	-	-
31. <i>Colubrina asiatica</i>	-	-	F	-	-	-
32. <i>Caesalpinia crista</i>	-	-	VF	-	-	-
33. <i>Atlantia monophylla</i>	-	-	VF	-	-	-
34. <i>Pisonia aculeata</i>	-	-	R	-	-	-
35. <i>Calophyllum inophyllum</i>	-	-	-	VF	-	-
36. <i>Thespesia populnea</i>	-	-	-	VF	-	-
37. <i>Strychnos nuxvomica</i>	-	-	-	VF	-	-
38. <i>Anacardium occidentale</i>	-	-	-	C	-	-
39. <i>Syzygium caryophyllatum</i>	-	-	-	VF	-	-
40. <i>Pandanus tectorius</i>	-	-	-	F	-	-
41. <i>Vitex negundo</i>	-	-	-	F	-	-
42. <i>Salvadora persica</i>	-	-	-	R	-	-
43. <i>Vateria indica</i>	-	-	-	-	C	-
44. <i>Hopea parviflora</i>	-	-	-	-	C	-
45. <i>Poeciloneuron indicum</i>	-	-	-	-	C	-
46. <i>Euphorbia nivulia</i>	-	-	-	-	F	-
47. <i>Cordia dichotoma</i>	-	-	-	-	F	-
48. <i>Erythrina suberosa</i>	-	-	-	-	R	-
49. <i>Ixora arborea</i>	-	-	-	-	F	-
50. <i>Morinda citrifolia</i>	-	-	-	-	F	-

SPECIES	COMMUNITY					
	1	2	3	4	5	6
51. <i>Symplocos cochinchensis</i>	-	-	-	-	VF	-
52. <i>Caralia brachiata</i>	-	-	-	-	VF	-
53. <i>Medinilla malabarica</i>	-	-	-	-	F	-
54. <i>Diospyros ebenum</i>	-	-	-	-	VF	-
55. <i>Dipterocarpus alatus</i>	-	-	-	-	F	-
56. <i>Palaquium ellipticum</i>	-	-	-	-	F	-
57. <i>Aporosa villosa</i>	-	-	-	-	F	-
58. <i>Terminalia paniculata</i>	-	-	-	-	R	-
59. <i>Mangifera indica</i>	-	-	-	-	VF	-
60. <i>Vitex negundo</i>	-	-	-	-	F	-

R = Less than 20%, VF = 20%-40%, F = 40%-60%, C = 60%-80%, D = More than 80%.

ASSESSMENT OF WET COASTAL PLANT COMMUNITY ALONG THE EAST COAST

Table - 28 : COMPOSITION OF MANGROVE COMMUNITIES BY TRANSECT METHOD IN BATIGHAR FOREST, ORISSA.

(Length of transect—38m, date - June 1972)

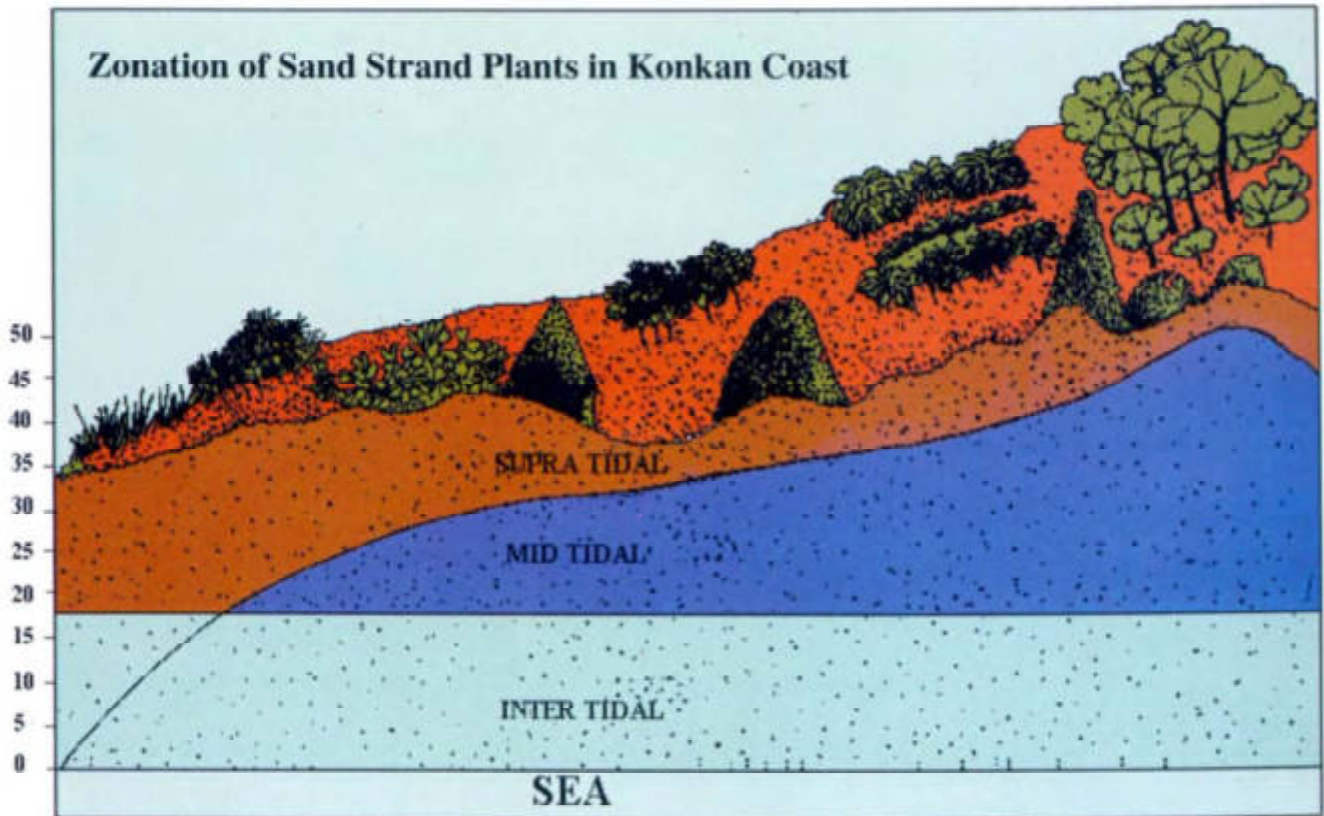
SPECIES	F	D	R.F	R.D.	R.A.	I.V.I.
1. <i>Rhizophora apiculata</i>	5	33	8.62	7.69	19.42	35.73
2. <i>Rhizophora mucronata</i>	5	36	8.62	8.39	15.32	32.13
3. <i>Excoecaria agallocha</i>	5	40	8.62	9.32	14.24	32.18
4. <i>Cerops decandra</i>	5	94	8.62	21.91	1.60	32.13
5. <i>Avicennia officinalis</i>	4	27	6.89	6.29	18.62	31.80
6. <i>Bruguiera gymnorrhiza</i>	3	19	5.17	4.42	10.81	20.41
7. <i>Kandelia candel</i>	3	22	5.17	5.12	10.10	20.39
8. <i>Sonneratia caseolaris</i>	1	6	1.72	1.36	11.21	14.21
9. <i>Xylocarpus granatum</i>	2	19	3.44	4.42	8.36	14.22
10. <i>Dalbergia spinosa</i>	4	25	6.89	5.42	0.82	13.13
11. <i>Aegiceras corniculatum</i>	2	14	3.44	3.26	3.02	9.72
12. <i>Bruguiera parviflora</i>	3	9	5.17	2.09	2.91	9.17
13. <i>Phoenix paludosa</i>	1	6	1.72	1.94	5.90	9.01
14. <i>Sonneratia apetala</i>	3	3	5.17	0.69	2.21	8.07
15. <i>Brownlowia tersa</i>	2	19	3.44	4.42	0.06	7.92
16. <i>Derris trifoliata</i>	2	17	3.44	3.96	0.01	7.41
17. <i>Xylocarpus mekongensis</i>	1	3	1.72	0.69	2.70	5.11
18. <i>Merope angulata</i>	1	14	1.72	3.26	0.07	5.05
19. <i>Avicennia alba</i>	2	6	3.44	1.39	0.04	4.87
20. <i>Tamarix indica</i>	1	7	1.72	1.73	0.02	3.37
21. <i>Aegialitis rotundifolia</i>	1	4	1.72	0.93	0.21	2.86
22. <i>Lumnitzera racemosa</i>	1	4	1.72	0.93	0.13	2.78
23. <i>Entolaysonia obovata</i>	1	2	1.72	0.46	0.01	2.19
	58	429				324.13

F = Frequency, D = Density, R.F. = Relative Frequency, R.D. = Relative Density, R.A. = Relative Abundance, I.V.I. = Importance Value Index

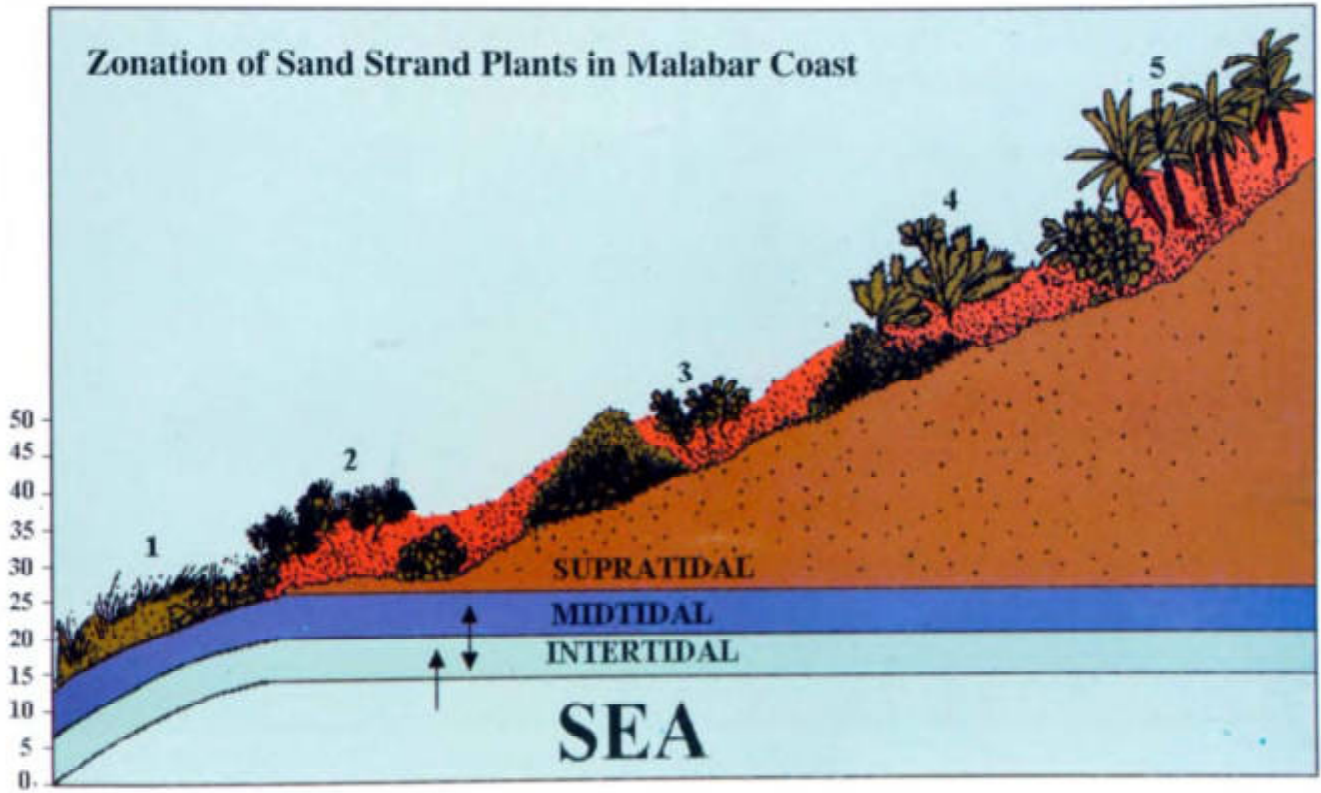
The statistical data may be divided into 4 size classes based on the I.V.I., as follows :

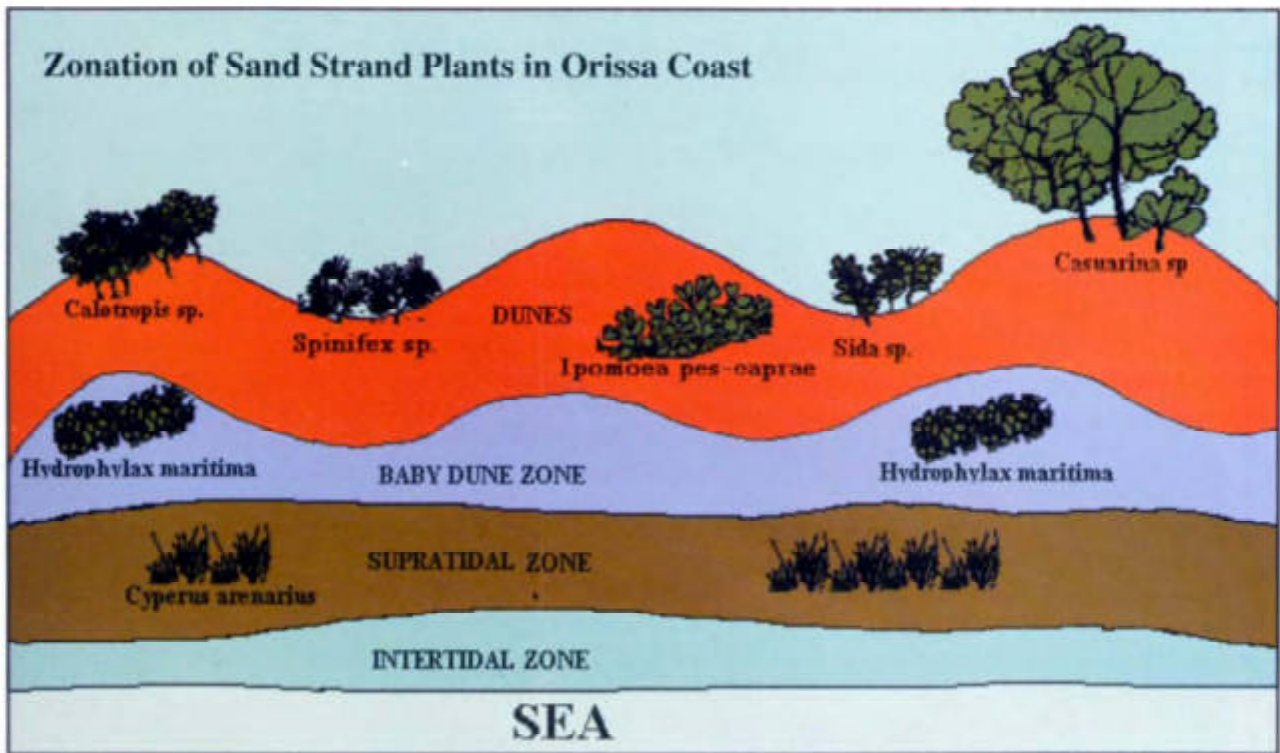
RANGE OF CLASS	CLASS	Total number of species occurred
07.19 - 12.18	A	13
12.19 - 22.18	B	5
22.19 - 32.18	C	3
32.19 - 42.18	D	2

Zonation of Sand Strand Plants in Konkan Coast



Zonation of Sand Strand Plants in Malabar Coast





Island Vegetation in Andaman

It is observed from the class values that there are at least 10 leading species from class B-D which are dominating in the stand with the concept of importance value index. These 10 species have a combined I.V.I. value of 246 out of the total I.V.I. value of 324 and the average I.V.I. value is about 24.

On the other hand, 13 species in the class A, have a combined I.V.I. value of 78 out of the total I.V.I. value of 324 and the average I.V.I. value of the 13 species is only 6. Therefore it is cleared that 10 species in the class B-D have a maximum importance value index in the Eumangal strand.

Table - 29 : COMPOSITION OF MANGROVES BY TRANSECT METHOD IN BHITARKANIKA FOREST, ORISSA. (Length of transect—30m. Date - July 1972)

SPECIES	F	D	R.F	R.D.	R.A.	I.V.I.
1. <i>Heritiera fomes</i>	4	40	9.09	13.2	16.4	38.6
2. <i>Excoecaria agallocha</i>	4	35	9.00	11.6	15.0	35.4
3. <i>Sonneratia apetala</i>	3	7	6.80	2.3	18.3	27.3
4. <i>Bruguiera sexangula</i>	4	22	9.00	7.0	10.2	26.2
5. <i>Avicennia officinalis</i>	3	12	6.80	3.8	12.4	23.0
6. <i>Cynometra iripa</i>	2	19	4.50	6.0	9.8	20.3
7. <i>Aglaiia cucullata</i>	3	16	6.80	5.1	8.1	20.0
8. <i>Aegiceras corniculatum</i>	3	20	6.80	6.6	2.4	15.8
9. <i>Phoenix paludosa</i>	1	25	2.20	8.6	3.4	13.6
10. <i>Intsia bijuga</i>	2	16	4.50	5.3	3.8	13.6
11. <i>Bruguiera gymnorhiza</i>	3	12	6.80	3.8	4.4	13.0
12. <i>Acanthus ilicifolius</i>	2	20	4.50	6.4	1.5	12.4
13. <i>Cerbera manghus</i>	2	9	4.50	2.8	4.9	12.2
14. <i>Hibiscus tiliaceus</i>	2	13	4.50	4.1	2.6	11.2
15. <i>Brownlowia tersa</i>	3	10	6.80	3.2	0.4	10.4
16. <i>Dalbergia spinosa</i>	1	10	2.20	3.2	4.5	9.9
17. <i>Xylocarpus mekongensis</i>	1	5	2.20	1.6	4.5	8.3
18. <i>Derris trifoliata</i>	1	9	2.20	2.8	0.4	5.4
	44	300				316.6

F = Frequency, D = Density, R.F. = Relative Frequency, R.D. = Relative Density, R.A. = Relative Abundance, I.V.I. = Importance Value Index

The semi mangal strand may be divided into 4 size classes based on the I.V.I., as follows :

RANGE OF CLASS	CLASS	Total number of species occurred
04.5 - 14.4	A	10
14.5 - 24.4	B	4
24.5 - 34.4	C	2
34.5 - 44.4	D	2

It is observed from the class values that there are at least 8 leading species from class B-D which are dominating in the stand with a combined I.V.I. value of 206 out of the total value of 316 and the average I.V.I. value is 26. On the other hand, 10 species in the class A,

have a combined I.V.I. value of 110 out of the total 316 and the average I.V.I. value of the 10 species is only 11. Therefore it is clear that 8 species in class B-D have maximum importance value index in the semi mangal strand.

THE OFFSHORE REGION OF INDIAN COASTAL SYSTEM (EXCLUSIVE ECONOMIC ZONE)

A detailed submarine contour map shows that at about 100 fathoms or 183-200 m, the most prominent break of the sea slope occurs in the submarine floor around India. Thus the limit of 100 fathoms or 183-200 m equal to that of our Gangetic plain constitute the Continental Shelf in India. The Continental Shelf is widest near the Gulf of Khambat about 400 km across and narrowest off the delta mouths (Sundarbans & Krishna). This shelf in India is about 300,000 sq. km and out of this eastern coast having 100,000 sq. km and western coast possesses 200,000 sq. km.

Deposits on the shelf around India are mostly from subaerial erosion of land areas and from coastal regions consisting of gravels, sands, silts and muds. According to the nature of deposits, the Continental Shelf can be divided into 2 regions : 1) **Littoral region**, that includes on shore zone between low tide and high tide regions and 2) **Neritic region**, that is the zone between low water and 200 m depth of the sea on the off shore zone.

The Neritic regions are considered to be Exclusive Economic Zone due to accumulation of rich physical, biological and economically viable resources. They serve as Nation's life line by providing the much needed proteins to masses and the environmental services of unestimated monetary value. India has an Exclusive Economic Zone estimated to be about 2.02 million sq. km, of this West coast, including Lakshadweep constitutes maximum (42.5 %) followed by Andaman and Nicobar island (29.7 %) and East coast (27.8 %). The biological wealth is concentrated in the relatively narrow strip formed by the continental shelf, coastal margins and estuaries. The continental shelf on the West coast is generally broader than on the East coast. Gujarat has the longest coast line and broadest continental shelf where it extends to more than 300 km from the shore. The shelf is narrowest along Andhra Pradesh and Tamil Nadu coasts, where the 200 m line stretches to a maximum of 13 km from the coast.

This part of marine resource in India is highly endowed with vast physical potentialities of oils and

natural gases, source of drinking water, common salt, magnesium, nodules of manganese, common source of phosphorus, sulphur, iron and many chemicals. Biodiversity and its components in this part are remarkable in various forms and sizes starting from the microscopic phytoplankton to the giant whale. This marine system is the store house of many fishes, molluscs, crustacean, seaweeds, seagrasses and plankton. The seaweeds could offer a solution for the millions of people as an alternative food due to their high nutritional value, like fish. They could be used in a variety of ways in food, pharmaceuticals, textiles and chemical industries. Algin, carrageenan and agar from the seaweed are used extensively for icecream, malted milk, cheese, chocolates, puddings and salad. Apart from these, there are many other seaweeds which are used as direct food, fodder, fertilizer and energy biomass. It is estimated that present production of seaweeds in India is about 60,000 tons which can be targeted to 1 lakh if modern technology is available. NIO, CSMCRI, CMFRI in India have shown various effort for developing these seaweeds. Research should be made for high yielding and protein rich seaweeds for aquaculture so that with the help of rural industries poor people could be benefited. Like seaweeds, seagrasses are also important habitat and food for many marine organism and fishes.

Apart from these seaweeds and seagrasses, the E.E.Z. is far richer source of sea-food namely plankton which are the microscopic plants and animals that abound in the sea water in millions, turning it into a rich nutritious soup. It is estimated that about 0.2 million tons of phytoplankton occur as largest quantity of living species in ocean. This phytoplankton serve as first food chain for the enormous numbers of zooplankton known as copepods. The basic food producer is the phytoplankton which passes from copepods to smaller fishes and final food chain ends when larger fish like tuna, shark, etc. consume these smaller fishes. It would be wise to develop a method by which this sea-food soup could be available directly to the people as powder plankton.



Crocodile Farm at Bhagabhatpur, Sundarbans

Recreation in Puri Beach, Orissa



Openbilled storks roosting in Coastal Wetland

Logs carried out by natural tide, Andaman





Olive Ridley Turtle coming for egg laying along the Gahrimatha Beach, Orissa

Mangroves Protecting the Tropical Rain Forest, Andaman



Crocodile breeding farm in Bhitarkanika, Orissa

Horseshoe crab, *Carcinoscorpius rotundicauda*, an endangered coastal sp.



Another important field for ocean biological resources are the use of plant and animal diversities as many of them are used for medicinal purpose. The marine pharmacology is a promising field for many important chemicals and life saving drugs even in the area of cancer.

It is estimated that there are numerically more living things in the sea than on land. The amount of life produced on land per unit time is very small compared to the huge quantity of living matter produced in the sea. In the total biodiversity scenario of the world, India's share is about 7 %. But with reference to marine biodiversity, India with a 3 % share of world ocean has 8 % of total marine biodiversity. The percentage of marine diversity out of the total biodiversity of India is about 15.05 %. This marine biodiversity is however restricted to only a very small part of the ocean. At the global level it is estimated that 90 % of marine species live in at most 50 million sq. km of the total 352 million sq. km.

Marine algal diversity shows that there are several places, both on the peninsular coast and in the nearby islands and archipelagos, which have a rich algal vegetation. Among these are: Dwarka, MulDwarka, Okha, Kuchchh and Saurashtra, Mumbai, Malvan, Karwar and further down the Western coast, Kanya Kumari, at the southern most extremity, Rameswaram, Pamban, Krusadi group of islands and neighbouring islands, Tuticorin, Hare Island and Church Island, all in the southern part of the Eastern coast, and Mahabalipuram, Chennai and Waltair further up on the eastern coast. In addition, the Lakhadweeps, the Andamans and the Nicobar islands are also rich in algal communities.

In all the areas, luxuriant algal growth, belonging to the species of Chlorophyta, Phaeophyta and Rhodophyta are well represented. Although it is often difficult to demarcate zones due to the complexity of the associations, it is nevertheless possible in most areas to divide the algal vegetation into some belts viz., the infra-littoral belt, extending from low water mark to deeper waters, the littoral belt, extending between high and low water marks. This zone may often show three clear zones : Low-littoral, Mid-littoral and Supra-littoral zones.

Of the red algae, *Chrysymenia uvaria*, *Halymenia dilatata*, *Dictyurus purpurescens*, *Neurymenia fraxinifolia* and *Scinaia carnososa* are some of the typical forms met with in the infra-littoral region. Others like *Halymenia venusta*, *Asparagopsis taxiformis* and *Botryocladia leptopoda* though characteristic of the infra-littoral belt, are sometimes found further up in the littoral region. The lower littoral zone is covered mostly by species of *Gelidium*, *Polysiphonia*, *Ceramium*, *Laurencia* and *Gracilaria*, while the mid - littoral and upper littoral regions show more of brown and green algal communities and comparatively fewer red algae. *Colpomenia sinuosa*, *Iyengaria stellata* and *Hydroclathrus clathratus* and species of *Padina*, *Sargassum* and *Dictyota* are some of the typical brown algae of this region. The green algae are represented by the species of *Codium*, *Caulerpa*, *Ulva*, *Enteromorpha*, *Chaetomorpha* and *Cladophora*.

Within the tidal limits, there are rock pools of different sizes and depths which harbour interesting algal associations. In the very deep rock pools red algae like *Botryocladia leptopoda* and *Galaxaura oblongata* intermingled with brown and green algae are prominent. In higher pools, distribution of red algal species of *Amphiroa*, *Gracilaria* along with *Champia parvula*, *Heterosiphonia muelleri*, *Piagora ceranoides*, and species of *Padina*, *Sargassum* and *Dictyota*, of brown algae and also green algae like *Acetabularia mobii*, *Chamaedoris awriculata*, species of *Enteromorpha*, *Ulva*, *Caulerpa* and *Chaetomorpha* are well marked. In the supra-littoral region, the rocks, exposed to heavy swell and surf, harbour a characteristic flora, comprising species of *Chaetomorpha*, *Cladophora* and *Halimeda* of the green algae, *Ectocarpus*, *Myriogloea*, *Namacystus* and *Chnoospora* of the brown algae, *Porphyra*, *Liagora*, *Sarcodia*, *Grateloupia*, *Gracilaria* of the red algae, and blue-green algae like species of *Lynghya*, *Microcoleus* and *Calothrix*.

Species of *Boergesenia*, *Udotea* and at places *Avrainvillea* are found on reefs and coralline substrata, heavily silted with fine sand and mud which frequently get exposed at low tide. In such situations *Acetabularia*

and *Neomeris* are also found at times growing on fragments of dead corals.

In shallow lagoons, several brown algae like *Cystophyllum muricatum*, *Dictyopteris delicatula*, *Hormophysa triquetra*, *Spathoglossum asperum*, *Stoechospermum marginale* and species of *Turbinaria*, *Sargassum* and *Padina* occur associated with red algae like *Dictyurus*, *Acanthophora*, *Gracilaria* and *Hypnea*.

Seagrasses in the E.E.Z. is another field of special interest in India. They are angiospermous plants specially adapted in a complete marine ecosystem. Near about 14 species of seagrasses have so far been reported from India starting from Chilka lake in Orissa, to different bays, lagoons, river estuaries, backwaters of Andhra Pradesh and Tamil Nadu coast. Concentration of seagrasses have been found more on Palk bay and Gulf of Mannar. They serve as unique habitat and food for many marine fishes and other animals. Some of them are used for important medicine and useful fertilizer.

Another important biological resource in the marine ecosystem is the coral reefs which as the most specialised and diverse group command the greatest importance by virtue of their biological productivity. They harbour largest diversity of resident flora and fauna, complexity of trophic organization and finally the resources, both organic and inorganic, that are of direct economic importance. For common man it forms a beautiful environment of attractive and colourful life. So far known, the diversity of coral in Indian coast represents 42 genera and 9 subgenera from Nicobar islands, 25 genera and 8 subgenera from Andaman islands, 28 genera and 9 subgenera from Lakshadweep, 20 + 1 from Gulf of Kutch and 26 + 4 from Gulf of Mannar. (Wafer *et al.*, 1991)

Most abundant and valuable bio-diversity in the E.E.Z. are Phytoplankton, Zooplankton, Nekton and Benthos. The phytoplankton includes a number of taxa, such as *Diatoms*, *Dinoflagellates*, *Coccolithophores*, *Silicoflagellates*, Blue green algae and Bacteria. Phytoplankton and Zooplankton occur everywhere differing only with respect to species composition and relative abundance. The nutrient rich coastal waters

are dominated by *Diatoms*, whereas the nutrient-deficient oceanic waters contain *Dinoflagellates* in abundance. A total of 260 species of *Diatoms* were reported from the Indian seas. In the Indian Ocean it is also observed that the *Dinoflagellates* predominate in phytoplankton. There is generally a gradual decline in phytoplankton abundance from coastal to oceanic waters.

Zooplankton constitute primary consumers. Almost all animal phyla are represented in the plankton either in juvenile or adult phase of their life history. Sponges, coelenterates, molluscs, echinoderms have planktonic larvae. A number of protozoas (forameniferans, radiolarians, etc.), rotifers, chaetognaths, cladocerans, mysids, copepods and a number of other crustaceans, and hemichordates have planktonic adults. Copepods are primary grazers in the sea and convert plant material into animal meat. Crustaceans is an important group and present in plankton, nekton and benthos.

As many as 23 and 21 species of Appendicularians were recorded from the Arabian Sea and Bay of Bengal respectively.

Free swimmers or nekton are important components of marine biodiversity and constitute important fisheries of the world. The dominant taxa in nekton are fish, the others being crustaceans, molluscs, reptiles and mammals. Out of a total of 25000 fish species known from world seas, 4000 species are from the Indian ocean, of which 1800 are from the Indian seas. Majority of the nekton are found in the neritic region of the E.E.Z.

Sea snakes are usually oceanic forms but some may swim near to shore. Out of the 50 species of snakes known from the Indo-Pacific, 20 species are known from Indian seas. Majority of these species visit the shore at some part of their life. Turtles are most common in the coastal region. Out of the total eight species known from world seas, five are represented in India. Four of these species occur in the Andaman and Nicobar Islands. Turtles visit the shore during breeding time to lay the eggs. There are some sandy beaches on the East coast and Andaman & Nicobar islands which are frequented by turtles to lay eggs.

Diversity of Coastal Plant Communities in India

Marine mammals belong to two orders *Sirenia* and *Cetacea*, which include a total of 27 species. But majority of these are oceanic forms and occasionally a few individuals get stranded on the shore.

Among invertebrates, there are a few species of molluscs and crustaceans which are active swimmers. About 200 species of cuttle fish, squid, octopus are known

from the Indian ocean. These are important bioresources of the Exclusive Economic Zone.

The extensive survey on the E.E.Z., reveals that most important marine fauna, more than 4500 species inhabit in the Exclusive Economic Zone of Indian waters out of which Mollusca represents the single largest group. The following table shows the marine fauna in the EEZ.

Table 30 : MARINE FAUNA OF INDIAN REGION

Group	Taxa (Species)
1. Sponges	± 500
2. Corals	337
3. Hydromedusae	± 130
4. Actinaria (Sea Anemones)	± 30
5. Sipuncula	± 38
6. Echiura	± 33
7. Phoronid	3
8. Crustacea :	899
i) Ostracoda	120
ii) Copepoda	500
iii) Cirripeds	104
vi) Isopod	175
9. Mollusca	3370
10. Echinodermata :	765
i) Crinoidea	95
ii) Asteroidea	180
iii) Ophiuroidea	180
iv) Echinoidea	150
v) Holothuroidea	160
11. Hemichordates	12
12. Protochordates:	116
i) Sessile Tunicate	50
ii) Pelagic Tunicate	62
iii) Cephalochordate	14
13. Pisces	1800
14. Reptilia	26
15. Mammals	27

(Source : Animal Resources : Protozoa to Mammalia, ZSI, 1991.)

COASTAL LIVELIHOOD

Coast line and the marine belt contain all types of natural resources for the livelihood of the people. Recently, increasing population has become more dependent to these resources in multifarious ways for better development of their life status. Living and nonliving resources are tapped for economic development of the country. Living resources include capture and culture fisheries, mariculture, crab culture and capture, shrimp and prawn culture, fodder, seaweeds, mangrove fuel wood, coral reefs, seagrasses and many others.

Recent advances in resources analysis and utilization indicate that 90% of the world's livelihood depends on coastal and oceanic biomass. The coastal offshore water in India is endowed with 2548 species of fishes (Ramakrishna, 1996) out of which 548 species are commercially important. In India within 7500 km coast line there are 1.42 million hectares of brackish water swamps and 0.9 million hectares of lakes, lagoons and estuaries which are utilized for biomedicine, shrimp, prawn and mollusc culture, collection of various food and other resources, anti-disease seaweeds, etc. by nearly 220 million people directly or indirectly for their livelihood. Besides these, India exports various marine products like prawns, frozen fish, crabs and turtles, etc. to over 54 countries. Total catch of marine shrimps in India has increased from 68,000 tonnes in 1960 to over 2.44 lakh tonnes in 1993.

MARINE FISH RESOURCES

India exports marine fishes to 54 countries out of which Japan and Hongkong are the major importers. Frozen shrimps are most valued item followed by fresh and frozen fishes, turtles and different molluscs. In 1993-94 India's total fish production was 45.72 lakh tonnes, the net marine product exported was 2,43,960 lakh tonnes valuing to 2503.62 crores rupees.

The major export items are :

PRAWNS

Panaeus monodon
P. indicus

P. semisculaus
P. merguliensis
Metapanaeus monoceros
M. affinis
M. dobsonii
M. brevicornis
Macrobrachium rosenbergii

FISHES

Chanos chanos
Mugil cephalus
Etroplus suratensis
E. maculatus
Lates calceifer
Megalops cyprinoides
Poteynemus indicus

TURTLE*

Four species of turtles viz. *Eretmochelys imbricata* (Hawksbill), *Lepidochelys olivacea* (Olive Ridley), *Chelonia mydas* (Green turtle) and *Dermochelys coriacea* (Leatherback) are found to occur around the Lakshadweep islands (Bhaskar, 1984).

(* Capture and export of turtle is now banned due to conservation measures.)

MOLLUSCAN RESOURCES

According to the data from Sea Food Export, global harvest of aquaculture has been increasing all through these years and out of world total production of 85,700 tonnes of molluscs in 1992, 35,00,719 tonnes came from aquaculture, (harvest of mussels and oysters only was 10,67,403 tonnes of which 9,53,529 tonnes i.e. 89.2% was from culture).

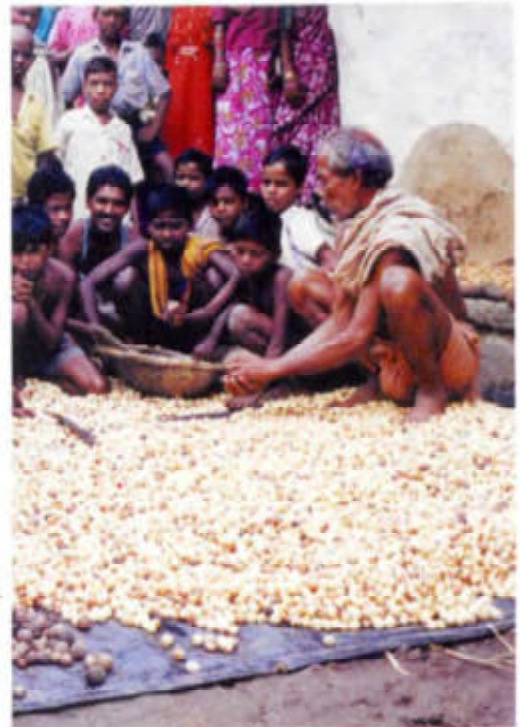
The major cultivable molluscs of India are :

PEARL OYSTERS

Pinctada fucata
Lamellidens marginalis



Leaves of *Avicennia marina* a good fodder collected from Mangrove Forests



The seeds of *Calophyllum inophyllum* are being processed by Coastal people for Oil and Soap production, Orissa



Prawn culture as a means of Livelihood, Bhitarkanika, Orissa



Fishing in the mangrove forests, Andaman

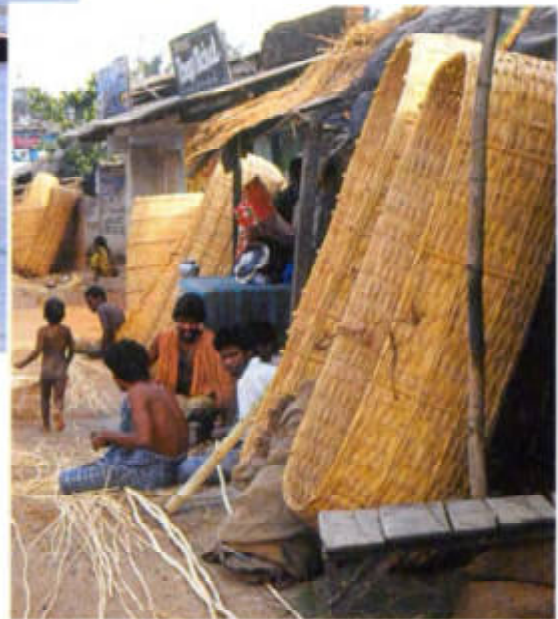


Marketing of Marine Fish, Gopalpur, Orissa



Extensive Prawn Culture in Chilka Lake

Coastal people involved in handicrafts for preparation of Baskets and other materials from Bamboo splints



Member of Onge Tribe in Little Andaman, living on Coastal Resources



MUSSELS

Perna viridis
Perna indica

GASTROPODS

Trochus niloticus
Anacus pyrum
Strombus sp. (Cowries)

OYSTERS

Crossostrea mardrasensis

CLAMS

Anadora granosa
Meritrex meritrex
M. costa
Tridachna kataylaysia opima

CEPHALOPODS

Sepia pharonis
Sepioteuthis lissimania

CORAL REEFS

Coral reefs are highly productive ecosystems, which are responsible for nurturing numerous species of fish and marine organisms and thus providing economic resources in the form of food, building materials, pearls, shells, sheltered harbour, etc. According to Smith (1978) the reef fishery potentiality is about 9 % of the commercial fish catch of the world.

Out of six million sq. km of sea area in India over 18,000 sq. km is occupied by coral reefs. Reefs and coral atolls are present in Andaman and Nicobar islands, Lakshadweep, Gulf of Kuchchh, Gulf of Mannar and Palk Strait. 439 species of reef building corals belonging to 79 genera occur in India.

Region	Families	Genera	Species
Gulf of Kuchchh	9	23	37
Lakshadweep	13	37	103
Gulf of Mannar	13	36	96
Andaman islands	16	31	82
Nicobar islands	16	43	103

The important contributions of Coral Reefs are :

- i. Breeding and nursery ground for many organisms including fishes, lobsters, shrimps, copepods, different molluscs and echinoderms.
- ii. Act as a protecting zone against erosion by sea waves as well as from cyclones.
- iii. Harbours medicinally potential organisms.
- iv. Generates income through tourist attraction with its fascinating underwater life.
- v. Breeding ground for ornamental fishes. 200 species of ornamental fish are reported from the coral reefs of Andaman.

MANGROVE RESOURCES

Mangroves are characterized by their adaptation to saline habitat with periodic tidal submergence. They are found to grow along estuaries, tidal creeks and lagoons of the coast or oceanic islands. The significant role of mangroves and its ecosystem have been realized throughout the world. It is well known that mangroves act as Cost free, Self-repairing, Static, Border Security Forces for protecting inland life and properties against cyclone, flood and storms. Its ecosystems is providing highest importance by virtue of its biological productivity and sustainable life support to the people living around the coastal belt. It also helps to maintain coastal atmospheric equilibrium, soil stabilization, building of new islands & extending the coastal land through accretion. Global threat regarding the rise of temperature due to greenhouse drift and the sea level rise which may submerge the low lying areas along the coasts can be easily overcome with suitable management of the mangrove vegetation that can finally increase the level of land of those particular areas.

In the mangrove ecosystem, the plants, animals, soil microbes and surrounding physical environment are interrelated by simple or complex processes by which a continuous exchange and assimilation of energy occurs. It forms a complex web, sheltering different groups of organisms like polychaetes, molluscs, crustaceans, fishes, insects, copepods, nematodes, reptiles, birds and mammals.

The contribution of Mangroves :

- i. Act as barrier against cyclones, tidal waves and erosion by sea.
- ii. Extend land area by gradual reclamation through propagation towards seawards side and increase the level of land.
- iii. Provide important livelihood resources in the form of fishes, prawns, crabs, shrimps and molluscs, honey, etc.
- iv. Provide timber for building boats, jetties, fishing nets, firewood and plywood, leaves for thatching, etc.
- v. Mangroves leaves are very good fodder for cattle and are reported to increase the yield of milk.
- vi. Many mangroves trees are potential sources of tannins and different phytochemicals.
- vii. It shelter varied fauna including monitor lizards, estuarine crocodiles, fishing cats and tigers (Sundarban) and therefore act as important sanctuaries.
- viii. Aesthetic beauty and diversity of biological forms attract a lot of tourists and thus generate income.

SEAGRASS RESOURCES

Seagrasses are marine Angiospermic plants, which usually occur in shallow water near the coast, between the mangrove communities of the coast and the offshore coral reefs. The common seagrasses of India are *Cymodocea rotundata*, *Cymodocea serrulata*, *Enhalus acoroides*, *Halophila ovata*, *Halodule spinifolia*, *Halodule uninervis*, *Syringodium isoetifolium*, *Thalassia*

hermprichii, *Potamogeton crispus*, *Potamogeton malaianus*, *Potamogeton pectinatus*, etc. Some of them like *Thalassia* sp., *Posidona* sp., *Cymodocea* sp., *Ruppia* sp., *Potamogeton* sp. and *Zinnichellia* sp. are also known to inhabit estuarine shallows. Out of 16 seagrass genera of the world 14 are present in India along the coralline coasts in Palk Strait, Gulf of Mannar, Lakshadweep, Andaman and Nicobar islands and the Gujarat coast. *Ruppia maritima* is found in the aquacultural areas of West Bengal and is reported to be used by the farmers to prevent diseases in prawn farms.

Like mangroves, seagrass ecosystem provides shelter and food for shrimps, and other invertebrates. They also trap and stabilize sediments and act as a buffer zone for the coral beds. Higher vertebrates like fish, turtles (reptile), and dugong (mammal) are also found to graze on seagrass beds.

Seaweed Resources

Seaweeds or marine macrophytic Algae contribute to about 30% of the world's aquacultural production. One third of the seaweed resources of the Indian Ocean are found only along the Indian coast. The estimated potential harvest is around 77,000 tonnes and the present harvest is about 40,000 tonnes annually. Seaweeds have a variety of uses in the production of food, confectionaries, textile, chemicals, pharmaceutical, fertilizer and fodder. They are also being used in preparation of various cosmetic products, extraction of minerals, trace elements, bioactive substances and food supplements. The seaweed *Spirulina* is widely used as nutritive supplement. Recently advances are being made towards the production of biodegradable polymers (plastics) from certain seaweeds.



Fish Market controlled by Women near Pichavaram, Tamil Nadu

Fishing in Mangroves, Pichavaram, Tamil Nadu



Fishermen's activity, Kalupada Ghat, Chilka

Fishermen waiting for Fishing Boats, Kalupada Ghat, Chilka





Coastal Livelihood of Nicobarese settled in Little Andaman

A different methods of Prawn seed collection without using the net, Pichavaram



The Fisherman procuring fish for his subsistence, Cauvery Mouth, Tamil Nadu

Livelihood of the Coastal Children; By catching different types of decorative Molluscs, Tamil Nadu



HISTORY OF COASTAL FLORA IN INDIA

From 1789-1899 :

The earliest attempt for studying plants from the Indian coastal area was made by William Roxburgh and published "Plants of the Coast of Coromandel" in 1795. Mr. S. Kurz in 1870 made a report on the vegetation of the Andaman islands and it was published in Govt. printing Press, Calcutta.

From 1880 onwards Mr. Heing, a forest officer collected many specimens from the Sundarbans areas and prepared a comprehensive list for Sundarbans working plan. During this period Mr. C.B. Clarke had also given particular attention to the coastal Sundarban plants and comprehensive account on the flora of the Sundarbans was presented in the presidential address before the Linnean society of London on 1895. During these period several infrequent publications regarding mangroves and strand plants had been focused in different forms since the publication of Flora of British India by J.D. Hooker in 1875-1897. Special attention was paid by Cleghorn, H., regarding sand binding plants of Madras beach and in 1856, published "The Sand binding plants of Madras beach" in Madras Jour. Litt. Sci. Within this period particular attention to the coastal flora was given by Schimper A.F.W. and probably the first classical work on the total Indo-Malayan coast was published in 1891 as "Die Indomalayische strand flora" in Bot. Mitt. Trop. This work was based on the littoral flora of Malayan archipelago by his own observation and also findings of Kurz's work on the shore of Andaman and Myanmar. During this period Nairne, A.K., also made investigation on the plants of western India and published "The flowering plants of the western India" from Bombay and London in 1891.

From 1900-1956 :

During this period various workers in India were seriously engaged in investigation of different regional floras of India, probably this was the

botanical renaissance in India when various workers published floras including some coastal plants. Though little inclusive information for Coastal Plants were available from those floras but nevertheless, they provide some interesting information regarding the flora of coastal region in India. In 1903 David Prain published, "Flora of Sundarbans" in Rec. Bot. Surv. India, which consists of a comprehensive information regarding the plants of West Bengal coast. Simultaneously Captain T. Cooke worked on the Flora of the Presidency of Bombay and published the flora of Presidency of Bombay, London 1903-1908. It also includes the various plants of Bombay Coast. Blatter, E. in 1905 published the Mangroves of Bombay presidency and its biology, in Jour. Bom. Nat. Hist. Soc. In the year 1908-1909 he also published the flora of Kutch Part-I & Part-II. Burns, W. in the year 1907-1909 investigated the sea shore vegetation and published, "A study of the sea shore vegetation" in Jour. Bom. Nat. Hist. Soc. Gamble 1916-1920 studied extensively the flora of Madras Presidency including Andhra Pradesh, Tamil Nadu, Karnataka and Kerala region and published the flora of Presidency of Madras in 3 vols. This voluminous work also includes the plants of Coromandel Circar coast as well Konkon and Malabar regions. H.H. Haines while publishing the Botany of Bihar and Orissa during 1921-1925 included some interesting plants of Orissa coast. Fyson, P. F. studied the vegetation of Trinavelly coast and published "An ecologically regressive vegetation of Trinavelly coast" in Proc. Ind. Sci. Cong., 1919. Parkinson C.S. published "Forest flora of Andaman island" from Govt. Central Press, Simla in 1923. Curtis in 1933 prepared a classification of Sundarban flora and included in the working plan of Sundarbans, Forest Division, West Bengal. Griffith in 1936 also visited south Bengal areas and made a note on the tour on the south Bengal. Erlenson, E.W. published "Plant colonization on two tropical islands" in Jour. Ind. Bot. Soc., 1936.

In 1939 Dr. D. Chatterjee studied the endemic flora of India and Burma which also includes some

coastal plants communities and published it in Jour. Asiat. Soc. Bengal. Venkateshwarlu, W., published estuarial flora of the Godavari in Jour. Bombay Nat. Hist. Soc. Dr. K.P. Biswas & S.K. Chaudhury worked on the strand vegetation of the eastern coast and made comprehensive studies along the sandy shores of Chitagong, Digha, Puri, Gopalpur, Chilka Lake and Ennur salt lake of Madras and published in Indian Science Congress, 36 session at Allahabad, 1949. During these period Arora, R. K. & Agarwal, K. R. made some studies on the Malpe coast and published 'observation on the vegetation of Malpe coast and neighbouring island' in Jour. Ind. Bot. Soc. Mooney, H.F. also studied the plants of Bihar and Orissa and published a supplement to the Botany of Bihar and Orissa in 1950. Bharucha, F. R. also studied the vegetation of Bombay and its environs and published in Jour. Gujarat. Res. Soc. 1950. Navalkar, B.S. studied in Bombay coast and published "Succession of Mangrove vegetation of Bombay and Salsette", in Jour. Bombay Nat. Hist. Soc., 1951.

Recent Work :

The depth of ecological knowledge and increased consciousness regarding the different environmental factors responsible for establishment of different floristic pattern of the country along with biological potentialities for sustainable development specially took priority during this period and within a short time most fragile ecosystems of the country has been focused by the combined effort of different workers in the study of Wet coastal ecosystem of the country, particularly on mangroves. Mangrove symposium held at Calcutta, 16th to 19th Oct., 1957. In the proceedings of this Mangrove Symposium organised by Govt. India by the Ministry of Food and Agriculture, various valuable information regarding botanical and ecological features of the Wet Coastal Mangroves were supplied by many workers. Among them silvicultural features and management of mangroves in India by I.M. Qureshi, Utilization and extension of mangroves by D.H. Kulkarni, Mangrove vegetation of the Godavari, Western India, Andaman islands and Salsette island by R.S. Rao, G.S. Puri, S. K. Jain, R.P. Patil and K.C. Subni, Mangroves in India by G.S. Mathanda, Ecological studies on mangroves

by M.A. Waheed Khan, Utilization of mangroves by A.C. Dey and Nature and distribution of mangrove by D. Chatterjee are of very elaborated information on Indian Wet Coastal Mangrove Ecosystem. Some of the important ecological investigations on the seashore and neighbouring islands vegetation also took priority during this period and Nayar M. P. published the vegetation of Kanya Kumari District, in Bull. Bot. Surv. India, 1959, Lawrence, G. A., 1960 published the vegetation of Kanya Kumari district in Jour. Bombay Nat. Hist. Soc., Satyanarayana, Y. published Ecological studies of Bombay coast in Jour. Biol. Sci. 1958. Shah G. L., published Vegetation along the seashores in Salsette island Bombay in Bull. Bot. Surv. India, 1962. Srinivason K.S., published Aspect of vegetation of Church island of Tuticorin Port, South India in Jour. Bombay Nat. Hist. Soc., 1960. Sidhu S. S., published Studies on the mangroves in India, East Godavari regions in Indian Forester, 1963. Sundarraj D.D. and M. Naggurjun published Flora of Hare and Church island of Tuticorin, in Jour. Bombay Nat. Hist. Soc., 1964 and Jain S.K. published Vegetation and succession of plant communities in Kuchchh, Gujarat in Proc. Symp. Record - Adv. Trop. Ecology, Raju D.C.S. studied vegetation on West Godavari and published A study of Tropical delta in Proc. Symp. Record-Adv. Trop. Ecol.

Since 1960 work have been carried out by the Ecology Unit, Botanical Survey of India, regarding coastal physiographic subdivisions and it was often felt that the descriptive consolidated account of the coastal flora of India would be an essential prerequisite for the sustainable development, conservation and management of the coastal ecosystem in India. Rao, R.S. worked on the flora of Goa and vegetation of Daman, Dadra and Nagar Haveli of W. India Abstract published in the Proc. Indian Sci. Cong., 1965. Marlange M. & V. M. Meher-Homji also worked on phyto sociological studies in Pondicherry region and published in Jour. Indian Bot. Soc., 1965.

Dr. T. Anand Rao in the Ecology Unit, Botanical Survey of India, known as a pioneer worker for Indian coastal flora and vegetation. The master, with his out standing capabilities and keen interest with the team work of soil scientist, ecologist and

taxonomist made extensive survey throughout the coastal regions in India except some parts of Karnataka, Sundarbans and Andaman and Nicobar islands. His monumental collections on coastal plants in the Ecology Herbarium and in the CNH CAL are the primary coastal plant diversity resources for the present and future generation. His valuable scientific investigations have initiated many of the scientist as well as young stars for developing practical ecological knowledge in the field of coastal ecology. His working knowledge and dynamism in the field collection and methodologies in the quantitative ecological data collections are incomparable. He has published more than 30 scientific papers and more than 4 books and produced 7 Ph.D students during the tenure of his service. The present work is based on his coastal collection in the Ecology Unit and collection made by the present authors. The major publication on the coastal ecosystem by Dr. T.A. Rao and his team from 1965 to 1993 are ultimate result of his earnest devotion on coastal plant diversity in India.

Within 1965-69 Dr. K. Srinivasan made extensive collection of marine algae from several areas of Indian mainland coast and from the Andaman, Nicobar and Lakshadweep group of islands, result of these work was elaborately published in the *Phytologia indica* 1969 from Botanical Survey of India. This is probably the Primary work on seaweeds.

During the period from 1975 onwards study on coastal ecosystem has been carried out in more specialised ways on the regional basis and investigations on some critical constituents of the Indian coastal ecosystem have been studied by various workers throughout India and abroad.

Blasco F., C. Caratini, S. Chandra and G. Thanikaimoni in 1974 produced work on Main characteristics of Indian Mangroves (wet coast) and published in Symp. Int. Biol. Mgf. Mangr. Hawaii, Krishnamurthy, K., V. Sundaraj and R. Santhanam also published in the same symposium regarding some aspect of Indian Mangroves of Proto Novo. Dwivedi *et al.* also worked on the ecology in Goa and published in the same volume. They also published Marine living resources and ecosystem along the west

coast of India in 3rd Int. Ocean Develop. Tokyo. In 1975 Blasco F., published Mangroves in India from Inst. Fr. Pondicherry. In 1976 Untawale, A. G. worked on Goa regions and published Ecology of an estuarine mangrove of Goa in Bull. Nat. Inst. Oceanography. Prof. V.J. Chapman in 1975 published a valuable data regarding Mangrove of the world in his book 'Mangrove Vegetation'

In 1977 Blasco F., published 'Outlines of Ecology, Botany and Forestry of the Mangals of Indian Subcontinent' in Ecosystem of the World 1: Wet Coastal Ecosystem.

In 1978 Mukherjee B.B. & Mukherjee J. published Mangroves of Sundarbans, India in Phyto morphology. In 1979 Mitra, R.L. and L.K. Banerjee worked on mangrove genus *Bruguiera* (Rhizophoraceae) in India and published in Bull. Bot. Surv. India. In 1980, Department of Science and Technology, Govt. of India, New Delhi published State of Art report on mangrove ecosystems in India. Qasim, S. Z, worked on biological productivity of the Indian Ocean and published in Indian Jour. Marine Sci.

In 1983 Naskar, K. and D.N. Guha Baskhi worked on Sundarbans and published 'World famous mangrove forest of the 24 Paraganas District'

Rao, T.A. and Banerjee L.K. Published Tidal mangroves of the Mahanadi delta in Proc. Semi. Res. Devlop. and Env., Andhra University, 1985. Rao, T.A. and Mcher Homjii, 1985 studied the Strand plant communities of Indian subcontinent and published it in Proc. Indian Acad. Sci.

In 1984, Banerjee L.K., published vegetation of Bhitarkanika Sanchuary Utkal coast in Jour. Econ. Tax. Bot. In the same year Mr. P. Sanyal and Banerjee L.K., published 'Dancing Mangals of Indian Sundarbans' in Jour. Ind. Soc. Coast. Agri. Res.

In 1987 Banerjee L.K. published Comparative study on Mangrove of Sundarbans and that of the Mahanadi delta in E. India in Jour. Econ. Tax. Bot. He also published Ecological studies on the Mangals in the Mahanadi estuarine delta in Tropical Ecology.

In the year 1989 Banerjee L.K., A.R.K. Sastry and M.P. Nayar worked extensively on Indian Mangroves and published a Book 'Mangroves in India, Identification Manual' from Botanical Survey of India.

In 1990, Banerjee L.K. and Rao. T.A. published another book 'Mangroves of Orissa coast and their Ecology' from Bishen Singh Mahendra Pat Singh, Dehra Dun.

In 1992, Narendra Prasad studied the Krishna estuary and published an ecological reconnaissance of Mangals in Krishna Estuary in Trop. Ecosys. & Management ed. K. P. Singh & J. S. Singh Wiley Eastern Limited, New Delhi, In the same book D. Chandra Mohan, studied in detail regarding the Tropical Marine Ecosystem: Microbial component. Dr. A. Pant provided good accounts on primary productivity of the Arabian sea. P.M.A. Bhattathiri also studied primary production of Tropical Marine Ecosystem. M.V.M. Wafar worked on management and conservations options for Indian Coral Reefs. Banerjee L.K. worked on the Mangal Formation of the Mahanadi Delta - Exploitation and Management and published in the same book, Trop. Ecosys. and Management.

In 1993, Banerjee L.K. published 'Influence on Salinity of Mangrove Zonation' in the book, 'Towards the rational use' Academic publisher, Netherland.

In 1993, Rao. T.A. & Meher Homji published Dry coastal Ecosystem of the Indian Subcontinent in Ecosystems of the World 2B. Dry Coastal Ecosys. ed. Eddy vander Maarel, Elsevier - New York, Tokyo.

More recently, Remote Sensing data, due to its repetitive, synoptic and multi spectral nature, has proved to be an immense value in monitoring of coastal vegetation. Indian Remote Sensing Satellite (IRS) data have been extensively used to map mangroves and other coastal vegetation for the entire country's coastline. S. Nayak and A. Bahuguna of Space Application Centre, Ahmedabad in 2001 published, 'Application of remote sensing data to monitor mangroves and other coastal vegetation in India' in Indian Jour. of Marine Science, volume 30(4).

Special adaptation in Coastal Plants in India



Spreading of stiltroots of *Rhizophora apiculata* Bl.



Rhizophora apiculata Bl.

Stiltroots of *Rhizophora* provide shelter for various micro and macro organism as well as act as tide breaker



Mature stiltroots of
Rhizophora apiculata Bl.



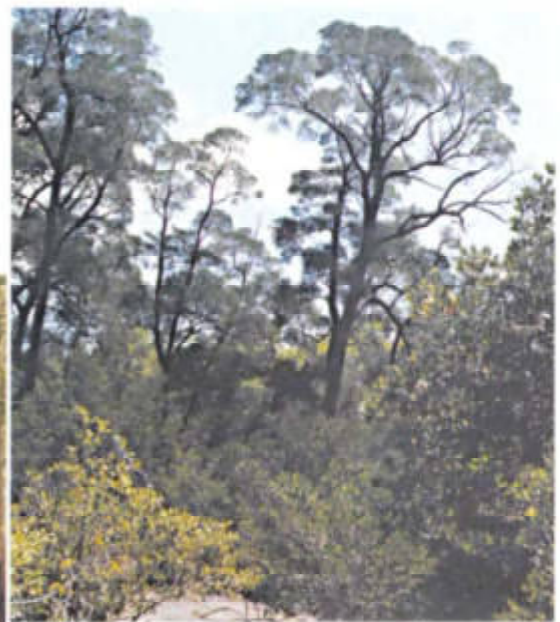


Stiltroots of *Rhizophora mucronata* Poir.



Stiltroots and hypocotyles of *Rhizophora mucronata* Poir.

Roots and stems of *Ceriops tagal* (Perr.) Rob.



Lumnitzera littorea (Jack.) Voigt



Knee roots of *Bruguiera gymnorrhiza* (L.) Savigny



Hypocotyles of *Bruguiera gymnorrhiza* (L.) Savigny



Growth of *Bruguiera parviflora* (Roxb.) Griff.

Formation of Mangrove wall in Kalighat, Andamans





Roots of *Xylocarpus granatum* Koen.



Pneumatophores of *Sonneratia apetala* Buch.-Ham.

Knee roots of *Bruguiera gymnorrhiza* (L.) Savigny



Pneumatophores of *Pemphis acidula* Forst.



Knee roots of *Bruguiera parviflora* (Roxb.) Griff.



Hypocotyles of *Rhizophora mucronata* Poir.



Woody pneumatophores of *Heritiera fomes* Buch.-Ham.

Wind action to the *Manilkara littoralis* (Kurz) Dubard communities





Avicennia officinalis L. in Sundarbans



Roots of *Excoecaria agallocha* L.

Hightide view in Sundarbans



Pneumatophores of
Rhizophora mucronata Poir.



Bhitarkanika mangroves in Orissa



Mangroves in Pichavaram, Tamil Nadu



Growth of *Phoenix paludosa* Roxb. in Andamans

Mangroves of Andamans





West mangroves of Gujarat

Growth of *Bruguiera gymnorrhiza* (L.) Savigny in Andamans

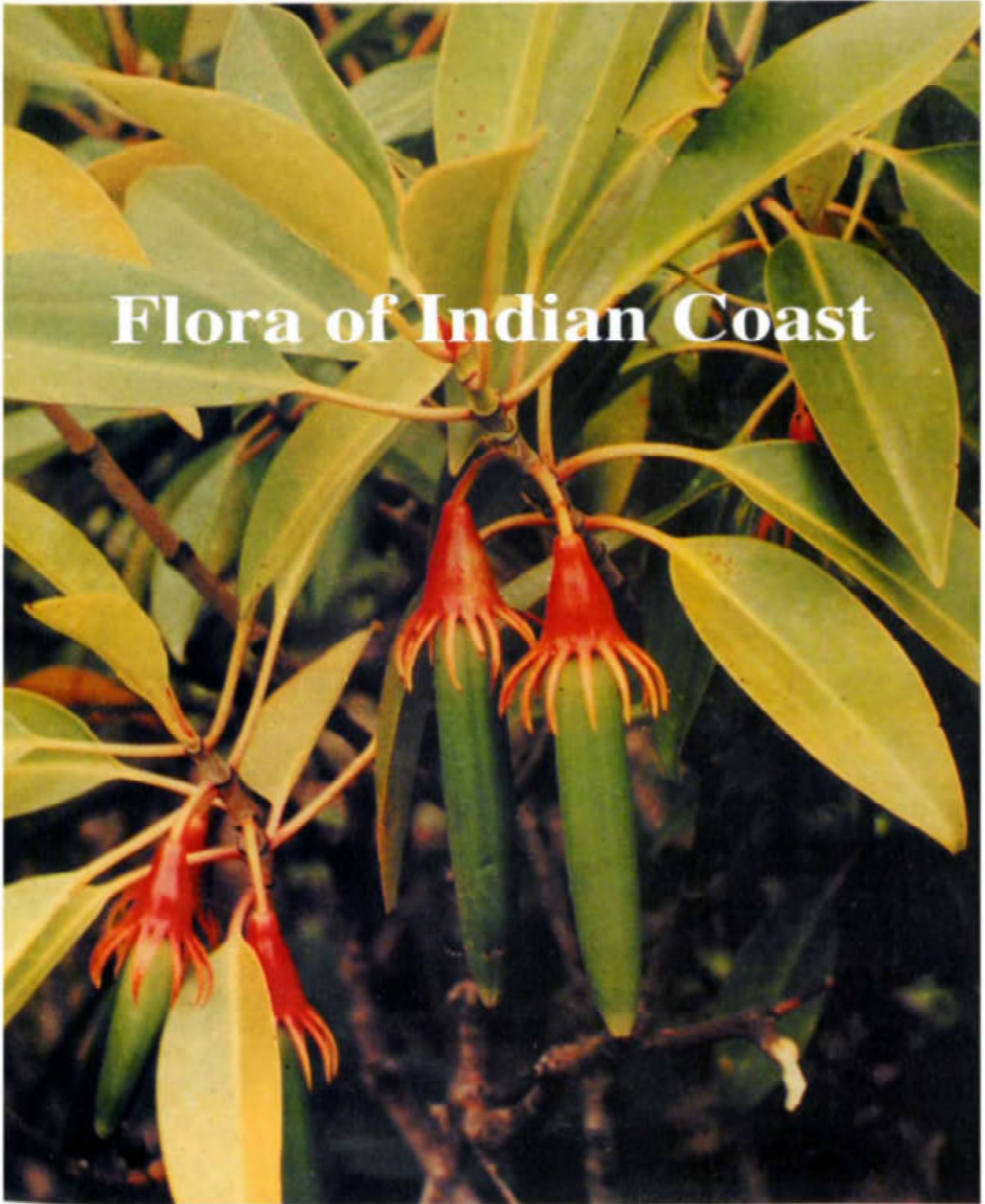


Growth of *Nypa fruticans* Wurm. in Andamans



Hypocotyles of *Rhizophora apiculata* Bl.

Flora of Indian Coast



DILLENIA CEAE

Dillenia L.

Dillenia pentagyna Roxb., Pl. Cor. 1:21, t. 20. 1795; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1:38. 1872; Majumdar in Fl. India 1: 156. 1993.

Deciduous tree, 10-25 m tall. Leaves 20-50 x 10-20 cm, oblong-lanceolate or oblong-ovate, entire to dentate, pubescent on nerves, obtuse at apex, obtuse or cuneate at base. Flowers 2.5-3 cm across, yellow, fragrant, umbellate on 3 mm long leafless shoots. Fruits 15 x 13

mm, subglobose, fleshy, yellow, orange or red. Seed 5 x 3.5 mm, ovoid, black.

Ecology : Frequent on sandy and rocky coastal fringes.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Kerala, Maharashtra, Karnataka, Goa coast and Andaman & Nicobar Islands.

ANNONACEAE

KEY TO THE GENERA

- 1a. Stragglers; connectives concealing anthers; peduncles hooked; petals constricted at base 2. *Artabourys*
 1b. Trees or shrubs; connectives not concealing anthers; peduncles not hooked; petals not constricted :
 2a. Carpels tomentose; ovules 4-8 1. *Alphonsea*
 2b. Carpels glabrous; ovules 1-2 3. *Polyalthia*

1. *Alphonsea* Hook. f. & Thoms.

KEY TO THE SPECIES

- 1a. Leaves ovate-oblong, obtusely acuminate 1. *lutea*
 1b. Leaves narrow-oblong, acuminate 2. *ventricosa*

1. *Alphonsea lutea* (Roxb.) Hook. f. & Thoms., Fl. Indica 153. 1855; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 89. 1872; Mitra in Fl. India. 1:209. 1993.

Trees; young branches brown pubescent. Leaves 10-15 x 3.5-7 cm, ovate to elliptic, glabrous above, sparsely pubescent beneath, acuminate at apex, rounded at base. Flower 8-10 mm long, in dense, leaf opposed, fascicles. Bracts minute. Ripe carpels broadly ovoid. Seeds 3-6 in 2 rows.

Ecology : Frequent along the back mangroves on sand ridges and back shore forest fringes.

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

Distrib. : Orissa, Maharashtra, Karnataka and Tamil Nadu coast.

2. *Alphonsea ventricosa* (Roxb.) Hook. f. & Thoms. Fl. Indica 152, 1885; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 89. 1872; Mitra in Fl. India 1: 211. 1993.

Trees 6-10 m tall; stems much-branched, smooth; bark ash-coloured. Leaves 6-8 x 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. 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.

Ecology : Rare in riverine scrub jungles and back mangroves.

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

Distrib. : Orissa, Andamans.

2. *Artabotrys* R. Brown

Artabotrys hexapetalus (L.f.) Bhandari, Baileya 12:149. 1964; *A. odoratissimus* (Roxb.) R. Br.: Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 54. 1872; Mitra in Fl. India 1: 251. 1993.

Monocarp 14-20 in a cluster, each up to 2.5 cm, sessile. Seeds up to 2 x 1 cm, solitary, oblong.

Ecology : Frequent in sandy seashore hedges and bushes.

Straggling shrub up to 6 m. Leaves 7-10 x 2.5-4 cm, oblong-lanceolate, entire or undulate, glossy above, acuminate at apex, cuneate at base. Flowers up to 1.5 cm, fragrant, solitary or paired, terminal or leaf opposed.

Fl. & Fr.: All through the year.

Distrib.: West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coast.

3. *Polyalthia* Blum.

KEY TO THE SPECIES

- 1a. Spreading shrubs; berries green 1. *korintii*
 1b. Erect shrubs; berries purple 2. *suberosa*

1. *Polyalthia korintii* (Dunl.) Thw., Enum. 398. 1864; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 64. 1872; Mitra in Fl. India 1:273. 1993

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

Ecology : Frequent, forming coastal scrubs usually in association with *Carissa spinarum* and *Maba buxifolia*.

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

Distrib. : Eastern peninsula from Vishakapatnam southwards to Tinnevely. New for Orissa coast.

2. *Polyalthia suberosa* (Roxb.) Thw., Enum. 398. 1864; Hook. f. & Thoms. in Hook. f., Brit. India. 1: 65, 1872; Mitra in Fl. India 1:278. 1993.

Erect shrubs or small trees, up to 4 m tall; stems much-branched; young branches rusty-pubescent, old ones glabrous with thick corky bark. Leaves 4-10 x 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. Ripe carpels 5-6 mm across spherical, usually purple-coloured. Seeds one, rarely two.

Ecology : Common in coastal scrubs usually in association with *Eugenia bracteata*, *Strychnos nuxvomica* and *Maba buxifolia*.

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

Distrib. : Throughout the coast.

MENISPERMACEAE

KEY TO THE GENERA

- 1a. Leaves peltate; stamens connate :
- 2a. Leafbase cordate; stamens not exceeding petals 1. *Cissampelos*
- 2b. Leafbase obtuse; stamens exceeding petals; 3. *Stephania*
- 1b. Leaves other than peltate; stamens free :
- 3a. Blades pinnately nerved; flowers bright yellow 4. *Tiliacora*
- 3b. Blades palmately nerved; flowers not bright yellow :
- 4a. Lianas or woody climbers; inflorescence on old wood or often on leafless branchlets, pseudoracemes 5. *Tinospora*
- 4b. Stragglers; inflorescence axillary, fasciated or racemose 2. *Cocculus*

1. *Cissampelos* L.

1. *Cissampelos pareira* L. var. *hirsuta* (Buch.-Ham ex DC.) L., Sp. Pl. 1031. 1753; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 103. 1872; Gangopadhyay in Fl. India 1:317. 1993.

Dioecious climbers; stems slender, pubescent, much-branched. Leaves 2-7 x 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

fasciated on axillary panicles; female flowers in axillary pendulous racemes. Bracts foliaceous, orbicular. Drupes 1-2 mm across, scarlet-coloured, hard.

Ecology : Rare, on hedges and scrubs along the coastal area; common along the roadsides and gardens.

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

Distrib. : Wide spread throughout the coastal area in India.

2. *Cocculus* DC.

KEY TO THE SPECIES

- 1a. A woody climber; leaves narrowly elliptic, acute at base 2. *pendulus*
- 1b. A bushy and scarcely woody climber; leaves ovate, obtuse at base 1. *hirsutus*

1. *Cocculus hirsutus* (L.) Diels., Engler, Pflanzenr. 46:236. 1910; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1:101. 1872; Gangopadhyay in Fl. India 1:318. 1993.

Straggling or climbing shrubs up to 6 m long, hirsute, evergreen, branches densely tomentose. Leaves 3-6 x 2-3.5 cm, basal leaves larger ovate-cordate, upper ones entire and lower ones 3-5 lobed, mucronate at apex, rounded at base. Male flowers in axillary panicles, female

flowers 0.5-2.5 cm long in axillary fascicles or racemes. Drupes 4-8 x 3-4 mm, laterally compressed.

Ecology : Frequent in coastal bushes, sand dunes and coastal scrubs.

Fl. & Fr. : August - May.

Distrib. : West Bengal, Orissa, Gujarat, Karnataka and Tamil Nadu coast.

2. *Cocculus pendulus* (J. R. & G. Forst.) Diels., Engler, Pflanzenr. 46:237. 1910; *Cocculus laevis* DC.: Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 102. 1872; Gongopadhyay in Fl. India 1:320. 1993.

Twining shrubs, much branched; branches slender, puberulous. Leaves 1.6-5 x 0.5-3 cm oblong-lanceolate to oblong-ovate, glabrous or slightly puberulous; obtuse, mucronate or emarginate at apex, truncate, cuneate,

rounded or trilobed at base. Male flowers minute, in axillary fascicles, female flowers axillary solitary. Drupes 4-7 x 4-5 mm reddish, obovoid or reniform, compressed.

Ecology : Rare on coastal hill slopes and lee side of sand dunes.

Fl. & Fr. : October - January.

Distrib. : Gujarat and Tamil Nadu coast.

3. *Stephania* Lour.

Stephania japonica (Thunb.) Miers., Contrib. Bot. 3: 213. 1871; *Stephania hernandifolia* (Willd.) Walp., Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 103. 1872; Gongopadhyay in Fl. India 1:335. 1993.

Large slender climber, 2-10 m long, roots tuberous; stem striate. Leaves 4-17 x 4-15 cm, ovate-triangular, membranous to papyraceous, shiny glabrous above, acute, acuminate or obtusely mucronate at apex, peltate or truncate at base. Male flowers 1-1.5 mm long,

yellow, white or green. Female flowers yellow. Drupes 4-8 x 4.7 mm red obovoid or subglobose. Seeds 5-6 mm long.

Ecology : Frequent along wayside thicket, sandy slopes and coastal cliffs.

Fl. & Fr. : March - September.

Distrib. : Karnataka and Tamil Nadu coast.

4. *Tillacora* Colebrooke

Tillacora acuminata (Lam.) Miers., Ann. Mag. Nat. Hist. (ser. 2) 7:39. 1851; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 99. 1872; Pramanik in Fl. India 1:343. 1993.

Large woody climbers, 5-8 m tall. Stems form a woody base, striate. Leaves 4.5-22 x 4-14 cm, ovate or lanceolate, glabrous, acuminate at apex truncate or subcordate at base. Flowers 1-1.5 mm across, bright yellow, arranged in axillary racemose cymes; female

flowers smaller than the male. Drupes obovoid, compressed, glabrous.

Ecology : Frequent along the river banks of coastal hill slopes and lee side of coastal sand dunes.

Fl. & Fr. : April - December.

Distrib. : West Bengal, Orissa, Tamil Nadu and Kerala coast.

5. *Tinospora* Miers.

Tinospora cordifolia (Willd.) Miers. ex Hook. f. & Thoms. in Hook. f., Fl. Ind. 184. 1855; Hook. f. in Hook. f., Fl. Brit. India 1: 97. 1872; Pramanik in Fl. India 1:347. 1993.

Woody climber 10-15 m high with lenticellate stem. Leaves 4-10 x 3-7 cm ovate or cordate glabrous, cuspidate at apex and sinuate at base. Male Flowers 2-2.5 mm across, greenish yellow, fasciated in axillary

racemes; female flowers 2.5 mm across, solitary axillary or on leafless branches. Drupes globose radiating from a carpophore.

Ecology : Frequent along the coastal scrub and coastal tropical evergreen formation.

Fl. & Fr. : January-April; January-May.

Distrib. : Throughout Indian coast.

NYMPHAEACEAE

Nymphaea L.

KEY TO THE SPECIES

- 1a. Leaves glabrous; flowers bluish-white 1. *nouchali*
1b. Leaves pubescent beneath; flowers red 2. *pubescens*

1. *Nymphaea nouchali* Burm. f., Fl. Indica 120. 1768; *N. stellata* Willd.: Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 114. 1872; Mitra in Fl. India 1:430. 1993.

Perennial, aquatic herbs with creeping rhizomes. Leaves 10-20 x 6-15 cm, broadly orbicular, floating, glabrous along both surfaces, shallowly undulate, cordate at base. 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.

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

Fl. & Fr. : June-December.

Distrib. : Warmer parts of India as well as backshore coastal ditches, throughout the coastal region including Andaman & Nicobar Islands.

2. *Nymphaea pubescens* Willd., Sp. Pl. 2: 1154. 1797; *N. lotus auct. non L.*, Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 114. 1872; Mitra in Fl. India 1:431. 1993.

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

Ecology : Mostly found in ponds and pools, often cultivated.

Fl. & Fr. : Throughout the year.

Distrib. : Warmer parts, mainly on fresh water ditches along coast, throughout the coastal region including Andaman & Nicobar Islands.

PAPAVERACEAE

Argemone L.

Argemone mexicana L., Sp. Pl. 508. 1753; Masters in Hook. f., Fl. Brit. India 1: 117. 1872; Debnath & Nayar in Fl. India 2:2. 1993.

Annual, herb, 30-125 cm high, spinescent, with yellow latex. Leaves 3-22 x 2-8 cm, elliptic, ovate pinnatifid, sinuate-lobulate, margin spiny, acute at apex, cordate at base. Flowers 4-7 cm across, solitary, terminal

or axillary. Capsule 10-30 x 8-2 mm, many, blackish brown.

Ecology : Frequent along scrub jungles, waste land and on the lee ward side of sand dunes.

Fl. & Fr. : February-May.

Distrib. : Exotic, throughout Indian coast.

BRASSICACEAE

Brassica L.

KEY TO THE SPECIES

- 1a. Sepals erect; pods sessile cylindrical, beak conical 2. *napus*
 1b. Sepals spreading; Pods slightly compressed, beak long 1. *juncea*

1. *Brassica juncea* (L.) Czern., Consp. Pl. Chark. 8, 1859; Hook. f. & Anders. in Hook. f., Fl. Brit. India 1: 157. 1872; Hajra, Chowdhery and Bhaumik in Fl. India 2:134. 1993.

Herb 20-100 cm tall, glabrous. Basal leaves 6-10 x 2-5 cm, oblong-lanceolate, lyrate-pinnatifid, toothed; middle leaves oblong-ovate, dentate, upper leaves narrow-lanceolate, toothed. Flowers 7 mm across, bright yellow, in racemes. Siliqua 2-5 cm, torulose, with seedless beak. Seeds reddish brown.

Ecology : Cultivated all along the coast, escapes on the lee side of the coastal sand dunes.

Fl. & Fr. : March-May.

Distrib. : All through the coast.

2. *Brassica napus* L., Sp. Pl. 666. 1753; *B. campestris* L. sub sp. *napus* (L.) Hook. f. & Anders. in Hook. f., Fl. Brit. India 1: 156. 1872; Hajra, Chowdhery and Bhaumik in Fl. India 2:135. 1993.

Herbs 50-150 cm, annual or biannual. Leaves 5-22 x 1-70 cm, lyrate-pinnatifid, upper leaves sessile, acute at apex, cordate at base. Flowers 1-2 cm long, yellow, in racemes. Siliqua 4-11 cm x 3-4 mm, attenuate to a slender beak. Seeds obscurely dentate.

Ecology : Frequent on moist sandy places on sea shore. Cultivated for oil.

Fl. & Fr. : March-May.

Distrib. : West Bengal, Orissa and Andhra Pradesh coast.

CAPPARACEAE

KEY TO THE GENERA

- 1a. Herbs; fruits siliqua 1. *Cleome*
 1b. Shrubs or trees; fruits baccate :
 2a. Sepals fused, forming a distinct tube 3. *Maerua*
 2b. Sepals free, rarely connate at base but never forming a tube :
 3a. Disc large, tubular, trumpet-shaped, petaloid; stamens 4-6, inserted halfway on gynophore 2. *Cadaba*
 3b. Disc otherwise; stamens numerous, inserted at base of gynophore :
 4a. Shrubs with simple leaves 3. *Capparis*
 4b. Trees with trifoliate leaves 4. *Crateva*

1. *Cleome* L.

KEY TO THE SPECIES

- 1a. Androgynophore conspicuous 9-16 mm long; plants pubescent with gland tipped hairs, foetid 3. *gynandra*
 1b. Androgynophore mostly absent, if present under 3 mm long :
 2a. Plant with retrorse scattered soft linear prickly appendages 2. *aspera*
 2b. Plants without retrorse or prickly appendages :
 3a. Stamens 6; leaflets linear to filiform 1. *angustifolia*
 3b. Stamens 8-many; leaflets elliptic-oblong or obovate to spatulate 4. *viscosa*

1. *Cleome angustifolia* Forsskal, Fl. Aegypt Arab. 120. 1775; *C. tenella* L. f.: Hook. f. & Thoms. in Hook. f, Fl. Brit. India 1: 169. 1872; Raghavan in Fl. India 2: 302. 1993.

Annual herbs, slender, 10-50 cm tall. Leaves 3-foliolate; leaflets 1.2-2 cm long, narrowly linear or oblanceolate, acute at apex, narrowed at base. Flower 3 - 3.5 mm across, yellow, axillary, solitary or in terminal lax racemes. Capsule 1.5-5 cm x 1.5-2 mm, linear, glabrous. Seeds 0.5-0.7 mm, suborbicular, brown.

Ecology : Frequent along rocky slopes, in sandy soil and waste land along the coast.

Fl. & Fr. : June-January.

Distrib. : Andhra Pradesh, Tamil Nadu, Pondichery, Karnataka, Maharashtra and Kerala coast.

2. *Cleome aspera* Koenig ex DC., Prodr. 1: 241. 1824; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 169. 1872; Raghavan in Fl. India 2:303, 1993.

Herbs, prostrate or ascending with soft minute prickles. Leaves 3 foliate, upper most ones simple; central leaflets up to 2-5 x 0.5 cm, lateral leaflets up to 1.5 x 0.4 cm, linear-oblong to lanceolate, subobtuse to retuse and mucronate at apex, cuneate at base. Flowers 3 mm across, white or creamy yellow with orange or reddish streaks, in leafy racemes. Capsules 2-3 cm long narrowed at both end, beaked. Seeds 12-20 suborbicular, yellowish to dark brown.

Ecology : Frequent in scrub jungles and waste land in sandy or gravelly soil.

Fl. & Fr. : Throughout the season; peak period June-October.

Distrib. : Andhra Pradesh, Orissa, Tamil Nadu,

Pondichery, Maharashtra, Gujarat, Goa and Kerala coast.

3. *Cleome gynandra* L., Sp. Pl. ed. 1. 671. 1753. *Gynandropsis pentaphylla* (L.) DC.: Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 171. 1872; Raghavan in Fl. India 2: 309. 1993.

Annual herb up to 1.2 m, strongly foetid, glandular hair. Leaves 3-5 foliolate, 7.5 x 6.5 cm; leaflets obovate-elliptic, unequal, entire or denticulate-serrulate, acute at apex, cuneate at base. Flower 1-2 cm across, white or creamy yellow, in lax corymbose racemes. Capsule cylindric, 3-12 x 4-8 mm tapering at both ends, sticky glandular-pubescent. Seeds 15-40, reniform.

Ecology : Frequent as weeds of fallow or cultivated land and along the lee side of coastal sand dunes, scrub land and waste sandy places.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coastal districts.

4. *Cleome viscosa* L., Sp. Pl. 672. 1753; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 170. 1872; Raghavan in Fl. India 2:317. 1993.

Annual herb up to 1.2 m tall, viscid, glandular hairy, foetid. Leaves 3-5 foliolate; leaflets 6-45 x 2-25 cm, subequal, elliptic-oblong or obovate, entire, acute at apex, cuneate at base. Flower 1-1.5 cm across, yellow or white, in leafy, lax racemes; bracts foliaceous. Capsule linear-oblong, tapering at both ends, beaked. Seeds reniform, reddish brown to black.

Ecology : Common on sandy beaches, back side of the dunes and rocky crevices on sea shore.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coast.

2. *Cadaba* Forsskal

Cadaba fruticosa (L.) Druce in Bot. Exch. Cl. Soc. Brit. Isles 3: 415. 1914; *Cadaba indica* Lamk., Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1:171. 1872; Raghavan in Fl. India 2:250. 1993.

Straggling shrub, young branches hairy. Leaves 2.5 x 0.5-2.5 cm, glaucous, chartaceous or coriaceous, entire, emarginate or mucronate at apex, ovate or obovate

at base. Flowers 1.5 cm, greenish to creamy white in terminal, one sided corymbose racemes.

Ecology : Frequent on sandy and rocky sea shore and lee side of sand dunes.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coast except Andaman & Nicobar islands.

3. *Capparis* L.

KEY TO THE SPECIES

- 1a. Leaves small, early caducous except on young twigs, plants apparently leafless 2. *decidua*
 1b. Leaves large, persistent
 2a. Leaves not stiff, cuneate at base; scandent shrub 3. *sepiaria*
 2b. Leaves stiff, rounded at base; erect shrub or small tree 1. *brevispina*

1. *Capparis brevispina* DC., Prodr. 1:246. 1824; *C. zeylanica* Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1:174. 1872; Raghavan in Fl. India 2: 260. 1993.

Erect shrubs or small trees 4-6 m tall; stems much-branched, rigid, thorny; twigs densely clothed with brown papillae. Leaves 5-8 x 2-5 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 axils. Fruits 3-6 cm across, ovoid to fusiform berries, red when ripe.

Ecology : Common in coastal scrubs in association with *Memecylon edule*, *Randia fasciculata* and *Rouria minor*.

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

Distrib. : Malabar, Karnataka, Deccan and Orissa coast.

2. *Capparis decidua* (Forsskal) Edgew. J. Linn. Soc. Lond., Bot. 6: 184. 1862; *Capparis aphylla* Roth.: Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 174. 1872; Raghavan in Fl. India 2: 265. 1993.

Shrubs or small trees up to 7 m tall. Leaves 3-18 x 1-3 mm, linear-spathulate, fleshy, spinous at apex, narrowed at base. Flowers 1.5-2.5 cm across, brick-red or orange-red or yellowish, in racemes. Berries 14-20 mm

across, globose-ovoid, scarlet-red. Seeds 1-4, 2-5 x 2-4 mm, reniform.

Ecology : Frequent on riverine scrubs and muddy substrate of back mangroves.

Fl. & Fr. : February - May; September - November.

Distrib. : Throughout the Indian coast and Andaman & Nicobar Islands.

3. *Capparis sepiaria* L. Syst. Nat. ed. 10, 2: 1071. 1759; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 176. 1872; Raghavan in Fl. India 2: 289. 1993.

Shrubs or rarely trees, 2-6 m tall. Leaves 1.5-5.5 x 0.4-3.5 cm, ovate or ovate-elliptic or suborbicular, herbaceous or subcoriaceous, pubescent, acute or rounded at apex, acute or subcordate at base. Flowers 8-10 mm across, creamy or greenish white, in terminal corymbose. Fruits 8-12 mm across, globose, yellow or black. Seeds 1-2, 6 x 4 mm, discoid, brown.

Ecology : Common on coastal scrubs and sandy beaches.

Fl. & Fr. : March - July; October - November.

Distrib. : Throughout Indian coast and Andaman Islands.

4. *Crateva* L.

Crateva adansonii DC. ssp. *odora* (Buch.-Ham.) Jacobs in Blumea 12: 198. 1964; *C. religiosa* Forst. var. *roxburghii* (R. Br.) Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 172. 1872; Raghavan in Fl. India 2: 322. 1993.

Deciduous trees 4-6 m tall; stems branched, unarmed. Leaves digitately 3-foliolate, each 5-9 x 2-5 cm elliptic or oblanceolate, membranaceous, cuneate at base, acuminate at apex. Flowers 2-3 cm across, yellow,

arranged in terminal corymbs. Fruits 3-4 cm across, fleshy berries. Seeds many embedded in pulp.

Ecology : Frequent along the river banks, coastal scrubs and Lee side of sand dunes, usually in association with *Eugenia bracteata* and *Litsea nitida*.

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

Distrib. : Throughout Indian coast, specially on river banks.

5. *Maerua* Forsskal

Maerua oblongifolia (Forsskal) A. Rich. in Guill. & Pers., Fl. Seneg. Tent. 1: 32, t. 6. 1847; *M. arenaria* (DC.) Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 171. 1872; Raghavan in Fl. India 2: 331. 1993.

Scandent shrubs, up to 4 m. Leaves 2.5-8 x 0.8-3.5 cm, elliptic-oblong or lanceolate, coriaceous, retuse and mucronate at apex, attenuate at base. Flowers 2-2.5 cm across, white or green in dense, axillary corymbs.

Berries 1.5-2.5 cm long, pale brownish, 1 seeded. Seeds 5-6 mm, globose.

Ecology : Common in coastal sandy tract and scrub jungles.

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

Distrib. : Throughout the coastal sandy areas from the sea level to 600 m.

VIOLACEAE

Hybanthus Jacq.

Hybanthus enneaspermus (L.) F. Muell., Fragm. 10: 81. 1876. *Ionidium suffruticosum* (L.) Roem. & Schult.: Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 185. 1872; Banerjee & Pramanik in Fl. India 2: 343. 1993.

Suffrutescent perennial herbs 15-40 cm tall; stems glabrous or pubescent, sparingly branched. Leaves 1-4 x 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. Flowers 1-

1.5 cm across, purple, solitary axillary. Capsules 0.7-1 cm across, subglobose. Seeds 1-2 mm across, ovoid, longitudinally striate.

Ecology : Common weed spreading from inland to the sea-shore and river-banks.

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

Distrib. : Throughout Indian coastal area on sandy beaches and sand dunes.

FLACOURTIACEAE

KEY TO THE GENERA

- 1a. Petals absent :
 2a. Flowers bisexual; stamens 8 1. *Casuarina*
 2b. Flowers unisexual; stamens numerous 2. *Flacourtia*
 1b. Petal present with a scale at base inside 3. *Hydnocarpus*

1. *Casearia* Jacq.

Casearia tomentosa Roxb., Fl. Ind. 2: 421. 1832; Clarke in Hook. f., Fl. Brit. Ind. 2: 593. 1879; Mitra in Fl. India 2: 397. 1993.

Tree up to 8 m, tomentose. Leaves 5-22 x 2.5-8.5 cm, ovate-lanceolate, subcoriaceous, distantly serrate or crenate, obtusely short acuminate at apex, rounded at base.

Flowers 5-8 mm across, greenish white in dense axillary glomerules. Capsules 1.5-2.8 cm long, ellipsoid.

Ecology : Frequent in coastal scrub jungles, dry deciduous forests lands and river banks.

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

Distrib. : All through the coastal districts.

2. *Flacourtia* L'Heritier

Flacourtia indica (Burm. f.) Merr., Interpr. Kumph. Herb. Amb. 377. 1917; *F. ramontchii* L'Herit.: Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1:193. 1872; Mitra in Fl. India 2: 402. 1993.

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 x 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 1-1.3 cm in diam., globose, dull-red or bluish-red when ripe.

Ecology : Frequent in scrubs, along the river banks and coastal thickets, in association with *Hugonia mystax* and *Ziziphus oenoplia*

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

Distrib. : Tropical and sub-tropical regions of Indian coast.

3. *Hydnocarpus* Gaertn.

Hydnocarpus pentandra (Buch.-Ham.) Oken, Allg. Naturgesh. 3, 2: 1381. 1841; *H. wightiana* Blume., Hook. f., & Thoms. in Hook. f., Fl. Brit. India 1: 197. 1872; Mitra in Fl. India 2: 422. 1993.

Trees 5-25 m tall, evergreen. Leaves 5-25 x 3.5-10 cm, variable, ovate elliptic to oblanceolate, dark green and shiny above, subserrate, acuminate at apex, cuneate at base. Male flowers 6 mm across, greenish, in racemose fascicles, female flower 1 cm across, solitary. Berries 5-

10 cm across, globose, pericarp reddish brown. Seeds 1.7-2.2 x 1-1.5 cm, 15-20, ovoid-oblong.

Ecology : Frequent in moist deciduous and semievergreen forest of Western Ghat near the coast. Cultivated elsewhere.

Fl. & Fr. : June, June onwards.

Distrib. : Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala coast.

POLYGALACEAE

KEY TO THE GENERA

- 1a. Stamens 8; flowers in racemes 1. *Polygala*
 1b. Stamens 4 - 5; flowers in spikes 2. *Salomonina*

1. *Polygala* L.

KEY TO THE SPECIES

- 1a. Caruncle appendages nearly or quite covering the seed; large or small shrub 1. *arillata*
1b. Caruncle appendages narrow or absent; herbs :
2a. Caruncle hood shaped, truncate :
3a. Prostrate or decumbent weak herbs, leaves orbicular or obovate 2. *arvensis*
3b. Erect or stout herbs; leaves oblong-elliptic 3. *chinensis*
2b. Caruncle galeate, bristly crustaceous, lined by 3 membranous appendages 4. *erioptera*

1. *Polygala arillata* Buch.-Ham. ex D. Don, Prodr. Fl. Nep. 199. 1825; Bennett in Hook. f., Fl. Brit. India 1: 200. 1872; Banerjee in Fl. India 2: 458. 1993.

Shrubs 4 m tall. Leaves 7-11 x 3-4 cm, elliptic or ovate-lanceolate, subcoriaceous, acute-mucronate at apex, acute or cuneate at base. Flower 12-18 cm long, bright yellow, in terminal racemes. Capsules 10-12 x 12-15 mm, sub-orbicular, pink. Seeds 4-8 mm diam., brown-black; caruncle cupular, orange-red.

Ecology : Frequent on hill slopes and sand ridges along the coast.

Fl. & Fr. : March-May; June-August.

Distrib. : Maharashtra, Tamil Nadu, Karnataka and Kerala coast.

2. *Polygala arvensis* Willd., Sp. Pl. 3(2): 876. 1803; *P. chinensis auct. non. L.*: Bennett in Hook. f., Fl. Brit. Ind. 1: 204. 1872. p.p.; Banerjee in Fl. India 2: 460. 1993.

Herbs, 5-30 cm high, procumbent or erect; branches arising from base. Leaves 10-40 x 5-20 mm, obovate, oblanceolate to oblong, fleshy, obtuse or emarginate and mucronate apex, narrowed at base. Flowers 4 mm long, yellow in axillary or lateral racemes. Capsule 3-5 x 2.5-4 mm, narrowly winged along margins. Seeds 3 x 2 mm, oblong-ellipsoid, black; caruncle hood shaped, 3 fid.

Ecology : Common on sandy beaches and dunes.

Fl. & Fr. : June-August; September-December.

Distrib. : Coastal areas of West Bengal, Orissa, Andhra Pradesh, Karnataka, Tamil Nadu and Gujarat coast.

3. *Polygala chinensis* L., Sp. Pl. 704. 1753; Bennett in Hook. f., Fl. Brit. India 1: 204. 1874; Banerjee in Fl. India 2: 464. 1993.

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

Ecology : Frequent along the sea-shores, sandy river-banks, and road-sides.

Fl. & Fr. : Probably all round the year.

Distrib. : Throughout the Indian coastal districts.

4. *Polygala erioptera* D.C., Prodr. 1: 326. 1824; Bennett in Hook. f., Fl. Brit. India 1: 203. 1872; Banerjee in Fl. India 2: 467. 1993.

Herbs, up to 60 cm long, pubescent. Leaves 6-45 x 1-8 mm, oblong to linear, revolute, glabrescent above, tomentose beneath, acute or obtuse at apex, narrowed at base. Flowers 4.5 mm long, pink or purple, solitary or in condensed leaf opposed racemes. Capsule 3.5-5 x 2-2.5 mm, oblong ellipsoid, pubescent. Seeds 3 x 1.5 mm, black; caruncle galeate.

Ecology : Common in sandy waste places, fallow lands, road sides and coastal scrub jungles.

Fl. & Fr. : January-December.

Distrib. : West Bengal, Andhra Pradesh, Maharashtra, Gujarat, Tamil Nadu, Karnataka and Kerala coast.

2. *Salomonina* Lour.

Salomonina ciliata (L.) DC., Prodr. 1: 334. 1824; *S. oblongifolia* DC.: Bennett in Hook. f., Fl. Brit. India 1: 207. 1874; Banerjee in Fl. India 2: 490. 1993.

Delicate, erect, annuals, 6-17 cm tall; stems winged, simple or branched. Leaves 3-9 x 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. Fruits didymous, laterally compressed, margin

muriculate. Seeds orbicular, black, glabrous, without caruncles.

Ecology : Frequent in moist sandy places along the sea-shores, sometimes in and around the dune slacks.

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

Distrib. : Throughout the peninsular coast.

CARYOPHYLLACEAE

KEY TO THE GENERA

- 1a. Erect herbs; sepals not keeled 1. *Polycarpaea*
 1b. Spreading herbs; sepals keeled 2. *Polycarpon*

1. *Polycarpaea* Lamark

KEY TO THE SPECIES

- 1a. Leaves spatulate, in rosettes at the root and at the internodes;
 flowers spicate at the ends of subumbellate branches 2. *spicata*
 1b. Leaves subulate, not forming rosettes; flower in irregular cymes 1. *corymbosa*

1. *Polycarpaea corymbosa* (L.) Lamk. Tabl. Encyl. 2: 129. 1797; Edgew. & Hook. in Hook. f., Fl. Brit. India 1: 245. 1874; Majumdar in Fl. India 2: 549. 1993.

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

Ecology : Common along sea-shore, lee sides of sand dunes and sandy river-banks.

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

Distrib. : Throughout Indian coast.

2. *Polycarpaea spicata* Wight & Arn., Ann. Nat. Hist. 3: 91. 1839; Edgew. & Hook. in Hook. f., Fl. Brit. India 1: 245. 1874; Majumdar in Fl. India 2: 552. 1993.

Herb 5-12 cm tall; branches filiform. Leaves 6-12 mm long, obovate-spathulate, nerveless; radical leaves in rosette. Flowers 4 mm across, in crowded spike, bracteate. Capsule stout. Seeds shiny.

Ecology : Frequent on sand stones and rocky crevices along the shore.

Fl. & Fr. : October-November.

Distrib. : Gujarat and Tamil Nadu coast.

2. *Polycarpon* L.

Polycarpon prostratum (Forsk.) Aschers. & Schweinf. in Oesterl. Bot. Zeitschr. 39:128. 1889; *P. toeflingiae* (Wall. ex Wt. & Arn.) Benth.: Edgew. & Hook. in Hook. f., Fl. Brit. India 1: 245. 1874; Majumdar in Fl. India 2: 553. 1993.

Spreading annual herbs with profused dichotomous branches. Leaves 1-2 x 0.2-0.5 cm, verticillate, linear or linear-lanceolate, acute at apex, narrowed at base. Flowers 2-4 mm across, greenish-white,

in axillary and terminal branched cymes. Bracts scarious. Capsules 3-4 mm across, yellow or green.

Ecology : Frequent along the sea-shores, common along the river-banks and waste places.

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

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu and Gujarat coast.

PORTULACACEAE

Portulaca L.

KEY TO THE SPECIES

- 1a. Nodes with a ring of stipular hairs.
 - 2a. Leaves ovate-elliptic 3. *quadrifida*
 - 2b. Leaves terete 2. *pilosa*
- 1b. Nodes without stipular hairs 1. *oleracea*

1. *Portulaca oleracea* L., Sp. Pl. 445. 1753; Dyer in Hook. f., Fl. Brit. India 1: 246. 1874; Rao in Fl. India 3: 4. 1993.

Erect or decumbent herbs; stems glabrescent, nodal hair absent. Leaves 3-4 x 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 in an involucre of cauline leaves. Capsules 5-8 mm across, ovoid, dehiscing above base. Seeds many, reniform.

Ecology : Common in waste places, sea-shores, open gardens, often cultivated as a vegetable.

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

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

2. *Portulaca pilosa* L. ssp. *pilosa* Geesink, Blumea 17: 295. 1969. *P. tuberosa* Roxb.: Dyer in Hook. f., Fl. Brit. India 1: 247. 1874; Rao in Fl. India 3: 6. 1993;

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.

Ecology : Frequent along the sea-shore, sand dunes and sandy river-banks.

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

Distrib. : Throughout the Indian coastal area.

3. *Portulaca quadrifida* L., Mant. 73, 1767; Dyer in Hook. f., Fl. Brit. India 1: 247. 1874; Rao in Fl. India 3: 6. 1993.

Creeping herbs; stems filiform, reddish-brown, rooting at nodes. Leaves 6-8 x 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.

Ecology : Frequent along the sea-shores, road-sides and waste places, often cultivated in gardens.

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

Distrib. : Throughout the warmer parts of India, West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

TAMARICACEAE

Tamarix L.

KEY TO THE SPECIES

- 1a. Stamens 5 :
 2a. Leaves not sheathing; flowers bisexual 4. *indica*
 2b. Leaves sheathing; flowers unisexual 2. *dioica*
 1b. Stamens 10 :
 3a. Leaves vaginate; racemes spirally twisted 1. *aphylla*
 3b. Leaves vaginate in the lower part, racemes not spirally twisted 3. *ericoides*

1. *Tamarix aphylla* (L.) Karsten, Deut. Fl. 641. 1882; *T. articulata* Vahl.: Dyer in Hook. f., Fl. Brit. India 1: 249. 1872; Shetty & Pandey in Fl. India 3: 22. 1993.

Tree, 4-6 m tall with jointed branchlets enclosed by leaf sheath at base. Leaves triangular. Flowers 2.5 mm across, pinkish, arranged in panicle. Capsule trigonous. Seeds terete, pilose.

Ecology : Frequent on sandy saline habitat, along the back shore and sandy river beds.

Fl. & Fr. : August-September.

Distrib. : Probably introduced from North Africa through Israel, Persia and Afganistan. In India it is usually found along the coast of Andhra Pradesh, Gujarat and drylands of Punjab and Uttar Pradesh.

2. *Tamarix dioica* Roxb. Fl. Ind. ed. Carey 101. 1832; Dyer in Hook. f., Fl. Brit. India 1: 240. 1874; Shetty & Pandey in Fl. India 3: 24. 1993.

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.

Ecology : Rare along the river-beds and moist sandy areas along estuaries.

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

Distrib. : Orissa, Gujarat, Konkan and Maharashtra coast.

3. *Tamarix ericoides* Rottl. & Willd., Ges. Naturf. Fr. Berlin Naue Schr. 4: 214. 1803; Dyer in Hook. f. Fl. Brit.

India 1: 249. 1874; Shetty & Pandey in Fl. India 3: 25. 1993.

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. Capsules 5-6 mm long, 3-valved. Seeds 2-3 mm long, oblong, silky comose at apex.

Ecology : Frequent along the sandy river-beds, estuarine mouth.

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

Distrib. : West Bengal, Orissa, Maharashtra and Gujarat coast.

4. *Tamarix indica* Willd. in Ges. Naturf. Fr. Berlin Neue Schrift. 4: 214. 1803; *T. gallica auct non L.*: Dyer in Hook. f., Fl. Brit. India 1: 48, 1874; Shetty & Pandey in Fl. India 3: 25. 1993.

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.

Ecology : Common along the river-banks, usually prevalent within the zone of fresh and brackish water mixture, frequent along the sea-shore.

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

Distrib. : Throughout India, specially in Orissa, Andhra Pradesh, Gujarat and Tamil Nadu coast.

ELATINACEAE

Bergia L.

KEY TO THE SPECIES

- 1a. Herbs, not aromatic, erect, tomentose or glabrous :
 2a. Stem slender and wiry, tomentose, not succulent 1. *ammanniodes*
 2b. Stem stout, glabrous, succulent 2. *capensis*
 1b. Shrubs, aromatic, decurrent, hairy 3. *suffruticosa*

1. *Bergia ammanniodes* Roxb. ex Roth., Nov. Pl. Sp. 219. 1821; Dyer in Hook. f., Fl. Brit. India 1:251. 1874; Bhattacharya in Fl. India 3:33. 1993.

Herbs 10-35 cm tall; stem reddish purple, glandular-pubescent, swollen at nodes. Leaves 15-30 x 3-8 mm, oblanceolate or obovate-oblong, upper half sparsely serrate, acute at apex, attenuate at base. Flower 2 mm across, reddish-pink, in axillary fascicles. Capsule 0.2-4 mm, subglobose, reddish. Seeds numerous, minute, dark brown.

Ecology : Frequent along the seasonally inundated fallow fields, river banks and marshy areas near the coast.

Fl. & Fr. : August-March.

Distrib. : West Bengal, Orissa, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka and Kerala.

2. *Bergia capensis* L. Mant. Pl. 241. 1771; *B. vesticillata* Willd.: Dyer in Hook. f., Fl. Brit. India 1: 252. 1874; Bhattacharya in Fl. India 3: 34. 1993.

A herb with succulent glabrous branchlets, rooting at nodes, stem reddish. Leaves 2-4.5 x 0.8-1.5 cm oblanceolate, elliptic or lanceolate chartaceous, glabrous, margin serrulate, base attenuate, apex obtuse. Flower cluster

of 20 or more flowers. Flower 2.5 mm across, cream or pink. Capsule 2 mm, furrowed.

Ecology : Commonly found on sandy moist areas and back shore swamps.

Fl. & Fr. : November-January.

Distrib. : Gujarat, Maharashtra and Karnataka coast.

3. *Bergia suffruticosa* (Delile) Fenzl., Denksch. Bot. Ges. 3: 183. 1841; *Bergia odorata* Edgew.: Dyers in Hook. f., Fl. Brit. India 1: 251. 1874; Bhattacharya in Fl. India 3: 36. 1993.

Shrubs, aromatic, decurrent, hairy, bark papery. Leaves 5-18 x 2-10 mm elliptic to ovate or oblong to lanceolate, crenate, pubescent, stipulate, obtuse to subacute at apex, narrowed at base. Flowers 3-4 mm across, whitish-pink, solitary or 2-8 in fasciculate cymes. Capsule ovoid, whitish-pink. Seeds numerous, minute, oblong-ellipsoid, dark brown to shining black.

Ecology : Rare on sandy wetlands, river banks and inundated fallow fields near the coast.

Fl. & Fr. : October-February.

Distrib. : Gujarat, Maharashtra and Karnataka.

CLUSIACEAE

Calophyllum L.

KEY TO THE SPECIES

- 1a. Inflorescence terminal or axillary 3. *polyanthum*
 1b. Inflorescence always axillary:
 2a. Lammina usually over 13 x 5 cm; petals present 2. *inophyllum*
 2b. Lammina upto 13 x 5 cm; petals absent 1. *apetalum*

1. *Calophyllum apetalum* Willd., Ges, Naturf. Fr. Berlin Mag. 5:79. 1811, p.p.; *C. wightianum* Wall. ex Planch & Triana, Anders in Hook. f., Fl. Brit. India 1: 274. 1874; Singh in Fl. India 3: 88. 1993.

Tree up to 30 m tall. Leaves 5-20 x 2.5-5 cm ovate or obovate or oblong to elliptic, glabrous, coriaceous, glaucous on both surface, slightly recurved at margin, obtuse-retuse or emarginate at apex, narrowed at base. Flowers 1-2.5 cm in diam., white in axillary racemes. Drupes 1-2 x 1 cm, ovoid-elliptic, red when ripe. Stone 7.5-13 x 5-7 mm, ovoid to ellipsoid, smooth.

Ecology : Frequent in evergreen formation on Western Ghats, near sea coast.

Fl. & Fr. : September-May.

Distrib. : Maharashtra, Karnataka, Tamil Nadu and Kerala coast, specially in W. Ghats from Mysore to Travancore.

2. *Calophyllum inophyllum* L., Sp. Pl. 513. 1753; Anders. in Hook. f., Fl. Brit. India 1: 273. 1874; Singh in Fl. India 3: 92. 1993.

Trees 12-15 m tall; trunk 30-70 cm in girth with milky exudate; bark pale grey, widely fissured. Leaves 8-15 x 6-10 cm, broadly ovate or elliptic-oblong, shining along both surfaces, rounded or emarginate at apex, truncate at base; nerves numerous, closely parallelled.

Flowers 1.2-1.5 cm across, white, fragrant, polygamous, in axillary racemes. Drupes 3 x 4 cm in diam., globose, shortly acuminate at apex.

Ecology : Common along the sea-shores and river-banks, often cultivated for timber and oil from the seeds.

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

Distrib. : Throughout the coastal areas and river banks.

3. *Calophyllum polyanthum* Wall. ex Choisy, Descr. Guttif. inde 43. 1849; *C. tomentosum* auct. non Wight, Anders. in Hook. f., Fl. Brit. India 1:274. 1874. p.p.; Singh in Fl. India 3:94. 1993.

Tree, 7-45 m tall. Leaves 10-15 x 3-4 cm, ovate to elliptic or oblong-lanceolate, undulate, shiny, coriaceous, glabrous, acute or acuminate at apex, acute or cuneate or narrowed at base. Flowers 1-2 cm in diam., in terminal or axillary simple or paniculate racemes. Drupes 2.5-3 x 2 cm, subglobose or ovoid, yellow or dark purple at maturity. Seed elliptic or ovoid, brown.

Ecology : Frequent on sandy river banks and coastal scrubs, common in high altitude.

Fl. & Fr. : January-July; sometimes up to November.

Distrib. : West Bengal, Karnataka, Tamil Nadu and Kerala.

MALVACEAE

KEY TO THE GENERA

- 1a. Trees; young parts with peltate scales 10. *Thespesia*
 1b. Shrubs, undershrubs or herbs; young parts without peltate scales:
 2a. Flowers capitate 6. *Malachra*
 2b. Flowers solitary 7. *Pavonia*
 3a. Fruits schizocarp:
 4a. Ovules solitary 9. *Sida*
 4b. Ovules 2 - many 2. *Abutilon*
 3b. Fruits capsules:
 5a. Calyx irregularly 2-3 lobed, spathaceous, deciduous 1. *Abelmoschus*
 5b. Calyx not 2-3 lobed, not spathaceous, not deciduous :
 6a. Capsule winged 3. *Fioria*
 6b. Capsule not winged:
 7a. Style 1, distantly 5 branched 5. *Hibiscus*
 7b. Style more than one:
 8a. Style branches coherent into club shaped mass. Seeds cottony 4. *Gossypium*

8b. Style branches spreading. Seeds not cottony :

9a. Leaves with nectaries. Fruit a mericarp, glochidiate 11. *Urena*

9b. Leaves not with nectaries. Fruit a 5-valved capsules, pubescent..... 8. *Senega*

1. *Abelmoschus* Medik.

Abelmoschus moschatus Medikus, Malv. 46. 1787;
Hibiscus abelmoschus L., Masters in Hook. f., Fl. Brit.
India 1: 342. 1874; Paul in Fl. India 3: 308. 1993.

Herbs up to 2 m tall; hirsute; tap-root tuber like.
Leaves 4-18 x 3-20 cm, extremely variable in shape and
size, 3-7 palmilobed to palmiparted, upper leaves
narrower, often hastate or sagitate, serrate to dentate, acute
or acuminate at apex. Flowers 10 cm across, yellow with

dark purple centre, axillary, solitary. Capsules 4-8 x 2.5
cm, ovoid to globose. Seeds 3-4 mm, ribbed, musk scented.

Ecology : Rare along the forest edges and hill slopes near
the coast.

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

Distrib. : Orissa, Tamil Nadu, Maharashtra and Kerala
coast.

2. *Abutilon* Gaertn.

Abutilon indicum (L.) Sweet., Hort. Brit. 1: 54. 1826;
Mast. in Hook. f., Fl. Brit. India 1: 326. 1874; Paul in Fl.
India 3: 266. 1993.

Erect, annual or perennial herbs or undershrubs;
stems velutinous. Leaves 2-7 x 2-5 cm ovate or
suborbicular, crenate or denate, 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.

Ecology : Rare along sea-shore, common along road-sides
and waste places.

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

Distrib. : Widespread throughout the East coastal plains
and waste places on sand beaches.

3. *Floria* Mattei

Floria vitifolia (L.) Mattei, Bot. Ort. Bot. Palermo n.s.
2:71. 1916; *Hibiscus vitifolia* L., Masters in Hook. f., Fl.
Brit. India 1:338. 1874; Paul in Fl. India 3:311. 1993.

Herbs 1-2 m tall. Leaves 2.5-15 x 2-12 cm,
broadly ovate to orbicular, crenate serrate, 5 lobed or
unlobed, acute at apex, subcordate to rounded at base.
Flowers 2.5-5 cm long, yellow with dark purple centre.

Capsules 1.5-2 cm across, beaked, 5 winged. Seeds
2-3 mm across, reniform, brownish-black.

Ecology : Frequent along roadsides, forest edges and
waste lands along the coast.

Fl. & Fr. : April-December.

Distrib. : Throughout the coastal districts.

4. *Gossypium* L.

KEY TO THE SPECIES

- 1a. Segments of leaves linear-lanceolate with an extra tooth in sinus.
Epicalyx segments connate at base 1. *arboresum*
- 1b. Segments of leaves ovate-oblong without extra tooth in sinus.
Epicalyx segments free 2. *herbaceum*

1. *Gossypium arboreum* L., Sp. Pl. 693. 1753; Masters in Hook. f., Fl. Brit. India 1: 347. 1874; Paul in Fl. India 3: 387. 1993.

Shrubs 1-2 m tall; branchlets covered with dense stellate hairs, purple. Leaves ovate to orbicular, 3, 5 or 7 lobed or parted, stipulate, cordate at base. Flowers 3-5 cm long, pale yellow, with or without purple centre, axillary, solitary. Capsules 1.5-3 cm across, ovoid or globular, beaked. Seeds 5-7 mm across white or rusty.

Ecology : Frequent on coastal gardens and beaches. Cultivated as ornamental plant.

Fl. & Fr. : July-September.

Distrib. : Mostly found throughout the coastal districts.

2. *Gossypium herbaceum* L., Sp. Pl. 693. 1753; Masters in Hook. f., Fl. Brit. India 1: 346. 1874; Paul in Fl. India 3: 389. 1993.

Herbs 1-1.5 m tall; branchlets sparsely stellate-tomentose. Leaves ovate-rounded, palmately 3, 5 or 7 lobed, stipulate, acute at apex, cordate at base. Flowers 2-5 cm long, yellow with purple centre, axillary solitary. Capsule 3-4 cm long, oblong-obtuse, 4 loculed. Seeds 5-8 x 3-6 mm, ovoid, greyish white with floss and fuss.

Ecology : Frequent on sandy waste places and black cotton soil, near the coast. Cultivated.

Fl. & Fr. : August-September.

Distrib. : Maharashtra, Goa, Karnataka and Kerala coast.

5. *Hibiscus* Medik.

KEY TO THE SPECIES

- 1a. Stems mostly armed with recurved thorns; sepals eglandular; stipules foliaceous, semisagittate 3. *surattensis*
- 1b. Stems unarmed; sepals glandular; stipules not foliaceous not semisagittate :
- 2a. Herbs or undershrubs; epicalyx not cupular :
- 3a. Leaves unlobed; epicalyx filiform, not densely hairy 2. *micranthus*
- 3b. Leaves lobed; epicalyx lanceolate, densely hairy 1. *laurifolius*
- 2b. Trees; epicalyx cupular 4. *tiliaceus*

1. *Hibiscus laurifolius* Willd., Sp. Pl. 3: 811. 1800; Masters in Hook. f., Fl. Brit. India 1: 338. 1874; Paul in Fl. India 3: 334. 1993.

Shrub 2-4 m tall, stems yellow, stellate hairy. Leaves 1-15 x 0.5-19 cm, ovate orbicular, lower leaves 3-5 lobed, serrate to dentate, acute to acuminate at apex, cordate or rounded at base. Flower 6-10 mm across, yellow with dark purple centre. Capsule 2-2.5 x 1.5-1.8 cm, globose to obovoid, 5 valved, densely hairy. Seed 2-2.5 mm, numerous, reniform, black.

Ecology : Frequent on back shore dunes and coastal scrubs.

Fl. & Fr. : September-November.

Distrib. : Andhra Pradesh, Tamil Nadu, Maharashtra, Karnataka and Kerala coast.

2. *Hibiscus micranthus* L. f., Suppl. Pl. 308. 1781; Masters in Hook. f., Fl. Brit. India 1: 335. 1874; Paul in Fl. India 3: 331. 1993.

Shrubs up to 2.6 m tall, branches slender, terete, scabrid. Leaves 1.5-4.5 x 0.5-1.5 cm, ovate or oblong, serrate, scabrid, stipulate, acute to obtuse at apex, rounded to cordate at base. Flower 0.6-1.2 cm across, purplish-white or pink, axillary, solitary. Capsule globose, 5 valved. Seeds reniform, black, with long white silky hairs.

Ecology : Frequent on back shore sands, waste lands and coastal scrub jungles.

Fl. & Fr. : April-September.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Gujarat coast.

3. *Hibiscus surattensis* L., Sp. Pl. 1753; Masters in Hook. f., Fl. Brit. India 1: 334. 1874; Paul in Fl. India 3: 327. 1993.

Trailing herbs, stem hairy covered with recurved prickles. Leaves 3-7 x 4-12 cm, suborbicular or ovate, lower ones 3-5 palmilobed, upper ones 5 palmiparted, crenate serrate, hairy, acute at apex, auricled at base. Flowers 3-5 cm long, yellow, with deep purple centre. Capsule 1.2 x 1 cm, ovoid, with bristle like shiny, white or yellow hairs. Seeds 3-4 mm long, downy, blackish brown.

Ecology : Frequent on sand beaches, coastal scrubs and forest edges.

Fl. & Fr. : September-October; December-February.

Distrib. : Maharashtra, Gujarat, Saurashtra, Karnataka and Kerala coast.

4. *Hibiscus tiliaceus* L., Sp. Pl. 694, 1753; Mast. in Hook.

Malchra capitata (L.) Syst. Nat. ed. 12, 2: 458. 1767; Mast. in Hook. f., Fl. Brit. India 1: 329. 1874; Paul in Fl. India 3: 367. 1993.

Undershrubs or herbs 1-3 m tall, stellately hairy. Leaves 1.5-10 x 1-9 cm, ovate or suborbicular, crenate or denate, obtuse at apex, cordate at base. Flowers 1-1.6 cm across, yellow, 2-4 together in involucrate heads. Fruits

f., Fl. Brit. India 1: 343, 1875; Paul in Fl. India 3: 322. 1993.

Trees 3-6 m tall or lianas; stems much-branched, glabrous, closed to ground level. Leaves 5-16 x 4-18 cm, orbicular, cremlate, stellate beneath, acute or acuminate at apex, cordate at base. 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.

Ecology : Common along the islands near estuaries, banks of creeks and channels and occasional in the back mangroves.

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

Distrib. : Throughout the East, West and Gujarat coastal regions as well as in Andaman and Nicobar islands.

6. *Malchra* L.

schizocarps; mericarps 5, indehiscent rounded at apex. Seeds triangular, pointed.

Ecology : Occasional along the river-banks and back shores, common along road-sides and near waste places.

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

Distrib. : Almost throughout the Indian coastal area.

7. *Pavonia* Cav.

KEY TO THE SPECIES

- 1a. Epicalyx 5, ovate, shortly connate at base; mericarp not winged:
 2a. Mericarp pyriform, echinate all over 1. *glechomifolia*
 2b. Mericarp triquetrous, ridged and crested 2. *procumbens*
 1b. Epicalyx 10, linear, setaceous; mericarp winged 3. *zeylanica*

1. *Pavonia glechomifolia* (A. Rich.) Garcke ex Schewin. f., Beitr. Fl. Aethiop. 1:54. 1867; Masters in Hook. f., Fl. Brit. India 1: 330. 1874. p.p.; Paul in Fl. India 3: 372. 1993.

Shrubs, up to 1.5 m high; stems purple with scattered stellate hairs. Leaves 1.2-3.5 x 1.4-3 cm, ovate-cordate, entire or 3 angled, irregularly dentate, acute at

apex, cordate at base. Flowers 1-2 cm across, yellow with dark purple centre, axillary, solitary. Schizocarp 5-6 mm across; mericarps 4 mm long, pyriform. Seed 3 x 2 mm, pyriform, brown.

Ecology : Frequent in dry coastal sands and scrub jungles.

Fl. & Fr. : September-February.

Distrib.: Tamil Nadu, Kerala, Maharashtra and Gujarat coast.

2. *Pavonia procumbens* (Wight & Arn.) Walp., Rep. Bot. Syst. 1: 301. 1842; Paul in Fl. India 3: 374. 1993.

Glandular, pubescent herbs or undershrubs. Leaves 4-8 x 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.

Ecology : Frequent along the sea-shore and river-banks, locally common along roadsides.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the Indian coastal areas.

3. *Pavonia zeylanica* (L.) Cav., Diss. 3: 134, t. 48, f. 2. 1787; Masters in Hook. f., Fl. Brit. India 1: 331. 1874; Paul in Fl. India 3: 377. 1993.

Herbs up to 1 m tall; stem stout and woolly at base, branches decumbent, pubescent. Leaves 1-4 x 0.8-3.5 cm, orbicular to obovoid-rounded, deep 3-5 lobed, dentate, stipulate, acute at apex, cordate at base. Flowers 10 mm long, pale yellow or pink, axillary solitary. Seeds 3 x 1.5 mm, reniform, minutely pubescent.

Ecology : Frequent in the lee side of the coastal dunes and coastal scrubs.

Fl. & Fr. : July-December.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Maharashtra and Gujarat coast.

8. *Senra* Cav.

***Senra incana* Cav., Diss. 2: 83, t. 35, f. 3. 1786; Masters in Hook. f., Fl. Brit. India 1: 334. 1874; Paul in Fl. India 3: 347. 1993.**

Pubescent, climber. Leaves 1.5-3.5 x 2-3 cm, orbicular or deeply 3 lobed, stellate pubescent, entire, acute at apex, deeply cordate at base. Flowers 3 cm long, violet,

rarely yellow, axillary solitary. Capsules 3.5 x 4.5 mm, ovoid, ribbed. Seeds 2 x 1 mm, reniform, pubescent, brown.

Ecology : Endemic in coastal areas of Gujarat.

Fl. & Fr. : November-April.

Distrib. : Gujarat (Kutchhh districts).

9. *Sida* L.

KEY TO THE SPECIES

- 1a. Plants velvety; awns of carpels retrorsely hairy 3. *cordifolia*
 1b. Plants not velvety; awns of carpels not retrorsely hairy :
 2a. Mericarp glabrous:
 3a. Leaves elliptic-lanceolate; stipules of each pair dissimilar 1. *acuta*
 3b. Leaves ovate-orbicular; stipules of each pair similar 2. *cordata*
 2b. Mericarp hairy:
 4a. Leaves rhomboid, covered with rigid hairs, not velutinous 5. *rhombifolia*
 4b. Leaves ovate-oblong, velutinous 4. *ovata*



Dillenia pentagyna



Dillenia indica



Nymphaea nauchali



Nymphaea pubescens



Crateva religiosa



Hydnocarpus laurifolia



Heritiera littoralis



Brownlowia tersa



Grewia tiliaefolia



Erythroxylon monogynum



Ochna obtusata



Aglaiia cucullata

1. *Sida acuta* Burm. f., Fl. Ind. 147. 1768, *S. carpinifolia* auct. non L. f.: Masters in Hook. f., Fl. Brit. India 1: 323. 1874; Paul in Fl. India 3: 281. 1993.

Herbs, stems pubescent. Leaves 1.9 x 0.5-2.5 cm, lanceolate to linear, serrate, acute at apex, rounded at base. Flowers 8-10 mm across, light yellow, axillary solitary or 2-8 in clusters. Mericarp 4 mm long, 6-10, tetrahedral, 1 seeded. Seeds 2 mm long, triangularly ovoid, dark brown.

Ecology : Frequent along road sides, in waste lands, both in shady and open sand dunes.

Fl. & Fr. : September-May.

Distrib. : West Bengal, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

2. *Sida cordata* (Burm. f.) Borss., Blumea 14: 182, 1966. *S. humilis* Cav.: Masters in Hook. f., Fl. Brit. India 1: 322, 1874; Paul in Fl. India 3: 283. 1993.

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

Ecology : Frequent along the sea-shores, river-banks and roadsides.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Gujarat coast.

3. *Sida cordifolia* L., Sp. Pl. 684. 1753; Masters in Hook. f., Fl. Brit. India 1: 324. 1874; Paul in Fl. India 3: 285. 1993.

Erect herbs, 50-70 cm tall; stems much-branched, tomentose. Leaves 1-6 x 0.5-1.5 cm, ovate, crenate, obtuse or acute at apex, truncate at base. Flowers 1-2 cm across, yellow, axillary, corymbose or solitary. Mericarps 8-10,

3.5 mm long excluding awns, retrorsely hairy. Seeds 2 mm across, flattened reniform, glabrous, dark brown or black.

Ecology : Common along the river-banks, sandy sea-shore and roadsides.

Fl. & Fr. : March-April; July-August.

Distrib. : Throughout the Indian coastal areas.

4. *Sida ovata* Frosskal, Fl. Aegypt-Arab. 124. 1775. *S. grewioides* Guill. & Perrot.: Masters in Hook. f., Fl. Brit. India 1: 323. 1874; Paul in Fl. India 3: 288. 1993.

Shrubs, 20-30 cm tall; stellate pubescent. Leaves 1.5-5 x 1-4 cm, ovate-oblong, crenate, densely stellate-velutinous, obtuse at apex, rounded at base. Flowers 1-1.5 cm long, yellow or yellowish white, axillary, solitary sometimes paired. Schizocarps 5 mm across, indehiscent, blackish, mericarps 3-4 mm across, with prominent reticulation. Seeds 2 mm in diam, rounded-reniform.

Ecology : Common in dry open beaches and sand dunes.

Fl. & Fr. : July-February.

Distrib. : Andhra Pradesh, Maharashtra and Gujarat coast.

5. *Sida rhombifolia* L., Sp. Pl. 684. 1753; Masters in Hook. f., Fl. Brit. India 1: 323. 1874; Paul in Fl. India 3: 289. 1993.

Erect herbs. Leaves serrate to crenate, entire towards base, stellate pubescent, stipulate, acute at apex, narrowed at base. Flowers 1-1.5 cm across, yellow or pale orange, axillary, solitary. Mericarps 6-12, glabrous. Seeds 2 mm across, flattened, reniform, brown or black.

Ecology : Common on backwards sandy beaches and sand dunes also along the road sides of sea shore.

Fl. & Fr. : July-December.

Distrib. : All through the coastal districts.

10. *Thespesia* Sol. ex Correa

KEY TO THE SPECIES

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

1. *Thespesia populnea* (L.) Sol. ex. Correa, Ann. Mus. Nat. Paris 9: 290. 1807; Masters in Hook. f., Fl. Brit. India 1: 345. 1874; Paul in Fl. India 3: 352. 1993.

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

Ecology : Common along sea-shore, river-banks and outer fringes of mangroves, often planted along the road side for shed tree.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Gujarat, Maharashtra and Andaman coast.

2. *Thespesia populneoides* (Roxb.) Kostel., Allg. Med. Pharm. Fl. 5: 1861. 1836; Paul in Fl. India 3: 353. 1993. *f. populnea* (L.) Corr. sensu Masters in Fl. Brit. India 1: 345. 1874.

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

Ecology. : Frequent along the muddy sea-shores and outer fringes of the mangroves.

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

Distrib. : Bengal coast and Andhra coast. New record for Orissa coast.

11. *Urena* L.

Urena lobata L., Sp. Pl. 692. 1753, s.l.; Masters in Hook. f., Fl. Brit. India 1: 329. 1874; Paul in Fl. India 3: 380. 1993.

Shrub 0.5-2 m tall, stellate hairy. Leaves 1-12 x 0.5-12.5 cm, extremely variable in size and shape, usually ovate to orbicular, unlobed to shallowly lobed, crenate-serrate, obtuse to acute at apex, shallowly cordate at base. Flower 2-3 cm across, pink with purple centre, axillary, solitary or 2-3 in clusters. Schizocarps 5-8 mm across,

globose; mericarp 4-5 mm, stellate hairy and reticulate veined. Seeds 2-3 mm across, reniform, brown.

Ecology : Occasional on sandy sea shore, coastal scrubs and hill slopes along the coast.

Fl. & Fr. : August-December.

Distrib. : Throughout the coastal districts.

STERCULIACEAE

KEY TO THE GENERA

- 1a. Trees :
- 2a. Flowers unisexual 3. *Heritiera*
- 2b. Flowers bisexual :
- 3a. Capsules glabrous 1. *Guazama*
- 3b. Capsules rusty tomentose 6. *Pterospermum*
- 1b. Herbs or undershrubs :
- 4a. Stamens alternating with ligulate staminodes 4. *Melhania*
- 4b. Stamens without staminodes :
- 5a. Fruits a straight or spirally twisted follicles; seeds tuberculate 2. *Helicteres*
- 5b. Fruit a globose or subglobose capsule; seeds not tuberculate:
- 6a. Ovary 1-loculed 7. *Waltheria*
- 6b. Ovary 5-loculed 5. *Melochia*

1. *Guazama* Adans.

Guazama ulmifolia Lamk. Encycl. Meth. Bot. 3: 52, 1789. *G. tomentosa* H.B.K. Nov.: Masters in Hook. f., Fl. Brit. India 1: 375, 1874; Mallick in Fl. India 3: 424, 1993.

Trees, 4-16 m tall, young twigs tomentose. Leaves 6-15 x 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, indurated, coarsely tuberculate.

Ecology : Occasional in coastal scrubs and along roadside.

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

Distrib. : Naturalised throughout the coastal districts in India

2. *Helicteres* L.

Helicteres isora L., Sp. Pl. 963, 1753; Masters in Hook. f., Fl. Brit. India 1: 365, 1874; Mallick in Fl. India 3: 426, 1993.

Trees 3-8 m tall; branchlets rough with scattered stellate hairs. Leaves 10-23 x 11-17 cm, broadly elliptic or elliptic-obovate, stellate hairy, densely hairy along margin, shortly acuminate at apex, obliquely cordate at base. Flowers 4-5 cm long, crimson, axillary, solitary or in clusters. Follicles 4-8 x 0.5-1 cm, cylindrical, spirally

twisted with apical beak, stellate-tomentose. Seeds 2 mm long, many angular, wrinkled, tomentose.

Ecology : Very frequent on coastal hill slopes and scrub jungles. Common in dry deciduous forests.

Fl. & Fr. : April-December; October-January.

Distrib. : Orissa, Maharashtra, Karnataka and Kerala coast.

3. *Heritiera* Aiton.

KEY TO THE SPECIES

- 1a. Fruits smooth, not globose, distinctly ridged:
 2a. Fruits 3 - 4 cm across with a transverse circular ridge 1. *fomes*
 2b. Fruits 8 - 12 cm across with a longitudinal ridge 3. *littoralis*
 1b. Fruits rough, globose, ridges absent or ill-developed 2. *kanikensis*

1. *Heritiera fomes* Buch.-Ham., Symes Ava. Emb. t. 28, 1800; Masters in Hook. f., Fl. Brit. India 1: 363, 1874; Mallick in Fl. India 3: 428, 1993.

Trees, 6-30 m tall, 30-80 cm in girth; stems with well-developed buttressed and innumerable blind rootsuckers 15-30 x 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 x 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; 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.

Ecology : 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 irapa*, *Amoora cucullata* and *Intsia bijuga*.

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

Distrib. : Sundarbans, West Bengal and Mahanadi delta in Orissa.

2. *Heritiera kanikensis* N.C. Majumdar & L.K. Banerjee in Bull. Bot. Surv. India 27(1-4): 150, 1987.

Tree, 5-7 m tall, branches rough, pale brown, young branches lepidote. Leaves alternate, elliptic lanceolate, 4-10 x 2-5 cm, acute or rarely obtuse at apex, acute to subacute at base, entire, coriaceous, upper surface scaly when young, becoming glabrous at maturity, lower surface hairy with adpressed scales, midrib depressed above, prominent below, lateral nerves slender, in 9-12 pairs; petiole 8-11 mm long, younger small scaly, the older one glabrous. Inflorescence axillary, laxly paniculate, 2-8 cm long, peduncle stellate-pubescent, brown pedicels slender, 5-10 mm long, densely stellate-pubescent. Calyx campanulate, 4-5 mm long, tube ca 3 mm long, lobes 4, erect, triangular, ca 1.5 mm long, both surfaces pubescent with stellate hairs, more in the inside of tube towards base. Petals absent. Male flowers with a convex torus at base covered with brownish white granular cells. Androgynophore 1 mm long, glabrous; thecae 8 in a tube like ring crowned by sterile ovaries at the apex. Female flowers with young ovaries, ellipsoid, ca 0.8 mm long, black, glandular when young, glabrous at maturity; style very short, ca 0.5 mm, glabrous, stigma minute, globose. Pedicels swollen at maturity. Fruit globose, rough, brown, 1.8 cm diam., with a dorsiventral ridge, developing up to a height of 4 mm towards apex, without a transverse circular ridge.

Ecology : 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 irapa*, *Amoora cucullata* and *Intsia bijuga*.

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

Distrib. : Orissa, Bhitarkanika.

3. *Heritiera littoralis* Dryand, Ait. Hort. Kew. ed. 1, 3: 546, 1789; Masters in Hook. f., Fl. Brit. India 1: 369. 1874; Mallick in Fl. India 3: 429. 1993.

Trees, 12-20 m tall, 30-90 cm in girth; buttresses wavy, up to 30 cm in diam., producing blind rootsuckers; bark pale-brown; sap wood white merging into reddish-brown heart wood. Leaves 7-24 x 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, borne in axillary panicles; male flowers: 3-4 mm across; androgynophores white, headed by 8-10 anther thecae in a regular ring; female flowers: 4-5 mm across, 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.

Ecology : 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 *Manilkara hexandra*. Common in the littoral forests of Andaman.

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

Distrib. : Mahanadi delta, Orissa, Karnataka, Andaman & Nicobar island and Cochin coast.

4. *Melthania* Forsk.

Melthania incana Heyne ex Wight & Arn., Prodr. 68. 1834; Masters in Hook. f., Fl. Brit. India 1: 372. 1874; Mallick in Fl. India 3: 439. 1993.

Herbs, branchlets densely stellate-tomentose. Leaves 1.5-3.5 x 1-1.5 cm, linear oblong to elliptic-lanceolate, serrulate, chartaceous, tomentose beneath, obtuse and apiculate at apex, rounded or subcordate at base. Flower 8 mm long, yellow, in axillary cymes.

Capsule 6 x 3 mm, subglobose, hairy. Seeds 2-4 in each locule, ovoid, tubercled angled.

Ecology : Frequent on red soil in open dry places and scrub jungles near the coast.

Fl. & Fr. : July - December.

Distrib. : Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Kerala coast.

5. *Melochia* L.

Melochia corchorifolia L., Sp. Pl. 675. 1753; Masters in Hook. f., Fl. Brit. India 1: 374. 1874; Mallick in Fl. India 3: 441. 1993.

Herbs, 0.5-1 m tall; young twigs covered with stellate hairs. Leaves 2-3 x 0.5-1 cm ovate, membranous, serrate, acute at apex, cuneate rounded at base. Flowers 4-5 mm across, purple, in terminal, head-like clusters, involucre by 4 stipules. Capsules 3-4 mm across,

globose, septically dehiscent into 5 cocci. Seed 2 mm, 1 in each locule, brown, trigonous.

Ecology : Frequent in moist places, river-banks and sandy sea-shores.

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

Distrib. : Throughout the coastal districts in India.

6. *Pterospermum* Schreb.

KEY TO THE SPECIES

- 1a. Leaves prominently nerved; capsules ovoid, obtusely angled, creamy tomentose 1. *suberifolium*
 1b. Leaves obscurely nerved; capsule pyriform, acutely angled rusty tomentose 2. *xylocarpum*

1. *Pterospermum suberifolium* (L.) Lam., Ill. 3: 136. t. 576. 1794; Hook. f., Fl. Brit. India 1: 367. 1874; Mallick in Fl. India 3: 453. 1993.

Trees 8-10 m tall; young parts stellate-tomentose. Leaves 7.5-11.5 x 3.5-6 cm, oblong to obovate-oblong, tomentose, stipulate, entire, acuminate at apex, cuneate rounded or subcordate at base. Flowers 4-5 cm across, white, 1-3 in axillary peduncles. Capsules 4-6 x 2-2.5 cm, ovoid-oblong, 4-5 valved, creamy tomentose. Seeds 0.5 x 4 mm, 2-4 in each locule with a broad terminal wing.

Ecology : Frequent on back shore sands and coastal scrubs.

Fl. & Fr. : July; November-February.

Distrib. : Orissa, Andhra Pradesh, Maharashtra, Karnataka, and Tamil Nadu coast.

2. *Pterospermum xylocarpum* (Gaertn.) Sant. and Wagh in Bull. Bot. Surv. India 5: 108. 1963. *P. heyneanum* Wall.: Masters in Hook. f., Fl. Brit. India 1: 83. 1874; Mallick in Fl. India 3: 454. 1993.

Trees, 6-12 m tall; twigs rusty-tomentose. Leaves 6-20 x 4-12 cm, ovate, 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.

Ecology : Frequent in riverine scrubs, secondary forests, and road sides near the sea shore.

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

Distrib. : Throughout Western peninsula, West Bengal, Orissa, Karnataka and Tamil Nadu coast.

7. *Waltheria* L.

Waltheria indica L., Sp. Pl. 673. 1753; Masters in Hook. f., Fl. Brit. India 1: 374, 1874; Mallick in Fl. India 3: 473. 1993.

Erect, stellate-pubescent herbs or undershrubs. Leaves 3-5 x 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 mm in diam., ovoid, 2-valved. Seeds mostly one.

Ecology : A polymorphous weed, frequent on sand dunes, river-banks and dams.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

TILIACEAE

KEY TO THE GENERA

1a. Small trees or shrubs :

2a. Sepals connate below; staminodes present 1. *Brownlowia*

2b. Sepals free; staminodes absent 3. *Grewia*

1b. Herbs or undershrubs :

3a. Capsules echinate 4. *Triumfetta*

3b. Capsules not echinate 2. *Corchorus*

1. *Brownlowia* Roxb.

Brownlowia tersa (L.) Kosterm. in Reinward. 4: 536. 1959; *B. lanceolata* Benth.: Masters in Hook. f., Fl. Brit. India 1: 381. 1874; Daniel & Chandrabose in Fl. India 3: 480. 1993.

Trees, 1-2 m tall; young twigs covered with brown lepidotes. Leaves 10-18 x 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. Fruits 1-1.5 cm across, pyriform or obliquely ovoid, woody, brown with a distinct line of two valved carpels. Seed 1, obovoid, glossy.

Ecology : Common along the intertidal 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.

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

Distrib. : Sunderbans in West Bengal and Mahanadi delta in Orissa coast. Also in Andamans.

2. *Corchorous* L.

KEY TO THE SPECIES

- 1a. Plant prostrate; capsule 4 loculed 3. *depressus*
- 1b. Plant erect; capsule 3-5 loculed :
 - 2a. Capsule globose or subglobose 2. *capsularis*
 - 2b. Capsule subcylindric or straight :
 - 3a. Capsule winged; beak divided into 3 fid 1. *aestuans*
 - 3b. Capsule not winged, not beaked :
 - 4a. Capsule 10 ribbed, glabrous 4. *olitorius*
 - 4b. Capsul angled, scabrous 5. *trilocularis*

1. *Corchorous aestuans* L., Syst. Nat. ed. 10, 1079. 1759; *C. acutangulus* Lamk.: Masters in Hook. f., Fl. Brit. India 1: 398. 1874; Daniel & Chandrabose in Fl. India 3: 485. 1993.

Erect annual herbs or undershrubs, 1-1.5 m tall. Leaves 2-7 x 1-4 cm, ovate-lanceolate or elliptic-oblong, serrate, glabrous or pubescent, acute at apex, rounded at base. Flowers 2-4 mm across, yellow in axillary cymes. Capsules 2.5-3 cm long, 6-angled; alternate angles winged; horns 3, bifid at apex. Seeds numerous, dark brown, truncate at both ends.

Ecology : Frequent along the river-banks and moist places, common on pastures and cultivated lands.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Kerala coast.

2. *Corchorous capsularis* L., Sp. Pl. 529. 1753; Masters in Hook. f., Fl. Brit. India 1: 397. 1874; Daniel & Chandrabose in Fl. India 3: 485. 1993.

Herbs 1-2.5 m tall, glabrous. Leaves 5-15 x 1.5-8 cm, ovate-lanceolate to linear-lanceolate, serrate, basal most serration prolonged into filiform processes, pubescent, stipulate, acute to acuminate at apex, rounded at base. Flower 3-5 mm long, yellow, 1 or 2 in axillary or leaf opposed cymes. Capsule 1 cm across, globose, scabrous, 5 loculed. Seeds 3 x 1 mm cuniform, glabrous, brown.

Ecology : Frequent on moist sandy beaches, cultivated for jute of commerce.

Fl. & Fr. : July-November.

Distrib. : Throughout Indian coastal area.

3. *Corchorus depressus* (L.) Vicairy in J. Asiat. Soc. Bengal 16: 1160. 1847; *C. antichorus* Rughsh.; Masters in Hook. f., Fl. Brit. India 1: 398. 1874; Daniel & Chandrase in Fl. India 3: 486. 1993.

Herbs, branches many from thick woody rootstock. Leaves 1-4 x 0.7-1.5 cm, narrowly to broadly elliptic, crenate-serrate, stipulate, obtuse at apex and base. Flower 6-8 mm across, yellow, in leaf opposed cymes. Capsule 7-22 mm long, cylindrical, 4 loculed, beaked. Seeds 1.5 mm long, roughly triangular, black.

Ecology : Frequent on sandy waste places and edges of the coastal scrubs.

Fl. & Fr. : Almost throughout the year.

Distrib. : Andhra Pradesh, Maharashtra, Tamil Nadu and Gujarat coast.

4. *Corchorus olitorius* L., Sp. Pl. 529. 1753; Masters in Hook. f., Fl. Brit. India 1: 397. 1874; Daniel & Chandrase in Fl. India 3: 487. 1993.

Herbs up to 1.5 m tall, base woody. Leaves 4-15 x 3-5 cm, lanceolate to ovate-lanceolate, serrate, basal most serration prolonged into filiform processes, stipulate, acute at apex, slightly rounded at base. Flowers

12-15 mm across, yellow, in leaf opposed cymes. Capsule 2-7 cm long, subcylindric, 10 ribbed, 5 loculed, beaked. Seeds 2 x 1.5 mm, trigonous, black.

Ecology : Common on moist sandy beaches and back side of the coastal dunes.

Fl. & Fr. : July-January.

Distrib. : Throughout Indian coast.

5. *Corchorus trilocularis* L., Mant. Pl. 77. 1767; Masters in Hook. f., Fl. Brit. India 1: 397. 1874; Daniel & Chandrase in Fl. India 3: 488. 1993.

Herbs 30-150 cm tall, pubescent. Leaves 1.3-10 x 0.4-3.5 cm, narrowly oblong-lanceolate to broadly oblong elliptic, crenate serrate, basal most serrations prolonged into filiform processes, obtuse at apex and base. Flowers 1.2 cm across, yellow, in leaf opposed cymes. Capsules 2-7 cm long, 3 angular, 3 loculed, beaked. Seeds 1-1.2 mm long, black.

Ecology : Frequent on moist sandy areas and waste lands along the sea shore.

Fl. & Fr. : Almost throughout the year.

Distrib. : West Bengal, Orissa, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

3. *Grewia* L.

KEY TO THE SPECIES

1a. Drupes not lobed :

2a. Leaves sub-entire or serrulate; drupes globose not parted 1. *nervosa*

2b. Leaves dentate; drupe obovoid, 2 parted 4. *tenax*

1b. Drupes lobed :

3a. Stipules auriculate; drupe 2 lobed 5. *tiliacifolia*

3b. Stipules not auriculate; drupe 4 lobed :

4a. Climbing shrubs; drupes fleshy glabrous 6. *umbellifera*

4b. Erect shrubs; drupe not fleshy, not glabrous :

5a. Leaves distinctly serrate; drupe 2 lobed 3. *serrulata*

5b. Leaves crenate; drupe more than 2 lobed :

6a. Drupe 2-4 lobed, tomentose 2. *rhamnifolia*

6b. Drupe 4 lobed, glabrous 7. *villosa*

1. *Grewia nervosa* (Lour.) Panigr. in Taxon 34: 702, 1985. *G. microcos* L., *nom. illeg.*: Masters in Hook. f. Fl. Brit. India 1: 392, 1874; Daniel & Chandrabose in Fl. India 3: 502, 1993.

Tree. Leaves 9-23 x 4-10.5 cm, elliptic-oblong, lanceolate or ovate-lanceolate, subentire or serrulate, acute or acuminate at apex, rounded or cordate at base. Flowers 5-7 mm long, white or yellow, in axillary and terminal panicles. Drupes 8-10 mm across, globose or subglobose.

Ecology : Frequent on semi-evergreen forests along the back shore.

Fl. & Fr. : March-December; June-March.

Distrib. : Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu, Kerala and Andaman & Nicobar Island.

2. *Grewia rhamnifolia* Heyne ex Roth. Nov. Pl. Sp. 244, 1821; *G. orientalis auct. non L.*: Master in Hook. f., Fl. Brit. India 1: 384, 1874 *p.p.*; Daniel & Chandrabose in Fl. India 3: 507, 1993.

Straggling shrubs or lianas; stems covered with stellate hairs. Leaves 6-12 x 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.

Ecology : Frequent in scrubs along sandy river banks in association with *Kourea minor*, *Hugoniu mystax* and *Cavissa spinarum*

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

Distrib. : Mahanadi delta in Orissa also common in Western and Eastern Ghats.

3. *Grewia serrulata* DC., Prodr. 1: 510, 1824; *G. levigata auct. non Vahl* 1790.; Masters in Hook. f., Fl. Brit. India 1: 381, 1874; *G. multiflora auct. non A. L. Juss* : Masters in Hook. f., Fl. Brit. India 1: 388, 1874; Daniel & Chandrabose in Fl. India 3: 509, 1993.

Trees. Leaves 1-18 x 1.5-7 cm, lanceolate, ovate-lanceolate, elliptic-ovate or obovate, sharply serrate, acute or acuminate at apex, rounded or narrowed at base.

Flowers 1.5-2.5 cm long, greenish white, in axillary, umbellate cymes. Drupes 5-15 mm across, 2 lobed, globose when not lobed, dry black.

Ecology : Frequent on the lee side of coastal dunes in moist deciduous formation and scrub jungles.

Fl. & Fr. : April-December; June-March.

Distrib. : West Bengal, Orissa, Gujarat.

4. *Grewia tenax* (Forsskal) Fiori in Agric. Colon. 5: Suppl. 23, 1912; *G. populifolia* Vahl.: Masters in Hook. f., Fl. Brit. India 1:385, 1874; Daniel & Chandrabose in Fl. India 3: 511, 1993.

Shrubs, 2-3 m tall. Leaves 0.5-4 x 0.5-2.5 cm, broadly ovate, round or elliptic, coarsely dentate, obtuse at apex, rounded or obtuse at base. Flowers 8-10 mm long, white, in axillary or leaf opposed cyme. Drupes 6-10 mm across, 2 parted, orange yellow.

Ecology : Occasional in coastal scrub jungles.

Fl. & Fr. : May-February.

Distrib. : Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat and Maharashtra coast.

5. *Grewia tiliaefolia* Vahl, Symb. Bot. 1: 35, 1790; Masters in Hook. f., Fl. Brit. India 1: 386, 1874, "*tiliaefolia*"; Daniel & Chandrabose in Fl. India 3: 511, 1993.

Trees 6-15 m tall; bark peeling off. Leaves 1.7-36 x 1-24 cm, elliptic, elliptic-ovate to ovate-rotund, serrate to crenate-serrate, acuminate or rounded at apex, oblique cordate at base. Flowers 3-6 mm long, yellow in axillary cymes. Drupes 2.5-5 x 7-10 mm, black, 2 lobed, lobes globose.

Ecology : Frequent in moist and dry deciduous and semi-evergreen forests along the back shore and in coastal scrubs.

Fl. & Fr. : January-September, May-October.

Distrib. : West Bengal, Orissa, Maharashtra, Gujarat and Kerala coast.

6. *Grewia umbellifera* Beddome, For. Man. Bot. 37, 1871; Masters in Hook. f., Fl. Brit. India 1: 393, 1874; Daniel & Chandrabose in Fl. India 3: 513, 1993.

Climber. Leaves 9-15 x 6-8.5 cm, elliptic or elliptic-ovate, glandular-serrate, acute or acuminate at apex, rounded or subacute at base. Flowers 8-15 mm long, white in axillary or terminal umbellate cyme. Drupes 1-2 cm across, distinctly 4 lobed, fleshy, purple.

Ecology : Frequent in moist deciduous and semi-evergreen forests on back shore.

Fl. & Fr. : April-November; June-February.

Distrib. : Karnataka, Tamil Nadu, Maharashtra and Kerala.

7. *Grewia villosa* Willd., Ges. Naturf. Freunde Berlin Neue Schr. 4: 205. 1803; Masters in Hook. f., Fl. Brit.

India 1:388. 1874; Daniel & Chandrabose in Fl. India 3: 515. 1993.

Trees 3-5 m tall. Leaves 3-15 x 3-12 cm, ovate, orbicular or cordate, crenate or serrulate, rounded or abruptly acuminate at apex, cordate at base. Flowers 10 mm long, dull yellow, in axillary, leaf opposed cymes. Drupes 1.2-1.5 cm across, subglobose, yellowish red, villose.

Ecology : Occasional in coastal scrubs and dry deciduous forests.

Fl. & Fr. : Almost throughout the year.

Distrib. : Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Gujarat and Kerala.

4. *Triumfetta* L.

Triumfetta rhomboidea Jacq., Enum. Pl. Craib. 22. 1760; Masters in Hook. f., Fl. Brit. India 1: 395, 1874; Daniel & Chandrabose in Fl. India 3: 520. 1993.

Stellate, pubescent undershrubs, 30-60 cm tall. Leaves 2-10 x 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.

Ecology : Frequent along the river-banks and sea-shores, common on moist places.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat coast.

ELAEOCARPACEAE

Elaeocarpus L.

Elaeocarpus serratus L., Sp. Pl. 515. 1753; Masters in Hook. f., Fl. Brit. India 1: 401. 1874, *p.p.*; Murti in Fl. India 3: 553. 1993.

Trees 25-30 m tall; branchlets with pubescent leaf scars. Leaves 5-13 x 2.5-6 cm, oblong, obovate or elliptic, repand-serrate or crenate, acute at apex, cuneate or obtuse at base. Flowers 8-10 mm long, creamy white

in axillary, drooping racemes. Drupes 2.5-3.5 cm long, oblong-obovoid, greenish-yellow, 1-2 seeded.

Ecology : Frequent along the back shore hill slope and semi-evergreen forests of Western Ghats.

Fl. & Fr. : March-June; July-October.

Distrib. : Maharashtra, Karnataka, Tamil Nadu and Kerala coast.

LINACEAE

KEY TO THE GENERA

- 1a. Erect annuals 2. *Linum*
 1b. Climber or straggler 1. *Hugonia*

1. *Hugonia* L.

Hugonia mystax L., Sp. Pl. 675. 1753 "*myxstrax*"; Hook. in Hook. f., Fl. Brit. India 1: 413. 1874; Hajra in Fl. India 3: 576. 1993.

Scandent shrubs; branches yellowish, tomentose, with alternate horizontal branchlets. Leaves 3-6 x 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; Flowers 1-1.5 cm across, yellow, in terminal or upper axils of branchlets.

Drupes 1-1.2 cm in diam., globose, yellow or orange-red with scanty pulp and persistent calyx.

Ecology : Common along riverine scrubs and coastal thickets, in association with *Rourea minor* and *Clausena heptaphylla*.

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

Distrib. : Orissa coast and Western peninsula.

2. *Linum* L.

Linum usitatissimum L., Sp. Pl. 277. 1753; Hook. f., Fl. Brit. India 1: 410. 1874; Hajra in Fl. India 3: 580. 1993.

Annual herbs 60-80 cm tall. Leaves 1-3.5 cm long, lanceolate, narrowed at both end. Flowers 2-3 cm in axillary cymes. Capsules globose, mucronate.

Ecology : Commonly cultivated throughout the coastal areas as flax plant.

Fl. & Fr. : January-August.

Distrib. : Throughout India.

ERYTHROXYLACEAE

Erythroxylum P. Br.

Erythroxylum monogynum Roxb., Pl. Corom. 1: t. 88. 1795; Hook. f., Fl. Brit. India 1: 414. 1874; Chatterjee & Sharma in Fl. India 3: 590. 1993.

Tree 2-10 m tall, bark brown, very rough, lenticellate, wood scented. Leaves 1-4.5 x 0.5-2.4 cm, obovate, entire, stipulate, obtuse at apex, narrowed at base. Flowers 3 mm long, yellowish-white or greenish, in

axillary fascicles. Drupes 10 x 4 mm, straight, blood-red when ripe, ovoid, 1 seeded.

Ecology : In dry hilly regions and evergreen forests along the sea shore.

Fl. & Fr. : Throughout the year.

Distrib. : Andhra Pradesh, Maharashtra, Karnataka and Tamil Nadu coast.

ZYGOPHYLLACEAE

KEY TO THE GENERA

- 1a. Erect, prickly woody herb :
 - 2a. Leaves opposite :
 - 3a. 1-3 foliate leaves; flowers pink; fruits unarmed..... 1. *Fagonia*
 - 3b. 1-2 foliate leaves; flowers white; fruits 4-5 cornered or winged 4. *Zygophyllum*
 - 2b. Leaves alternate 2. *Peganum*
- 1b. Prostrate silky herb 3. *Tribulus*

1. *Fagonia* L.

Fagonia indica var. *schweinfurthii* Hadidi., Rech. fr., Fl. Iran. 98: 6, t. 6. 1972; *F. arabica* non L., Edgew. & Hook. in Hook. f., Fl. Brit. India 1: 425. 1874.

Branching woody herb with spines. Leaves 1-3 foliolate, leaflets 0.5-1 cm, elliptic or linear, acute at apex, narrowed at base. Flowers 0.2-0.4 cm, purple, solitary,

axillary. Capsules pubescent, 5 cornered with 1 seeded cocci.

Ecology : Common along the dry coastal sand stones and lateritic coast line.

Fl. & Fr. : August-September.

Distrib. : Gujarat and Konkan coast.

2. *Peganum* L.

Peganum harmala L., Sp. Pl. 444. 1753; Hook. f., Fl. Brit. India 1: 486. 1875.

Dichotomously branched, deep rooted, bushy herbs. Leaves 4-6 cm, linear-lanceolate, pinnatifid, narrowed at both end. Flowers 0.8 cm across, yellowish white, axillary, solitary. Capsules globose.

Ecology : Common on back shore sands and sand stones along the coast.

Fl. & Fr. : April-August.

Distrib. : Gujarat, Maharashtra and Karnataka coast. Used as medicinal herbs.

3. *Tribulus* L.

Tribulus terrestris L., Sp. Pl. 38. 1753; Hook. in Hook. f., Fl. Brit. India 1: 423. 1874.

Prostrate annual herbs; stems much-branched, pubescent. Leaves 2-4 cm long, opposite, anisophyllous, paripinnate; leaflets 3-6 pairs, each 4-10 x 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.

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

Fl. & Fr. : Mostly throughout the season.

Distrib. : Orissa, West Bengal, Gujarat and Maharashtra coast.

4. *Zygophyllum* L.

Zygophyllum simplex L., DC. Prodr. 1: 705. 1824; Edgew. & Hook. in Hook. f., Fl. Brit. India 1: 424. 1874.

Prostrate herb or small shrubs. Leaves 0.2-0.4 cm cylindrical, sessile, fleshy, obtuse at apex, narrowed at base. Flowers small, white or yellow with purple spots in axillary peduncle. Capsule deflex, rough, 5 compressed ribs with 2-3 seeds.

Ecology : Common on coastal desert on sandy and laterite shore.

Fl. & Fr. : September-December.

Distrib. : Gujarat, Runn of Kuchchh and Konkan coast. Probably from tropical Africa.

OXALIDACEAE

KEY TO THE GENERA

- 1a. Leaves palmately trifoliolate 2. *Oxalis*
 1b. Leaves pinnate 1. *Biophytum*

1. *Biophytum* DC.

Biophytum sensitivum (L.) DC., Prodr. 1: 690. 1824; Hook. in Hook. f., Fl. Brit. India 1: 436. 1874.

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 x 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.

Ecology : Common along sandy river-banks, in open places, and cultivated field.

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

Distrib. : Throughout the Indian coast.

2. *Oxalis* L.

Oxalis corniculata L., Sp. Pl. 435. 1753; Hook. in Hook. f., Fl. Brit. India 1:436. 1874.

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

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

Fl. & Fr. : During the rainy season.

Distrib. : Throughout the coast.

BALSAMINACEAE

Impatiens L.

Impatiens balsamina L., Sp. Pl. 938. 1753; Hook. in Hook. f., Fl. Brit. India 1: 453. 1874.

Succulent herb up to 75 cm, branchlets glabrescent. Leaves 3.5-6.5 x 0.5-1 cm, linear-lanceolate or elliptic, serrate, acuminate at apex, attenuate at base. Flowers 2 cm across, solitary or in clusters of 2 or 3. Capsule 1 x 0.5 cm, oblong or ellipsoid, tomentose. Seeds 2 mm, ovoid tubercled.

Ecology : Common on exposed sandy backshore and on sea front cliffs.

Fl. & Fr. : October-February.

Distrib. : Midnapur coast in West Bengal, Satavva in Orissa, Ratnagiri in Konkan coast and Maharashtra, Tamil Nadu and Karnataka coast.

RUTACEAE

KEY TO THE GENERA

- 1a. Plants armed with spines or prickles :
 2a. Plants with axillary spines; leaves simple 3. *Merope*
 2b. Plants with prickles; leaves trifoliolate 5. *Toddalia*
- 1b. Plants unarmed :
 3a. Leaflets alternate; ovary 2 or 5 celled :
 4a. Flowers in panicles; ovary 5 celled 2. *Glycosmis*
 4b. Flowers in corymbose cymes; ovary 2 celled 4. *Murraya*
 3b. Leaflets opposite; ovary 4 celled 1. *Clausena*

1. *Clausena* Burm.

Clausena heptaphylla Wight & Arn. Prodr. 95. 1834; Hook. in Hook. f., Fl. Brit. India 1: 504. 1874.

Strongly aromatic, glabrous shrubs or small trees. Leaves imparipinnate, 8-11 foliolate; leaflets 6-8 x 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.

Ecology : Common in riverine scrubs, sand-bars within the tidal forests, in association with *Rourea minor*, *Hugonia mystax* and *Carissa spinarum*.

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

Distrib. : Orissa, Ganjam, Annamalais, Andaman and Travancore coast.

2. *Glycosmis* Correa

Glycosmis pentaphylla (Retz.) DC. Prodr. 1: 538. 1824, *quoad basio*; Hook. in Hook. f., Fl. Brit. India 1: 500. 1875.

Undershrubs or shrubs up to 3 m tall. Leaves pinnate, 3-5, or 7 foliolate; leaflets 4-13 x 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.

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

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

Distrib. : Throughout the coastal districts.

3. *Merope* Roem.

Merope angulata (Willd.) Swingle in Journ. Washington Acad. Sci. 5: 423. 1915; Back. & Bakh. Fl. Java 2: 106. 1965. Nayar, K. & M.P. Nayar in Fl. India 4: 300. 1997.

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 x 1.5-3.5 cm

simple, oblong or elliptic-oblong, entire, thick, coriaceous, obtuse or acute at apex, obtuse at base. Flowers 1-1.3 cm across, white, fragrant, axillary, solitary or in pairs or in few-flowered clusters. Fruits 3-4 x 1.5-2 cm, ovoid, triquetrous, beaked, coriaceous, berry, filled with mucilaginous fluid. Seeds 4, 1 in each locule, 1.5-2 cm

long, ovoid-oblong, compressed with a narrow beak at apex, attached to the apiculus of fruit.

Ecology : Common in estuarine Islands along the intertidal as well as supratidal regions of several creeks and channels, in association with *Ceriops decandra* and

Aegialitis rotundifolia.

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

Distrib. : Its occurrence is restricted only to the tidal forests of Orissa.

4. *Murraya* Koen. ex L.

Murraya koenigii (L.) Sprengel in L. Syst. Veg. (ed.16) 2: 315. 1826; Hook. in Hook. f., Fl. Brit. India 1: 503. 1875.

Shrub or small tree 5-10 m tall. Leaves 30 cm, pinnate; leaflets 15-25, asymmetrical, 4 x 1.5 cm, oblong-lanceolate, acute at apex and oblique at base. Flowers 6-15 cm long, white, fragrant, arranged in terminal paniculate cyme. Fruit subglobose, purplish black when ripe.

Ecology : Frequently found along the coastal region as a planted garden tree. Sometimes found in coastal scrub forest.

Fl. & Fr. : In two peaks, during March-May and July-August; Throughout the year.

Distrib. : Throughout the East and West coast.

5. *Toddalia* Juss.

Toddalia asiatica (L.) Lamk. III, 2:166. 1792. *T. aculeata* Pers.: Hook. in Hook. f., Fl. Brit. India 1: 497. 1874.

Erect bushy or rambling shrubs; branches puberulous, armed with prickles. Leaves trifoliolate; leaflets sessile, each 3-7 x 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.

Ecology : Frequent in riverine scrubs and coastal thickets.

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

Distrib. : West Bengal, Orissa, Chilka and throughout western peninsula.

SIMAROUBACEAE

Samadera Gaertn.

Samadera indica Gaertn., Fruct. 2: 352. t. 156. f. 3. 1791; Bennet in Hook. f., Fl. Brit. India 1: 519. 1875. Basak Fl. India 4: 420. 1997. *Quassia indica* (Gaertn.) Nootb., Fl. Mal. 6:199. 1962.

Small tree or shrub. Leaves 20 x 7.5 cm, elliptic-lanceolate, fleshy, obtuse at apex, narrowed at base.

Flowers 1.5-1.8 cm long, whitish arranged in umbels. Fruits 3.7 x 2.5 cm, drupaceous, winged.

Ecology : Rare on backwater fringes and river bank near the coast.

Fl. & Fr. : September-October.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

SURIANACEAE

Suriana L.

Suriana maritima L., Sp. Pl. 284. 1753; Bennet in Hook. f., Fl. Brit. India 1: 522. 1875; Vajravelu & Basak in Fl. India 4: 422. 1997.

Shrub, up to 2 m high. Leaves 1-3 x 0.2-0.5 cm, linear-spathulate, entire, acute at apex, attenuate at base. Flowers 5-7 mm across, bright yellow, in solitary axillary or terminal cymes. Fruits 4 x 3 mm, obovoid. Seeds 2 mm long, oblong.

Ecology : Monotypic species. Common on dead coral reefs, rocky and sandy coast where accumulation of calcium shells are more.

Fl. & Fr. : Almost throughout the year.

Distrib. : Along the coral islands of Tamil Nadu coast from Rameswaram to Kanya Kumari and Lakshadweep.

OCHNACEAE

Ochna L.

Ochna obtusata DC., Ann. Mus. Paris 17: 411, Pl. 11. 1811; Safai & M.P. Nayar in Fl. India 4: 429. 1997. *O. squarrosa* (auct. L.) Rottb.: Bennet in Hook. f., Fl. Brit. India 1: 523. 1875.

Trees or shrubs, 2-3 m tall; branches glabrous, with annular scars; stipules simple, caducous. Leaves alternate, distichous, 4-14 x 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. Fruits 3-5, attached to an elongated torus.

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

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

Distrib. : Orissa, Tamil Nadu and Kerala coast.

MELIACEAE

KEY TO THE GENERA

- 1a. Leaflets usually toothed :
- 2a. Fruit 1-2 seeded drupe; seed albuminous 3. *Cipadessa*
- 2b. Fruit 1-seeded drupe; seed exalbuminous 2. *Azadirachta*
- 1b. Leaflets usually entire :
- 3a. Anther included in the staminal tube. Fruit a loculicidal capsule:
- 4a. Ovary 3-celled; ovules 1-2 in each cell 1. *Aglata*
- 4b. Ovary 4-celled; ovules 2-12 in each cell 5. *Xylocarpus*
- 3b. Anther exerted or filaments free. Fruit a indehiscent berry 4. *Walsura*

1. *Aglata* Lour.

KEY TO THE SPECIES

- 1a. Leaflets 7-11, terminal leaflet forms a cup at base 1. *cucullata*
- 1b. Leaflets 3-7, terminal leaflet not forms a cup 2. *elaegnoidea*



Tamarix aphylla



Calophyllum calaba



Calophyllum inophyllum



Hibiscus tiliaceus



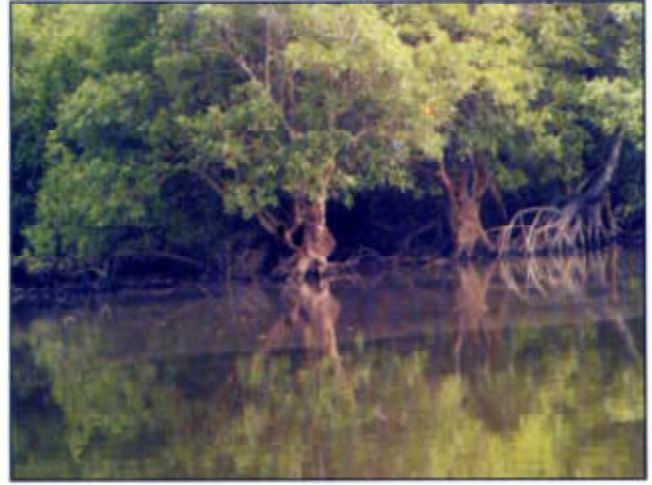
Thespesia populnea



Heritiera fomes



Xylocarpus granatum



Xylocarpus moluccensis



Scolopia acuminata



Polyalthia suberosa



Mesua ferrea



Walsura trifoliata

1. *Aglaia cucullata* (Roxb.) Pellegrin in Lecomte, Fl. Indo-china 1: 171, 1911. Jain & Bennet in Fl. India 4: 460, 1997. *Amoora cucullata* Roxb.: Hiern in Hook. f., Fl. Brit. India 1: 560, 1875.

Diococious trees or treelets, 3-8 m tall with numerous blind rootsuckers beneath; stems few branched; barks soft, lenticillate. Leaves 34-40 cm long imparipinnate, glabrous; leaflets 7-11, each 9-18 x 4-6 cm, elliptic-oblong or oblong-lanceolate, glabrous, inequilateral, obtuse at apex, oblique at base; terminal leaflets mostly forming a distinct cup at base. Flowers unisexual, 3-4 mm across, yellow, in axillary panicles. Fruits trilocular capsules, 8-12 cm across, globose, depressed, yellow when ripe. Seeds 3, completely covered by fleshy, orange arils.

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

Fl. & Fr. : Male flowers throughout the season, female

flowers during April-July; fruits during August-November.

Distrib. : Orissa in Mahanadi delta. Also reported from Sundarbans and Andamans but not collected.

2. *Aglaia elaeagnoides* (Juss) Benth., Fl. Austral. 1: 383, 1863; *A. roxburghiana* (Wight & Arn.) Miq.: Hiern in Hook. f., Fl. Brit. India 1: 555, 1875.

Tree, 7-10 m, branchlets stellate tomentose. Leaves up to 15 cm, odd pinnate; leaflets 4-7.5 x 1.5-2.5 cm, opposite, elliptic-oblong or obovate, coriaceous, glabrous above, tomentose below, margin entire, subacute or obtuse at apex, cuneate at base. Flowers 5 mm across yellowish in axillary panicles. Berry up to 1 cm, diam., globose, velvety tomentose. Seeds one, ellipsoid.

Ecology : Frequent on hill slopes along the back shore.

Fl. & Fr. : November-February.

Distrib. : Gujarat and Konkan coast.

2. *Azadirachta* A. Juss.

Azadirachta indica A. Juss., Mem. Mus. Hist. Nat. 19: 221, t. 2, f. 5, 1830. Jain & Bennet in Fl. India 4: 478, 1997. *Melia azadirachta* L., 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 x 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.

Ecology : Frequent along the lee side of the coastal dunes, and along road sides and gardens.

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

Distrib. : Throughout the coastal India.

3. *Cipadessa* Blume

Cipadessa baccifera (Roth) Miq. in Ann. Mus. Bot. Lugd. Batavu in 4: 6, 1868; Jain & Bennet in Fl. India 4: 482, 1997. *C. fruticososa* Blume Bijdr.: Hiern in Hook. f., Fl. Brit. India 1: 545, 1875.

Trees 3-6 m tall with more or less soft lenticellate bark. Leaves 13-20 cm long, imparipinnate; leaflets 7-11, each 4-9 x 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. Fruits 3-5 mm across, globular drupes with 5 pyrenes. Seeds 1 in each pyrene, elongated; testa thin, membranous.

Ecology : Frequent in scrubs along the river-banks.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

4. *Walsura* Roxb.

Walsura trifolia (Adr. Juss.) Harms in Engl. & Prantl, Nat. Pflanzenfam (ed.2) 19 B. 1: 119. 177. 1940; Jain & Bennet in Fl. India 4: 522. 1997. *W. ternata* Roxb.: Hiern Hook. f., Fl. Brit. India 1: 564. 1875.

Tree up to 12 m; branchlets densely tomentose. Leaves up to 12 x 9 cm 3-foliolate; leaflets 5-8 x 2-4.5 cm, oblong or ovate-lanceolate, thick-coriaceous, glabrous above, glaucous below, margin entire, obtuse or retuse at apex, cuneate at base. Flowers 8 mm across in axillary

and or terminal, corymbose, panicle. Berry 2 x 1 cm, velvety-tomentose. Seed 7 x 5 mm, solitary, ovoid.

Ecology : Rarely found on the sea-shore, in the crevices of the hill slope.

Fl. & Fr. : January-March.

Distrib. : Common on inland hills, frequently extend to the rocky sea shores along Gujarat and Konkan coast.

5. *Xylocarpus* Koen.

KEY TO THE SPECIES

- 1a. Buttresses present; rootsuckers absent; bark yellowish-white with papery flakes; leaflets obovate; fruits 20-35 cm across 1. *granatum*
- 1b. Buttresses absent; rootsuckers present; bark dark-red with thick flakes; leaflet not obovate; fruits less than 20 cm across :
 - 2a. Leaflets elliptic-oblong; fruits 8-15 cm across 2. *mekongensis*
 - 2b. Leaflets ovate-oblique; fruits 5-7 cm across 3. *moluccensis*

1. *Xylocarpus granatum* Koen., Naturforscher 20: 2. 1784. Jain & Bennet in Fl. India 4: 518. 1997. *Carapa moluccensis* auct. non Lamk.: Hook. f. fl. Brit. India 1: 567. 1875.

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 x 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. Fruits 30-40 cm across, spherical, pendulous, septifragal capsules, splitting tardily into 4 valves. Seeds more than 15, each 4-7 x 3-4 cm, pyramidal or triangular; testa corky.

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

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

Distrib. : Sundarbans, Mahanadi delta in Orissa, Godavari delta in Andhra Pradesh. Its distribution is not found extended beyond the Godavari delta in the mainland. It is common in the Andaman islands.

2. *Xylocarpus mekongensis* Pierre, Fl. Coch. t. 359B. 1897. Jain & Bennet in Fl. India 4: 518. 1997. *X. gangeticus* (Prain) Parkinson in Indian For. 60: 140. 1934.

Trees 10-15 m tall, 40-60 cm in girth with many blind rootsuckers from the lateral roots beneath the trees; bark reddish-brown with thick flakes. Leaves paripinnate, mostly bijugate; leaflets 2-4 pairs, each 9-18 x 4-7 cm, elliptic or oblong, coriaceous, obtuse at both ends. Flowers 3-4 cm, across, white in short-branched, axillary thyrses. Fruits 8-12 cm across, capsular, brown, leathery, globose. Seeds 1-2 cm across, flat, compressed, tetrahedral; testa corky.

Ecology : Frequent in tidal forests along the intertidal as well as supratidal regions in association with *Heritiera fomes* and *Bruguiera gymnorhiza*.

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

Distrib. : Sundarbans, Mahanadi delta, Orissa and Andamans.

3. *Xylocarpus moluccensis* (Lamk.) M. Roem. Syn. Hesper. 124. 1846. *Carapa moluccensis* Lamk., Hiern in Hook. f., Fl. Brit. India 1: 567. 1875.

Trees 10-20 m tall, 20-50 cm in girth with no blind rootsuckers; bark red with thick flakes; flakes constantly peeling off; wood dark red. Leaves paripinnate, 2-3 jugate; leaflets 7-12 x 3-6 cm, ovate, coriaceous, acute at apex, oblique at base. Flowers 2-3 cm across, red glandular within, on sparingly-branched, axillary thyrses. Fruits 10-18 cm across, globose, woody. Seeds 2-4 cm in diam., tetrahedral, angular margined due to compression; testa smooth, corky.

Ecology : Sporadic in the intertidal or supratidal regions, usually favouring sandy uplands within the tidal swamps in association with *Heritiera littoralis*, *Aglaja cucullata* and *Intsia bijuga*.

Fl. & Fr. : June-July (during formation of new leaves); September-December.

Distrib. : Only from Andaman (Chiratapu and Redskin islands).

OLACACEAE

Olax L.

Olax scandens Roxb., Pl. Cor. 2: 2, t. 102, 1798; Uniyal in Fl. India 5: 9, 2000; Hook. f., Fl. Brit. India 1: 575, 1875.

Woody, scandent shrubs; stems much-branched, cylindric, striate; branchlets armed with curved prickles. Leaves 3-9 x 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. Fruits 1-2 cm across, ellipsoid drupes, yellow when ripe, enclosed by accrescent calyx.

Ecology : Frequent along the river-banks, sandy uplands and sand bars in between the creeks and channels.

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

Distrib. : Throughout the coast.

OPILIACEAE

Cansjera Juss.

Cansjera rheedii Gmelin in L., Syst. Nat. ed. 13, 2(1): 280, 1791; Mathur in Fl. India 5: 40, 2000; Hook. f., Fl. Brit. India 1: 582, 1875.

Large, scandent shrubs; twigs ferruginous, pubescent, old stems lenticellate, spiny at base. Leaves 4-10 x 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.

Ecology : A root parasite, frequent in scrubs and coastal thickets.

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

Distrib. : Throughout the Mahanadi delta, Orissa, Tamil Nadu and Karnataka coast.

CELASTRACEAE

Maytenus Molina

Maytenus emerginata (Willd.) Ding Hou, Fl. Males. 6(2): 241, 1962; Ramamurthy in Fl. India 5: 120, 2000. *Celastrus emerginatus* Willd., Lawson in Hook. f., Fl. Brit. India 1: 621, 1875.

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 x 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. Fruits 8-14 x 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.

Ecology : Common in riverine scrubs, coastal thickets and sand bars, also within the mangrove swamps.

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

Distrib. : Eastern and Western peninsula near the coast.

RHAMNACEAE

KEY TO THE GENERA

- 1a. Under surface of leaves tomentose; stipules spinulose; fruit a dry or fleshy drupe 3. *Ziziphus*
 1b. Under surface of leaves glabrous; stipules not spinulose; fruit not drupe :
 2a. Flowers axillary cymes; fruit 3 seeded capsule 1. *Colubrina*
 2b. Flowers axillary fascicles or umbels; fruit 2-4 seeded pyrene 2. *Scutia*

1. *Colubrina* L. Rich. ex Brong.

Colubrina asiatica (L.) Brong. in Ann. Sci. Nat. Ser.1, 10: 369. 1827; Bhandari & Bansali in Fl. India 5: 169. 2000; Lawson in Hook. f., Fl. Brit. India 1: 642. 1875.

Unarmed, glabrous shrubs with many shining branches. Leaves 4-8 x 3-5 cm, alternate, ovate, dentate, obtusely acuminate at apex, rounded or cordate at base. 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.

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

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

Distrib. : Hookitola in Orissa, Chilka, Eastern and Western peninsula, Ratnagiri hills and Lakshadweep Island.

2. *Scutia* (DC.) Comm. ex Brongn.

Scutia myrtina (Burm. f.) Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 44: 168. 1875; Bhandari & Bansali in Fl. India 5: 207. 2000. *S. indica* Brongn., Lawson in Hook. f., Fl. Brit. India 1:640. 1875.

Straggler 5-8 m. Leaves 1.5-3 x 1.5-2 cm, obovate or orbicular, coriaceous, glossy above, entire, apiculate at apex, cuneate at base. Flowers 3 mm across, greenish

white in axillary umbellate clusters. Drupe 7 x 8 mm, subglobose.

Ecology : Frequent along sandy coastal scrubs, sand bars and degraded coastal hill slopes.

Fl. & Fr. : February-March; April-May.

Distrib. : Gujarat, Tamil Nadu, Karnataka and Malabar coast.

3. *Ziziphus* Miller

KEY TO THE SPECIES

- 1a. Scandent or straggling shrubs 4. *oenoplia*
 1b. Erect shrubs or trees :
 2a. Usually unarmed; leaves glabrous 1. *glabrata*
 2b. Armed; leaves tomentose :
 3a. Leaves rounded at apex; drupe less than 1.5 cm in diameter 2. *nummularia*
 3b. Leaves obtuse at apex; drupes more than 1.5 cm in diameter 3. *mauritiana*

1. *Ziziphus glabrata* Heyne ex Roth, Nov. Pl. Spec. 159, 1821; Bhandari & Bansali in Fl. India 5: 229. 2000; Lawson in Hook. f., Fl. Brit. India 1: 633. 1875.

Tree 8-10 m tall. Leaves 3-6 x 1.5-2.5 cm, ovate or oblong-elliptic, pubescent above, tomentose beneath, crenate, obtuse at apex, subcordate at base. Flowers 7 mm across, greenish white in axillary cymes. Drupe 6 mm across, globose-obovoid.

Ecology : Frequent along sandy river banks and coastal scrub forest.

Fl. & Fr. : December-February.

Distrib. : All along the Indian coast.

2. *Ziziphus nummularia* (Burm. f.) Wight & Arn. Prodr. 162. 1834; Bhandari & Bansali in Fl. India 5: 235. 2000; Lawson in Hook. f., Fl. Brit. India 1: 633. 1875.

Erect bushy shrub. Leaves 1-1.75 x 0.7-1.5 cm, orbicular or ovate, tomentose. Flowers 0.3-0.5 mm across, greenish white arranged in axillary cymes. Drupes 0.5-1 cm across globose.

Ecology : Common in sandy and gravelly soil along the inland forests of coastal tracks.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

3. *Ziziphus mauritiana* Lamk. Encycl. Method. Bot. 3: 319. 1789; Bhandari & Bansali in Fl. India 5: 233.

2000. *Z. jujuba* Lamk.: Lawson in Hook. f., Fl. Brit. India 1: 632. 1875.

Trees 4-8 m tall, branchlets drooping, armed with thorns. Leaves 1.5-6.5 x 1-3.5 cm alternate, broadly elliptic or ovate, dark-green, tomentose beneath, crenate 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.

Ecology : Frequent along scrub jungles and beach forests near the delta.

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

Distrib. : Throughout the coastal districts. Naturalised in India.

4. *Ziziphus oenoptia* (L.) Miller, Gard. Dict. ed. 8, no. 3. 1768; Bhandari & Bansali in Fl. India 5: 236. 2000; Lawson in Hook. f., Fl. Brit. India 1: 634. 1875.

Straggling, thorny shrubs with many pubescent branches ascending the nearest trees. Leaves 2-5 x 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. Fruits 4-6 mm across, globose drupes.

Ecology : Common in scrub jungles and coastal thickets usually in association with *Carisa spinarum*, *Eugenia bracheata* and *Memecylon edule*.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat and Maharashtra coast.

VITACEAE

KEY TO THE GENERA

- 1a. Leaves simple; inflorescence leaf-opposed; berries 1 seeded 2. *Cissus*.
 1b. Leaves many foliate; inflorescence axillary or pseudo-terminal;
 berries 2 to 4 seeded 1. *Cayratia*.

1. *Cayratia* Juss.

KEY TO THE SPECIES

- 1a. Leaves 3 foliate 2. *trifolia*
 1b. Leaves 7-11 foliate 1. *pedata*

1. *Cayratia pedata* (Lour.) A.L. Juss. ex Gagnep., Lecomte, Notul. Syst. (Paris) 1: 346, 1911; Shetty & Singh in Fl. India 5: 271, 2000. *Vitis pedata* Wall. ex Wight & Arn.: Lawson in Hook. f., Fl. Brit. India 1: 661, 1875.

Liane, 8-12 m. Leaves 8-15 cm, pinnately 5-7 foliolate; leaflets 7-12 x 3-6 cm, terminal one elliptic, oblong or ovate-lanceolate; laterals pedately lobed, inequilateral, membranous pubescent, acuminate at apex and cuneate at base. Flowers 3 mm across in axillary cymes. Berry 6 x 8 mm, subglobose, 2-4 seeded.

Ecology: Plains from the coast and also on sandy thickets along the coast. Sometimes found common along the inland forests.

Fl. & Fr.: April-July; Throughout the year.

Distrib.: Throughout Indian coast, particularly in West Bengal, Orissa, Tamil Nadu and Karnataka.

2. *Cayratia trifolia* (L.) Domin., Biblioth. Bot. 89: 37, 1972; Shetty & Singh in Fl. India 5: 275, 2000. *Vitis carnosa* (Lamk.) Wall.: Lawson in Hook. f., Fl. Brit. India 1: 654, 1875.

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. Fruits 1-1.5 cm across, depressed, globose berries, reddish-black when ripe. Seeds 3-4, with a chalaza on the back.

Ecology: Frequent along the outer fringes of mangroves, river-banks and road-side hedges and on rocky hill slopes near the coast.

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

Distrib.: Orissa, Chilka, Tamil Nadu, Karnataka and Maharashtra coast.

2. *Cissus* L.

Cissus vitiginea L., Sp. Pl.: 117, 1753; Shetty & Singh in Fl. India 5: 294, 2000. *Vitis lianaei* Wight & Arn.: Lawson in Hook. f., Fl. Brit. India 1: 649, 1875.

Densely pubescent vine. Leaves 5-8 x 4.5-8.5 cm, broadly cordate, 5-angular or deeply lobed, dentate, acuminate at apex, cordate at base. Flowers 3.5 mm across,

pale yellow in umbellate cymes. Berry 1 x 0.6 cm, pyriform, rugose apiculate.

Ecology: Frequent along the coastal plains and lee side of the coastal sand dune.

Fl. & Fr.: June-November. Throughout the year.

Distrib.: Throughout the East and West coast.

LEACEAE

Leea Royen ex L.

Leea indica (Burm. f.) Merr., Philipp. J. Sci. 14: 245, 1919; Naithani in Fl. India 5: 337, 2000. *L. sambucifolia* Willd.: Lawson in Hook. f., Fl. Brit. India 1: 666, 1875.

Creeping shrubs. Leaves 2-3 pinnate, 30 x 15 cm; pinnae 3 paired; leaflets odd-pinnate, 2-5 paired, 5.5-15 x 3-5 cm, oblong-lanceolate or ovate, coriaceous, dentate, acuminate at apex, obtuse at base. Flowers 5 mm across, greenish white arranged in leaf opposed

corymbose cymes. Berry globose, depressed; pyrenes 5 or 6.

Ecology: Frequent along the coastal scrub jungles and coastal cliffs.

Fl. & Fr.: April-May; October-November.

Distrib.: Tamil Nadu, Karnataka, Kerala coast, Gulf of Mannar and Andaman islands.

SAPINDACEAE

KEY TO THE GENERA

- 1a. Tendrillar and climbing herbs 2. *Cardiospermum*
 1b. No tendrils; erect shrubs or trees :
 2a. Fruits drupaceous, not winged :
 3a. Leaves 3-foliolate :
 4a. Petal present; fruit 1-2 lobed, subglobose 1. *Allophylus*
 4b. Petal 0; fruit not lobed, ovoid 6. *Schleichera*
 3b. Leaves paripinnate :
 5a. Fruit lobed, tomentose 4. *Lepisanthes*
 5b. Fruit not lobed, glabrous, fleshy 5. *Sapindus*
 2b. Fruits capsular, winged 3. *Dodonaea*

1. *Allophylus* L.

Allophylus cobbe (L.) Raeusch. Nomencl. Bot. ed. 3, 108. 1797; Pant in Fl. India 5: 346. 2000; Hiern in Hook. f., Fl. Brit. India 1: 674. 1875.

Shrubs or trees, 2-3 m tall, sometimes scandent; branches with plenty of pith, brown lenticells. Leaves trifoliolate, alternate; leaflets 2-12 x 1.5-5 cm very variable in shape and size; margin serrate, crenate or denate; 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. Fruits 5-7 mm across, globose, shining, red when ripe.

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

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Maharashtra coast.

2. *Cardiospermum* L.

Cardiospermum halicacabum L., Sp. Pl. 366. 1753; Pant in Fl. India 5: 356. 2000; Hook. f., Fl. Brit. India 1: 670. 1875.

Climbing herbs with angular, puberulous branches. Leaves alternate, hternate; leaflets or ultimate segments 3-6 x 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.

Ecology : Frequent in waste places, cultivated field and along the river-side hedges.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coastal districts, common in the cultivated fields in Andamans.

3. *Dodonaea* L.

Dodonaea viscosa (L.) Jacq. Enum. Syst. Pl. 19. 1760; Pant in Fl. India 5: 361. 2000 Hiern in Hook. f., Fl. Brit. India 1: 697. 1875.

Evergreen shrubs or small trees 1-2 m tall; stems glabrous, dark brown. Leaves 8-14 x 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. Fruits 1.7 cm across, membranous inflated, winged

capsules. Seeds globose, black.

Ecology : Common along sandy sea-shores, often cultivated as an ornamental species.

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

Distrib. : Throughout the coastal hedges, sandy sea shore and sandunes of coastal inland areas and Andamans.

4. *Lepisanthes* Bl.

Lepisanthes tetraphylla (Vahl) Radlk. Sitz. Ber. K. Bayer. Ak. Wiss. M. Ph. Kl. Muench. 8: 276. 1878; Pant in Fl. India 5: 372. 2000. *Hemigyrosa deficiens* Bedd.: 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 x 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.

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

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

Distrib. : Orissa, Godavari and Krishna delta in Andhra Pradesh, Maharashtra, Karnataka and Andamans.

5. *Sapindus* L.

Sapindus emarginatus Vahl., Symb. Bot. 3: 54. 1794; Pant in Fl. India 5: 381. 2000. *S. trifoliatus auct. non L.*: Hiern in Hook. f., Fl. Brit. India 1: 682. 1875, p.p.

Tree 12-15 m tall. Leaves even-pinnate, 15 x 17 cm; leaflets 3 pairs, each 5-10 x 2.5-4 cm, oblanceolate, thick-coriaceous, entire, emarginate or retuse at apex, cuneate at base. Flowers 5 mm across, brownish white arranged in axillary rusty panicles. Drupes ovoid, lobed,

smooth. Seeds without aril.

Ecology : Frequent along the banks of canals and rivers of the coastal areas. Sometimes trees are leased out for its soap yielding nuts.

Fl. & Fr. : February-April; Throughout the year.

Distrib. : Ganjam coast of Orissa, Andhra Pradesh, Karnataka, Tamil Nadu and Andamans.

6. *Schleichera* Willd.

Schleichera oleosa (Lour.) Oken, Allg. Naturgesch. 3(2): 1341. 1841; Pant in Fl. India 5: 384. 2000. *S. trijuga* Willd. in Hook. f., Fl. Brit. India 1: 681. 1875.

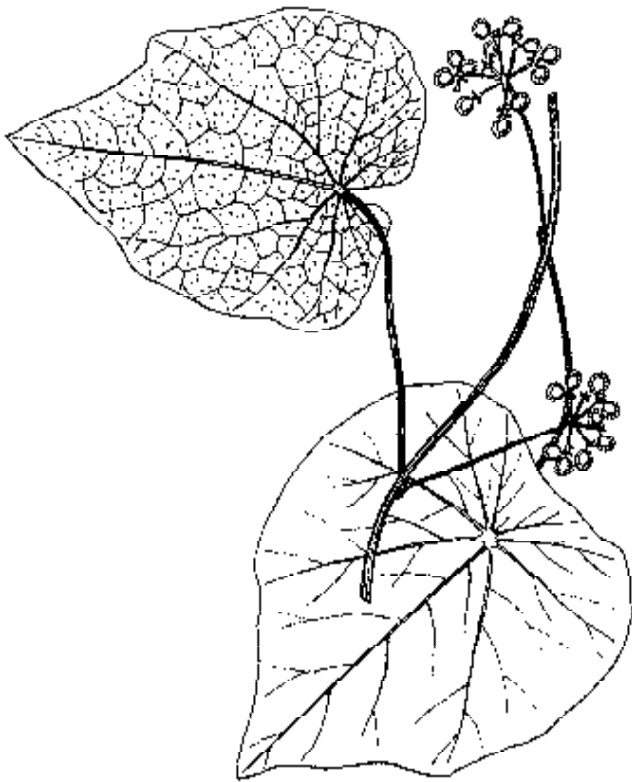
Tree, 15-25 m tall. Leaves even pinnate; leaflets 5-13 x 2.5-5.5 cm, oblong-elliptic, coriaceous, entire, obtuse-round at apex, cuneate-subcordate at base. Flowers 4 mm across, cream to yellowish, in pendulous panicles. Drupe 2.5 x 1.5 cm, ovoid, spiny. Seeds 1 cm

across, ovoid with fleshy aril.

Ecology : Frequent on dry sandy and lateritic areas of the coast.

Fl. & Fr. : March-April.

Distrib. : Frequent along the coast of West Bengal, Orissa, Tamil Nadu, Andhra Pradesh, Maharashtra and Andamans.



Stephania japonica (Thunb.) Miers



Cleome gynandra L.



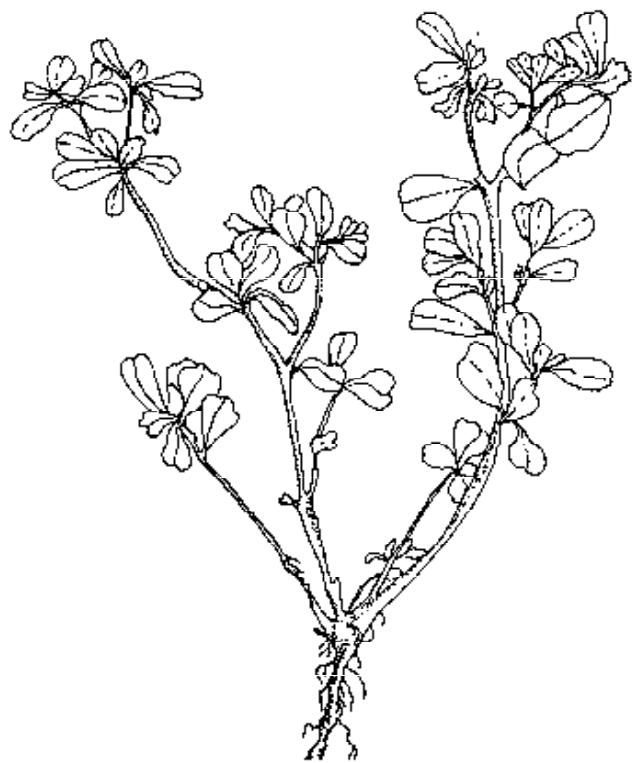
Hybanthus enneaspermus (L.) F. Muell.



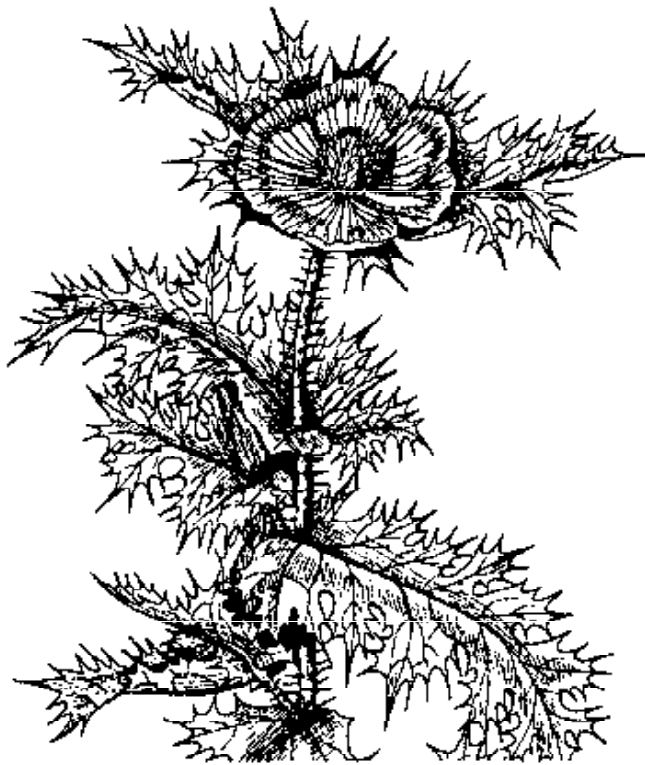
Polygala arillata Buch.-Ham. ex D. Don



Polycarpon prostratum (Forssk.) Aschers. & Schweinf.



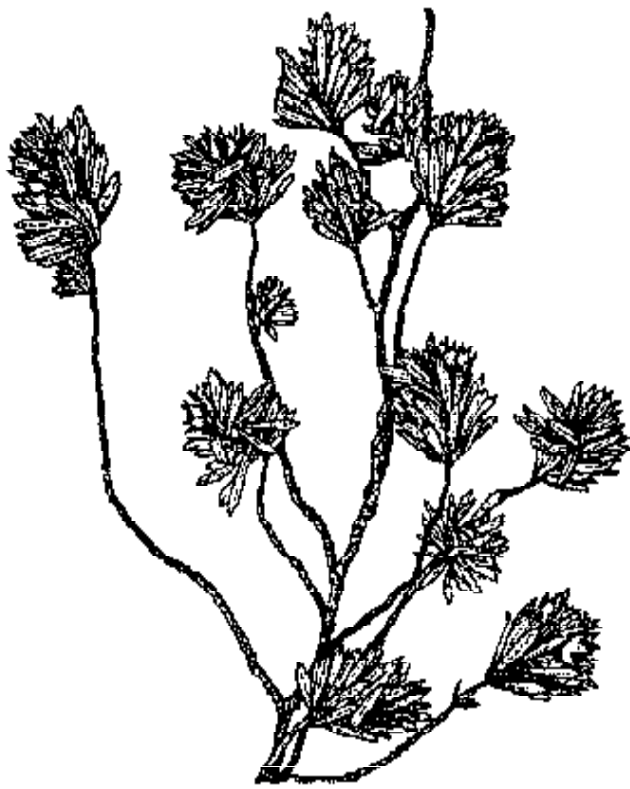
Portulaca oleracea L.



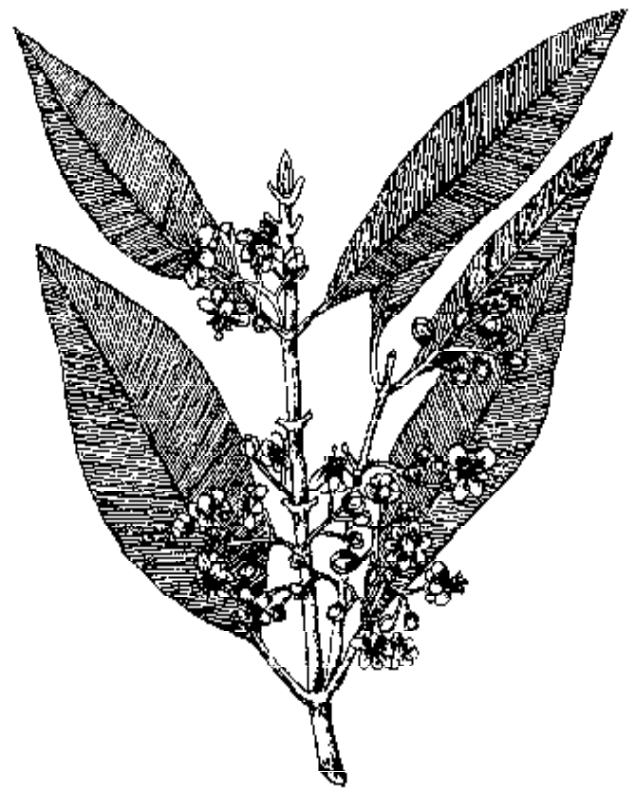
Argemone mexicana L.



Hibiscus micranthus L. f.



Suriana maritima L.



Calophyllum polyanthum Wall. ex Choisy



Fioria vitifolia (L.) Mattei



Sida acuta Burm. f.



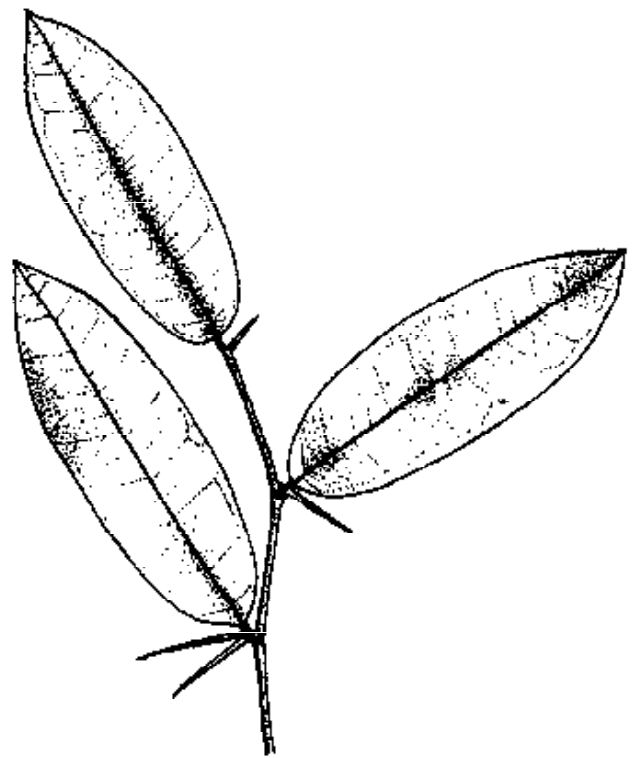
Guazama ulmifolia Lam.



Heritiera kanikensis Majum. et Baner.



Tribulus terrestris L.



Merope angulata (Willd.) Swingle

ANACARDIACEAE

KEY TO THE GENERA

- 1a. Carpels 5 or 1 only :
 2a. Carpels 5, 1 only fertile; drupe cuticular, valved 2. *Buchanania*
 2b. Carpels 1, fertile; drupe fleshy :
 3a. Fruit fleshy drupe, stamens 1-5, sometimes 1 or 2 fertile 5. *Mangifera*
 3b. Fruit a reniform nut on a fleshy hypocarp; stamens
 8-10, all or mostly fertile 1. *Anacardium*
- 1b. Carpels 4 or 3 :
 4a. Carpels 4; leaves pinnate; drupes compressed 4. *Lannea*
 4b. Carpels 3; leaves simple; drupes partly or wholly enclosed
 in hypocarp 3. *Holigarna*

1. *Anacardium* L.

Anacardium occidentale L., Sp. Pl. 583, 1753; Chandra & Mukherjee in Fl. India 5: 437, 2000; Hook. f., Fl. Brit. India 2: 20, 1876.

Trees, 6-8 m tall, often branched near the base. Leaves 7-14 x 6-10 cm ovate, oblong or obovate, glabrous, rounded or emarginate at apex, cuneate or obtusely rounded at base. Flowers 5-9 mm 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.

Ecology : 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 sand dunes, but never found along the windward sea-shore. Largely cultivated along the coastal districts.

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

Distrib. : Native from Costa Rica to Brazil and Ecuador. Introduced throughout the Indian coast.

2. *Buchanania* Spreng.

Buchanania axillaris (Desr.) T.P. Ramamurthy in Saldanha & Nicholson, Fl. Hassan Dist. 374, 1976; Chandra & Mukherjee in Fl. India 5: 441, 2000. *B. angustifolia* Roxb.: Hook. f., Fl. Brit. India 2:23, 1876.

Tree, 5-10 m long. Leaves 11-14.5 x 4.2-6 cm, oblong-elliptic, entire subacuate at apex and obtuse at

base. Flowers 6 mm across, greenish-white in panicles. Drupe 1 cm long.

Ecology : Rare along coastal cliffs and dry sand hills on the lee side of the sand dunes.

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

Distrib. : Tamil Nadu, Karnataka & Maharashtra coast.

3. *Holigarna* Ham.

Holigarna longifolia Roxb., Fl. Ind. 2: 80, 1824; Cor. Pl. 79, t. 282, 1820; Chandra & Mukherjee in Fl. India 5: 461, 2000; Hook. in Hook. f., Fl. Brit. India 2: 37, 1876.

Tree, 10-15 m tall, with whitish grey bark. Leaves 18-25 x 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. Flowers 2.5 mm diam., clustered, drupes oblong acrid.

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

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

Distrib. : Orissa, Andhra Pradesh and Tamil Nadu coast.

4. *Lannea* Rich.

Lannea coromandelica (Hout.) Merril., Journ. Arn. Arb. 19: 353. 1938; Chandra & Mukherjee in Fl. India 5: 463. 2000. *Odina wodier* Roxb.: Hook. in Hook. f., Fl. Brit. India 2: 29. 1876.

Trees, 6-10 m tall, deciduous; bark smooth, soft, thick, chlorophyllous; wood soft, exudes gum. Leaves 5-9 foliolate; leaflets 6-12 x 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. **Ecology** : Common in low lying areas along the outer fringes of tidal forests and river-banks. It can tolerate a wide range of ecological niches, from the hills up to the sea-shore.

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

Distrib. : Throughout the hotter parts of the coast and Andamans.

5. *Mangifera* L.

Mangifera indica L., Sp. Pl. 1: 200. 1753; Chandra & Mukherjee in Fl. India 5: 466. 2000; Hook. f., Fl. Brit. India 2: 13. 1876.

Tree 20-25 m tall. Leaves 10-20 x 2.5-4.5 cm, oblong or elliptic-lanceolate, coriaceous, entire, acuminate at apex and cuneate at base. Flowers 3-5 mm across,

polygamous, greenish white in 25 cm long terminal panicles.

Ecology : Indigenous or naturalised found throughout the inland plains and hills. Sometimes wild along the Rainagiri and Gulf of Mannar coastal region.

Fl. & Fr. : January-March; July-August.

Distrib. : Throughout India.

HIPPOCRATEACEAE

Salacia L.

Salacia chinensis L., Mant. Pl. 293. 1771; Ramamurthy & Naithani in Fl. India 5: 152. 2000. *S. prinoides* DC., Lawson in Hook. f., Fl. Brit. India 1: 626. 1875.

Erect or scandent shrub, Leaves 4-7.5 x 1.5-2.5 cm, elliptic-oblong, coriaceous, crenate, acuminate at apex, obtuse at base. Flowers 3-4 mm across, greenish yellow, fascicled in leaf axil or extra axillary branchlets.

Fruit globose fleshy one seeded.

Ecology : Common along the inner fringes of tidal swamps and coastal scrub jungles.

Fl. & Fr. : April-October.

Distrib. : West Bengal, Orissa, Andhra Pradesh and Tamil Nadu.

CONNARACEAE

Rourea Abul.

Rourea minor (Gaertn.) Leenh., Fl. Mal. 5: 514, 1958; Mondal in Fl. India 5: 538. 2000. *R. acuminata* 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 x 1-8 cm, coriaceous, ovate, ovate-lanceolate, obovate or sometimes suborbicular, entire, acuffinate or caudate at apex, obliquely obtuse at base. Flowers 2-3 cm long, deep purple, bell-shaped, in axillary panicles. Fruits 4-6 x 1-2 cm, ovoid, oblique, with

persistent calyx. Seeds ellipsoid, enclosed by yellow-coloured fleshy aril.

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

Fl. & Fr. : September-November; December-January.

Distrib. : This is collected for the first time from the Mahanadi delta at Bahakud island, found frequently in Karnataka, Kerala and Andaman island.

FABACEAE

PAPILIONACEAE

KEY TO THE GENERA

- 1a. Stamens free 30. *Sophora*
- 1b. Stamens united :
- 2a. Stamens monadelphous :
- 3a. Pods jointed :
- 4a. Anthers uniform 32. *Taverniera*
- 4b. Anthers dimorphic :
- 5a. Stigma minute; ovule 2 or 3 31. *Stylosanthes*
- 5b. Stigma globose; ovule many 38. *Zornia*
- 3b. Pods not jointed :
- 6a. Trees :
- 7a. Leaflets alternate 13. *Dalbergia*
- 7b. Leaflets opposite 24. *Pongamia*
- 6b. Erect prostrate herbs or shrubs :
- 8a. Pods dehiscent :
- 9a. Anthers uniform 27. *Rothia*
- 9b. Anthers dimorphic 11. *Crotalaria*
- 8b. Pods indehiscent :
- 10a. Leaves even-pinnate :
- 11a. Stamens 9; seeds blood red 1. *Abrus*
- 11b. Stamens 10; seeds brown 5. *Arachis*
- 10b. Leaves odd-pinnate :
- 12a. Anthers dimorphic 34. *Terumnus*
- 12b. Anthers uniform :
- 13a. Stigma capitate, large 14. *Derris*
- 13b. Stigma not capitate, small 9. *Canavalia*
- 2b. Stamens diadelphous :
- 14a. Stamens in two bundles of 5 each, (5)+(5)
- 15a. Leaves even-pinnate; ripe pod included in the calyx 29. *Smithia*
- 15b. Leaves odd-pinnate; ripe pod much exerted from calyx :
- 16a. Herbs or shrubs never twiners; pods jointed 2. *Aeschynomene*
- 16b. Trees or twining shrubs; pods not jointed 13. *Dalbergia*
- 14b. Stamens in bundles of 9+1 :
- 17a. Leaf rachis or leaflets modified into tendrils 36. *Vicia*
- 17b. Leaf rachis or leaflets not modified into tendrils :
- 18a. Pods jointed :
- 19a. Plants spiny; leaves exstipellate 3. *Ahagi*
- 19b. Plants not spiny; leaves stipellate :
- 20a. Joints of pods folded on one another 35. *Uraria*

- 20b. Joints of pods not folded :
- 21a. Joints of pods turgid; if compressed then corolla
not or hardly exerted 4. *Alysicarpus*
- 21b. Joints of pods compressed: corolla always
much exerted 15. *Desmodium*
- 18b. Pods not jointed :
- 22a. Small or large trees :
- 23a. Armed; petals unequal in size 16. *Erythrina*
- 23b. Unarmed; petals almost equal in size 7. *Butea*
- 22b. Herbs, undershrubs, shrubs or twiners :
- 24a. Climbing or twining herbs or shrubs :
- 25a. Leaves gland dotted beneath :
- 26a. Pods 3 to many seeded 6. *Alysia*
- 26b. Pods 1-2 seeded 26. *Rhynchosia*
- 25b. Leaves not gland dotted below :
- 27a. Styles bearded below the stignias :
- 28a. Petals almost equal in size 37. *Vigna*
- 28b. Petals very unequal in size 10. *Clitoria*
- 27b. Styles not bearded below the stigma :
- 29a. Anthers dimorphic 23. *Mucuna*
- 29b. Anthers uniform :
- 30a. Corolla enclosed within calyx 25. *Pycnospora*
- 30b. Corolla exerted :
- 31a. Style incurved 19. *Labiab*
- 31b. Style terete 22. *Macrotyloma*
- 24b. Erect or prostrate herbs; undershrubs or shrubs :
- 32a. Leaves or leaflets entire :
- 33a. Leaflets stipellate :
- 34a. Standard shorter than keel 21. *Macroptilium*
- 34b. Standard larger than keel :
- 35a. Wings obovate 20. *Lotus*
- 35b. Wings oblong or linear :
- 36a. Style glabrous 18. *Indigofera*
- 36b. Style pubescent 8. *Cajanas*
- 33b. Leaflets exstipellate :
- 37a. Pods 1-2 seeded 17. *Flemingia*
- 37b. Pods 3 to many seeded :
- 38a. Leaves even-pinnate; ovary stipitate 28. *Sesbania*
- 38b. Leaves odd-pinnate or 1 foliolate ovary sessile 33. *Tephrosia*
- 32b. Leaves or leaflets dentate; toothed or serrate, ovary not sessile 12. *Cullen*

1. *Abrus* Adans

Abrus precatorius L., Syst. Nat. ed. 12. 472. 1767; Baker in Hook. f., Fl. Brit. India 2: 175. 1876.

Slender, twining shrubs; branches terete, glabrous or young twigs slightly pubescent. Leaves 8-12 cm long, 16-30 jugate; leaflets 1-2 x 0.5-0.8 cm, oblong, glabrous, apiculate at apex, rounded at base. 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 beaked at apex. Seeds 4-6 mm across, ovoid, glossy scarlet, with black spot around the hilum.

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

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

Distrib. : Throughout the coastal thickets.

2. *Aeschynomene* L.

KEY TO THE SPECIES

- 1a. Leaflets 15-25 pairs; peduncle and calyx glabrous; pods indented on lower margin, smooth 2. *indica*
 1b. Leaflets 30-35 pairs; peduncle and calyx hispid; pods indented on both margins, echinate over seeds 1. *aspera*

1. *Aeschynomene aspera* L., Sp. Pl. 713, 1753; Baker in Hook. f., Fl. Brit. India 2: 152. 1876.

Erect herb, with stout main stem, full of white pith. Leaves odd pinnate; leaflets 61-101, linear, obtuse at apex. Flowers yellow up to 2 cm long in 2-4 flowered, corymbose, racemes. Pods 5-6 x 0.8 cm, 3-6 jointed.

Ecology : Common on marshy places, shallow ponds and ditches and coastal slacks, often cultivated for its valuable pith.

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

Distrib. : Almost throughout the coastal plains.

2. *Aeschynomene indica* L., Sp. Pl. 713. 1753; Baker in Hook. f., Fl. Brit. India 2: 152. 1876.

Erect, suffruticose, spreading undershrubs; branches slender, terete, striate with small warts or papillae. Leaves 3-12 cm long, imparipinnate; leaflets 4-6 x 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.

Ecology : Frequent in moist places, mostly under fresh water situation, sometimes along shallow ditches and rice-fields near sea coast.

Fl. & Fr. : August-December.

Distrib. : West Bengal, Orissa, Tamil Nadu, Kerala, Maharashtra, Andaman and Nicobar islands.

3. *Alhagi* Gagneb.

Alhagi pseudoalhagi (Bieb.) Desv. in J. Bot. 1: 120. 1823; *A. maurorum* Medik., Vorles. Chrupt. Phys. Oak. Ges. 2: 397. 1787; Baker in Hook. f., Fl. Brit. India 2: 145. 1876.

Bushy shrub, up to 1 m high, with straight spines bearing flowers. Leaves 2 x 1 cm, obovate-oblong, entire, mucronate or emarginate at the apex. Flowers 1.5 cm long, red or pinkish-violet, racemed on axillary spine. Pods

2-4 x 0.2 cm, linear-cylindric, jointed, beaked. Seeds subreniform, blackish.

Ecology : Common in alkaline and saline soils.

Fl. & Fr. : March-July.

Distrib. : Goa, Maharashtra and Gujarat coast.

4. *Alysicarpus* Necker ex Desvaux

KEY TO THE SPECIES

- 1a. Pods monoliform :
- 2a. Calyx shorter or as long as the first joint of the pod..... 3. *monilifer*
- 2b. Calyx much longer than the first joint of the pod :
- 3a. Joints of pods smooth 4. *roxberghianus*
- 3b. Joints of pods transversely ribbed, corrugate or reticulate :
- 4a. Pods 4-gonous 6. *tetragonolobus*
- 4b. Pods not 4-gonous :
- 5a. Pods longer than calyx; joints reticulately veined 2. *longifolius*
- 5b. Pods shorter than the calyx or as long as calyx;
joints transversely ribbed-corrugate 5. *scarious*
- 1b. Pods not monoliform :
- 6a. Leaflets broadly elliptic-oblong or linear lanceolate; pods
turgid, not indented 7. *vaginalis*
- 6b. leaflets suborbicular; pods compressed, shallowly indented on
both sutures 1. *homosus*

1. *Alysicarpus homosus* Edgew., J. Asiat. Soc. Beng. 21: 171. 1853; Baker in Hook. f., Fl. Brit. India 2: 157. 1876.

Diffuse, annual herbs, clothed with long spreading hairs. Leaflets 1.5-3 in diam, orbicular, obtuse at apex, cordate at base. Flowers 0.1 cm long, bluish or purplish in 4-8 flowered racemes. Pods 2.5 cm long, linear, flat, hairy. Seeds oval, smooth, brown.

Ecology : Common in wastelands and open forests, particularly among grasses. Rare in the dry coastal zone.

Fl. & Fr. : August; October.

Distrib. : West Bengal, Orissa and Gujarat coast.

2. *Alysicarpus longifolius* (Rotter ex Spreng.) Wight & Arn., Prod. 233. 1834; Baker in Hook. f., Fl. Brit. India 2: 159. 1876.

Erect perennial herbs, up to 1 m high. Leaflet 2-12 x 0.6-3 cm, linear-oblong to oblong-obovate, oppressed hairy on veins beneath, obtuse at apex, subcordate at base. Flowers 0.6 cm long, purplish in terminal and axillary, spicate racemes. Pods 0.2 cm broad, 4-6 jointed.

Ecology : Frequently found on moist sandy places near the coast, often cultivated.

Fl. & Fr. : September-November.

Distrib. : Throughout the plains.

3. *Alysicarpus monilifer* (L.) DC. Prodr. 2: 353. 1825; Baker in Hook. f., Fl. Brit. India 2: 157. 1876.

Diffused annual or perennial herbs; branches 30-60 cm long, densely covered with spreading hairs. Leaves simple, 1-1.5 x 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.

Ecology : Frequent along sandy river-banks, coastal scrub-jungles and sand dunes.

Fl. & Fr. : All through the year.

Distrib. : Through the coastal plains.

4. *Alysicarpus roxburghianus* Thoth. & Pramanik in Bull. Bot. Sur. India 21: 189. 1981; *A. hypoleurifolius auct. non* (L.) DC.: Baker in Hook. f., Fl. Brit. India 2: 158. 1876, p.p.

Herbs up to 1 m high. Leaves 2.8-10 x 0.3-0.6 cm, linear, acute at apex, rounded at base. Flower 0.6 cm long, pale rose or pinkish brown in lax, terminal racemes. Pods 0.8-1 cm long, moniliform, 3-6 jointed.

Ecology : Common in wasteland among grasses.

Fl. & Fr. : August-October.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Kerala and Karnataka coast.

5. *Alysicarpus scarious* (Rotter ex Sprang.) Grah. ex Thw., Enum. Zeyl. 88. 1859; *A. rugosus* (Willd.) DC. var *styracifolius* (DC.): Baker in Hook. f., Fl. Brit. India 2: 159. 1876.

Dwarf, diffuse herb, with pubescent stem. Leaflet 2-3 cm long, oblong or lanceolate, acute at apex, narrowed at base. Flowers 0.6 cm long in 3-8 cm long racemes. Pods 0.2 cm broad, 3-5 jointed.

Ecology : Rare in grasslands and scrub jungles along the coast.

Fl. & Fr. : August-November.

Distrib. : Throughout Indian coastal plains.

6. *Alysicarpus tetragonolobus* Edgew., J. Asiat. Soc. Beng. 21: 69. 1853 & J. L., Soc. 9: 312. 1866; Baker in Hook. f., Fl. Brit. India 2: 159. 1876.

Procumbent herb; stems marked with a line of hairs. Leaflets 1.5-3.5 x 0.3-1.5 cm, elliptic-oblong or lanceolate, hairy beneath, acute at apex, narrowed at base. Flowers 0.5 cm long, pink in lax racemes. Pods 0.8-1 cm long, longitudinally ridged, 2-6 jointed.

Ecology : Common in waste lands, open forests and on naked hillocks, rare in dry coastal zone.

Fl. & Fr. : August-October.

Distrib. : Throughout the coast.

7. *Alysicarpus vaginalis* (L.) DC., Prodr. 2: 353. 1825; Baker in Hook. f., Fl. Brit. India 2: 158. 1876.

Prostrate, glabrous annuals. Leaves 1-2.5 x 0.5-1.5 cm, elliptic-oblong, ovate or ovate-lanceolate, obtuse or retuse at apex, obtuse or cordate at base. Flowers 5-6 mm across, pinkish, in lateral or terminal racemes. Pods 3-4 cm, globose, joints turgid, tetragonous, reticulate-veinose.

Ecology : Common along the river-banks, coastal sands, road-sides and grass-lands.

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

Distrib. : Throughout the coastal sands and coastal plains.

5. *Arachis* L.

Arachis hypogea L., Sp. Pl. 741. 1753; Baker in Hook. f., Fl. Brit. India 2: 161. 1876.

Herbs; branchlets hispid. Leaves up to 4 cm; leaflets 2 pairs, 1.5-2.5 x 0.8-1.5 cm, obovate, thin-coriaceous, entire, obtuse mucronate at apex, cuneate at base. Flowers 1.5 cm across, yellow, axillary, solitary. Pods

oblong, geographic. Seeds ovoid or oblong.

Ecology : Native of Brazil, cultivated all along the coast.

Fl. & Fr. : May-August.

Distrib. : Throughout the coastal areas common in Gujarat and Maharashtra coast.

6. *Atylosia* Wt. & Arn.

Atylosia scarabaeoides (L.) Benth., Pl. Jungh. 2: 243. 1852; Baker in Hook. f., Fl. Brit. India 2: 215. 1876.

Herbaceous twiners, sometimes trailing along sands. Stems terete, brownish-grey, densely covered with scabrid hairs. Leaves 3-foliolate; leaflets 1-2.5 x 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 x 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 stropheoles.

Ecology : Frequent along sandy sea-shore, scrub jungles and inland forests.

Fl. & Fr. : February-June; September-October.

Distrib. : Throughout the coastal district.

7. *Butea* Roxb. ex Willd.

Butea monosperma (Lam.) Taub., Engler & Prantl, Nat. Pflanzenfam. 3, 3: 365. 1894; *B. frondosa* Roxb. ex Willd.: Baker in Hook. f., Fl. Brit. India 2: 194. 1876.

Tree up to 8 m; branchlet densely tomentose. Leaflets 10-18 x 9-15 cm, coriaceous, glabrous above, scarious below, entire, obtuse at apex, cuneate at base.

Flowers 5 cm across, flame coloured, in clusters at the nodes of rachis. Pods up to 16 x 5 cm.

Fl. & Fr. : February-April ; March onwards.

Distrib. : Almost throughout India, common in dry deciduous forests and rare along dry coastal regions.

8. *Cajanus* DC.

Cajanus cajan (L.) Millsp., Field Columb. Mus. Bot. 2, 1: 53. 1900; *C. indicus* Spreng., Baker in Hook. f., Fl. Brit. India 2: 217. 1876.

Shrub up to 3 m; branchlets densely silky pubescent. Leaves up to 10 cm, 3-foliolate; leaflets 4-8 x 1-2.5 cm, elliptic-lanceolate or oblong, chartaceous, densely velvety pubescent below, entire, acute or

acuminate, apiculate at apex, cuneate-subacute at base. Flowers 1.5 cm long, yellow in terminal panicles and axillary racemes.

Ecology : Originated in the East coastal area, now cultivated all through the coastal plains.

Fl. & Fr. : December-March; Onwards.

Distrib. : Throughout the coastal districts.

9. *Canavalia* DC.

KEY TO THE SPECIES

1a. Leaflets ovate; pods 12-24 cm long :

2a. Pods flat; seeds reddish brown or white 2. *gladiata*

2b. Pods obovoid; seeds dark brown 1. *cathartica*

1b. Leaflets obovate; pods 6-8 cm long 3. *maritima*

1. *Canavalia cathartica* Thou., J. Bot. Desv. 1: 81. 1813; *C. ensiformis* (L.) DC. var. *turgida* Baker in Hook. f., Fl. Brit. India 2: 196. 1876.

Perennial creepers; stems more or less twining, glabrous, often rooting at the nodes. Leaflets 4-6.5 x 3-5 cm, ovate, or ovate-elliptic, adpressed pubescent when young, obtuse or acute at apex, cuneate at base. Flowers 3.5-4 cm long, purple in axillary racemes on 6-15 cm long peduncles. Pods 13-17 x 2-2.5 cm, obovoid, inflated, ribbed and extra-ribbed along the suture, beaked at apex. Seeds 17-18 x 1-1.5 cm, dark-brown, with hilum 8-12 mm long, ecarunculate.

Ecology : Frequent along the estuarine sand-bars, sandy river-banks and lee side sand dunes.

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

Distrib. : West Bengal, Tamil Nadu, Kerala, Karnataka and Andaman & Nicobar islands.

2. *Canavalia gladiata* (Jacq.) DC., Prod. 2: 404. 1825; *C. ensiformis* (L.) DC.: Baker in Hook. f., Fl. Brit. India 2: 195. 1876.

Twining herbs. Leaves 3-foliolate; leaflets 4-12 x 3.5-9.0 cm, ovate or oblong, membranous, acute at apex. Flowers 2.5 cm long, red or white in curved, axillary, racemes. Pods 3-5 cm broad flat. Seeds subreniform, glabrous, reddish brown or white.

Ecology : Common on the edges of fields and gardens near habitations.

Fl. & Fr. : August-December.

Distrib. : Throughout the coastal districts.

3. *Canavalia maritima* (Aubl.) Thou., J. Bot. Desv. 1: 80. 1813; *C. obtusifolia* (Lamk.) DC.: Baker in Hook. f., Fl. Brit. India 2: 196. 1876.

Perennial trailers; stems terete, striate, puberulous, entirely or for the greater part decumbent or creeping, often rooting from the nodes. Leaflets 4-7 x 3.5-6.5 cm, broadly obovate or suborbicular, usually clothed with soft adpressed hairs when young, rounded or emarginate at apex, cuncate at base. Flowers 2.5-3.5 mm long, purple, arranged in axillary racemes on a 20-40 cm long peduncles. Pods 6-8 x 2-2.5 cm, compressed, glabrous, slightly curved and beaked at

apex. Seeds 11-13 x 7-8 mm, ellipsoid, pale-brown, 2-10, ecarunculate.

Ecology : Common along the sandy sea-shore, and estuarine sand bars, serve as a sandbinder in association with *Ipomoea pescaprae*, *Launaea sermentosa* and *Cyperus arenarius*. Occasionally found to form a pure strand over the sandy beach.

Fl. & Fr. : May-September; October-December.

Distrib. : Restricted mainly along the coastal beaches of Orissa, Karnataka, Tamil Nadu, Maharashtra, Kerala and Andamans.

10. *Clitoria* L.

Clitoria ternatea L., Sp. Pl. 753. 1753; Baker in Hook. f., Fl. Brit. India 2: 208. 1876.

Twining herb; stem pubescent when young. Leaves 6-13 cm long; leaflets 5 or 7, up to 45 x 25 mm, elliptic entire retuse at apex, obtuse or acute at base. Flowers blue, axillary solitary. Pods 6-9 x 0.8-1 cm,

slightly curved, beaked, sparsely pubescent, 7-11 seeded. Seeds yellowish brown.

Ecology : Frequent on hedges and thickets.

Fl. & Fr. : December-May.

Distrib. : Throughout coastal plains.

11. *Crotalaria* L.

KEY TO THE SPECIES

1a. Leaves 1-foliolate or simple :

2a. Stipule present :

3a. Pod glabrous :

4a. Stipules linear-subulate; corolla slightly longer than the calyx 12. *retusa*

4b. Stipules ovate; corolla twice as long as calyx 14. *spectabilis*

3b. Pod pubescent :

5a. Stipules linear 5. *juncea*

5b. Stipules semi-lunate :

6a. Flowers yellow 13. *semperflorence*

6b. Flowers blue :

7a. Leaves lanceolate 4. *heyneana*

7b. Leaves ovate or rhomboid-deltoid 15. *verucosa*

2b. Stipule absent :

8a. Prostrate herb :

9a. Pods 1-2 seeded 3. *hebecarpa*

9b. Pods 5-25 seeded :

10a. Corolla exerted 11. *prostrata*

10b. Corolla not exerted 2. *filipes*

- 8b. Erect or diffused herb or undershrub :
- 11a. Pods 8-10 seeded 7. *linifolia*
- 11b. Pods 2-4 seeded :
- 12a. Undershrubs 1. *burhia*
- 12b. Erect herbs 9. *nana*
- 1b. Leaves trifoliolate :
- 13a. Diffuse herb; pods sessile 8. *medicaginea*
- 13b. Erect undershrubs, pods long, stipitate :
- 14a. Leaflets more than 6 cm long 10. *pallida*
- 14b. Leaflets up to 2 cm long 6. *levigata*

1. *Crotalaria burhia* Buch.-Ham. ex Benth., Hook. in London Jr. Bot. 2: 474. 1843; Baker in Hook. f., Fl. Brit. India 2: 66. 1876.

A low undershrub, with very numerous, stiff, erecto-patent branches, clothed with fine, pale tomentum. Leaves 6-3.5 cm long, oblong or lanceolate, pale green, silky. Flowers 15-30 cm elongated, yellow, arranged in terminal racemes. Pod 5 x 4 mm, densely pilose, obliquely ovoid, beaked, 3-4 seeded, brown.

Ecology : Common on sandy soil on the lee side of coastal sand dunes.

Fl. & Fr. : August-January.

Distrib. : Gujarat coast.

2. *Crotalaria filipes* Benth., Hook. in London Jr. Bot. 2: 475. 1843; Baker in Hook. f., Fl. Brit. India 2: 66. 1876.

Prostrate herb, up to 50 cm long, with many stems from a woody root. Leaves ovate-oblong, obtuse or acute at apex, cordate or oblique at base. Flowers yellow, in 1-3 flowered racemes. Pods 0.8 cm long, glabrous, 8-10 seeded.

Ecology : Rare in wasteland among grasses.

Fl. & Fr. : October-December.

Distrib. : Gujarat, Karnataka and Maharashtra coast.

3. *Crotalaria hebecarpa* (DC.) Rudd, Phytologia 54: 28. 1983; *Heylandia letebrosa* DC.: Baker in Hook. f., Fl. Brit. India 2: 65. 1876.

Prostrate herb; branchlets hispid. Leaves 6-9 x 4-5.5 mm, cordate-ovate, chartaceous margin ciliate, obtuse at apex, and truncate at base. Flowers 4.5 mm across, yellow, axillary, solitary. Pods 4 x 3 mm, flat, oblong. Seed 3 mm, solitary reniform.

Ecology : Frequent in open gravelly ground in scrub jungles and coastal plains.

Fl. & Fr. : December-February; January onwards.

Distrib. : Throughout the coastal plains.

4. *Crotalaria heyneana* Grah. (in Wall, Cat. 5414. 1831-32, *nom. nud.*) ex Wight & Arn., Prod. 187. 1834; Baker in Hook. f., Fl. Brit. India 2: 78. 1876.

Erect undershrubs, up to 1 m tall; branches angled, sparsely hairy. Leaves up to 15 x 6 cm, elliptic-ovate or oblong, acute at apex, cuneate at base. Flowers up to 4 cm long in terminal or axillary racemes. Pods up to 4 cm long, oblong, 10-12 seeded.

Ecology : Common as an under growth in semi-evergreen forest along ghats near the coast.

Fl. & Fr. : November-February.

Distrib. : Karnataka, Kerala, Tamil Nadu coast.

5. *Crotalaria juncea* L., Sp. Pl. 714. 1753; Baker in Hook. f., Fl. Brit. India 2: 79. 1876.

Shrub; branchlets silky pubescent. Leaves 3-6 x 0.8-1.5 cm, oblong-elliptic, chartaceous, sericeous, ciliate margin, acute at apex and base. Flower 2 cm across, yellow in terminal racemes. Pods 3 x 1 cm, oblong-ternate, pubescent, 3-5 seeded. Seeds up to 4 mm.

Ecology : Common along the river banks, sandy seashore and hill slopes.

Fl. & Fr. : April-June.

Distrib. : Throughout the plains and coastal district.

6. *Crotalaria levigata* Lamk. ex DC., Prodr. 11: 131. 1825; Baker in Hook. f., Fl. Brit. India 2: 83. 1876.

Erect undershrubs, 20-30 cm tall; branches slender, smooth. Leaves 3-4.5 cm long, trifoliolate, leaflets

1.5-2 x 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 1.2-1.8 cm long, oblong, stalked, glabrous, 8-10 seeded.

Ecology : Rare in coastal thickets and scrub jungles on sandy habitat.

Fl. & Fr. : September-October.

Distrib. : Plains of the Western peninsula, Western Ghats from south Canara to Nilgiris and Anamalais.

7. *Crotalaria linifolia* L. f., Suppl. 322. 1781; Baker in Hook. f., Fl. Brit. India 2: 72. 1876.

Herb, 0.5 m high. Leaves 2-4 x 0.2-0.5 cm, oblong or oblanceolate, densely silky, rounded at apex, cuneate at base. Flowers pale yellow in lax, terminal racemes; bracts and bracteoles subulate, hairy. Pods ovoid black, 8-10 seeded.

Ecology : Frequent along lateritic coast and rocky slopes.

Fl. & Fr. : September.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Maharashtra, Karnataka and Kerala coast.

8. *Crotalaria medicaginea* Lamk. var. *luxurians* (Benth.) Bakers in Hook. f., Fl. Brit. India. 2: 81. 1876.

A diffuse herb, 20-50 cm high with several erect branches. Leaves 3 foliate, leaflets 1-2.5 x 0.4-0.9 cm, oblanceolate-obovate, obtuse-truncate. Flower 2-5 cm long, yellow, arranged in terminal racemes. Pod small, 4 x 4 mm, obliquely globose, hairy, 2 celled.

Ecology : Common in cultivated fields near the coast.

Fl. & Fr. : August-September.

Distrib. : Tamil Nadu, Gujarat and Orissa coast.

9. *Crotalaria nana* Burm. f., Fl. Ind. 156, t. 48, f. 2. 1768; Baker in Hook. f., Fl. Brit. India 2: 71. 1876.

Subshrub or diffuse herb, silky hairy, diffused annual, with slender, terete branches. Leaves 1-2 x 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.

Ecology : Frequent along sandy sea-shores, scrub jungles, and in coastal thickets.

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

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka and Gujarat coast.

10. *Crotalaria pallida* Ait., Hort. Kew. ed.1, 3: 20. 1789; *C. striata* DC., Baker in Hook. f., Fl. Brit. India 2: 84. 1876.

Erect undershrubs, 0.5-1 m tall; branches terete, striate, puberulose. Leaves 12-14 cm long, trifoliolate; leaflets 5-7.5 x 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. Pods up to 4.5 cm long, turgid, glabrous or pubescent, beaked at apex. Seeds 25-35.

Ecology : Frequent along the river-banks and road-sides, occasional along the sandy sea-shores.

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

Distrib. : Throughout the Indian coast.

11. *Crotalaria prostrata* Rottl. in Willd., Enum. Hort. Berol. 744. 1809; Baker in Hook. f., Fl. Brit. India 2: 67. 1876.

Prostrate herbs, up to 25 cm long, branches hairy. Leaves up to 3.3 x 1.2 cm, obovate-oblong, silky pubescent, obtuse at apex, oblique at base. Flowers 3-6 mm, yellow in terminal or axillary, 2-4 flowered racemes. Pods up to 1.5 cm long, linear-oblong, 12-15 seeded.

Ecology : Frequent on coastal sands, plain lands and sand dunes.

Fl. & Fr. : November-December.

Distrib. : Throughout the coastal districts.

12. *Crotalaria retusa* L., Sp. Pl. 715. 1753; Baker in Hook. f., Fl. Brit. India 2: 75. 1876.

Much-branched undershrubs, 0.5-1 m tall; branches striate, glabrous or white pubescent. Leaves 4-8 x 1-3 cm, oblong-oblanceolate, 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.

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

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

Distrib. : Probably a native of south-east Asia, sometimes cultivated in India.

13. *Crotalaria semperflorens* Vent., Jard. Cels. t. 17, 1804; Baker in Hook. f., Fl. Brit. India 2: 78. 1876.

Shrubs 7.5-10 cm high, hairy. Leaves 5-10 cm long, oblong, glabrous above, hairy below, acute or obtuse at apex, rounded at base. Flowers 1-2 cm long, yellow in lateral or terminal racemes. Pods 3-5 cm long, 10-12 seeded.

Ecology : Rare on coastal sands and crevices of the coastal rock.

Fl. & Fr. : August-October.

Distrib. : Karnataka, Tamil Nadu coast.

14. *Crotalaria spectabilis* Roth., Nov. Pl. Sp. 341. 1821; *C. leschenautii* DC., Baker in Hook. f., Fl. Brit. India 2: 76. 1876.

Erect herb up to 2.5 m high, branches striate, glabrescent. Leaves up to 12.8 x 5 cm, oblanceolate to obovate, glabrous above, glabrescent beneath, rounded to obtuse at apex, narrowed at base. Flowers 2.5 cm long, yellow tinged with purple in lax, terminal racemes. Pods

3-4.5 cm long, linear-oblong, cylindrical, 20-30 seeded.

Ecology : Rare on coastal ghats and hill slopes.

Fl. & Fr. : September-December; November - March.

Distrib. : Western Ghats, Kerala and Karnataka coast.

15. *Crotalaria verrucosa* L., Sp. Pl. 715. 1753; Baker in Hook. f., Fl. Brit. India 2:77. 1876.

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

Ecology : Common along the dry, sandy river-banks, and inland.

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

Distrib. : Throughout the coastal districts.

12. *Cullen* Medik.

Cullen corylifolia (L.) Medic., Vorles. Churpf. Phys. Oek. Ges. 2: 380. 1787. *Psoralea corylifolia* L., Baker in Hook. f., Fl. Brit. India 2: 103. 1876.

Low shrub, branchlets glandular-pubescent, warty. Leaves 4.5-6 x 3-4.5 cm, ovate, chartaceous, pubescent, dentate, acute at apex, obtuse at base. Flowers 4 mm across, purplish-violet, in axillary racemes. Pod 3

mm, ovoid, indehiscent, one seeded. Seed 3.5 mm, reniform.

Ecology : Frequent along the uplands near the coast.

Fl. & Fr. : March-April.

Distrib. : Throughout the coastal plains, sometimes highland near the coast.

13. *Dalbergia* L. f.

KEY TO THE SPECIES

- 1a. Unarmed trees, leaflets 6-9 cm long 2. *sissoo*
 1b. Spiny shrubs or small bushy trees, leaflets 3-5 cm long :
 2a. Flowers in congested corymb 1. *horida*
 2b. Flowers in axillary racemes 3. *spinosa*

1. *Dalbergia horrida* (Dennst.) Mahb., Taxon 26: 538. 1977; *D. spinosa* Baker in Hook. f., Fl. Brit. India 2: 234. 1876.

Straggler, 6 m high, branchlets glabrous spine tipped. Leaves 5 x 3 cm, odd pinnate leaflet 3-5 pairs, 2 x 1 cm, oblanceolate, membranous, glabrous, entire, base cuneate, obtuse at apex. Flower small 0.5 cm in diam., arranged in congested corymb. Pod 2 x 1.5 cm, reniform falcate, flattened. Seeds 1 or 2, 6 mm.

Ecology : Common in intertidal zones of creeks and canals, river banks, among *Rhizophora* populations in mangroves.

Fl. & Fr. : March-April.

Distrib. : Tamil Nadu, Kerala, Maharashtra, Karnataka coast and Andamans.

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

Trees up to 20 m tall, glabrous. Leaves alternate, bifarious, imparipinnate; rachis zig-zag; leaflets 6-9 x 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.

Ecology : Frequent along river-banks and scrubs, planted along the road sides.

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

Distrib. : Throughout India, not a coastal plant but planted.

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

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 x 0.5-1 cm, elliptic, ovate 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.

Ecology : Common in the intertidal zones along the estuarine banks, especially under the influence of fresh and brackish water mixture, usually in association with *Sonneratia apetala*. Frequent along the creeks and channels in the mangrove swamp.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coast.

14. *Derris* Lour.

KEY TO THE SPECIES

- 1a. Pods 5 seeded 2. *scandens*
 1b. Pods 1-2 seeded :
 2a. Pods ovoid orbicular 3. *trifoliata*
 2b. Pods roundish flat 1. *heterophylla*

1. *Derris heterophylla* (Willd.) Back. & Bakh., Fl. Java I: 619. 1963; *D. uliginosa* (Roxb.) Benth., Baker in Hook. f., Fl. Brit. India 2: 241. 1878.

Large twining or creeping shrubs; branches woody, glabrous with scattered lenticells. 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.

Ecology : Common along intertidal regions of the mangrove forests, on the banks of creeks and channels.

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

Distrib. : Throughout the coastal provinces.

2. *Derris scandens* (Roxb.) Benth., Jour. Linn. Soc. (Suppl.) 4 : 103. 1860; Baker in Hook. f., Fl. Brit. India 2: 240. 1876.

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 mm across, whitish or pinkish, clustered in axillary racemes. Pods 6-8 cm long, strap-shaped, narrow, winged along the upper suture. Seeds 1-3.

Ecology : Common along the intertidal regions of several creeks in the tidal forests.

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

Distrib. : East and West coastal wetlands.

3. *Derris trifoliata* Lour., Fl. Cochinch. 433. 1790; *D. uliginosa* (Willd.) Benth.; Baker in Hook. f., Fl. Brit. India 2: 241. 1878.

Climbing shrub. Leaves 10-25 cm long; leaflets 3-5, 4.5-13 x 2.5-6 cm, elliptic, subcoriaceous, acuminate at apex, rounded at base. Flowers 1-1.2 cm long, rose-pink in axillary racemes. Pods 3.5 x 2.5 cm, flat, obtuse at both ends, glabrous, brown to black.

Ecology : Common in mangrove swamps and creek, tidal forests and banks of back water.

Fl. & Fr. : April-July; September-October.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra, Andaman and Nicobar island.

15. *Desmodium* Desv.

KEY TO THE SPECIES

- 1a. All leaves 1 foliolate 3. *gaugeticum*
 1b. All leaves 3 foliolate :
 2a. Pods straight :
 3a. Pods covered with simple hairs 1. *biarticulatum*
 3b. Pods covered with hooked hairs 2. *dichotomum*
 2b. Pod falcate :
 4a. Creeping or trailing herbs 6. *triflorum*
 4b. Shrubs :
 5a. Leaflets oblong lanceolate, lateral ones very small 5. *motorium*
 5b. Leaflets obovate oblong, lateral ones not small 4. *gyroides*

1. *Desmodium biarticulatum* (L.) Muell., Fragm. Phyt. Austr. 2: 121. 1861; Baker in Hook. f., Fl. Brit. India 2: 163. 1876.

Trailing undershrubs with long taproots; branches reddish-brown, woody, glabrous. Leaves 3-foliolate; leaflets 8-11 x 3-5 mm, elliptic-oblong, coriaceous, entire, obtuse at both ends. Flowers 5-9 mm across, bright red, 2-3, fasciated in terminal simple or branched racemes. Pods 1-1.3 cm long, flat, biarticulate with adpressed hairs. Seeds broadly ellipsoid, smooth, 1 in each joint.

Ecology : Common along the sandy sea-shore, scrub-jungles, coastal thickets and outer zones of the mangrove swamps.

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

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

2. *Desmodium dichotomum* (Willd.) DC. Prod. 2: 336. 1825; *D. diffusum* Willd.; Baker in Hook. f., Fl. Brit. India 2: 169. 1876.

Scandent herb, hairy. Leaves 5-7 cm, 3-foliolate; leaflets 3-4.5 x 2-3 cm, chartaceous, obtuse at apex and base. Stipules leafy, auriculate, amplexicant. Flowers up to 3 mm long in terminal or axillary racemes. Pods up to 2 cm, margins indented, stiff hooked pubescent, obliquely rounded.

Ecology : Frequent along forests edges, coastal thickets and scrub jungles.

Fl. & Fr. : December-February; January onwards.

Distrib. : West Bengal, West coast in Kerala and Karnataka coast.

3. *Desmodium gangeticum* (L.) DC., Prodr. 2: 327. 1825; Baker in Hook. f., Fl. Brit. India 2: 168. 1876.

Erect or diffuse perennial undershrubs 1-1.5 m tall; branches woody, glabrous or slightly downy. Leaves very variable, 1-10 x 0.5-6 cm, ovate, glabrous or slightly scabrous beneath, acute at apex, rounded at base. 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.

Ecology : Occasional in coastal scrub-jungles, and in waste places. Common towards inland forests.

Fl. & Fr. : Throughout the year.

Distrib. : All coastal districts.

4. *Desmodium gyroides* (Roxb. ex Link) DC., Prodr. 2: 326. 1825; Baker in Hook. f., Fl. Brit. India 2: 175. 1876.

Shrub up to 2.5 m tall; branches woody. Leaves 3-foliolate. Leaflets oblong or obovate-oblong, pubescent beneath, side ones often superposed, obtuse at apex and base. Flowers up to 12 mm long in terminal and axillary racemes. Pods 2.5-3 cm x 0.4-0.5 cm, falcate, jointed.

Ecology : Frequent along the lee side of coastal dunes.

Fl. & Fr. : April-May.

Distrib. : West Bengal and Orissa coast.

5. *Desmodium motorium* (Houtt.) Merr., J. Am. Arb. 19:

345. 1938; *D. gyrans* (L. f.) DC. : Baker in Hook. f., Fl. Brit. India 2: 174. 1876.

Shrub up to 75 cm tall. Leaflets up to 5.5 x 3 cm, oblong or oblong-lanceolate, lateral ones very small broadly linear, acute at apex, retuse at base. Flowers 0.7 cm long, yellow tinged with purple in terminal or axillary panicles. Pods up to 4 cm long, falcate, indistinctly jointed, curved, 9-11 seeded.

Ecology : Frequent as undergrowth in moist and deciduous forests, rare along the coast.

Fl. & Fr. : June-November.

Distrib. : Almost throughout the East coastal districts.

6. *Desmodium triflorum* (L.) DC., Prodr. 2: 334. 1825; Baker in Hook. f., Fl. Brit. India 2: 173. 1876.

Slender, much branched, trailing herbs, often rooting at nodes. Leaves 3-foliolate, terminal one largest; leaflets 2-8 x 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 minute hooked hairs.

Ecology : Common along sandy river-banks, open grasslands and road sides.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coastal districts.

16. *Erythrina* L.

KEY TO SPECIES

1a. Armed, keel petals connate :

2a. Calyx campanulate 2. *suberosa*

2b. Calyx spathaceous 1. *stricta*

1b. Unarmed, keel petals free 3. *variegata*

1. *Erythrina stricta* Roxb., (Hort. Beng. 53. 1814, *nom. nud.*) Fl. Ind 3: 251. 1832; Baker in Hook. f., Fl. Brit. India 2: 189. 1876.

Tall tree; prickles whitish. Leaves 3-foliolate; leaflets 4-5 cm long, glabrescent, membranous, truncate at base. Flowers 2-3 cm long, bright red, in dense racemes.

Pods 10-15 cm long, linear, turgid.

Ecology : Frequent on river banks and road sides near sea shore.

Fl. & Fr. : March-April.

Distrib. : Orissa, West peninsular coastal district.

2. *Erythrina suberosa* Roxb., Fl. Ind. 3: 253. 1832; Baker in Hook. f., Fl. Brit. India. 2: 189. 1876.

Tree up to 10 m, branchlet tomentose, deeply cracked, dark and yellowish, white prickles. Leaves pinnately trifoliolate, 10-20 cm, leaflets rhomboid-ovate, thin coriaceous, glabrous above, densely matty or wooly below, margin entire, base deltoid or truncate, acute at apex. Flowers scarlet, corolla exerted, 3.5 x 1.2 cm, arranged in capitate racemes. Pod 6-15 x 3-8 cm, straight, torulose, 25 seeded.

Ecology : Common on dry forestlands and river banks near the coast.

Fl. & Fr. : March-June.

Distrib. : All along the peninsular coast.

3. *Erythrina variegata* L., Herb. Amboin. 10. 1754; *E. indica* Lamk.: Baker in Hook. f., Fl. Brit. India 2: 188. 1876.

Prickly, deciduous trees 4-10 m tall; stems and branches soft, with corky barks. Leaves 3-foliolate; leaflets 4-9 x 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.

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

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

Distrib. : Throughout the coastal districts of the East coast.

17. *Flemingia* Roxb. ex Ait.

KEY TO THE SPECIES

- 1a. Leaves 1-foliolate; racemes as long as leaves; flowers white 2. *strobilifera*
 1b. Leaves 3-foliolate; racemes shorter than the leaves;
 flowers purplish yellow 1. *macrophylla*

1. *Flemingia macrophylla* (Willd.) O. Kuntze ex Merr., Philippine J. Sci. Bot. 5: 130. 1910; *F. congesta* Roxb. ex Ait. f.: Baker in Hook. f., Fl. Brit. India 2: 228. 1876.

Woody shrubs up to 1.5 m tall; young branches hairy. Leaves digitately 3 foliolate; leaflets up to 16 x 6 cm, lanceolate or oblanceolate, acuminate at apex, cuneate at base. Flowers 0.9 cm long, white, in axillary or terminal racemes. Pods 1 cm long, oblong, slightly beaked, tomentose, enclosed within bracts, 2 seeded.

Ecology : Frequent as undergrowth in moist deciduous and semi evergreen forests, frequently found on coastal hill slopes.

Fl. & Fr. : February-March.

Distrib. : Throughout the West coastal regions and Ganjam coast.

2. *Flemingia strobilifera* (L.) Ait. & Ait. f., Hort. Kew. ed. 2, 4: 350. 1812; Baker in Hook. f., Fl. Brit. India 2: 227. 1876.

Shrub up to 1 m; branchlets tomentose. Leaves 5-15 x 2-4 cm, oblong-lanceolate, thin-coriaceous, gland dotted below, entire, acuminate at apex, rotund-subacute at base. Flowers 8 mm across, white in simple or branched racemes; bracts orbicular, membranous. Pods 1 x 0.5 cm, enclosed by bracts, 2-seeded.

Ecology : Frequent on coastal hill slopes.

Fl. & Fr. : April-June.

Distrib. : Western Ghats, Malabar and Karnataka coast.

18. *Indigofera* L.

KEY TO THE SPECIES

- 1a. Leaves simple :
- 2a. Leaves obovate; pods globose; seeds discoid 6. *linifolia*
- 2b. Leaves ovate-elliptic or cordate; pods oblong; seeds ovate 3. *cordifolia*
- 1b. Leaves compound :
- 3a. Leaflets 3 :
- 4a. Inflorescence solitary 2. *aspalathoides*
- 4b. Inflorescence raceme :
- 5a. Pods torulose 8. *oblongifolia*
- 5b. Pods not torulose 10. *trita*
- 3b. Leaflets more than 3 :
- 6a. Flowers solitary 11. *uniflora*
- 6b. Flowers in axillary racemes :
- 7a. Pods 2 seeded 7. *linnaei*
- 7b. Pods more than 2 seeded :
- 8a. Seeds 10-12 :
- 9a. Leaflets 5-7 4. *glabra*
- 9b. Leaflets 9-13 9. *tinctoria*
- 8b. Seeds 3-8 :
- 10a. Pods torulose 8. *oblongifolia*
- 10b. Pods not torulose :
- 11a. Pods tetragonous 5. *hirsuta*
- 11b. Pods cylindrical 1. *argentea*

1. *Indigofera argentea* Burm. f., Fl. Ind. 171. 1768. non L.; *I. semitrijuga* auct. non. Forsk.: Baker in Hook. f., Fl. Brit India 2: 98. 1876.

Diffusely branched undershrubs with terete branches. Leaves compound, leaflets more than 3, subsessile, broadly obovate, densely clothed with long silvery appressed hairs. Flowers red, 6-12 flowers arranged on racemes. Pods 1-1.5 cm long appressed hairy, white mucronate.

Ecology : Rare in dry sandy soils.

Fl. & Fr. : August-October.

Distrib. : Gujarat coast.

2. *Indigofera aspalathoides* Vahl ex DC., Prodr. 2: 231. 1825; Baker in Hook. f., Fl. Brit. India 2: 94. 1876.

Stiff, silvery hoary undershrubs, branches divaricate. Leaves 2-3 x 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,

cylindric, straight, covered with silky hairs, 5-6 seeded.

Ecology : Frequent along the sandy sea-shores and river-banks.

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

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Kerala and Karnataka coast.

3. *Indigofera cordifolia* Heyne ex Roth, Nov. Sp. Pl. 357. 1821; Baker in Hook. f., Fl. Brit. India 2: 93. 1876.

Prostrate herb; branchlets densely white-tomentose. Leaves 0.6 x 0.5 cm, ovate-cordate, chartaceous, entire, mucronate at apex, obtuse at base; stipules setaceous. Flower 3 mm across, bright red. in axillary racemes. Pods 3 mm, oblong, pubescent, beaked. Seeds cuboid, pitted.

Ecology : Frequent on poor gravelly soil.

Fl. & Fr. : September-December; November onwards.

Distrib. : Throughout coastal districts.

4. *Indigofera glabra* L., Sp. Pl. 751. 1753; *I. pentaphylla* Murray: Baker in Hook. f., Fl. Brit. India 2: 95. 1876.

Herb, 15-35 cm high, prostrate to ascending, pinkish or yellowish green. Leaves 3-5 cm long; leaflets 5-7, 10-12 x 6-10 mm, obovate to elliptic, ciliate along margin, obtuse to retuse at apex, rounded at base. Flower 3-3.5 mm long, pink to bright red in axillary racemes. Pods 20-30 x 1.5-2 mm, straight, cylindrical, beaked, 10-12 seeded. Seeds 2-2.5 x 1-1.5 mm, cylindrical, reddish-brown.

Ecology : Frequent along sandy sea shores, scrub forests, fallow land and open grassy ground, especially in waste places near the sea shore.

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

Distrib. : Throughout the coastal provinces.

5. *Indigofera hirsuta* L., Sp. Pl. 751. 1753; Baker in Hook. f., Fl. Brit. India 2: 98. 1876.

Subshrub up to 1 m; branchlets white-pilose. Leaves up to 15 x 6 cm, odd-pinnate; leaflets 5 pairs, 2-3.5 x 1-1.5 cm, elliptic-oblong, chartaceous, densely pilose, entire, obtuse at apex, subacute at base. Flowers 5 mm across, pink to brick red in axillary racemes. Pods 1 cm, straight, 4-gonous, tomentose, 5-seeded. Seeds up to 2 mm, cuboid, pitted.

Ecology : Frequent in scrub jungles, fallow fields, wastelands near the coast.

Fl. & Fr. : September-February; November onwards.

Distrib. : West Bengal, Tamil Nadu, Kerala, Goa, Karnataka coast.

6. *Indigofera tinifolia* (L.f.) Retz., Obs. 4: 29. 1786; Baker in Hook. f., Fl. Brit. India 2: 92. 1876.

Spreading annuals; stems much-branched, adpressed silvery-hairy. Leaves 1.5-2.5 x 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.

Ecology : Common along the sandy river-banks and lee side of the sand dunes.

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

Distrib. : Throughout the Indian coast.

7. *Indigofera linnaei* Ali, Bot. Notis. 111: 549. 1958 et in Nasir & Ali, Fl. W. Pak. 100: 75. 1977; *I. enneaphylla* L.: Baker in Hook. f., Fl. Brit. India 2: 94. 1876.

Prostrate herb, branchlets white-hirsute. Leaves up to 3.5 cm, odd pinnate; leaflets 2-5 x 5-9 mm, oblanceolate, membranous, densely hirsute below, entire, obtuse at apex, cuneate at base. Flowers 2.5 mm across, pink in axillary racemes. Pods 4 mm, ellipsoid, turgid, white-hirsute, 2-seeded. Seeds 3 mm, cuboid.

Ecology : Primary colonizer on disturbed ground. Frequent on gravelly soil, fallow field and scrub jungles along the coast.

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

Distrib. : Throughout the coastal districts.

8. *Indigofera oblongifolia* Forsskal, Fl. Aegypt Arab. 137. 1775; *I. paucifolia* DeLile: Baker in Hook. f., Fl. Brit. India 2: 97. 1876.

Shrub, 60-150 cm high, purplish to ash-grey, hairy. Leaves 3-5 cm long, leaflets 1-5, 10-30 x 3-6 mm, elliptic-obovate, acute at apex, cuneate at base. Flower 45 mm long, reddish pink in axillary racemes. Pods lax, constricted, apiculate, pinkish, 6-8 seeded. Seeds 2 x 1 mm, cylindrical, shiny, yellow to brown.

Ecology : Frequent on the lee side of coastal sand dunes, dry fallow land and road sides.

Fl. & Fr. : Throughout the year; September-December.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka and Gujarat coast.

9. *Indigofera tinctoria* L., Sp. Pl. 751. 1753; Baker in Hook. f., Fl. Brit. India 2: 99. 1876.

Erect, slender shrubs, 1-1.5 m tall; branches many, terete, sparsely strigose. Leaves 5-8 cm, 9-13 foliolate; leaflets 1.5-2 x 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, purple or red, in axillary racemes; Pods 3-5 cm long, glabrous, apiculate, 12-16 seeded.

Ecology : Occasional in sandy places near estuaries and back mangroves, cultivated in hills and plains.

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

Distrib. : Throughout the coastal regions.

10. *Indigofera trita* L. f., Suppl. 335. 1781 var. *scabra* (Roth.) Ali Bot. Notis 111. 558. 1958; *I. subulata* auct. non. Vahl ex Poir. : Baker in Hook. f., Fl. Brit. India 2: 96. 1876 excl. syn. *I. thoningii* Schum.

Woody herb, 30-200 cm high, pinkish to light green, hairy. Leaves pinnate 5-7 foliolate; leaflets 10-35 x 8-20 mm elliptic, hairy, mucronate at apex, obtuse or rounded at base. Flowers 4-5 mm long, pink to brick red, in axillary racemes. Pods 3-4 cm long, curved, 6-10 seeded. Seeds subtetragonous, dark brown, smooth.

Ecology : Frequent on coastal hill slopes and coastal laterites.

Fl. & Fr. : September-October; October-January.

Distrib. : Andhra Pradesh, Tamil Nadu and Karnataka coast.

11. *Indigofera uniflora* Buch.-Ham. ex Roxb., Fl. Ind. 3: 374. 1832; Baker in Hook. f., Fl. Brit. India 2: 94. 1876.

Prostrate herb; tap root stout; branches slender, hairy. Leaves pinnate; leaflets 3-7, 4-8 x 1-2 mm linear-oblongate, acute or obtuse at apex, cuneate at base. Flowers 0.5-1 mm long, pink solitary. Pods 10-12 x 2-3 mm, straight, subcylindrical, 3-7 seeded. Seeds 1 x 1 mm, cubical, smooth, yellowish-brown to reddish-brown.

Ecology : Mostly found on coastal hill slopes and gravels.

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

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Maharashtra.

19. *Lablab* Adans.

Lablab purpureus (L.) Sweet., Hort. Brit. ed. 1: 481. 1827; *Dolichos lablab* L., Baker in Hook. f., Fl. Brit. India 2: 209. 1876.

Large climber. Leaves 3 foliolate; leaflets 5-15 cm long, ovate oblong, membranous, acute at apex, obtuse

at base. Flowers 2-3 cm long, white, in axillary racemes. Pods 3-5 cm x 1-2 cm, 2-4 seeded.

Ecology : Cultivated in all the coastal districts.

Fl. & Fr. : February-April.

Distrib. : Throughout Indian coast.

20. *Lotus* L.

Lotus garcini DC., Prodr. 2: 212. 1825; Baker in Hook. f., Fl. Brit. India 2: 91. 1876.

Herbs, 15-30 cm tall; copiously branched, tomentose. Leaves 3 foliolate; leaflets 0.6-1 cm long, obovate, fleshy, tomentose. Flowers 0.6 cm long, copious, axillary solitary. Pods 0.9-1.2 cm long, linear, straight,

5-6 seeded.

Ecology : Frequent on coastal hill slopes. Sandy grounds, near the seashore.

Fl. & Fr. : April-June.

Distrib. : Maharashtra

21. *Macroptilium* (Benth.) Urb.

Macroptilium lathyroides (L.) Urban var. *semierectum* (L.) Urban, Symb. Antill. 9: 457. 1928; *Phaseolus semierectus* L., Baker in Hook. f., Fl. Brit. India 2: 201. 1876.

Suberect shrub, hairy. Leaves 3-foliolate; leaflets 5-7.5 cm, ovate, entire, acute or subobtuse at apex, deltoid at base. Flowers 2-3 cm long, deep purple and white, in

axillary racemes. Pods 5-7.5 cm long, recurved, many seeded.

Ecology : Frequent on coastal hill slopes. Introduced from South America.

Fl. & Fr. : April-September.

Distrib. : Western Ghats, Kerala and Karnataka coast.

22. *Macrotyloma* (Wight & Arn.) Verdc.

Macrotyloma dispermus (Klein ex Willd.) Verdc., Kew Bull. 24: 405. 1970; Hook. Ic. Pl. 38: 17. 1982; *Dolichos ciliatus* Klein ex Willd., Baker in Hook. f., Fl. Brit. India 2: 210. 1876.

Twining herbs. Roots tuberous, hairy. Leaves 3-foliolate; leaflets 2.5-7.5 cm long, oblong, ciliate at margin, acute at apex, rounded at base. Flowers 1-2 cm

long in subsessile cymes. Pods 2.5-4 cm long, linear-oblong, glabrous, 3-4 seeded.

Ecology : Frequent along the coastal sands and inland plains.

Fl. & Fr. : December-March.

Distrib. : Maharashtra, Karnataka and Kerala coast.

23. *Mucuna* Adans.

KEY TO THE SPECIES

- 1a. Pods curved like 'S' :
 2a. Pods not plaited, winged 1. *gigantea*
 2b. Pods plaited on the face, without wings 2. *monosperma*
 1b. Pods not curved like 'S' :
 3a. Flowers in axillary drooping racemes 4. *purita*
 3b. Flowers in corymbs 3. *pruriens*

1. *Mucuna gigantea* (Willd.) DC., Prodr. 2: 405. 1825; Baker in Hook. f., Fl. Brit. India 2: 186. 1876.

Large, woody, perennial twiners; stems glabrous, twisted. Leaves 3-foliolate; leaflets 8-10 x 4-7 cm, elliptic or ovate, very inequilateral, coriaceous, rounded base, acute at apex. Flowers 4-6.5 cm long, yellow bristly, drooping in axillary umbelliform racemes from 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, hilum extending more than 1/2 of the seed.

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

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

Distrib. : Sundarbans, Orissa, Malabar coast and Andaman.

2. *Mucuna monosperma* DC., Prodr. 2: 406. 1825; Baker in Hook. f., Fl. Brit. India 2: 185. 1876.

Perennial twiners; stems woody, brown rusty tomentose. Leaves 3-foliolate; leaflets 9-16 x 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.

Ecology : Frequent in sandy scrub jungles, river-sides and inland forests.

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

Distrib. : Throughout the coastal provinces.

3. *Mucuna pruriens* (L.) DC. var. *utilis* (Wall. ex Wight) Baker ex Burck., Ann. Jard. Britenz. 11: 187. 1893; *M. capitata* (Roxb.) Wight & Arn., Baker in Hook. f., Fl. Brit. India 2: 187. 1876.

Climbers; branchlets sparsely pubescent. Leaves 3-foliolate; leaflets 6 x 3.5 cm, ovate rhomboid, shortly cuspidate, membranous, not silky below. Flower up to 3.5 cm long, purple in 5-6 flowered corymbs. Pods 10-15 cm long with deciduous bristles.

Ecology : Occasional near sea shore.

Fl. & Fr. : November-January.

Distrib. : West Bengal coast.

4. *Mucuna purita* Hook., Bot. Misc. 2: 348., 1831; *M. pruriens* (auct. non. L.) DC.: Baker in Hook. f., Fl. Brit. India 2: 187. 1876.

Large climbers, stems slender, young twigs pubescent, at length glabrescent. Leaves 3-foliolate; leaflets 12-20 x 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.

Ecology : Frequent on sandy river-banks, scrubs and inland gardens.

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

Distrib. : Throughout the Eastern and Western provinces along the coast.

24. *Pongamia* Vent.

Pongamia pinnata (L.) Pierre, For. Fl. Cochinch. t. 385, 1899; *P. glabra* Vent.: Baker in Hook. f., Fl. Brit. India 2: 240. 1876.

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 x 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 x 2-

3.5 cm, flat, oblong-ovoid, woody, obscurely ridged along the suture, narrowed at base, mucronate at apex. Seed one.

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

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

Distrib. : Throughout the East and West coastal regions and Andaman & Nicobar islands.

25. *Pycnospora* R. Br. ex Wight & Arn.

Pycnospora lutescens (Poir.) Schindler, J. Bot. 64: 145. 1926; *P. hedyaroides* R. Br. ex Wight & Arn.: Baker in Hook. f., Fl. Brit. India 2: 153. 1876.

Trailing herbs; branchlets downy-pubescent. Leaves 3-foliolate; leaflets 1-2 x 0.7-1 cm, obovate, thin-coriaceous, ciliate margin, rotund at apex, cuneate at base. Flower 2.5 mm across, purple in lax racemes. Pods 7.5 x

4.5 mm, oblong, inflated.

Ecology : Frequent on dry sandy places and rocky slopes along the coast.

Fl. & Fr. : March-June.

Distrib. : Western Ghats, West coast, Karnataka, Kerala and Tamil Nadu.

26. *Rhynchosia* Lour.

KEY TO THE SPECIES

1a. Plants trailing; flowers in capitat racemes; pods orbicular, seeds strophiolate..... 1. *capitata*

1b. Plants twining; flowers in lax racemes; pods elliptic lanceolate seeds estrophiolate..... 2. *minima*

1. *Rhynchosia capitata* (Heyne ex Roth.) DC., Prod. 2: 386. 1825; *R. aurea auct. non* (Willd.) DC.: Baker in Hook. f., Fl. Brit. India 2: 221. 1876.

Twining, annual herbs; branches winged, covered with white, spreading hairs. Leaves 3-foliolate; leaflets 2-3.5 x 1.5-3.0 cm, pubescent, acute-obtuse at apex and base. Flowers 1-1.5 cm long, bright yellow in umbellate

racemes. Pods 1.0-1.5 x 0.9-1.5 cm, suborbicular compressed, transversely striated, hairy, 2-seeded.

Ecology : Frequent on dry coastal sands.

Fl. & Fr. : August-October.

Distrib. : Throughout the coastal plains.

2. *Rhynchosia minima* (L.) DC., Prod. 2: 385. 1825; Baker in Hook. f., Fl. Brit. India 2: 223. 1876.

Twining herbs; branchlets downy-pubescent. Leaves 3-foliolate; leaflet 1-1.8 x 1-2 cm, obovate-rhomboid, thin coriaceous, pubescent, gland dotted below, entire, obtuse-rotund, apiculate at apex, cuneate at base. Flower 8 mm across, yellow in axillary racemes. Pods

1.5 x 0.5 cm, pubescent, horned, 1-2 seeded. Seeds up to 3.5 mm, estrophiolate.

Ecology : Frequent on coastal scrubs on lee side of the sand dunes.

Fl. & Fr. : January; February onwards.

Distrib. : Throughout the coast.

27. *Rothia* Pers.

Rothia indica (L.) Druce., Rep. Bot. Exch. Club Brit. Isles 3: 423. 1914, *R. trifoliata* Pers.; Baker in Hook. f., Fl. Brit. India 2: 63. 1876.

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

3-4 cm long, linear, straight, covered with silky hairs, 8-15 seeded.

Ecology : 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.

Distrib. : West Bengal, Orissa and Andhra Pradesh.

28. *Sesbania* Scop.

KEY TO THE SPECIES

- 1a. Herbs; pods pendulous 1. *aculeata*
 1b. Shrubs; pods straight 2. *cannabina*

1. *Sesbania aculeata* Pers., Syn. Pl. 2: 316. 1807; var. *paludosa* Baker in Hook. f., Fl. Brit. India 2: 115. 1876.

Annual herbs 1.5-3 m tall. Leaves 15-30 cm long; leaflets 15-35 pairs, up to 20 x 6 mm, narrowly oblong, acute to rounded mucronate at apex, acute or obtuse at base. Flowers 15-12 mm across, yellow in lax axillary 6-10 flowered racemes. Pods 20-30 x 6 cm, linear, pendulous.

Ecology : Frequent in ditches and marshy places near the coast.

Fl. & Fr. : July-October.

Distrib. : West Bengal, Orissa, Tamil Nadu and Karnataka coast.

2. *Sesbania cannabina* (Retz.) Poir., Lam., Encycl. 7: 130. 1806; *S. aculeata* (Willd) Poir. var. *cannabina* (Ritz.) Baker in Hook. f., Fl. Brit. India 2: 115. 1876.

Shrubs; branches obscurely mucronate. Leaves 15-30 cm long, abruptly pinnate; leaflet 40-80, linear, acute at apex, narrowed at base. Flowers up to 0.6 cm long, yellow in 3-4 flowered subsessile racemes. Pods 15-20 x 0.3 cm, straight, beaked, numerous seeded.

Ecology : Cultivated and naturalised, introduced from Australia.

Fl. & Fr. : September - December.

Distrib. : West Bengal, Orissa, Maharashtra and Gujarat coastal districts.

29. *Smithia* Ait.

KEY TO THE SPECIES

- 1a. Stem densely bristly 4. *setulosa*
 1b. Stem not bristly :
 2a. Flowers solitary or 2-4 in the leaf axils 1. *conferta*
 2b. Flowers in racemes, heads or panicles :
 3a. Flowers in short axillary racemes; calyx veins parallel 3. *sensitiva*
 3b. Flowers in terminal, corymbose panicles; calyx veins
 anastomosing 2. *salsuginea*

1. *Smithia conferta* J. E. Sm., Rees, Cyclop. 33: no. 2. 1816; *S. geminiflora* Doth., Baker in Hook. f., Fl. Brit. India 2: 149. 1876 incl. vars.

Herbs up to 50 cm tall. Leaflets up to 1 cm long, oblanceolate, membranous, margin and midrib covered with bristles, acute at apex, narrowed at base. Flowers 1.3 cm long, yellow, 1-3 in axillary racemes. Pods 1.5 cm long, flattened, 5-4 jointed.

Ecology : Frequent along streams in coastal thickets.

Fl. & Fr. : Almost throughout the year.

Distrib. : Throughout coastal plains.

2. *Smithia salsuginea* Hance, J. Bot. 7: 164. 1869; *S. dichotoma* Dalz. ex Baker in Hook. f., Fl. Brit. India 2: 150. 1876.

Erect, annual herbs, 30-50 cm high. Leaflets 2-4 pairs, 0.5-1.5 x 0.3-0.6 cm, oblanceolate-oblong, obtuse at apex. Flowers 1.2 cm long, yellow in few-flowered, corymbose panicles. Pods with orbicular joints, papillose. Seeds elliptic, glabrous, smooth, yellow.

Ecology : Rare in the coastal thickets and sandbars.

Fl. & Fr. : July-September.

Distrib. : Karnataka, Goa, Maharashtra and Gujarat coast.

3. *Smithia sensitiva* Ait., Hort. Kew. ed. 1, 3: 494. 1789; Baker in Hook. f., Fl. Brit. India 2: 148. 1876.

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 x 1-3 mm, oblong entire, bristly along midribs. Flowers 6-9 mm across, bright yellow, 2-3 in axillary racemes. Lomentum 4-6 mm long, joints 4-5, warty, enclosed by scariaceous calyx.

Ecology : Frequent along sandy sea-shores and inward forests.

Fl. & Fr. : October-December.

Distrib. : Throughout the coastal provinces.

4. *Smithia setulosa* Dalz., Hook. J. Bot. Kew Gard. Misc. 3: 208. 1851; Baker in Hook. f., Fl. Brit. India 2: 149. 1876.

Herb up to 1 m tall; much branched. Leaflets 12-16, up to 3 cm long, linear margins covered with bristles, acute at apex, narrowed at base. Flowers up to 1.3 cm, yellow, in terminal panicle. Pods with 10-12 joints, flattened.

Ecology : Common on rocky slopes in the midst of grasslands.

Fl. & Fr. : October-December.

Distrib. : Tamil Nadu, Kerala, Karnataka, Maharashtra, Gujarat.

30. *Sophora* L.

Sophora tomentosa L., Sp. Pl. 373. 1753; Baker in Hook. f., Fl. Brit. India 2: 249. 1878.

A much branched evergreen, tomentose shrub or small tree, 1.5-2.5 m tall. Leaves 20-25 cm long; leaflets 11-19, ovate-elliptic, 3.5 x 2.2 cm, deep green, coriaceous above, thinly silvery tomentose beneath, acute at apex, obtuse at base. Flowers 12-17 cm, sulphur-yellow in

racemes. Pod 12-16 cm long, monoliform, thinly tomentose, constricted between the seeds and separated by a stipe, 6-9 seeded.

Ecology : Frequent on sandy and rocky coast line.

Fl. & Fr. : November-December.

Distrib. : Frequent along the islands of south Andamans.

31. *Stylosanthes* Swartz.

Stylosanthes fruticosa (Retz.) Alston, Trimen, Handb. Fl. Ceylon 6: Suppl. 77, 1931; *S. mucronata* Willd., Baker in Hook. f., Fl. Brit. India 2: 148. 1876.

Undershrub up to 75 cm; branchlets adpressed-tomentose. Leaves 3-foliolate; leaflets 0.7-1.5 x 0.2-0.4 cm, oblong-elliptic, chartaceous, ciliate margin, obtuse or mucronate at apex, subacute at base. Flowers

4 mm across, yellow, 3-5 in terminal heads. Pods 4 mm, oblong, beaked. Seeds 2 mm, reniform.

Ecology : Frequent in coastal plains and in grazing grounds near the sea shore.

Fl. & Fr. : November-January; December-February.

Distrib. : Karnataka and Kerala coast.

32. *Taverniera* DC.

Taverniera cunefolia Arn., Wt. Ic. t. 1055. 1846; *T. nummularia* (auct. non. DC.) Baker in Hook. f., Fl. Brit. India 2: 140. 1876.

Much branched, spreading herbs, or undershrubs; branches triangular, hoary. Leaves simple, alternate, 1.5-2 x 1-1.3 cm, obovate or suborbicular, glabrous, and canescent beneath, rounded at apex, cuneate at base. Flowers 1-1.5 cm across, in short axillary racemes. Pods

5-7 cm long, jointed, echinate, with transverse ridges. Seeds, smooth reniform.

Ecology : Frequent along the sandy scrub jungles, saline flats and along the sandy sea-shore.

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

Distrib. : Western Ghats and Saurashtra coast recently collected from Orissa near Paradeep coast.

33. *Tephrosia* Pers.

KEY TO THE SPECIES

- 1a. Leaves 1-foliolate 4. *strigosa*
- 1b. Leaves more than 1-foliolate:
 - 2a. Flowers 1 or 2 in leaf axils, stipules spinous 3. *spinosa*
 - 2b. Flowers in pseudoracemes or panicles, stipules not spinous :
 - 3a. Flowers clusters uninterrupted on the rachis :
 - 4a. Pods puberulous 2. *purpurea*
 - 4b. Pods densely hairy 5. *villosa*
 - 3b. Flower clusters interrupted on the rachis 1. *maxima*

1. *Tephrosia maxima* (L.) Pers., Syn. Pl. 2. 1807; *T. purpurea* Pers. var. *maxima* Baker in Hook. f., Fl. Brit. India 2: 113, 1876.

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

Ecology : Rare along sandy sea-shore and frequently seen on open places.

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

Distrib. : Orissa and West Bengal coast.

2. *Tephrosia purpurea* (L.) Pers., Syn. Pl. 2: 329. 1807; Baker in Hook. f., Fl. Brit. India 2: 112. 1876.

Erect bushy undershrubs 0.5-1 m tall; branches terete, glabrous or puberulous when young. Leaves 8-12 cm long, 9-17 foliolate; leaflets 0.5-3 x 0.3-1 cm,

opposite, obovate, or oblong-lanceolate, glabrous, rounded, emarginate or mucronulate at apex, cuneate at base. Flowers, 5-7 mm across, deep purple, in axillary or terminal racemes. Pods 3-4 cm, oblong, compressed, glabrous; Seeds 6-8.

Ecology : Common along the river banks and road sides, frequent along the sandy sea-shores.

Fl. & Fr. : Throughout the season.

Distrib. : Throughout the coastal districts.

3. *Tephrosia spinosa* (L. f.) Pers., Syn. Pl. 2: 330. 1807. Baker in Hook. f., Fl. Brit. India 2: 112. 1876.

Shrubs, branchlets, grey, canescent. Leaves 3 cm, stipulate, 4 or 5 pairs, obovate, 0.7-1.5 x 0.3-0.5 cm, chartaceous, appressed-pubescent, entire, base cuneate, apex truncate. Flowers 1 cm across, red, axillary. Pods recurved appressed pubescent. Seeds 7, ellipsoid.

Ecology : Frequent on sandy river beds and coastal scrubs.

Fl. & Fr. : April-May.

Distribution : Maharashtra, Gujarat and Andhra Pradesh coast.

4. *Tephrosia strigosa* (Dalz.) Sant. & Mahew., J. Bombay Nat. Hist. Soc. 54. 805. 1956; *T. tenuis* Wall. ex Dalz. & Gibs.: Baker in Hook. f., Fl. Brit. India 2: 111. 1876.

Teramnus labialis (L. f.) Spreng., Syst. 3: 235. 1826; Baker in Hook. f., Fl. Brit. India 2: 184. 1876.

Deep-rooted, perennial trailers; branches slender, spreading, appressed pubescent. Leaves 3-foliolate, alternate; leaflets 1-3.5 x 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

Herbs; branchlets opposed-pubescent. Leaves 2.5-4.5 x 0.3-0.6 cm, oblong, chartaceous, glabrous above, pubescent below, entire, obtuse, apiculate at apex, obtuse at base. Flowers 4 mm across, pink, axillary, solitary. Pods 2.5 x 0.4 cm, compressed, appressed-pubescent, 10-seeded. Seeds 1 mm, oblong-ellipsoid.

Ecology : Occasional on gravelly soil.

Fl. & Fr. : September-December.

Distrib. : Karnataka, Maharashtra, Gujarat and Lakshadweep.

5. *Tephrosia villosa* (L.) Pers., Syn. Pl. 2: 329. 1807; Baker in Hook. f., Fl. Brit. India 2: 113. 1876.

Erect undershrubs 0.5-1 m tall; branches terete, adpressedly hairy. Leaves 9-17 foliolate; leaflets 1-2 x 0.3-0.5 cm, obovate to oblanceolate, prominently reticulate-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 pillose, 8-9 seeded.

Ecology : Common along sandy river banks and in sea-shores.

Fl. & Fr. : August-September, November-December.

Distrib. : Throughout the coastal provinces and Andaman.

34. *Teramnus* Swartz.

in axillary racemes. Pods 2-5 cm, long, linear, beaked at apex.

Ecology : Frequent in moist places along the sandy sea shore, river banks and road sides. Common in dry inland places.

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

Distrib. : Throughout the coastal provinces.

35. *Uraria* Desv.

KEY TO THE SPECIES

- 1a. Erect herb, branches covered with hooked hairs 1. *lagopus*
 1b. Straggler, branches villose not covered with hooked hairs 2. *rufescens*

1. *Uraria lagopus* DC. var. *neglecta* (Brain) Ohashi in Hara, Fl. E. Himal. 3: 70. 1975. *U. lagopus* DC.: Baker in Hook. f., Fl. Brit. India 2: 156. 1832.

Herb, woody at base, stem covered with hooked hairs. Leaflets 7 x 5 cm, ovate, elliptic or oblong, puberulus with hooked hairs, mucronate at apex, acute or sub-cordate at base. Flower pink, dense in axillary or terminal racemes, bracts rounded at base. Seeds 2, pale greenish yellow.

Ecology : Rare, found as an undergrowth in deciduous forest in humus soil, near the coast.

Fl. & Fr. : July-September.

Distrib. : West Bengal, Tamil Nadu, Karnataka and Maharashtra coast.

2. *Uraria tufescens* (DC.) Schlinder, Fedde Rep. 21: 14. 1925. *U. hamosa* Wall. ex Wight & Arn.: Baker in Hook. f., Fl. Brit. India 2: 156. 1876.

Straggler; branchlets downy-villose. Leaves 3-foliolate; leaflets 4-10.5 x 2-5.5 cm, oblong or ovate-elliptic, tomentose below, chartaceous, ciliate margin, obtuse or mucronate at apex, truncate or obtuse at base. Flower 6 mm across, rose coloured in racemes or panicles. Pods 2.5-4.5 x 1 cm, 4-5 jointed, segments inflated.

Ecology : Frequent along rocky slopes near sea shore.

Fl. & Fr. : November-December.

Distrib. : Karnataka, Kerala and Maharashtra coast.

36. *Vicia* L.

Vicia sativa L., Sp. Pl. 736. 1753; Baker in Hook. f., Fl. Brit. India 2: 178. 1876 excl. var.

Climber, annual, with fistular stem and branches. Leaves paripinnate, ending into 2 to 3 fid tendrils; leaflets 3-8 pairs, 1.5-3.0 x 0.3-0.8 cm, lanceolate, oblong or obovate, hairy, emarginate at apex, narrowed at base.

Flowers up to 1 cm long, reddish blue, solitary. Pods 3.0-4.5 cm long, linear, flat, yellow or light brown.

Ecology : Frequent as weed in cultivated fields and gardens near the coast.

Fl. & Fr. : January-March

Distrib. : West Bengal, Tamil Nadu, Gujarat coast.

37. *Vigna* Savi.

KEY TO THE SPECIES

1a. Leaflets deeply lobed. Pods glabrescent :

2a. Stipules narrow lanceolate, standard 8 mm across 1. *aconitifolia*

2b. Stipules broad-obovate, standard 4 mm across 2. *trilobata*

1b. Leaflets slightly angled or lobed. Pods hairy 3. *unguiculata* ssp. *cylindrica*

1. *Vigna aconitifolia* (Jacq.) Marechal, Bull. Jard. Bot. Nat. Belg. 39: 160. 1969; *Phaseolus aconitifolius* Jacq.: Baker in Hook. f., Fl. Brit. India 2: 202. 1876.

Prostrate or suberect herbs; hairs yellow. Leaves 3-foliolate; leaflets 3-6 cm long, palmately 3 lobed. Flowers 5 mm long, yellow in axillary racemes. Pods

3-6 cm long pubescent when young, 5-8 seeded.

Ecology : Frequent in wasteland and scrub forest along the coast.

Fl. & Fr. : September-October.

Distrib. : Throughout the coastal districts.

2. *Vigna trilobata* (L.) Verdc., Taxon 17: 172. 1968 & Kew Bull. 24: 560. 1970; *Phaseolus trilobus* Aiton. *auct. multo non Dolichos trilobus* L.: Baker in Hook. f., Fl. Brit. India 2: 201. 1876.

Herb, prostrate or twining; branchlets angular, finely ribbed. Leaves 3-foliolate; leaflets palmately 3 lobed; lobes 1.5-3.5 x 1-1.5 cm, midlobe large, obovate-spathulate, lateral lobes oblique, ciliate, obtuse apiculate at apex, obtuse at base. Flowers 8 mm across, yellow in axillary racemes. Pods up to 4 cm, subterete, turgid, 7-10 seeded. Seeds 2 mm, oblong.

Ecology : Frequent along river banks, fallow land and on disturbed soil along the coast.

Fl. & Fr. : November-December.

Distrib. : Throughout the coastal provinces.

3. *Vigna unguiculata* (L.) Walp. ssp. *cylindrica* (L.) van Eseltine, Hendricks, Veg. New York 1(2): 11. 1931; *V. catjang* (Burm. f.) Walp. *nom. illeg.*: Baker in Hook. f., Fl. Brit. India 2: 205. 1876.

Twining, annual herb. Leaves 3-foliolate; leaflet 7.5-15 cm long, ovate-rhomboid, very variable in shape, acute at apex. Flowers 2.5 cm long, yellow or reddish in few flowered racemes. Pods 20-30 x 1.5 cm, 10-20 seeded. Seeds oblong.

Ecology : Escapes from cultivation, common along the coast.

Fl. & Fr. : June-January.

Distrib. : Throughout the West coast.

38. *Zornia* J.F. Gmel.

KEY TO THE SPECIES

- 1a. Leaves linear lanceolate; loment 4-6 bristles retrorsely hairy 2. *gibbosa*
 1b. Leaves ovate; loment 4, bristles not retrorsely hairy 1. *diphylla*

1. *Zornia diphylla* (L.) Pers., Syn. 2: 318. 1807; *Z. diphylla* Pers. var. *zeylonensis* Benth.: Baker in Hook. f., Fl. Brit. India 2: 148. 1876.

Much branched annual or perennial herbs with long taproot system. Leaves distichous, 2-foliolate; leaflets 1.5-2 x 1-1.3 cm, ovate, glabrous, slightly pubescent along margins, apiculate at apex, oblique at base. 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.

Ecology : Frequent along the sandy or muddy sea shores and dry sandy areas near the coast.

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

Distrib. : East coast, Ganjam to Travancore.

2. *Zornia gibbosa* Span., Linnaea 15: 192. 1841; *Z. diphylla* (*auct. non L.*) Pers.: Baker in Hook. f., Fl. Brit. India 2: 147. 1878.

Much branched, diffused annuals; with slender, glabrous branches from woody rootstock. Leaves distichous, 2-foliolate; leaflets 1.5-1.7 x 0.2-0.5 cm, lanceolate, rarely ovate-lanceolate when young, glabrous, punctate, acute at apex, obtuse at base. 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.

Ecology : Common along sea coast, river banks, road sides and dry inland habitats.

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

Distrib. : Throughout the east and west coast.

CAESALPINIACEAE

KEY TO THE GENERA

- 1a. Leaves bipinnate :
 - 2a. Pods large, never twisted :
 - 3a. Sepals imbricate 1. *Caesalpinia*
 - 3b. Sepals valvate :
 - 4a. Pod flat, thin, flowers large, unarmed 4. *Delonix*
 - 4b. Pod monoliform, turgid, flowers small, armed 8. *Parkinson*
 - 2b. Pods small, twisted 5. *Dichrostachys*
- 1b. Leaves paripinnate :
 - 5a. Stamens free :
 - 6a. Stamens 10 :
 - 7a. Porus dehiscence of anthers 2. *Cassia*
 - 7b. Longitudinal dehiscence of anthers 3. *Cynometra*
 - 6b. Stamens 5-9 :
 - 8a. Flowers axillary racemes, pod dehiscent 6. *Humboldtia*
 - 8b. Flowers terminal panicles, pod indehiscent 7. *Intsia*
 - 5b. Stamens monadelphous 9. *Tamarindus*

1. *Caesalpinia* L.

KEY TO THE SPECIES

- 1a. Pods prickly 1. *bonduc*
- 1b. Pods not prickly 2. *crista*

1. *Caesalpinia bonduc* (L.) Roxb., Fl. Ind. 2: 362, *quoad basion.*; *C. bonducella* (L.) Flem.: Baker in Hook. f., Fl. Brit. India 2: 254. 1876.

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. Flowers 5-10 mm long, yellow, in supra axillary racemes; lower flower only fertile. Pods 4-6 cm, elliptic-oblong, turgid, densely prickly. Seeds 2 cm across, 1-3, globose, shining.

Ecology : Common in open dry hedges; sandy scrubs; coastal thickets, and occasionally along sandy sea-shore and on back mangrove.

Fl. & Fr. : August - December.

Distrib. : Throughout the coastal regions.

2. *Caesalpinia crista* L., Sp. Pl. 380. 1753. *C. nuga* (L.) Ait. f.: Baker in Hook. f., Fl. Brit. India 2: 255. 1876.

Large climbers or lianas, armed with hooked prickles. Leaves 18-30 cm long, decoumpound; 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 x 3-3.5 cm, ellipsoid, flat, compressed, beaked. Seeds 1, flat, smooth. **Ecology :** 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 tiliaceous* and *Phoenix palludosa*.

Fl. & Fr. : October-January; December-May.

Distrib. : Throughout the back mangroves both in the East and West coast.

2. *Cassia* L.

KEY TO SPECIES

- 1a. Foliar glands present :
- 2a. Glands always present present on the petioles; leaflets ovate-lanceolate :
- 3a. Leaflets 6-10 pairs; bracts obtuse; pods turgid; hilum end of the seeds slightly curved on one side 3. *sophera*
- 3b. Leaflets 3-5 pairs; bracts acute; pods less turgid; hilum end of the seeds straight 2. *occidentalis*
- 2b. Glands present between the pairs of leaflets (no glands on petiole), leaflets obovate 4. *tora*
- 1b. Foliar glands absent 1. *italica*

1. *Cassia italica* (Mill.) Spreng., Bot. Gart. Univ. Halle 21. 1800; *C. obovata* Collad.: Baker in Hook. f., Fl. Brit. India 2: 264. 1876.

Diffuse herb, woody at base. Leaves abruptly pinnate; leaflets 3-7 pairs, 1-3 x 0.3-1.5 cm, broadly oblong or obovate; obtuse mucronate at apex. Flower yellow, in axillary and terminal racemes. Pods 2.5-3.5 cm long, papery, oblong. Seeds obovoid-oblong, dark brown.

Ecology : Frequently found on dry openland and pastures near the coast.

Fl. & Fr.: July-February.

Distrib.: Gujarat, Karnataka, Maharashtra and Tamil Nadu coast.

2. *Cassia occidentalis* L., Sp. Pl. 377. 1753; Baker in Hook. f., Fl. Brit. India 2: 262. 1876.

Perennial shrubs, 1-2 m tall; stems glabrous, subquadrangular. Leaves paripinnate, 4-5 jugate, alternate; leaflets 3-6 x 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.

Ecology : Frequent on sandy sea shores, scrub jungles and along the road sides.

Fl. & Fr.: July-November; December-January.

Distrib.: Throughout the coastal provinces.

3. *Cassia sophera* L., Sp. Pl. 379. 1753; Baker in Hook. f., Fl. Brit. India 2: 262. 1876.

Erect perennial herbs or undershrubs up to 2 m tall; stems much branched, glabrous. Leaves paripinnate, 6-12 jugate, alternate; rachis 4-20 cm long; glands clavate or cylindric, above the petioles; leaflets 4-6 x 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.

Ecology : Mostly common towards inland, frequent along the river banks and lee side of the sandy sea coast.

Fl. & Fr. : July-November.

Distrib. : Throughout the Indian coast.

4. *Cassia tora* L., Sp. Pl. 376. 1753; Baker in Hook. f., Fl. Brit. India 2: 263. 1876.

Erect, perennial herbs or undershrubs 30-70 cm tall; stems terete, much branched. Leaves paripinnate, 3-jugate, rachis 1-3 cm, sulcate; glands sublanceolate above the petiolules in-between leaflets; leaflets 1-3.5 x 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.

Ecology : Common along road sides, wasteland, river banks and occasionally along the sandy sea-shores, in places exposed to biotic influence.

Fl. & Fr. : June-December.

Distrib. : Naturalised throughout the coastal plains.

3. *Cynometra* L.

KEY TO THE SPECIES

- 1a. Pods deeply wrinkled, apical part hooked 1. *iripa*
 1b. Pods rugose, apical part not hooked 2. *ramiflora*

1. *Cynometra iripa* Kostel., Allg. Med. Pharm. Fl. 4: 1341. *C. ramiflora* L. var. *mimosoides* Baker in Hook. f., Fl. Brit. India 2: 267. 1876.

Trees 4-12 m tall, 40-50 cm in diam., growing flash-wise with uniform crowns. Leaves 2-jugate, rarely 1-jugate; leaflets smaller in lower pairs, and larger in upper pairs, usually 2-7 x 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.

Ecology : Common along intertidal zones in the semi-mangrove forest in association with *Heritiera fomes*, *Excoecaria agallocha* and *Bruguiera* sp.

Fl. & Fr. : October-November; December-March.

Distrib. : Sundarbans, Orissa, Andaman.

2. *Cynometra ramiflora* L., Sp. Pl. 382. 1753; Baker in Hook. f., Fl. Brit. India 2: 267. 1876.

Trees 10-16 m tall, 40-70 cm in diam. Leaves 2-jugate, or 1 and 2-jugate; leaflet of lower pairs 2-4.5 x 1-2.5 cm and of upper pairs 4.5-10 x 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.

Ecology : Common along the inner as well as outer fringes of tidal forests, specially restricted in the island near estuaries, in association with *Heritiera littoralis*, *Xylocarpus* sp., *Amoora cucullata* and *Heritiera fomes*.

Fl. & Fr. : September-November; December-January.

Distrib. : East coastal region in Sundarbans, Orissa, Tamil Nadu and Andaman & Nicobar island.

4. *Delonix* Rafin.

Delonix elata (L.) Gamble, Fl. Pres. Madras 396. 1919; *Poinciana elata* L.: Baker in Hook. f., Fl. Brit. India 2: 260. 1876.

Tall tree 6-10 m high with ash-coloured or deep reddish brown, smooth bark. Leaves 4-15 cm long; pinnae 4-6 pairs; leaflets 10-20 pair, 0.7-1.5 x 0.3-0.4 cm, linear-oblong, obtuse at apex, narrowed towards base. Flowers

creamy-white to pale yellow in terminal racemes. Pods 15-20 cm long, linear-oblong, dark brown, 4-8 seeded.

Ecology : Wild along the western coast, cultivated throughout India.

Fl. & Fr. : April-November; December-January.

Distrib. : Throughout the Indian coast.

5. *Dichrostachys* (A. DC.) Wight & Arn.

Dichrostachys cinerea (L.) Wight & Arn., Prod. 271. 1834; Baker in Hook. f., Fl. Brit. India 2: 288. 1876.

Shrub, branchlets ending in spine. Leaves bipinnate; pinnae 8-14 paripinnate. Leaflets 10-12 pairs, 0.2-3 mm long, linear-oblique. Flower 1-2 mm long,

yellow, in crowded axillary spike. Pods 5-7.5 cm long, linear, twisted 6-10 seeded.

Ecology : Frequent along sandy uplands near the coast.

Fl. & Fr. : October-December.

Distrib. : Karnataka, Tamil Nadu and Goa coast.

6. *Humboldia* Reichb.

Humboldia brunonis Wall., Pl. Asiat. Rat. 3:17, t. 233. 1832; Baker in Hook. f., Fl. Brit. India 2: 274. 1876.

Evergreen trees up to 5 m tall. Leaves abruptly pinnate; leaflets 2 pairs, 17 x 5.5 cm, obovate-oblong, obtusely cuspidate at apex, obliquely acute at base.

Flowers 1.5 cm long, orange in axillary racemes. Pods flat, rigidly coriaceous.

Ecology : Rarely found along rocky coastal slopes.

Fl. & Fr. : November- December.

Distrib. : Karnataka, Kerala, Tamil Nadu coast.

7. *Intsia* Thouars

Intsia bijuga (Colebr.) O. Kuntze, Rev. Gen. Pl. 192. 1891; *Azelia retusa* Kurz.: Baker in Hook. f., Fl. Brit. India 2: 274. 1876.

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 branches, each flower in axil of a bract. 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.

Ecology : More or less common towards the inner mangroves, sometimes along the intertidal zones along the littoral forests in association with *Heritiera fomes*, *Cynometra ramiflora* and *Brownlowia tersa*.

Fl. & Fr. : January-March; Fruits present on the plant from March-December.

Distrib. : Sundarbans, Orissa and Andamans.

8. *Parkinsonia* L.

Parkinsonia aculeata L., Sp. Pl. 375. 1753; Baker in Hook. f., Fl. Brit. India 2: 260. 1876.

Shrubs or small trees, 2-6 m tall, armed with long spines. Leaves at first pinnate and fasciculate, later bipinnate, spinoscent 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.

Ecology : Frequent along the river-banks, coastal thickets and back mangroves. Commonly found as hedge plants in low-lying areas. Mostly cultivated.

Fl. & Fr. : October-March; June-July.

Distrib. : Eastern and Western peninsula.

9. *Tamarindus* L.

Tamarindus indica L., Sp. Pl. 34. 1753; Baker in Hook. f., Fl. Brit. India 2: 273. 1876.

Large tree. Leaves even pinnate, leaflets 10-12 pair, 0.25 cm long, linear oblong, rounded apex and base. Flowers small red and yellow in lax racemes. Pods curved linear, compressed.

Ecology : Introduced from tropical Africa, cultivated and naturalised throughout India.

Fl. & Fr. : April-December.

Distrib. : Throughout Indian coast.

MIMOSACEAE

KEY TO THE GENERA

- 1a. Stamens definite; seeds albuminous :
 - 2a. Anthers gland crested at least in an early stage :
 - 3a. Flowers in globose heads; small herb; pods small thin; leaflets small 6. *Neptunia*
 - 3b. Flowers in elongate spikes; prickly trees or large shrubs; pods turgid; leaflets distant 7. *Prosopis*
 - 2b. Anthers not gland-crested :
 - 4a. Pods straight, dehiscing at the sutures :
 - 5a. Undershurbs with elevated stigmas 3. *Desmanthus*
 - 5b. Large shrubs or small trees with capitate stigmas 4. *Leucaena*
 - 4b. Pods curved, indehiscent 5. *Mimosa*
- 1b. Stamens indefinite; seeds exalbuminous :
 - 6a. Plants armed with spines or prickles; stamens monadelphous 1. *Acacia*
 - 6b. Plants usually unarmed; stamens free 2. *Albizia*

1. *Acacia* Willd.

KEY TO THE SPECIES

- 1a. Flowers in elongate cylindrical spikes :
 - 2a. Pinnae more than 10 pairs; bark rough blackish..... 1. *chundra*
 - 2b. Pinnae less than 6 pairs; bark whitish, whitish grey or pale brown 3. *senegal*
- 1b. Flowers in spherical heads :
 - 3a. Leaves glabrous to pubescent; flowers bright yellow 2. *nilotica* ssp. *indica*
 - 3b. Leaves hairy; flowers greenish white 4. *tomentosa*

1. *Acacia chundra* Willd., Sp. Pl. 4: 1048. 1806; *A. seendra* (Roxb. ex Rottler) DC.: Baker in Hook. f., Fl. Brit. India 2: 295. 1878.

Tree, 9-12 m high woody and armed. Leaves bipinnate, 8-10 cm long, stipular spines hooked; rachies with small gland between the upper pinnae; Pinnae 10-20 pairs, 2-2.5 cm long, leaflets in 30-40 pairs. Flowers 2 mm across, white, arranged in 6-8 cm long spike. Pod 6 x 1 cm, flat, glabrous. Seeds 3-4.

Ecology : Common on sandy back shore, on hill slopes of the sand stone.

Fl. & Fr. : April-August.

Distrib. : Mainly on Gujarat coast.

2. *Acacia nilotica* (L.) Delile ssp. *indica* (Benth.) Brenan, Kew Bull. 12: 84. 1957; *A. arabica* auct. non (Lam.) Willd.: Baker in Hook. f., Fl. Brit. India 2: 293. 1878.

Tree up to 8 m; branchlets grey-pubescent. Leaves up to 4.5 cm, pinnae for 5 pairs; leaflets 15-20 pairs, 4 x 1 mm, elliptic, entire, glabrous, rotund apex, oblique at base. Flowers 1 mm across, bright yellow in axillary globose heads. Pods 18 x 1.5 cm, glaucous, moniliform, constricted, apex horned, 10-15 seeded.

Ecology : Planted in fallow land, road sides, river banks.

Fl. & Fr. : August-October; October onwards.

Distrib. : Throughout the coastal plains.

3. *Acacia senegal* (L.) Willd., Sp. Pl. 4: 1077. 1806; Baker in Hook. f., Fl. Brit. India 2: 295. 1878.

Tree, 3.0-6.5 m high; bark whitish. Leaves 2.5-7 cm, with stipular prickles; leaflets 6-20 pairs, 0.3 cm long, linear to elliptic-oblong, acute at apex, obtuse at base. Flowers 2-4 mm long, white or creamy, fragrant in dense spikes. Pods 4-10 x 1.5-2.5 cm, oblong, flat, pale brown, 4-6 seeded. Seed 7 mm across, suborbicular, disc like.

Ecology : Frequent in coastal sand dunes and scrub forests.

Fl. & Fr. : July-February.

Distrib. : Gujarat coast.

4. *Acacia tomentosa* Willd., Sp. Pl. 4: 1087. 1806; Baker in Hook. f., Fl. Brit. India 2: 294. 1878.

Trees, 5 m high, spiny, young parts tomentose. Leaves 4 cm long, bipinnate, pinnae 1.5 cm long, up to 10 pairs; leaflets 0.3 cm, linear-oblong, membranous, acute at apex, narrowed at base. Flower 2-3 mm long, red, in globose heads. Pods 15 x 1.5 cm, falcate, up to 8 seeded.

Ecology : Frequent along the coastal scrubs and back side of the dunes.

Fl. & Fr. : November-March.

Distrib. : Gujarat and Karnataka coast.

2. *Albizia Durazzini*

KEY TO THE SPECIES

- 1a. Petiole eglandular; pinnae 2-3 pairs; flowers pedicillate 2. *lebbeck*
 1b. Petiole glandular; pinnae 9-13 pairs; flowers sessile 1. *amara*

1. *Albizia amara* (Roxb.) Boiv., Encycl. 19. siecle 2: 34. 1834; Baker in Hook. f., Fl. Brit. India 2: 301. 1878.

Tree up to 8 m; branchlets densely yellowish or grey-pubescent. Leaves 12 x 9 cm, pinnae 9-13 pairs; leaflets 20-25 pairs, 8 x 2.5 mm, narrow-elliptic, oppressed-pubescent or glabrescent, ciliate margin, obtuse at apex, subacute at base. Flowers up to 5 mm, cream coloured in axillary clustered or racemose heads. Pods 8-20 x 2-3, flat, apex and base rotund, up to 10 seeded. Seeds 1 x 0.5 cm, ovoid.

Ecology : Frequent in dry coastal zones on sandy and rocky slopes.

Fl. & Fr. : March-May; June onwards.

Distrib. : Visakhapatnam, N. Circars and Godavari of Andhra Pradesh, Karnataka and Maharashtra coast.

2. *Albizia lebbeck* (L.) Benth., Hook. Lond. J. Bot. 3: 87. 1844; Baker in Hook. f., Fl. Brit. India 2: 298. 1878.

Deciduous trees with many spreading branches. Flowers greenish-white. Pods thin, flat.

Ecology : Frequently planted along road sides, occasionally found naturalised near the river banks and low lying forests.

Fl. & Fr. : March-April.

Distrib. : Throughout the coastal districts.

3. *Desmanthus Willd.*

Desmanthus viragatus (L.) Willd., Sp. Pl. 4: 1047. 1806; Baker in Hook. f., Fl. Brit. India 2: 290. 1878.

Shrubs, branches wiry, glabrescent. Leaves 3.5 cm long; pinnae 3-5 pairs; leaflets 15-20 pairs, oblong-linear, ciliate along margin, mucronate at apex, truncate at base. Flowers white in axillary heads. Pods 10 cm long,

straight, 25-30 seeded.

Ecology : Frequent in sandy and rocky coast. Native of tropical America, naturalised throughout India.

Fl. & Fr. : May-July.

Distrib. : Throughout the coastal provinces.

4. *Leucaena* Benth.

Leucaena latisiliqua (L.) Gillis. *Taxon* 23: 190. 1974. *L. glauca* Benth.: Baker in Hook. f., *Fl. Brit. India* 2: 290. 1878.

Deciduous unarmed tree up to 8 m tall. Leaves bipinnate; leaflets 20-30, 0.9-1.2 cm, linear acute. Flowers in heads, white, 1.2-1.8 cm across. Pods 12-15 x 0.9-1.2 cm flat, strap shaped, 15-20 seeded.

Ecology : Introduced from tropical America, naturalised all over India but grows well on deep fertile soil with adequate irrigation. Frequently planted along the lee side of coastal sand dunes and river banks.

Fl. & Fr. : November-March.

Distrib. : Introduced throughout the coastal plains.

5. *Mimosa* L.

KEY TO THE SPECIES

1a. Prostrate or diffuse herbs or undershrubs; pinnae 1-2 pairs;

stamens 4; pods with bristles along the margins 2. *pudica*

1b. Erect or straggling shrubs or small trees; pinnae more than 2 pairs;

stamens 8; pods pubescent 1. *hamata*

1. *Mimosa hamata* Willd., *Sp. Pl.* 4: 1033. 1806; Baker in Hook. f., *Fl. Brit. India* 2: 291. 1878.

Shrub 3-5 m high; with straight or curved prickles. Leaves bipinnate, pinnae 6-8; leaflets 6-10 pairs, 3-6 mm long, ovate-oblong, apex mucronate. Flower 1-2 mm long, pink in axillary and terminal heads. Pods pubescent, prickly on sutures, 4-6 seeded.

Ecology : Frequent along the sandy back shore.

Fl. & Fr. : March-April.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

Leaves bipinnate, sensitive; pinnae 4-6 cm long; rachises clothed with ascending bristles; leaflets 10-25 pairs, each 3-10 x 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.

Ecology : Common along the river banks, and embankments near low lands, sandy wastelands and lee side of the coastal dunes.

Fl. & Fr. : May-September.

Distrib. : Throughout the coastal provinces.

2. *Mimosa pudica* L., *Sp. Pl.* 518. 1753; Baker in Hook. f., *Fl. Brit. India* 2: 291. 1878.

Perennial undershrubs, erect or rambling; stems woody, armed with prickles, glabrous when young.

6. *Neptunia* Lour.

Neptunia oleracea Lour., *Fl. Cochinch.* 654. 1790; Baker in Hook. f., *Fl. Brit. India* 2: 285. 1878.

Floating herbs; stems fleshy, spongy with fibrous adventitious roots at the nodes. Leaves bipinnate, thigmotropic; pinnae 2-4 pairs; leaflets 3-16 x 1-5 mm, sessile, linear-oblong, glabrous, acute at apex, oblique at base. Flowers 1-2 cm long, deep yellow, in axillary pedunculate heads. Pods 1-2 x 0.5-1 cm, ovoid flat,

deflexed into a short stipe and beaked at apex, suture with membranous wings. Seeds 4-6 compressed, flat.

Ecology : Common in ditches and low land along the coast and inland fresh water tanks.

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

Distrib. : Throughout the coastal provinces.

7. *Prosopis* L.

KEY TO THE SPECIES

- 1a. Internodes with prickles :
 2a. Pods straight 2. *glandulosa*
 2b. Pods pendulous 1. *cineraria*
 1b. Internodes without prickles 3. *julifera*

1. *Prosopis cineraria* (L.) Druce, Rep. Bot. Soc. Exch. Club, Brit. Isles. 1913, 3: 422. 1914; *P. spicigera* L.: Baker in Hook. f., Fl. Brit. India 2: 288. 1878.

Small tree with short, straight prickles. Leaves bipinnate, pinnae 2 pairs; leaflets 5-10 pairs, 0.6-1.2 cm long, obliquely oblong, acute at apex. Flowers 0.2 cm long, creamy-yellow, in axillary spikes. Pods 12-20 cm long, pendulous, subtorulose, turgid, 10-15 seeded. Seeds brown, oblong.

Ecology : Frequent along road sides, scrub jungles and sandy ridges along the coast.

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

Distrib. : Gujarat, Tamil Nadu, Karnataka and Maharashtra coast.

2. *Prosopis glandulosa* Torrey, Ann. Lyceum Nat. Hist. New York 2:192, t. 2. 1827. *P. juliflora* (sw.) DC. var. *glandulosa* (Torrey) Cockerell., Bull. Agri. Exp. Stat. New Mexico 15:58. 1895.

Medium sized, deciduous tree; with pendulous branches and stout spines. Pinnae 1-2 pairs; leaflets 10-18, linear-oblong. Flowers creamy yellow, in axillary

spikes. Pods 13-20 x 0.8 cm, linear, straight or falcate, beaked.

Ecology : Introduced from America now naturalised throughout arid zone.

Fl. & Fr. : April-June.

Distrib. : Gujarat coast.

3. *Prosopis juliflora* (Sw.) DC. Prodr. 2: 447. 1825.

Shrub or tree about 8 m tall; spines up to 1.5 cm, axillary. Leaves 2-pinnae; pinnae up to 8 cm, 1 or 2 pairs; leaflets 0.8-1.8 x 0.25-0.3 cm, 15-18 pairs, entire, obtuse at apex and base. Flowers 1.5 mm across, yellowish in axillary spikes. Pods 12.5-20 x 0.7-0.9 cm, drupaceous. Seeds ovoid.

Ecology : Introduced from America a vigorous coloniser. Frequent on the lee side of coastal sand dunes, on the banks of rivers, scrub jungles, wasteland, etc.

Fl. & Fr. : December-March; February onwards.

Distrib. : Throughout the coastal districts of Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat and Maharashtra.

VAHLIACEAE

Vahlia Thunb.

KEY TO THE SPECIES

- 1a. Flowers subsessile, 2 or often 1 flowered in most of the upper axils; filaments with a small hairy scales at their base 2. *digyna*
 1b. Flowers peduncled, 2 or rarely 1 flowered in most of the upper axils; filaments without a scale at their base 1. *dichotoma*

1. *Vahlia dichotoma* (Murray) Kuntze, Rev. Gen. Pl. 227. 1891; *V. oldenlandioides* Roxb.: Clarke in Hook. f., Fl. Brit. India 2: 399. 1878.

Erect herbs 10-30 m tall; branches diffuse or erect pubescent. Leaves 2-3.5 x 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. Capsules 3-4 mm across, ovoid or subglobose, with adpressed hairs. Seeds many, golden-brown.

Ecology : Frequent in moist places along the sandy sea shore.

Fl. & Fr. : January-April.

Distrib. : Tamil Nadu, Karnataka, Kerala, Maharashtra and Gujarat coast.

2. *Vahlia digyna* (Retz.) Kuntz, Revis. Gen. Pl. 227: 1891. *V. viscosa* Roxb.: Clarke in Hook. f., Fl. Brit. India 2: 399. 1878.

Herb. Leaves 0.5-2 x 0.3-0.5 cm, oblong-lanceolate, chartaceous, entire, acute at apex and obtuse at base. Flowers 2 mm across, in pairs at upper leaf axil, sessile. Capsule 1.5-2 mm. Seeds ovoid, 0.15 mm.

Ecology : Frequent along the coastal beaches, sand dunes and crevices near the rocky sea shore.

Fl. & Fr. : February; April.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu and Pondicherry coast.

CRASSULACEAE

Kalanchoe Adans.

Kalanchoe pinnata (Lamk.) Pers., Syn. Pl. 1: 446. 1805; *Bryophyllum calycinum* Salisb.: Clarke in Hook. f., Fl. Brit. India 2: 413. 1878.

Succulent herb, swollen at nodes. Leaves 7.5-15 x 4-6.5 cm, oblong or ovate-elliptic, thick-coriaceous, crenate, obtuse at apex, oblique at base. Flowers 2-3 cm across, greenish red in pendulous panicles. Follicles 1.5 cm with many seeds.

Ecology : Frequent along the sandy stones exposed rocks and within the sandy deposit of crevices in the supratidal zone of the sea shore.

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

Distrib. : Probably African elements frequently found in Orissa, Andhra Pradesh, Tamil Nadu and Gujarat coast.

DROSERACEAE

Drosera L.

KEY TO THE SPECIES

1a. Rootstocks not bulbous; leaves linear or obovate :

2a. Leaves obovate, in rosettes at base 1. *burmanni*

2b. Leaves linear, cauline 2. *indica*

1b. Rootstock bulbous; leaves semilunate 3. *peltata*

1. *Drosera burmanni* Vahl., Symb. 3: 50. 1794; Clarke in Hook. f., Fl. Brit. India 2: 424. 1878.

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 orthigmotropic 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.

Ecology : More or less common along the lee side, on moist sandy places or along open grasslands near the seashore.

Fl. & Fr. : December-April.

Distrib. : Orissa, Tamil Nadu, Kerala and Maharashtra coast.

2. *Drosera indica* L., Sp. Pl. 282. 1753; Clarke in Hook. f., Fl. Brit. India 2: 424. 1878.

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.

Ecology : Frequent on moist sandy places and grasslands near the sea shore.

Fl. & Fr. : August-October.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

3. *Drosera peltata* Smith ex Willd., Sp. Pl. 1: 1546. 1798; Clarke in Hook. f., Fl. Brit. India 2: 424. 1878.

Herb with a basal tuber. Basal leaves rosulate; cauline leaves 2.5-4 x 1.5-2.5 mm, alternate or opposite, peltate with tentacles. Flowers 0.8 cm across, white in lateral raceme.

Ecology : Rare on moist sandy soil and sand deposited exposed rocks along the coast.

Fl. & Fr. : October-January; February-May.

Distrib.: Tamil Nadu and Konkan coastal areas.

HALORAGIDACEAE

Myriophyllum L.

Myriophyllum indicum Willd., Sp. Pl. 4: 407. 1805; Clarke in Hook. f., Fl. Brit. India 2: 433. 1878.

Slender submerged herbs; branches floriferous, floating when water level recedes. Leaves heterophyllus, 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.

Ecology : Frequent in sandy slacks and ponds near the coast; common in fresh-water ponds.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coast.

RHIZOPHORACEAE

KEY TO THE GENERA

- 1a. Flowers ebracteolate; calyx 8-13 lobed 1. *Bruguiera*
 1b. Flowers bracteolate; calyx 4-6 lobed :
 2a. Petals with appendages :
 3a. Calyx ovate, acute; stamens 10-12 3. *Ceriops*
 3b. Calyx linear-oblong; stamens numerous 4. *Kandelia*
 2b. Petals without appendages :
 4a. Plants with stilt roots and hypocotiles 5. *Rhizophora*
 4b. Plants without stilt roots and hypocotiles 2. *Carallia*

1. *Bruguiera* Lamark.

KEY TO THE SPECIES

- 1a. Flowers solitary :
 2a. Flowers red, petal lobes not reflexed..... 2. *gymnorrhiza*
 2b. Flowers yellow, petal lobes reflexed..... 4. *sexangula*
 1b. Flowers not solitary, 2-5 flowered :
 3a. Calyx tube semi-cylindrical, ridged..... 3. *parviflora*
 3b. Calyx tube cup-shaped, not ridged 1. *cylindrica*

1. *Bruguiera cylindrica* (L.) Bl. En. Pl. Java 1: 93. 1827, *quoad basionym*; *B. caryophylloides* (Burm. f.) Bl.: Henslow in Hook. f., Fl. Brit. India 2: 438. 1878.

Trees 10-12 m tall, stems smooth, lenticellate; stem base buttressed, with many stilt roots; twigs bronze-coloured with stipular scars. Leaves 8-16.5 x 5.5-6.5 cm oblanceolate, or rarely elliptic, thick, coriaceous, bronze-green, acute at apex, cuneate at base. Flowers, white, 1-1.3 cm across, 3 in axillary cymes. Hypocotyle 10-14 cm long, 5 mm in diam., more or less cylindrical, straight or slightly curved towards apex.

Ecology : 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*.

Fl. & Fr. : March-August, or rarely throughout the season.

Distrib. : West Bengal, Orissa and extends up to the Godavari delta, Andhra Pradesh and in mangrove swamps of Andaman.

2. *Bruguiera gymnorrhiza* (L.) Savigny in Lam. Enc. 4: 696. 1798; Henslow in Hook. f., Fl. Brit. India 2: 437. 1878.

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 x 5.5-7.5 cm, elliptic-oblong or ovate-elliptic, thick, coriaceous, dark-green, entire, acute at apex, obtuse at base. Flowers, scarlet, up to 3.5-4 cm solitary, axillary. Hypocotyle, angular, cigar-shaped, 15-17 x 1.5-2.5 cm narrowed at apex.

Ecology : 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 found common along the interior island in association with *Heritiera fomes*, *Amoora cucullata*, *Synometra mimosoides* and *Excoecaria agallocha*.

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. : Throughout the coast along the mangrove swamps of Inlands and Andamans except in Tamil Nadu.

3. *Bruguiera parviflora* (Roxb.) W. & A. ex Criff., Trans. Med. Phys. Soc. Calcutta 8: 10. 1836; Henslow in Hook. f., Fl. Brit. India 2: 438. 1878.

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 x 2.5-4 cm, elliptic, coriaceous, dark-green with yellow mid-ribs, acute at apex, cuneate at base. Flowers greenish-yellow, 1.3-1.5 cm long, sub-cylindrical, 3 in axillary peduncles cymes. Hypocotyle 15-25 cm long, cylindrical, smooth, slightly curved towards middle.

Ecology : Common along the intertidal zones near estuaries just after *Avicennia marina*. Usually much more tolerant of submergence, salinity and soft silty clay soil. It is often establishes itself as a pure stand on the inner side of the mangrove, or frequently in association with *Bruguiera cylindrica*, *Aegialitis rotundifolia* and *Lumnitzera racemosa*.

Fl. & Fr. : March-July.

Distrib. : Only in mangrove swamps of West Bengal and Orissa coastal areas. Common and gregarious in Andamans.

4. *Bruguiera sexangula* (Lour.) Poir. in Lamk. Enc. suppl. 4: 262, 1816. *B. eriopetala* Wight & Arn. ex Arn. Henslow in Hook. f. Fl., Brit. India 2: 438. 1878.

Trees 6-15 m tall 20-40 cm in diam.; stems shortly buttressed, with many stilt roots from the base; bark reddish-brown, fissured, lenticellate. Leaves 10-15 x 4-5.5 cm elliptic-oblong, or oblanceolate, coriaceous, acute at apex, obtuse or truncate at base. Flowers yellow, 3-3.5 cm long, solitary, axillary.

Hypocotyle 10-15 cm long.

Ecology : 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. It is often found in association with *Acrostichum*, *Tamarix*, *Salvadora persica* and never in association with *Bruguiera cylindrica* or *Bruguiera perviflora*.

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. : Only in West Bengal, Orissa and Andamans.

2. *Carallia* Roxb.

Carallia brachiata (Lour.) Merr. in Philip. J. Sci. 15: 249. 1919. *C. integerrima* DC. Hook. f., Fl. Brit. India 2: 439. 1878.

Evergreen tree. Leaves 3.5-8.5 x 2.5-5.5 cm elliptic or oblong, thick glaucous, entire or serrulate, obovate-acuminate towards apex, obtuse or acute at apex, narrowed at base. Flowers 1-4 mm across, white, in

cymose capitate. Fruits-berry 4-6 mm across, globose, 1 seeded.

Ecology : Frequent in evergreen formation near the rocky coast.

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

Distrib. : Inland hills of West Bengal, Assam and Maharashtra, Kerala, Calicut and Andaman Island.

3. *Ceriops* Arn.

KEY TO THE SPECIES

- 1a. Petals with 3 clavate appendages; anthers shorter than the filaments 2. *tagal*
 1b. Petals fringed, not with clavate appendages; anthers longer than the filaments 1. *decandra*

1. *Ceriops decandra* (Griff.) Ding Hou in Fl. Thailand. 2: 11. 1970. *C. roxburghiana* Arn.: Hensl. in Hook. f., Fl. Brit. India 2: 436. 1878.

Trees, about 4-10 m tall and 10-30 cm in diam.; stems reddish-brown, much-branched; bark light-gray, lenticular fistures, peeling in thin flakes; stem base pyramidal in outline, with many stilt roots. Leaves 5-14 x 4-10 cm, obovate or elliptic-oblong, coriaceous, rounded or emarginate at apex, cuncate at base. Flowers white, 3-4 mm across, resinous, 8-14 flowered, condensed cymes arranged in the axils of several nodes or form upper axils of branchlets. Fruits ovoid, conical, hypocotyle 12-14 cm long, angular, sulcate.

Ecology : Common along the edges of mangrove swamps, intertidal zones of several creeks and canals and sometimes towards the outer mangrove zones on elevated sandy habitat, usually in association with *Excoecaria agallocha*, *Rhizophora apiculata* and *Bruguiera gymnorrhiza*.

Fl. & Fr. : February-November; almost throughout the year.

Distrib. : Common in West Bengal, Orissa, Andhra Pradesh and Tamil Nadu but rare in Karnataka, Kerala, Maharashtra, Gujarat coastal areas and Andamans.

2. *Ceriops tagal* (Perr.) C. B. Rob. in Philipp. J. Sc. 3(Bot.): 306, 1908. *C. candolliana* Arn.: Henslow in Hook. f., Fl. Brit. India 2: 346. 1878.

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 x 3-6 cm, obovate, or obovate-oblong, coriaceous, entire, emarginate or rounded at apex, cuneate at base. Flowers 5-7 mm, across, white, resinous, 6-10, arranged in condensed cymes from the upper axils. Fruits ovoid, 1.5-2 cm long, with persistent reflexed,

calyx lobes; hypocotyle 20-25 cm long, club-shaped, pointed towards the radical end.

Ecology : Frequent along the intertidal zone, inner and outer fringes of the mangrove swamps. Usually found in association with *Ceriops decandra*, *Bruguiera cylindrica* and *Xylocarpus gangeticus*.

Fl. & Fr. : February-August; September-December.

Distrib. : Rare in West Bengal and Orissa mangrove swamps-but common in west coastal mangrove swamps and Andaman islands.

4. *Kandelia* W. & A.

Kandelia candel (L.) Druce, Rep. Bot. Exch. Club Br. Isl. 3: 420. 1914. *K. rheedei* Wight & Arn.: Hensl. in Hook. f., Fl. Brit. India 2: 437. 1878.

Trees or shrubs 5-9 m tall, 20-40 cm in diam. with many soft, upright branches; stem base flesh-coloured, suddenly inclined to from 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. Flowers, 1-1.5 cm long, white, arranged in axillary, dichotomously branched cymes.

Fruits 2.5-3.5 cm long, ovoid, conical, solid; hypocotyle spindle-shaped, 30-80 cm long, terete, narrowly pointed towards the radical ends.

Ecology : 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*. Surprisingly this has become rare in all location except Goa mangroves.

Fl. & Fr. : Throughout the year.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Goa and reported but not found in Andaman Islands.

5. *Rhizophora* L.

KEY TO THE SPECIES

- 1a. Inflorescences 2-flowered; petals glabrous 1. *apiculata*
 1b. Inflorescences more than 2-flowered; petals hairy :
 2a. Style obscure, 0.5-1 mm long 2. *mucronata*
 2b. Style conspicuous, 3-5 mm long 3. *stylosa*

1. *Rhizophora apiculata* Bl. En. Pl. Jav. 1: 91. 1827; *R. conjugata* auct. non. L.: Hensl. in Hook. f., Fl. Brit. India 2: 436. 1878.

Trees 15-20 m tall, 30-100 cm in diam.; stem base without tap root system from beginning; supporting stilt roots arial, many, branched; branches sympodial. Leaves 10-20 x 5-9 cm, elliptic-oblong, sub-lanceolate

or ovate-lanceolate, decussate, entire, coriaceous, acute, epiculate 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.



Lepisanthes tetrathylla



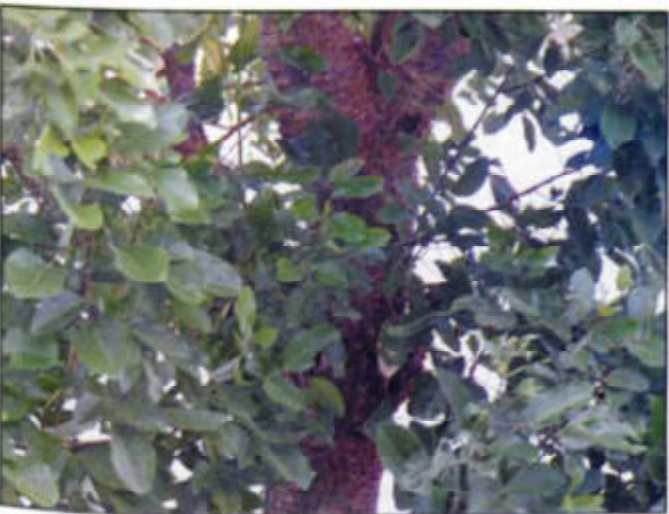
Derris heterophylla



Derris scandens



Dendrolobium umbellatum



Erythrina fusca



Pongamia pinnata



Sophora tomentosa



Cynometra iripa



Intsia bijuga



Acacia planifrons



Neptunia oleracea



Bruguiera cylindrica

Ecology : 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 *Rizophora mucronata* and *Xylocarpus obovata* or sometimes as pure strands. Four to six meters of the total height of these plants remain submerged in saline water during high tides thus showing a remarkable adaptation to the surrounding conditions.

Fl. & Fr. : Mostly throughout the season.

Distrib. : Throughout the mangrove areas and Andaman and Nicobar Islands.

2. *Rhizophora mucronata* Poir. in Lamk. Tab. Encycl (Text) 2: 517. 1794; Hensl. in Hook. f., Fl. Brit. India 2: 435. 1878.

Trees 10-20 m tall, 60-150 cm in diam., much-branched; branches marked with closed leaf scars; stem base with numerous stilt roots; stilt roots branched, lenticellate with a root cap; aerial roots present; tap root abortive. Leaves decussate, 10-18 x 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. Fruits 3-4 cm across, ovoid, conical, solid brown; hypocotyle 30-70 cm long, cylindrical, warty.

Ecology : 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 gangeticus* and *Avicennia officinalis*.

Fl. & Fr. : Mostly throughout the season.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Maharashtra, Goa, Gujarat and also in Andaman and Nicobar Islands.

3. *Rhizophora stylosa* Griff. Not. Pl. As. 4: 665. 1854 and Ic 4, t. 640, 1854; Ding Hou in van Steenis Fl. Males. 5: 456. 1858. *R. mucronata* var. *stylosa* Schimp. Bot. M. II. Trop. 3: 92. 1981.

Trees 8-12 m tall, with numerous stilt roots; branches sympodial, leaf-scars closely arranged. Leaves 6-16 x 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. Hypocotyle cylindrical, warty, 40-50 cm long or more at maturity.

Ecology : Rare, along muddy sea shores and along sandy seabeach facing the sea. It usually favours a separate ecological niche than the other two species of the genus and usually found in association with *Avicennia marina* and *Aegialitis rotundifolia*.

Fl. & Fr. : Mostly throughout the season.

Distrib. : A new distribution for India from Orissa mangroves. Common in Andaman Islands.

C O M B R E T A C E A E

KEY TO THE GENERA

- 1a. Petals absent..... 3. *Terminalia*
 1b. Petals present :
 2a. Calyx limb persistent; leaves alternate..... 2. *Lumnitzera*
 2b. Calyx limb deciduous; leaves opposite..... 1. *Combretum*

1. *Combretum* L.

KEY TO THE SPECIES

- 1a. Flower with 5 calyx limb and 5 petals; bracteoles linear 2. *roxburgii*
 1b. Flower with 4 calyx limb and 4 petals; bracteoles lanceolate 1. *albidum*

1. *Combretum albidum* G. Don., Trans. L. Soc. London. 15: 429. 1827; *C. ovalifolium* Roxb.: Clarke in Hook. f., Fl. Brit. India 2: 458. 1878.

Glabrous liane. Leaves oblong or ovate lanceolate 7-10 x 4-6 cm, thin coriaceous, 7-9 nerved, entire, acuminate at apex, cuneate at base. Flowers 5 mm across, polygamous dioecious, greenish yellow, arranged in terminal or axillary panicle. Fruit 2 x 1.8 cm, 4 winged. Seed solitary.

Ecology : Frequent in coastal scrub jungles and lee side of the sand dunes.

Fl. & Fr. : February-March; April-May.

Distrib. : Midnapur in West Bengal, Paradeep in Orissa, Nizampattanam in Andhra Pradesh and Tamil Nadu coast.

2. *Combretum roxburgii* Spreng., Syst. 2: 331. 1825. *C. decundrum* Roxb.: Clarke in Hook. f., Fl. Brit. India 2: 452. 1878.

Struggling climber. Leaves 6-10 x 2-4 cm oblong, entire, abruptly acuminate at apex and obtuse at base. Flowers 5-7 mm across, white arranged in terminal or axillary panicle; bracteoles linear as long as flower. Fruit with 5 papery wings, oblong, 2.5-3 cm long.

Ecology : Frequent in coastal scrubs and thickets.

Fl. & Fr. : February-March; April-May.

Distrib. : North Circar coast from Chilka, Ganjam-Godavari, also in Karnataka and Maharashtra coast.

2. *Lumnitzera* Willd.

KEY TO THE SPECIES

- 1a. Flowers white; knee-like pneumatophores absent. 2. *racemosa*
 1b. Flowers red; knee-like pneumatophores present. 1. *littorea*

1. *Lumnitzera littorea* (Jack.) Voigt., Hort. Suburb. Calc. 39. 1845; *L. coccinea* Wight & Arn.: Clarke in Hook. f., Fl. Brit. India 2: 452. 1878.

Trees 8-15 m tall, 30-60 cm in diam., with knee-like pneumatophores; bark dark-brown, fissured. Leaves 1.5-4.5 x 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.

Ecology : Rare, mostly restricted towards the middle zone of estuarine islands, sometimes found forming pure stands along the back mangroves.

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

Distrib. : Restricted only in Andaman and Nicobar islands.

2. *Lumnitzera racemosa* Willd., Neue Schr. Ges. Naturf. Fr. Berl. 4: 187. 1805; Clarke in Hook. f., Fl. Brit. India 2: 452. 1878.

Trees 3-8 m tall, without pneumatophores; bark reddish-brown, lenticellate. Leaves 4-8.5 x 1.5-3.5 cm, obovate, thick, coriaceous, entire, emarginate at apex, cuneate at base. Flowers 9-11 mm long, white, sessile, in axillary spikes; receptacles 3-5 mm long, tubular, with two adnate, persistent bracteoles. Fruits 8-10 x 4-6 mm, compressed, woody, ellipsoid, 1-seeded, drupes. Seeds elongated, pointed towards apex.

Ecology : 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.

Fl. & Fr. : March-May; June-July.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Maharashtra and Gujarat coast. Also found in Andaman and Nicobar Islands.

3. *Terminalia* L.

KEY TO THE SPECIES

- 1a. Fruit not winged :
 2a. Leaves clustered at the end of branchlets; fruits glabrous 2. *catappa*
 2b. Leaves not clustered; fruit shining 3. *chebula*
 1b. Fruit with 5 equal angles and wings 1. *arjuna*

1. *Terminalia arjuna* (DC.) Wight & Arn., Prodr. Fl. Ind. Orient., 314. 1834; Clarke in Hook. f., Fl. Brit. India 2: 447. 1878.

Tree 20-40 m tall. Leaves 7-12 x 3.5-5 cm, oblong, obovate or oblanceolate, coriaceous, obtuse at apex and subcordate at base. Flowers 3-4 mm across, white, arranged in axillary panicles. Drupe 5 winged, 4.5-6 x 2-3 cm.

Ecology : Common along the riparian region and coastal plains.

Fl. & Fr. : April-July, August-September.

Distrib. : Throughout the coastal plains in India.

2. *Terminalia catappa* L., Syst. Nat. (ed. 12) 2: 674. 1767; Clarke in Hook. f., Fl. Brit. India 2: 444. 1878.

Tree up to 25 m tall. Leaves obovate 15-30 x 10-17 cm, densely clustered at the end of branchlets, glabrous above, tomentose below, entire, obtuse or retuse at apex and subcordate at base. Flowers 4 mm across, white arranged in 10-12 cm long axillary spikes. Drupe 3.5 x 3.5 cm, ellipsoid, 2 ridged.

Ecology : Commonly planted along the coastal districts for shade from its extensive crown cover and edible drupe.

Fl. & Fr. : April-May; July-August.

Distrib. : All over the coastal plains and specially common in Gujarat coast.

3. *Terminalia chebula* Retz., Obs. Bot. 5: 31. 1788; Clarke in Hook. f., Fl. Brit. India 2: 446. 1878.

Tree 15-20 m tall with rusty villose branchlets. Leaves 7-12 x 4-6.5 cm, ovate or elliptic, coriaceous, densely villose below, obtuse or apiculate at apex, rounded at base. Flowers 3-4 mm across, white in axillary spikes, Drupe 4 x 2.5 cm, glossy, angled, obovoid or ellipsoid.

Ecology : Common along the dry deciduous coastal plains and beside the coastal sand dunes.

Fl. & Fr. : March-May; August-October.

Distrib. : All over the coastal plains.

MYRTACEAE

KEY TO THE GENERA

- 1a. Fruit capsular, opening by valves, not fleshy 1. *Melaleuca*
 1b. Fruit berry, not opening by valves, fleshy 2. *Syzygium*

1. *Melaleuca* L.

Melaleuca leucadendron L., Sp. Pl. Suppl. 324. 1763. Hook. f., Fl. Brit. India 2: 465. 1879.

Small tree with thick spongy bark and drooping branches. Leaves 5-7 x 1-3 cm, elliptic or lanceolate, 3-7 nerved, falcate acute or acuminate at apex, obtuse at base. Flower 3-4 mm across, greenish yellow arranged in 4-6 cm long spike. Fruits not seen.

Ecology : Frequently planted as a hedge plant in the coastal areas for obtaining the volatile oil, used for expelling mosquitoes and other medicinal value.

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

Distrib. : Australian, introduced in India, mostly in West coast.

2. *Syzygium* Gaertn.

KEY TO THE SPECIES

- 1a. Flowers in paniculate cymes 1. *cumini*
 1b. Flowers solitary or fascicled..... 2. *ruscifolium*

1. *Syzygium cumini* (L.) Skeels, U. S. Dept. Agric. Bur. Pl. Bull. 2: 248. 1912; *Eugenia jambolana* Lamk.: Duthie in Hook. f., Fl. Brit. India 2: 499. 1879.

Evergreen trees, 10-20 m tall; bark smooth, greyish-white. Leaves 4-16 x 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.

Ecology : Frequent in scrubs, river banks and back mangroves; commonly cultivated in garden as fruit trees.

FL& Fr. : March-April; May-June.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Maharashtra coast.

2. *Syzygium ruscifolium* (Willd.) Sant. & Wagh., Bull.

Bot. Surv. India 5: 109. 1963. *Eugenia bracteata* Roxb. ex DC.: Duthie in Hook. f., Fl. Brit. India 2: 502. 1879.

Shrubs or small trees, 0.5-2 m tall; branches rusty-pubescent when young. Leaves 3-6 x 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. Fruits 1 cm in diam., globose berries, red when ripe.

Ecology : Common along the riverine scrubs, coastal thickets and sandy sea-shores, usually in association with *Carissa spinarum* and *Clausena heptaphylla*.

FL& Fr. : Throughout the year.

Distrib. : Throughout the Indian coast specially West Bengal, Orissa (Chilka), Andhra Pradesh and Andaman.

MELASTOMATACEAE

KEY TO THE GENERA

- 1a. Leaves ribbed from base; seeds many :
 2a. Stamens equal; fruit opening by pores at apex 3. *Osbeckia*
 2b. Stamens unequal; fruit bursting irregularly 2. *Melastoma*
 1b. Leaves not ribbed but penninerved with faint intra marginal nerves; seed 1 1. *Memecylon*

1. *Memecylon* L.

KEY TO THE SPECIES

- 1a. Peduncles 6 mm long; leaves shining above, 10 cm long 1. *edule*
 1b. Peduncles 12 mm long; leaves sometimes shining above, 18 cm long..... 2. *grande*

1. *Memecylon edule* Roxb. var. *ovatum* (J. E. Smith) Clarke in Hook. f., Fl. Brit. India 2: 558. 1879.

Shrubs or small trees, 0.5-2 m tall; branches many, glabrous. Leaves 5-14 x 3-7 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. Fruits 4-8 mm across, globose; berries, dark blue when ripe.

Ecology : Common in sandy scrubs and coastal thickets, usually in association with *Carissa spinarium* and *Syzygium ruscifolium*.

Fl. & Fr. : April-June; July-August.

Distrib. : East and West coast, Western Ghats and Travancore.

2. *Memecylon grande* Retg., Obs. 4: 26. 1786; Clarke in Hook. f., Fl. Brit. India 2: 557. 1879.

Tree glabrous. Leaves 7-12 cm elliptic or ovate-entire, ovate-acuminate at apex and narrowed towards base. Flowers 2-3 mm across, Flowers bluish, in axillary or terminal cymes. Berry 4-6 mm globose, 1 seeded.

Ecology : In coastal scrub jungles and lee side of the sand dunes.

Fl. & Fr. : March-May; August-September.

Distrib. : West coast, Goa and from Karnataka to Kerala.

2. *Melastoma* L.

Melastoma malabathricum L., Sp. Pl. 390. 1753; Clarke in Hook. f., Fl. Brit. India 2: 523. 1879.

Densely hairy shrubs. Leaves 7.5-12 cm oblong or lanceolate, hairy entire, acute at apex and narrowed at base. Flower 1-1.5 cm, purple in terminal, solitary or clustered cymes, Fruit 6 mm in diam., soft berry like

capsule. Seeds minute, numerous.

Ecology : Common in both East and West coasts, along the river banks and sandy moist areas.

Fl. & Fr. : March-May; August-September.

Distrib. : Throughout the coastal provinces.

3. *Osbeckia* L.

Osbeckia zeylanica Willd., Sp. Pl. 2: 300. 1799; Clarke in Hook. f., Fl. Brit. India 2: 516. 1879.

Herb up to 40 cm tall, branches tetragonous. Leaves 2-4 cm, oblong or elliptic, entire, hairy acuminate at apex, narrowed at base. Flower 1 cm across, purple or mauve, in leafy capitate heads. Capsule 3-5 mm with hairy scales, ovoid-oblong. Seeds numerous.

Ecology : Frequent along the moist hill slopes near the coast and sandy scrub jungles.

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

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu and Karnataka coast.

LYTHRACEAE

KEY TO THE GENERA

1a. Herbs with glabrous leaves :

2a. Bracts leaf-like; capsules septicial 4. *Rotala*

2b. Bracts scale-like; capsules indehiscent, or bursting irregularly 1. *Ammannia*

1b. Shrubs or trees with pubescent leaves :

3a. Flower in axillary or terminal panicles 2. *Lagerstroemia*

3b. Flowers axillary, solitary 3. *Pemphis*

1. *Ammannia* L.

KEY TO THE SPECIES

- 1a. Cymes distinctly-peduncled; petals present 2. *multiflora*
 1b. Cymes not distinctly-peduncled; petals absent 1. *baccifera*

1. *Ammannia baccifera* L., Sp. Pl. 120. 1753; Clarke in Hook. f., Fl. Brit. India 2: 569. 1879.

Erect herbs, up to 50 cm tall; stems much-branched, rigid, quadrangular. Leaves 2-4 x 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, in 3 to many flowered cymes. Capsules 1-2 mm across, depressed globose; seeds many.

Ecology : Common in paddy fields, moist sandy areas and river banks.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh and Maharashtra coast.

2. *Ammannia multiflora* Roxb., Fl. Ind. ed. Carey

447. 1832; Clarke in Hook. f., Fl. Brit. India 2: 570. 1879.

Much-branched, erect or decumbent herbs; stems quadrangular, often rooting at nodes. Leaves up to 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. Capsules 1-1.3 mm across, globose, reddish-brown, partially exerting from calyx.

Ecology : Common along moist sandy places and paddy fields.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra coast.

2. *Lagerstroemia* L.

Lagerstroemia speciosa (L.) Pers., Synops. 2: 72. 1806. *L. flog-eginae* Retz.: Clarke in Hook. f., Fl. Brit. India 2: 577. 1879

Deciduous trees or shrubs, 3-8 m tall. Leaves 8-25 x 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.

Ecology : Rarely wild in sandy scrubs along river banks. planted as an ornamental trees in gardens and parks.

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

Distrib. : Throughout the coast.

3. *Pemphis* Forst.

Pemphis acidula Forst., Char. Gen. 68. t. 34. 1776; Clarke in Hook. f., Fl. Brit. India 2: 573. 1879.

Shrubs or small tree attaining 6 m. Leaves 2.5-3 cm, oblong thick, fleshy, entire, minutely covered with grey silky hairs, obtuse at apex, narrowed at base. Flowers 2.4-3.1 cm, campanulate, 12-many ribbed, whitish-pink or rose coloured, axillary, solitary. Capsules 1-1.2 cm long, coriaceous, obovoid, included within the calyx tube. Seeds many, angular, 3 mm.

Ecology : Restricted in maritime strand, mostly on coral strand and rocky seashore.

Fl. & Fr. : April-June; July-September.

Distrib. : Lakshadweep: Kalpati Island; Andaman: Brooks and Baratang; Tamil Nadu: Western part of Rameswaram Islands, Ramanathapuram and Tirunelveli coast, Gulf of Mannar.

4. *Rotala* L.

Rotala verticillaris L., Mant. 157. 1771. *Ammannia rotala* F. Muell.: 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.

Ecology : Frequent along moist sandy places near the coast, low lying areas and rice fields.

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

Distrib. : West Bengal, Orissa, Karnataka, Kerala and Maharashtra coast.

BARRINGTONIACEAE

KEY TO THE GENERA

- 1a. Flowers white; spikes erect; berries globose, fleshy 2. *Careya*
- 1b. Flowers scarlet; racemes pendent; berries angular, fibrous 1. *Barringtonia*

1. *Barringtonia* Forst.

KEY TO THE SPECIES

- 1a. Leaves entire; racemes erect; fruits more than 6 cm long 2. *asiatica*
- 1b. Leaves not entire, racemes pendulous, fruits less than 1.5 cm long :
 - 2a. Calyx lobes valvate; leaves crenate 3. *racemosa*
 - 2b. Calyx lobes imbricate; leaves minutely denticulate 1. *acutangula*

1. *Barringtonia acutangula* (L.) Gaertner, Fruct. Sem. Pl. 2: 97. t. 101. 1790; Clarke in Hook. f., Fl. Brit. India 2: 508. 1879.

Tree 4-8 m tall with tomentose branchlets. Leaves 7-10.5x4-8 cm, coriaceous, glossy above, crenulate, obtuse or rounded at apex, attenuate at base. Flowers 1.5-0.5 cm across, scarlet, arranged in axillary 20-30 cm long pendulous raceme. Berry 1.5-0.5 cm, ellipsoid or ovoid, angular, fibrous. Seed solitary.

Ecology : Very common along the banks of coastal back waters and lagoons, extends towards the coastal plains.

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

Distrib. : Karnataka, Tamil Nadu, Malabar coast.

2. *Barringtonia asiatica* (L.) Kurz., Rep. Pegu. App. A 65, App. B 52. 1875; *B. speciosa* J.R. & G. Forst.: Clarke in Hook. f., Fl. Brit. India 2: 507. 1879.

Tree 8-15 m tall with densely crowned, leathery leaves on branchlets. Leaves 30-37 x 12-18 cm obovate, glossy thick, sessile, entire, obtuse at apex and gradually narrowed at base. Flowers 3.5 cm across, white with scarlet stamens, showy, with leaf like bracts at lower pedicel, arranged in 6-8 flowered raceme. Fruit 7-8 x 5-6 cm, ovoid, quadrangular, 1 seeded.

Ecology : Common along the river banks of Oceanic islands under salt flow.

Fl. & Fr. : November-December & March-April; February-March. Usually flowers open during night.

Sepal petal and stamens ring dehisce in the early morning. Known as Queen of the seashore.

Distrib. : Restricted in Andaman and Nicobar Island only.

3. *Barringtonia racemosa* (L.) Spreng., *Syt. Neg.* 3: 127. 1826; Clarke in Hook. f., *Fl. Brit. India* 2: 507. 1879.

Evergreen tree attaining 20-25 m height. Leaves 12-16 x 5-6 cm, ovate oblong, dentate, obtuse at apex and cuneate at base. Flower 0.6-1 cm across, white

arranged in 20-30 cm long pendulous raceme. Fruits ovoid, quadrangular, exocarp thick and fibrous, 1.3-1.5 cm long.

Ecology : Common along the fresh and brackish water river bank and sandy coastal areas in both East and West coast.

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

Distrib. : Sundarban, Quilon, South Canara, Mangalore and Maharashtra coast.

2. *Careya* Roxb.

Careya arborea Roxb., *Cor. Pl.* III. 14, t. 218. 1811 & *Fl. Ind.* 2: 638. 1832; Clarke in Hook. f., *Fl. Brit. India* 2: 511. 1879.

Tree up to 6-10 m tall. Leaves 30 x 15 cm, oblong or orbicular, glabrous, crenate-denticulate, obtuse or shortly denticulate at apex, narrowed at base. Flowers 4.5-4.8 cm across, white, in spikes. Fruit 7 x 5 cm across,

globose, surrounded by an enlarged calyx at the mouth. Seed ellipsoid.

Ecology : Frequent on dry coastal zones on rocky or sandy places.

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

Distrib. : Throughout the dry deciduous forests in India and coastal belt of Travancore, Honover and Malpac.

SONNERATIACEAE

Sonneratia L. f.

KEY TO THE SPECIES

- 1a. Petals absent :
 2a. Calyx 4-merous; leaves narrowly elliptic 2. *apetala*
 2b. Calyx 7-8-merous; leaves obovate to suborbicular 4. *griffithii*
 1b. Petals present :
 3a. Flowers red with expanded calyx tube; leaves usually mucronate 3. *caseolaris*
 3b. Flowers white with cup-shaped calyx tube; leaves emucronate 1. *alba*

1. *Sonneratia alba* J. Smith, *Recs. Cycl.* 33(2): 1819; Clarke in Hook. f., *Fl. Brit. India* 2: 580. 1879.

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 dichasial or terminal branchlets. Fruits 4-5 cm across, ovoid-globose, apex concave-depressed with tip pointed; base resting on cup-shaped calyx-tube. Seeds many.

Ecology : Rare along the outer zones of muddy sea shores; on sandy or hard calcareous substratum, covered with oyster shells.

Fl. & Fr. : February-October.

Distrib. : Reported new from Hookitola island in Orissa, common along the west coast, specially Ratnagiri, Goa, Maharashtra, Kerala and Andaman islands.

2. *Sonneratia apetala* Buch.-Ham., Symes, Embassy Ava 3: 477. 1800; Clarke in Hook. f., Fl. Brit. India 2: 579. 1879.

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 x 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.

Ecology : 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 and brackish water mixture; in association with *Tamarix troupilii*, *Excoecaria agallocha*, and *Ceriops decandra*.

Fl. & Fr. : February-May; June-July.

Distrib. : East coast up to the Godavari delta. Recently it is collected from west coast Kōhlapur.

3. *Sonneratia caseolaris* (L.) Engl., E. & P. Nachtr. 261. 1897. *S. acida* L. f., Clarke in Hook. f., Fl. Brit. India 2: 579. 1879.

Trees 6-15 m tall, 30-70 cm in diam., with many drooping branches and numerous short 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.

Ecology : Less common than *S. apetala*; in the intertidal zones under more saline conditions than *S. apetala*; in association with *Avicennia alba* and *Bruguiera cylindrica*.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Maharashtra and Andaman islands.

4. *Sonneratia griffithii* Kurz., J. As. Soc. Bengal 40(2): 56. 1871; Clarke in Hook. f., Fl. Brit. India 2: 580. 1879.

Trees 8-15 m tall, 30-60 cm in diam.; branches pale-green, glabrous, drooping; bark slightly fissured when old. Leaves 6-12 x 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 with calyx tubes and reflexed calyx lobes at base. Seeds many.

Ecology : Common along the intertidal zones just near the estuaries and often restricted towards the islands; in association with *Avicennia alba* and *A. marina*.

Fl. & Fr. : February-May; June-July.

Distrib. : West Bengal, Orissa and Andaman mangrove swamps.

ONAGRACEAE

Ludwigia L.

KEY TO THE SPECIES

- 1a. Floating herbs; flowers usually white 1. *adscendens*
 1b. Erect or ascending herbs; flowers yellow :
 2a. Seeds in fruit pluriserial above and uniserial below 2. *hyssopifolia*
 2b. Seeds in fruit pluriserial throughout 3. *perennis*

1. *Ludwigia adscendens* (L.) Hara, J. Jap. Bot. 28: 291. 1953; *L. repens* L.: Clarke in Hook. f., Fl. Brit. India 2: 587. 1879.

Marshy herbs; stems glabrous, light brown, white hairy at nodes. Leaves 1-5 x 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.

Ecology : Frequent along sandy ditches and moist places along the lee ward side of coastal sand dunes.

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

Distrib. : Throughout the Indian coast.

2. *Ludwigia hyssopifolia* (G. Don) Exell, Garica de orta 5: 471. 1957, Bennet in Ind. For. 92: 227. 1966.

Undershrubs, 30-80 cm tall, with pointed horizontal roots from submerged vertical root system; stems much-branched, tinged red. Leaves 5-13 x 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.

Ecology : Frequent along the edges of ponds and ditches; often in rice fields near the coast.

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

Distrib. : Throughout the coastal districts.

3. *Ludwigia perennis* L., Sp. Pl. 119. 1753 (excl. "*follis oppositis*"); *L. parviflora* Roxb. : Clarke in Hook. f., Fl. Brit. India 2: 588. 1879.

Annual herbs, 10-40 cm tall; stems glabrous with raised decurrent lines from leaf-base. Leaves 1-8 x 0.5-2 cm, elliptic-oblong subacute 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.

Ecology : Common weed in fresh water swamps and moist sandy places.

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

Distrib. : Throughout the coastal districts.

PASSIFLORACEAE

Passiflora L.

KEY TO THE SPECIES

- 1a. Stipules semiauriculate; petals present 1. *foetida*
 1b. Stipules linear-subulate; petals absent 2. *suberosa*

1. *Passiflora foetida* L., Sp. Pl. 959, 1753; Master in Hook. f., Fl. Brit. India 2: 599. 1879.

Tendrils-climbers; stems hispid hairy. Leaves 5-10 x 2.5-8 cm, ovate, 3-lobed, ciliate with gland-tipped golden hairs, acuminate at apex, cordate at base. Flowers 2-6 cm across, white with bluish-purple corona, axillary, solitary; bracts pinnatisect. Berries 2-3 cm across, subglobose, surrounded by persistent bracts.

Ecology : Frequent on hushes and hedges along river-side and in scrub jungles. Common on hill slopes and islands.

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

Distrib. : Islands of Chilka lake, Andhra Pradesh, Tamil Nadu and Karnataka hill slopes near the coast.

2. *Passiflora suberosa* L., Sp. Pl. 958, 1753; Master in Hook. f., Fl. Brit. India 2: 599. 1879.

Slender tendrils-climbers; stems terete, glabrous. Leaves 3-8 x 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.

Ecology : Rare along hedges in scrub jungles and coastal thickets.

Fl. & Fr. : February-March; May-June.

Distrib. : Chilka lake, Karnataka and Maharashtra coast.

CUCURBITACEAE

KEY TO GENERA

- 1a. Anther cells flexuous or cauduplicate :
- 2a. Corolla rotate, not companulate, 5 partite to base :
- 3a. Corolla lobes fimbriate; fracts present 9. *Trichosanthes*
- 3b. Corolla lobes entire; fracts absent :
- 4a. Connectives of anther loculi produced; tendril simple 5. *Cucumis*
- 4b. Connectives of anther loculi not produced; tendril 2-3 fid 3. *Citrullus*
- 2b. Corolla companulate, 5 lobed halfway down 4. *Coccinia*
- 1b. Anther cells straight or curved, not cauduplicate :
- 5a. Flowers 5-10 mm long, greenish yellow :
- 6a. Seeds with central projection, margin belted without partition wall 2. *Bryonopsis*
- 6b. Seeds without central projection, margin not belted with partition wall 6. *Diplocyclos*
- 5b. Flowers 1-4 m long, dull yellow :
- 7a. Bracts not ciliated and if present not resembling stipules :
- 8a. Styler disc cup-shaped; fruit baccate 8. *Melothria*
- 8b. Styler disc obscure; fruit rosulate 7. *Kedrostis*
- 7b. Bracts ciliated, resembling stipules at leaf base 1. *Blastania*

1. *Blastania* Kotschy & Peyr.

Blastania garcinii (Burm. f.) Cogn., DC. Monog. Phan. 3: 629. 1881; Clarke in Hook. f., Fl. Brit. India 2: 629. 1879.

Branched climber. Leaves 1.5-5.5 x 1.5-5.5 cm deeply lobed, obovate or ovate, villose on both surfaces, denticulate, acute at apex, lobed at base. Flowers unisexual, 1-1.5 cm broad on 3-4 flowered subcapitate

peduncles. Fruits 4.5 x 1 cm inversely subreniform, reddish. Seeds oblong, dark grey.

Ecology : Frequent on back shore sand and sandy waste places on the lee side of coastal dunes.

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

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Saurashtra coast.

2. *Bryonopsis* Arn.

Bryonopsis laciniosa (L.) Naud., Ann. Sc. Nat. 4. ser. 12: 141. 1859; *Bryonia laciniosa* L.: Clarké in Hook. f., Fl. Brit. India 2: 622. 1879.

Slender, elongated scandent herb. Leaves scabrous, denticulate, acute at apex. Male flowers 0.5-1 cm across, yellow papillose. Female flowers fasciculate. Fruits 1-1.7 cm spherical, yellowish green

striped. Seeds 5 mm long, belted, narrowly attenuate with raised projection.

Ecology : Frequent on sandy coastal hedges and waste places.

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

Distrib. : Both the East and West coast.

3. *Citrullus* Neck.

KEY TO THE SPECIES

- 1a. Perennial; fruit up to 7 cm in diam. 1. *colocynthis*
 1b. Annual; fruit up to 25 cm in diam. 2. *lanatus*

1. *Citrullus colocynthis* (L.) Schr., *Linnaea* 12: 414. 1838; Clarke in Hook. f., *Fl. Brit. India* 2: 620. 1879.

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 mm across, subglobose, longitudinally striped or marked yellow. Seeds ovoid, smooth.

Ecology : Rare, in waste places near the coast, sand dunes and river-banks.

Fl. & Fr. : September-October, November-December.

Distrib. : Throughout the coast, specially common in Maharashtra and Gujarat.

2. *Citrullus lanatus* (Thunb.) Matsum. & Nakai, *Cat. Sem. et sport. Hort. Bot. Univ. Imp. Tokyo* 30. 1916; *C. vulgaris* Schrad.: Clarke in Hook. f., *Fl. Brit. India* 2: 621. 1879.

Annual herb; branchlets angular, villous. Leaves 11-15 x 8-10 cm deeply 3 fid, pubescent, lobes obovate-oblong, acute or acuminate at apex. Tendrils robust, 2 fid. Flowers 2 cm across, yellow, axillary, solitary. Fruit large, fleshy, dark green, striped white. Seeds many, oblong, compressed.

Ecology : Cultivated on sandy soil along coastal areas and along the sandy banks of rivers.

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

Distrib. : Widely cultivated along the sandy coastal belts and sandy river banks. West Bengal, Orissa, Maharashtra, Tamil Nadu, Karnataka and Andaman & Nicobar islands.

4. *Coccinea* Wight & Arn.

Coccinea grandis (L.) J. Voight., *Hort. Suburb. Cal.* 59. 1845; *Cephalandra indica* Naudin.: Clarke in Hook. f., *Fl. Brit. India* 2: 621. 1879.

Scandent herb with angular, glabrous branches. Leaves 5-10 cm long, palmately lobed, chartaceous, minutely denticulate. Male flowers 2.5-3 cm long, white, campanulate with 2-6 cm peduncles. Female flowers in

1-3 cm long peduncles. Fruit 5 x 2.5 cm, oblong, avoid with juicy pulp. Seeds 5 x 2.5 mm, oblong.

Ecology : Frequent on coastal thickets and lee side of sand dunes.

Fl. & Fr. : March-October; October-November.

Distrib. : All along the coastal regions.

5. *Cucumis* L.

KEY TO THE SPECIES

- 1a. Fruit smooth, obovoid or oblong-ovoid :
 2a. Perennial; leaves deeply 5-7 lobed 1. *callosus*
 2b. Annual; leaves angular or shortly lobed 2. *melo*
 1b. Fruit echinate, round 3. *prophetarum*

1. *Cucumis callosus* (Rottl.) Cogn., Engl. Pflerich. IV. 275, II. 129. 1924; *C. trigonus* Roxb.: Clarke in Hook. f., Fl. Brit. India 2: 619. 1879.

Annual or perennial herbaceous climbers or trailers; branches rigid angular; tendrils simple. Leaves 3-5 x 4-6 cm, palmately lobed, sinuate-dentate, rounded at apex, narrowed at base. Flowers 8-12 mm 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.

Ecology : Frequent along dry sandy places near the coast, backshore, mangroves and inward sandy places.

Fl. & Fr.: February-March; June-July.

Distrib.: Throughout the coastal districts.

2. *Cucumis melo* L., Sp. Pl. 1011. 1753; Clarke in Hook. f., Fl. Brit. India 2:620. 1879.

Vine, prostrate. Leaves 3.5-5.5 x 4-7.5 cm suborbicular, 5 angular, denticulate, chartaceous rotund apex and cuneate base. Flowers 0.8-1.5 cm across, yellow, monoecious. Fruit 3 cm long ellipsoid or oblong. Seed 3 x 2 mm, compressed.

Ecology : Common on scrub jungle thickets, along river banks, arable land, often cultivated.

Fl. & Fr. : July-December.

Distrib. : Widely distributed along both the East and West coast.

3. *Cucumis prophetarum* L., Cent. I. Pl. 33. 1755; Clarke in Hook. f., Fl. Brit. India 2 : 616. 1879.

Scandent herb with angular, sulcate branchlets. Leaves 2-4 x 1.5-3.5 cm, suborbicular, scabrous, crisped, 3-5 lobed, lobes obtuse at apex, truncate at base. Male flowers: 3-5 mm long, white, solitary or fasciculate; peduncles 1-5 mm, hirsute. Female flowers: with 2-3 cm long peduncles. Fruits 3-4 cm long, sparsely echinate, striped. Seeds 4-4.5 mm long, oblong, ash coloured.

Ecology : Frequent on sandy sea shore and on the waste sandy places of back shore sands.

Fl. & Fr. : April-May; August-October.

Distrib. : Gujarat, Maharashtra, Tamil Nadu and Karnataka coast.

6. *Diplocyclos* (Endl.) P. & K. Corr.

Diplocyclos palmatus (L.) C. Jeffrey, Kew Bull. 15: 352. 1962. *Bryonia laciniosa* L.: Clarke in Hook. f., Fl. Brit. India 2: 622. 1879.

Glabrous climbing herb. Leaves 5-7 x 7.5-9.5 cm, 5 lobed, scabrid above; lobes elliptic-oblong, denticulate, acute at apex, cordate at base. Flowers 1-1.5 cm across, monoecious, in axillary clusters. Fruit

globose, 1.5 x 1 cm with vertical greenish and white patches. Seeds ovoid, 5 x 3 mm.

Ecology : Common on back shore sandy scrubs and lee side of sand dunes.

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

Distrib. : Gujarat, Maharashtra and Tamil Nadu coast.

7. *Kedrostis* Medik.

Kedrostis rostrata (Rottl.) Cong., DC. Monogr. Phan. 3: 636. 1881. *Rhynchosarpha foetida* Schrad.: Clarke in Hook. f., Fl. Brit. India 2: 627. 1879.

Branched scandent herb, branchlets glandular pubescent. Leaves 4.5-5.5 x 4-6 cm., broadly ovate-cordate, chartaceous, softly pubescent, irregularly dentate, acute at apex, deeply emarginate at base. Flowers unisexual, male with longer peduncles than female flower, 8 mm across, yellow arranged in racemes.

Fruits flask-shaped, 2.5 cm across. Seeds 4 mm, obovoid, turgid, granular.

Ecology : Restricted on sea shore sandy beaches and dunes.

Fl. & Fr. : January-March.

Distrib. : Gujarat, Saurashtra, Andhra Pradesh and Tamil Nadu coast.

8. *Melothria* L.

KEY TO THE SPECIES

- 1a. Plant monoecious; leaves not polymorphous :
 2a. Male flowers fasciated; seeds scorbiculate 2. *maderaspatana*
 2b. Male flowers not fasciated; seeds smooth 3. *perpusilla*
 1b. Plants dioecious. Leaves polymorphous 1. *heterophylla*

1. *Melothria heterophylla* (Lour.) Cogn., DC. Monog. Phan. 3: 618. 1881; *Zehneria umbellata* Thw.: Clarke in Hook. f., Fl. Brit. India 2: 625. 1879.

Scandent herb. Leaves 6-20 cm long, coriaceous, divided or undivided, denticulate, acute at apex, emarginate at base. Male flowers: 3-5 mm long, puberulous, whitish, few to many flowered. Female flowers: solitary. Fruits 4.5 x 2-2.5 cm, brown, oblong. Seeds 5-7 mm long, subspherical, blunt at base.

Ecology : Frequent on sea shore sand bars and sand dunes.

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

Distrib. : Throughout the coastal provinces.

2. *Melothria maderaspatana* (L.) Cogn., DC. Monog. Phan. 3: 623. 1881; *Mukia scabrella* (L. f.) Arn.: Clarke in Hook. f., Fl. Brit. India 2: 623. 1879.

Annual scandent herb. Leaves 4-12 x 3-9 cm, membranous, entire, ovate, angulate or 3-5 lobed. Male flowers: 4-5 mm long, hirsute, yellow fasciculate. Female flowers: solitary. Fruits 7-10 mm, brownish yellow, globose, juicy. Seeds ovoid, grey, suborbiculate.

Ecology : Common on sea shore sands, and coastal thickets.

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

Distrib. : Orissa, Tamil Nadu, Karnataka and Saurashtra coast.

3. *Melothria perpusilla* (Bl.) Cogn., DC. Monog. Phan. 3: 607. 1881. *Zehneria hookeriana* Arn.: Clarke in Hook. f., Fl. Brit. India 2: 624. 1879.

Branches slender, sulcate. Leaves 5-9 x 4-7 cm, ovate-cordate, 3-5 lobed glabrous, undulate-denticulate, acute at apex. Male flowers: 3-4 mm across, campanulate, 6-20 flowered; Female flowers: solitary or rarely subumbellate. Fruits 8-10 cm thick, globose. Seeds 4.0-4.5 x 2.5-3.0 mm, ovate oblong, brown.

Ecology : Frequent along the rocky slopes of backshore plains.

Fl. & Fr. : July-October; August-November.

Distrib. : West Bengal, Andhra Pradesh, Tamil Nadu, Karnataka and Kerala coast.

9. *Trichosanthes* L.

KEY TO THE SPECIES

- 1a. Male racemes largely bracteate; bracts puberulous; calyx segments dentate 2. *tricuspidata*
 1b. Male racemes minutely bracteate; bracts glabrous; calyx segments entire 1. *cucumerina*

1. *Trichosanthes cucumerina* L., Sp. Pl. 1008. 1753; Clarke in Hook. f., Fl. Brit. India 2: 609. 1879.

Annual or perennial herbs; stems tendrillar climbing or twining, scabrid, pubescent. Leaves 7-9 x

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.

Ecology : Frequent on hedges and bushes in coastal scrub jungles, river-banks and inland cultivated fields.

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

Distrib. : Throughout the coastal districts.

2. *Trichosanthes tricuspidata* Lour., Fl. Cochinch. 589. 1790; *T. bracteata* (Lamk.) Voigt.: Clarke in Hook. f., Fl. Brit. India 2: 606. 1879.

Stems robust, branched, sulcate. Leaves variable in size broadly ovate, membranous, deeply palmate 3-5 lobed, denticulate. Male flowers: 4-6 cm across; female flowers: axillary solitary. Fruits red with 10 longitudinal orange streaks. Seeds 12 x 6 mm ovate oblong, whitish.

Ecology : Frequent on sandy slopes and waste sandy places on beach and back shore plains.

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

Distrib. : Orissa, Tamil Nadu, Gujarat, Maharashtra and Karnataka coast.

BEGONIACEAE

Begonia L.

Begonia malabarica Lamk., Encycl. 1: 393. 1785; Clarke in Hook. f., Fl. Brit. India 2: 655. 1879.

Shrub, 1-2 m tall, stems with persistent leaf-scars. Leaves 6-15 x 4-8 cm, ovate-cordate, chartaceous, stiff pubescent, irregularly dentate-biserrate, acuminate at apex and oblique at base. Flowers 1 cm across, rose to white, arranged in terminal or lateral cymes or dichasial corymbs.

Capsule 1.5-2 cm winged. Seeds oblong 0.4 mm, pitted.

Ecology : Frequent along the sand deposited crevices on back shore rocks.

Fl. & Fr. : March-June; April onwards.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka, Kerala coast and south Kanara.

CACTACEAE

Opuntia Mill.

Opuntia dillenii Haw., Suppl. Pl. Succ. 79. 1819; Clarke in Hook. f., Fl. Brit. India 2: 657. 1879.

Erect, spiny, straggling shrubs; stems widely branched, articulated, articulations surrounded by ring or 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.

Ecology : Frequent along sandy sea shores and sand bars near river mouth. Cultivated as hedge plant.

Fl. & Fr. : April-July; August-September.

Distrib. : Throughout the coastal provinces. Naturalised in India.

AIZOACEAE

KEY TO THE GENERA

- 1a. Flowers in dichasial or polychasial cyme 3. *Mollugo*
 1b. Flowers in clusters or solitary :
 2a. Carpels free 1. *Gisekia*

2b. Carpels united :

3a. Flowers sessile :

4a. Operculum of capsule 2 valved; ovary 2 locular 6. *Zaleya*

4b. Operculum of capsule 1-valved; ovary 1 locular 5. *Trianthema*

3b. Flowers pedicellate or subsessile :

5a. Leaves succulent 4. *Sesuvium*

5b. Leaves not succulent 2. *Glinus*

1. *Gisekia* L.

Gisekia pharnaceoides L., Mant. 2:562. 1771; Clarke in Hook. f., Fl. Brit. India 2: 664. 1879.

Diffuse, succulent herbs with long tap roots; stems glabrous, terete, often pink-tinged. Leaves opposites or in whorls, each 5-30 x 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 5, free, papillose, membranous, indehiscent carpels. Seeds reniform, finely tuberculate; funicles semicircular.

Ecology : Common along sandy sea shores, river-banks, and sand bars in between tidal forests.

Fl. & Fr. : Throughout the season.

Distrib. : West Bengal, Orissa, Tamil Nadu.

2. *Glinus* L.

KEY TO THE SPECIES

1a. Flowers stellate-pubescent, subsessile 1. *lotoides*

1b. Flowers glabrous, pedicellate 2. *oppositifolius*

1. *Glinus lotoides* L., Sp. Pl. 463. 1753; *Mollugo hirta* Thunb.: Clarke in Hook. f., Fl. Brit. India 2: 662. 1879.

Prostrate, stellate-pubescent, annual herbs with long tap roots. Leaves variable in size and shape, 5-30 x 4-20 mm, opposite, 3-nate or apparently verticillate, glabrous or densely villose, elliptic-ovate, obovate, or sub-orbicular, obtuse or rounded at apex, cuneate at base. Flowers 3-5 mm across, sub-sessile, greenish-white, 3-4, in axillary clusters. Capsules 4-11 mm long, ovoid, 5-valved, many-seeded. Seeds reniform, granulated with white strophioles.

Ecology : Common along the sea-shore, river-banks, road-sides and waste places; usually prefers dry reclaimed soil.

Fl. & Fr. : February-April; September-October.

Distrib. : Throughout the coastal district specially on beaches, dunes and sandy road side.

2. *Glinus oppositifolius* (L.) A. DC., Bull. Herb. Boiss. 2, 1: 559. 1901; *Mollugo spargula* L.: Clarke in Hook. f., Fl. Brit. India 2: 662. 1879.

Diffused, glabrous, annual herbs; branches terete, up to 70 cm long. Leaves 1-2 x 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. Capsules 2-3 mm across, ellipsoid, many-seeded. Seeds reniform, dark-brown, strophiolate.

Ecology : Frequent along sea-shores, river-banks, and road-sides; common in waste places and cultivated fields.

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

Distrib. : Throughout the coastal areas.



Bruguiera gymnorrhiza



Bruguiera parviflora



Bruguiera sexangula



Ceriops decandra



Ceriops tagal



Kandelia candel



Rhizophora apiculata



Rhizophora mucronata



Rhizophora stylosa



Lumnitzera littorea



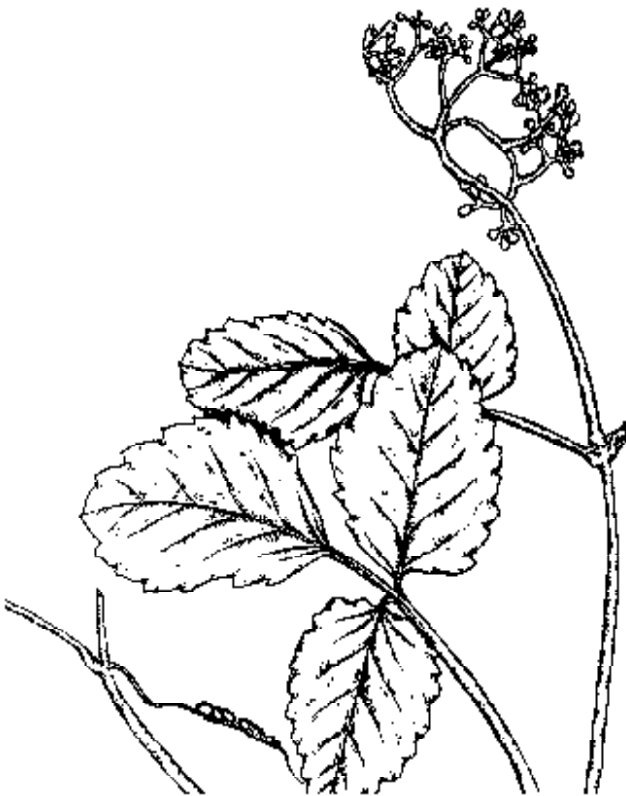
Lumnitzera racemosa



Cansjera rheedii Gmelin



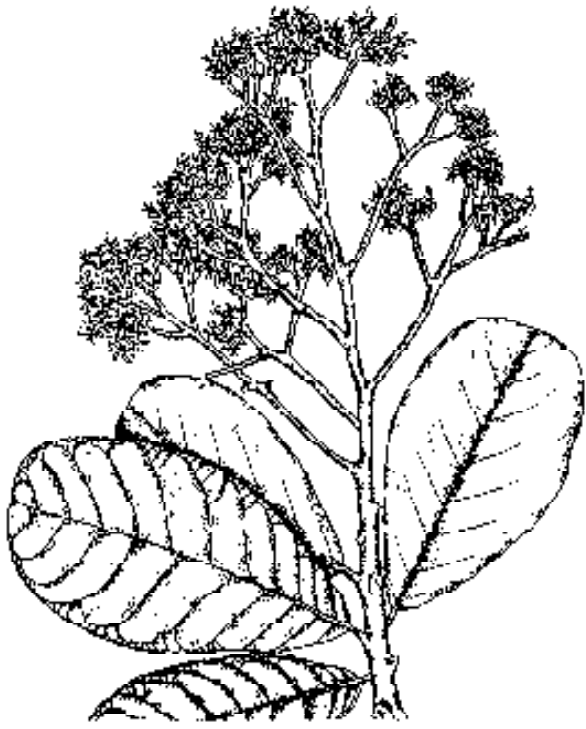
Colubrina asiatica (L.) Brongn.



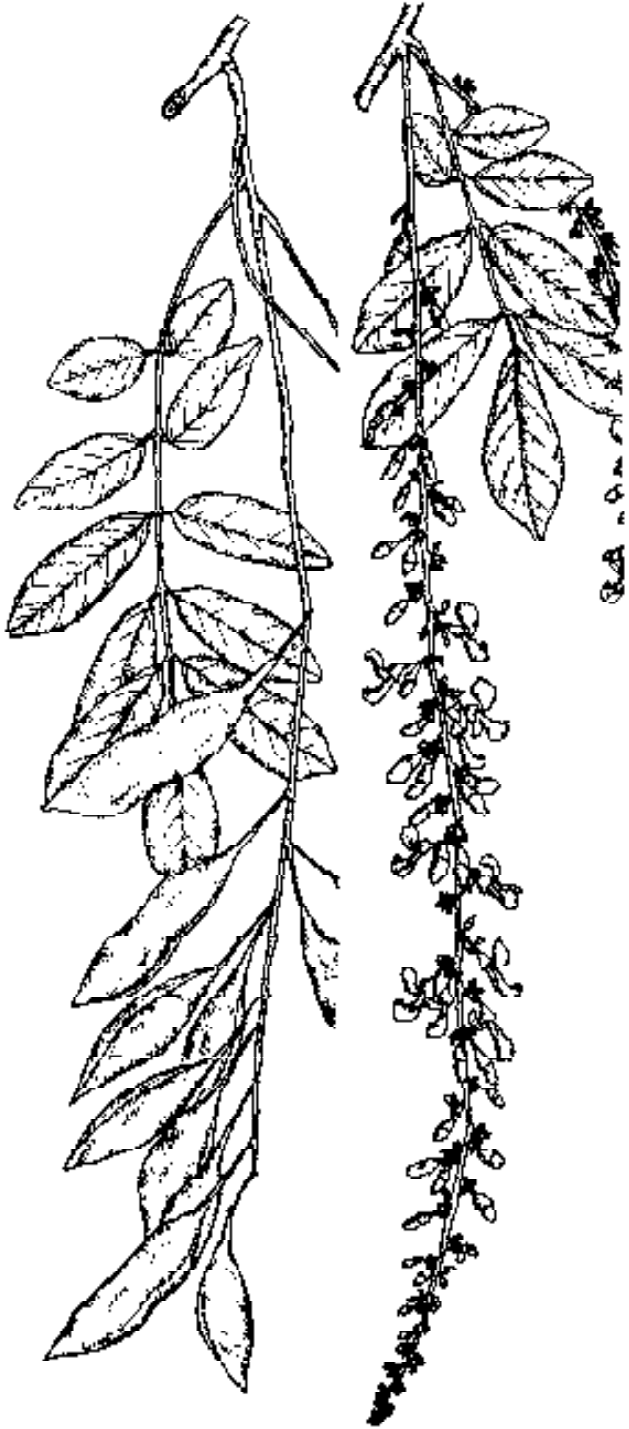
Cayratia pedata (Lour.) A.L. Juss. ex Gagnep



Sapindus emarginatus Vahl



Anacardium occidentale L.



Deris scandens (Roxb.) Benth.



Rothia indica (L.) Deuce

3. *Mollugo* L.

KEY TO THE SPECIES

- 1a. Seeds reniform :
 2a. Seeds dark-brown, granulated 4. *pentaphylla*
 2b. Seeds golden-yellow, not granulated 2. *disticha*
 1b. Seeds orbicular not reniform :
 3a. Capsule ellipsoid; flowers in corymbose cymes 3. *nudicaulis*
 3a. Capsule globose; flowers in subumbellate cymes 1. *cerviana*

1. *Mollugo cerviana* (L.) Seringe, DC. Prodr. 1: 392. 1824; Clarke in Hook. f., Fl. Brit. India 2: 663. 1879.

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.

Ecology : Frequent along sandy river-banks, sea-shores and waste places.

Fl. & Fr. : Mostly throughout the year.

Distrib. : Throughout the East and West coast.

2. *Mollugo disticha* (L.) Seringe, DC. Prodr. 1: 392. 1924; Clarke in Hook. f., Fl. Brit. India 2: 663. 1879.

Much-branched, diffuse, puberulo-glandular herbs; stems up to 50 cm tall, angular. Leaves 2-3.5 x 0.2-0.4 cm, in whorls of 3-8, linear or lanceolate, acute at apex, tapering at base. 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.

Ecology : Frequent along sea-shores, sandy river-banks, and sand bars in-between the creeks and channels.

Fl. & Fr. : Mostly throughout the year.

Distrib. : All along the East coast of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coast.

3. *Mollugo nudicaulis* Lamk. Encycl. 4: 234.1797; Clarke in Hook. f., Fl. Brit. India 2:664. 1879.

Erect herb. Leaves 4 x 2 cm, radical, spatulate, membranous, entire, retuse at apex, attenuate at base. Flowers 3 mm across, white arranged in terminal corymbose cymes. Capsules 2 mm, ellipsoid. Seeds angular.

Ecology : Common on sandy sea shore and sand dunes in waste places.

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

Distrib. : Mainly along the Orissa, Andhra Pradesh, Tamil Nadu and Gujarat coast.

4. *Mollugo pentaphylla* L., Sp. Pl. 89. 1753; Backer in Fl. Mal. 4: 268.1951. *M. stricta* L., 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 x 0.3-0.7 cm, obovate-spathulate in false whorls of 4-5, sessile, 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.

Ecology : Common in sandy sea shore and sand bars along the river banks, frequently found on road side.

Fl. & Fr. : Mostly throughout the season.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Goa, Maharashtra and Gujarat coast.

4. *Sesuvium* L.

KEY TO THE SPECIES

- 1a. Flowers deep purple or pinkish violate; seeds smooth..... 1. *portulacastrum*
 1b. Flowers white; seeds with raised radiating lines..... 2. *sesuvioides*

1. *Sesuvium portulacastrum* (L.) L., Syst. ed. 10: 1058. 1759; Clarke in Hook. f., Fl. Brit. India 2: 659. 1879.

Succulent, perennial herbs with long tap-roots; stems creeping, much-branched, greenish or red, rooting from nodes. Leaves 2-6 x 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-violet, axillary, solitary. Capsules 5-7 mm across, included within the perianth, many-seeded. Seeds black, reniform, smooth with long funicles.

Ecology : 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 sand binder just behind the intertidal region of the sea-shore.

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

Distrib. : Throughout the coastal areas.

2. *Sesuvium sesuvioides* (Fenzl) Verdc.; Kew Bull. 349.1957; *Trianthema hydasipa* Edgn.: Clarke in Hook. f., Fl. Brit. India 2: 661.1879.

Minutely papillose or glabrous herb. Leaves 1.5-2 cm, oblong or elliptic, scarious, glabrous, acute at apex and obtuse at base. Flowers 3-4 mm across, white, ribbed, sessile in axillary clustered or solitary. Capsule 5-6 mm, elongated, beak at apex. Seeds 10-15, black with raised radiating lines.

Ecology : Frequent along the rocky shore on waste sand deposited areas.

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

Distrib. : More or less restricted to Maharashtra, Gujarat and Saurashtra coast.

5. *Trianthema* L.

KEY TO THE SPECIES

- 1a. Flowers solitary 1. *portulacastrum*
 1b. Flowers clustered..... 2. *triquetra*

1. *Trianthema portulacastrum* L., Sp. Pl. 223. 1753; *T. monogyna* L.: Clarke in Hook. f., Fl. Brit. India 2: 660. 1879.

Much-branched, prostrate annuals with long tap roots; stems flattened on the nodes, thick finely puberulose. Leaves 2-4 x 1-3 cm, obovate, 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 operculum. Seeds reniform, black.

Ecology : Frequent along sandy coast, in waste places.

Fl. & Fr. : May-August.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

2. *Trianthema triquetra* Rottl. ex Willd., Neue. Schr. Naturfr. Berlin 4: 181. 1803; *T. crystallina* (auct. div. non Vahl.) Roxb.: Clarke in Hook. f., Fl. Brit. India 2: 660. 1879.

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 with single valve. Seeds 2, superposed, often 1, reticulate with papillose margins.

Ecology : 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.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

6. *Zaleya* L.

3. *Zaleya decandra* (L.) Burm. f., Fl. Ind. 110 t. 31. 1768; *Z. govindia* (Buch.-Ham. ex G. Don) Nair, Bull. Bot. Surv. India 8: 86. 1966.

Fleshy prostrate herb, woody at base. Leaves 1-3.5 x 0.5-2 cm, elliptic-oblongate, fleshy, entire, obtuse at apex, cuneate at base. Flowers 0.5 cm across, pinkish in axillary sessile clusters. Capsules 0.3-0.6 cm

long with two valved operculum, yellowish red.

Ecology : Common along the sea shore sand and waste sandy places along the lee side of sand dune.

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

Distrib. : Orissa, Tamil Nadu, Gujarat, Karnataka and Kerala coast.

A P I A C E A E

Centella L.

Centella asiatica (L.) Urban., Mart. Fl. Bras. 11: 287. t. 78. 1897. *Hydrocotyle asiatica* L.; Clarke in Hook. f., Fl. Brit. India 2: 669. 1879.

Prostrate herb with perennial root stock and rooting at nodes. Leaves 1-2.5 x 1-3 cm orbicular, reniform, chartaceous, crenate dentate, rounded at apex, cordate at base. Flowers 1.5 mm across, pink or red in

axillary fasciculated umbel. Mericarp 1.5 mm, flattened.

Ecology : Frequent along the moist sandy sea shore plains and inland areas.

Fl. & Fr. : Throughout the years.

Distrib. : Throughout the Indian coast, most common towards the eastern part.

R U B I A C E A E

KEY TO THE GENERA

- 1a. Trees or shrubs :
 - 2a. Plants armed 12. *Randia*
 - 2b. Plants unarmed :
 - 3a. Ovules two in each cell one pendulous, one erect 13. *Scyphiphora*
 - 3b. Ovules either solitary or more than two in each cell :
 - 4a. Flowers in fascicles, cymes or solitary :
 - 5a. Flowers 4-merous :
 - 6a. Styles much longer than corolla lobes 11. *Pavetta*
 - 6b. Styles shorter than corolla lobes 6. *Ixora*
 - 5b. Flowers more than 4-merous :
 - 7a. Flowers 5-merous; leaves not pandurate :
 - 8a. Leaves distichous; corolla lobes not villose within, beaked 8. *Lasianthus*
 - 8b. Leaves not distichous; corolla lobes villose within, not beaked 14. *Tarenna*
 - 7b. Flowers 7-8-merous. Leaves pandurate 4. *Guetarda*

- 4b. Flowers in umbels or in globose head :
- 9a. Fruit a syncarp 9. *Morinda*
- 9b. Fruit a 1-seeded drupe 2. *Canthium*
- 1b. Herbs or undershrubs :
- 10a. Ovules many in each locule :
- 11a. Fruits densely hairy 3. *Dentella*
- 11b. Fruits glabrous 10. *Oldenlandia*
- 10b. Ovules solitary in each locule :
- 12a. Fruits winged 5. *Hydrophyllax*
- 12b. Fruits not winged :
- 13a. Calyx tube densely pubescent 7. *Knoxia*
- 13b. Calyx tube glabrous 1. *Borreria*

1. *Borreria* C. F. Mey.

KEY TO THE SPECIES

- 1a. Flowers pinkish, clustered axillary 1. *articulares*
- 1b. Flowers white, in terminal sessile head 2. *ocymoides*

1. *Borreria articulares* (L. f.) F. N. Williams, Bull. Herb. Boiss. 5: 956. 1905. *S. hispida* L.: Hook. in Hook. f., Fl. Brit. India 3: 200. 1880.

Erect or prostrate herbs, deep rooted; stems quadrangular, wingless, hispid or glabrous, much-branched, from woody rootstock. Leaves 5-15 x 4-12 mm, subsessile, 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.

Ecology : Common along the lee ward side of the sea shore dunes, road sides, river banks, and dry grasslands.

Fl. & Fr. : July-September; December-January.

Distrib. : Throughout the coastal provinces.

2. *Borreria ocymoides* (Burm. f.) DC., Prodr. 4: 544. 1830; *Spermacoci ocymoides* Burm. f.: Hook. in Hook. f., Fl. Brit. India 3: 200. 1880.

Erect herbs, 30-50 cm tall. Leaves 3.5-5 x 0.5-1.5 cm, elliptic-oblong to linear-lanceolate, pubescent or nearly glabrous, acute at apex, attenuate at base. Flowers 2 mm across, white, in axillary whorls or in terminal, sessile heads. Capsule 0.7 mm, truncate. Seeds oblong.

Ecology : Rare on sandy and gravelly soils and waste places along the sea shore.

Fl. & Fr. : September-February; Throughout the year.

Distrib. : Tamil Nadu : Rameswaram Islands and Kerala coast.

2. *Canthium* Lamk.

KEY TO THE SPECIES

- 1a. Small shrubs, flowers greenish, fruits globose 2. *parviflorum*
- 1b. Trees, unarmed, flowers white, fruits ellipsoid 1. *dicoccum*

1. *Canthium dicoccum* (Gaertn.) Merr., Ph. J. Sci. 35: 8.1928; *C. didymum* Roxb.: Hook. in Hook. f., Fl. Brit. India 3: 132. 1880.

Small trees or shrubs 2-5 m tall, with drooping branchlets; branches glabrous, 4-angled, unarmed. Leaves 6-18 x 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 umbeliform cymes; flower-buds salverform. Fruits 1-1.5 cm long, ovoid or semiovoid, many, together; pyrenes flat, concave.

Ecology : Frequent along the sandy riverine scrubs, sand bars, in-between the creeks and channels and coastal thickets, in association with *Ochna squarrosa* and *Toddlatia asiatica*.

Fl. & Fr. : January-February; March-April.

Distrib. : Found in Hetamundia (Orissa), Tamil Nadu and Kerala coast.

2. *Canthium parviflorum* Lam., Encycl. 1: 602. 1785; Hook. in Hook. f., Fl. Brit. India 3: 136. 1880.

Armed shrubs up to 5 m. Leaves 2-4 x 1.5-2.5 cm, elliptic-ovate to obovate, chartaceous, glabrous, subacute at apex, attenuate at base. Flowers 5-7 mm across, greenish in lax cymes. Drupe globose, 1 cm across, pyrenes furrowed.

Ecology : Common on coastal hedges and bushes.

Fl. & Fr. : May-August; July onwards.

Distrib. : Andhra Pradesh, Tamil Nadu and Karnataka coast, Rameswaram Island.

3. *Dentella* J. R. G. Forst.

Dentella serpyllifolia Wall. ex Craib, Fl. Siam. Enum. 2: 27. 1932; *D. repens* Forst.: Hook. in Hook. f., Fl. Brit. India 3: 42. 1880.

Dichotomously branched prostrate herbs, rooting at nodes. Leaves 2-8 x 1-3 mm, sessile, spatulate, oblong, sparsely hairy, acute at apex, narrowed at base. Flowers 4-5 mm, white, axillary, solitary, covered with

blunt, hyaline setae. Fruits 4-5 mm long, obovoid, densely setose.

Ecology : Common along sandy river-beds, embankments and road-sides.

Fl. & Fr. : Mostly throughout the year.

Distrib. : West Bengal, Orissa, Karnataka and Kerala coast.

4. *Guettarda* L.

Guettarda speciosa L., Sp. Pl. 991. 1753; Hook. f., Fl. Brit. India 3: 126. 1880.

Tree, 8-15 m tall. Leaves 10-15 x 6-9 cm, ovate-pandurate, subcoriaceous, puberulous along upper nerves, pubescent below, obtuse or shortly acute at apex, rounded or obtuse at base. Flowers 1.5 cm across, funnel shaped, white arranged in helicoid cymes. Drupe

globose, woody, obscurely lobed. Seeds many.

Ecology : Frequent on rocky shore and on coral strands.

Fl. & Fr. : March-June; April onwards.

Distrib. : Tamil Nadu Coast, Minicoy, Kalpeni, Kalpati and Agathi Islands. Common along the littoral forests of Andamans.

5. *Hydrophylax* L. f.

Hydrophylax maritima L. f., Suppl. 126. 1781; Hook. in Hook. f., Fl. Brit. India 3: 199. 1880.

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 x 0.5-1.5 cm, sessile, ovate, thick, coriaceous, acute or acuminate at apex. Flowers 8-12 mm long, pinkish-purple, white-tinge within, funnel-shaped, sessile, solitary. Fruits 12-15 x 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.

Ecology : Common along sea-shores, restricted to beaches; sometimes found as pure strands. It is a sand stabilizer or sand binder, usually colonising over the first formed, small sand dunes as a pioneering species along the windward sea-shore ecosystem and growing in association with *Cyperus arenarius* and other taxa.

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

Distrib. : Throughout the coastal regions.

6. *Ixora* L.

KEY TO THE SPECIES

- 1a. Small trees; flowers white, less than 1 cm long 1. *arborea*
 1b. Shrubs; flowers scarlet, more than 1 cm long 2. *coccinea*

1. *Ixora arborea* Roxb. ex Sm., Rees, Cycl. 19: 125. 1811; *I. parviflora* Vahl.: Hook. in Hook. f., Fl. Brit. India 3: 142. 1880.

Small trees, 4-6 m tall; stems glabrous, much-branched, bark reddish-brown. Leaves 6-14 x 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. Fruits 4-6 mm in diam., globose, sometimes 2-lobed, drupaceous; pyrenes 1-2, thin-walled, concave within.

Ecology : Frequent along the outer mangroves and sand bars in-between the creeks, usually in association with *Olax scandens* and *Maba buxifolia*.

Fl. & Fr. : February-March; May-July.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

2. *Ixora coccinea* L., Sp. Pl. 110. 1753; Hook. in Hook. f., Fl. Brit. India 3: 145. 1880.

Much-branched, pluricaulous shrubs 30-60 cm tall. Leaves 2-10 x 1.5-6 cm sessile, ovate, ovate-oblong or obovate, coriaceous, acute or obtuse at apex, subcordate at base. Flowers 2-3 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, planoconvex.

Ecology : Found wild along the sandy river-banks, scrubs and coastal thickets; cultivated in gardens.

Fl. & Fr. : When wild, September-December; under cultivation, throughout the year.

Distrib. : Throughout the coastal districts.

7. *Knoxia* L.

Knoxia sumatrensis (Retz.) DC., Prodr. 4: 570. 1830. *K. corymbosa* auct. non Willd.: Hook. in Hook. f., Fl. Brit. India 3: 128. 1880.

Erect sparingly branched slender herbs; stems pubescent or densely hairy; nodes longitudinally grooved. Leaves 8-12 x 2.5-3 cm, opposite, penninerved, ovate-lanceolate or elliptic, pubescent, acute at apex, obtuse 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.

Ecology : Rare in scrub jungles along the river-banks.

Fl. & Fr. : August-September, October-December.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Kerala and Maharashtra coast.

8. *Lasianthus* W. Jack.

KEY TO THE SPECIES

- 1a. Calyx limb and teeth hairy, leaves abruptly acuminate at apex 1. *acuminatus*
 1b. Calyx limb and teeth glabrous, leaves mucronate at apex 2. *parvifolius*

1. *Lasianthus acuminatus* Wight, Calc. Journ. Nat. Hist. 6: 511.1846; Hook. f., Fl. Brit. India 3: 185. 1880.

Branched shrubs. Leaves 10-12 x 2.5-3.5 cm, elliptic-lanceolate, thin, rigid, acuminate at apex, acute at base. Flowers 25-26 mm, funnel shaped, in cymes or heads. Drupes small. Seeds narrow.

Ecology : Rare on hedges and bushes near coast.

Fl. & Fr. : March-April; June-September.

Distrib. : Karnataka coast, South Kanara (Sitanadi).

2. *Lasianthus parvifolius* Wight, Calc. Journ. Nat. Hist. 6: 512.1846; Hook. f., Fl. Brit. India 3: 186. 1880.

Branched shrubs. Leaves 3.5-4.5 x 1.25-2 cm, elliptic, glaucous, coriaceous, acute at apex and base. Flowers 6.2 mm across. Drupe 1-1.5 cm, diam., globose, glabrous. Seeds narrow.

Ecology : Rare on coastal thickets.

Fl. & Fr. : May-September.

Distrib. : Karnataka coast, south Kannara.

9. *Morinda* L.

Morinda citrifolia L., Sp. Pl. 176. 1753; Hook. in Hook. f., Fl. Brit. India 3:155. 1880.

Trees 3-8 m tall; branches 4-angled, pithy. Leaves 10-25 x 3-12 cm elliptic or elliptic-ovate, membranous, reticulo-venose, acute at apex, narrowed into base. Flowers white, sessile, in axillary capitate heads. Fruits 2-3 cm in diam., a syncarpium; drupes

globose with many 1-seeded pyrenes winged along margin.

Ecology : Found wild along the sea shores and sandy uplands; sometimes cultivated in the gardens.

Fl. & Fr. : July-August; September-December.

Distrib. : Throughout the coastal areas and dry deciduous zone.

10. *Oldenlandia* L.

KEY TO THE SPECIES

- 1a. Leaves sessile; calyx teeth subulate :
 - 2a. Diffused herbs; corolla tube usually not slender :
 - 3a. Flowers sessile or subsessile :
 - 4a. Capsule dehiscent loculicidally; flowers solitary 3. *diffusa*
 - 4b. Capsule not loculicidally dehiscent; flowers not solitary :
 - 5a. Leaves rigid, nerves indistinct; capsule hard 5. *nitida*
 - 5b. Leaves membranous, distinctly trinerved; capsule soft 7. *trinerva*
 - 3b. Flowers pedicillate :
 - 6a. Peduncle 2-4 cm long :
 - 7a. Flowers white, in cymes 2. *corymbosa*
 - 7b. Flowers lilac, in umbels 8. *umbellata*
 - 6b. Peduncles 30-60 cm long 6. *stricta*
 - 2b. Erect herbs; corolla tube slender 4. *herbacea*
- 1a. Leaves petiolate; calyx teeth triangular 1. *biflora*

1. *Oldenlandia biflora* L., Sp. Pl. 119. 1753; Hook. in Hook. f., Fl. Brit. India 3: 70. 1880.

Erect or ascending, glabrous herbs; stems quadrangular, sulcate, much-branched from the base. Leaves 1-5 x 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. Fruits 2-3 mm across, turbinate, ferunculate, not winged.

Ecology : Frequent along road-sides, open sandy places, river-banks and scrubs. Sometime submerged in water.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

2. *Oldenlandia corymbosa* L., Sp. Pl. 119. 1753; Hook. in Hook. f., Fl. Brit. India 3: 64. 1880.

Diffused, slender, annual herbs; stems quadrangular, glabrous. Leaves 8-24 x 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.

Ecology : Frequent on waste places, road-sides, gravelled yards and sea-shores.

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

Distrib. : Throughout the coast.

3. *Oldenlandia diffusa* (Willd.) Roxb., Fl. Ind. 1: 444. 1820; Hook. in Hook. f., Fl. Brit. India 3: 65. 1880. *Hedyotis diffusa* Willd. Sp. Pl. 1: 566. 1797.

Herb up to 30 cm tall. Leaves 2-5 x 0.2-0.4 cm, linear, chartaceous, margin revolute, acute or apiculate at apex, decurrent at base. Flowers 6 mm across, whitish or purplish, arranged in solitary or axillary pairs. Capsule 3 x 3 mm with persistent, calyx-lobes. Seeds reticulate.

Ecology : Frequent on sandy beaches and rocky crevices on shore.

Fl. & Fr. : Throughout the year.

Distrib. : West Bengal, Orissa and Andhra Pradesh coast.

4. *Oldenlandia herbacea* (L.) Roxb., Fl. Ind. ed. Carey, 424. 1832. *O. heyneii* G. Don.: Hook. in Hook. f., Fl. Brit. India 3: 56. 1880.

Erect, bushy, annual or biannual herbs; stems prominently branched, glabrous, 4-angled; branches dichotomous. Leaves 2-3 x 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. Fruits 3-4 mm across, globose, crowned by subulate calyx lobes.

Ecology : Frequent on waste places near the coast, along the river-banks and road-sides.

Fl. & Fr. : September-October; December-January.

Distrib. : Throughout the coastal districts.

5. *Oldenlandia nitida* Gamble, 421. 1921; Hook. in Hook. f., Fl. Brit. India 3: 61. 1880.

Erect herbs with diffuse branches up to 25-30 cm tall. Leaves 4-6 x 1-2 cm, elliptic or linear lanceolate, smooth or scabrid, margin recurved, acute at apex, obtuse at base. Flowers 0.5-0.6 cm across, white, arranged in terminal or axillary cymes. Capsules ovoid, glabrous. Seeds many, angular.

Ecology : Frequent on waste places and rocky crevices near coast.

Fl. & Fr. : May-June; August-October.

Distrib. : Tamil Nadu and Kerala coast.

6. *Oldenlandia stricta* L., Mant. 200. 1781; Hook. in Hook. f., Fl. Brit. India 3: 68. 1880.

Branched perennial herbs; tap root 40-60 cm long; branches glabrous, wiry, repeatedly trichotomous, sub-quadrangular. Leaves 10-25 x 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 mm long, slender, wiry. Fruits 5-8 mm long, obovoid, ribbed, crowned by subulate calyx teeth.

Ecology : More or less restricted along the sea-shore, riverine scrubs and coastal thickets.

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

Distrib. : Orissa, Tirunelveli and Nellore.

7. *Oldenlandia trinerva* Retz., Obs. Bot. Fasc. 4: 23. 1786; Hook. in Hook. f., Fl. Brit. India 3: 66. 1880.

Slender, procumbent, small annual herbs. Leaves 0.6-1.5 x 0.4-1 cm, elliptic, glabrous, thin, acute or orbicular at apex, narrowed at base. Flowers 0.5-0.7 cm across, white, axillary or terminal paniced cymes. Capsules small, globose, hairy. Seeds minute, numerous.

Ecology : Frequent on sandy beaches and lee side of sand dunes.

Fl. & Fr. : July onwards.

Distrib. : West Bengal: Digha; Orissa: Paradeep; Andhra Pradesh and Tamil Nadu coast.

8. *Oldenlandia umbellata* L., Sp. Pl. 119. 1753; Hook. in Hook. f., Fl. Brit. India 3: 66. 1880.

Much-branched, diffuse annual herbs; stems angular, scabridulous. Leaves 6-15 x 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. Fruits 2-3 mm across, flat or truncate at apex, not protruding from calyx lobes.

Ecology : Frequent on sea-shore, scrubs, river-banks, road-sides and dry sandy places.

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

Distrib. : Throughout the coastal provinces.

11. *Pavetta* L.

Pavetta indica L., Sp. Pl. 110. 1753; Hook. in Hook. f., Fl. Brit. India 3: 150. 1880.

Shrubs or small trees, 3-5 m tall; stems subquadrangular, glabrous, much-branched. Leaves 5-20 x 3-10 cm, ovate-oblong or elliptic-oblong, membranous, black-dotted, acute or acuminate at apex, cuneate at base. Flowers 1.4-1.6 cm long, white, fragrant, in terminal

corymbose cymes; bracts cupular. Fruits 4-5 mm in diam., globose drupeccous. Seeds 2, subglobose.

Ecology : Common along sea-shores, river-banks and scrubs.

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

Distrib. : Throughout the coastal districts.

12. *Randia* L.

KEY TO THE SPECIES

- 1a. Leaves ovate-spathulate; calyx lobes imbricate 1. *dumetorium*
 1b. Leaves obovate; calyx lobe not imbricate 2. *malabarica*

1. *Randia dumetorium* (Retz.) Poir., Lamk. Encycl. (Suppl.2): 829. 1812; Hook. in Hook. f., Fl. Brit. India 3: 110. 1880, *p.p.*

Shrub up to 3-5 m tall. Leaves 1.5-2 x 1-1.5 cm, ovate-spathulate, chartaceous, puberulous above, pubescent below, obtusely apiculate at apex, cuneate or attenuate at base. Flowers 2-2.5 cm across, white turning yellow, arranged in axillary, solitary or in fascicles. Berry 2 cm across, globose, with a crown of enlarged calyx-lobes. Seeds smooth.

Ecology : Common along the back shore sands and river banks.

Fl. & Fr. : January-July; Throughout the year.

Distrib. : West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coast.

2. *Randia malabarica* Lamk., Encyl. Method. 3: 25. 1789; Hook. in Hook. f., Fl. Brit. India 3: 111. 1880.

Thorny shrubs, 1-1.5 m tall; stems much-branched with divaricate branchlets. Leaves 4-7 x 2-3.5 cm, whorled on short branchlets, obovate or elliptic-oblong, sub-coriaceous, obtuse at apex, narrowed into a short petiole. 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.

Ecology : Common in scrubs, coastal thickets and sand bars in-between the mangroves; cultivated as hedge plants.

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

Distrib. : Throughout the coastal districts.

13. *Scyphiphora* Gaertn.

Scyphiphora hydrophyllacea Gaertn. Fl. Brit. India 3: 125. 1880.

Tree 3-5 m high, branchlets stout, swollen at the node. Leaves 3-5 cm x 2-2.5 cm, obovate, coriaceous, entire, obtuse at apex, narrowed towards base. Flowers 1.5 cm across, white, densely arranged in axillary pedunculate cymes. Drupe-subcylindric, 8-10 grooved. Seed subcylindric, membranous.

Ecology : This rare mangrove tree resembles *Lumnitzera racemosa* and often found associated along the banks of intertidal creeks and canals but very scarce in distribution.

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

Distrib. : Restricted only in the Sarcomanto light house region at the Godavari delta. It is common in Andaman island.

14. *Tarenna* Gaertn.

Tarenna asiatica (L.) Alst., Trim. Handb. Fl. Ceylon (ed. 2) 6: 150.1931; *Webera corymbosa* Willd.: Hook. in Hook. f., Fl. Brit. India 3: 102. 1880.

Shrubs 2-6 m tall; stems glabrous, much-branched. Leaves 6-20 x 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, ellipsoid, 2-loculed berries. Seeds angular, 4-6.

Ecology : Frequent along river-banks and coastal thickets.

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

Distrib. : Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

A S T E R A C E A E

KEY TO THE GENERA

- 1a. Capitula homogamous; florets all ligulate :
 - 2a. Florets all ligulate 21. *Launea*
 - 2b. Florets all tubular :
 - 3a. Anther cells tailed at base 9. *Echinops*
 - 3b. Anther cells cleft at base or subentire :
 - 4a. Leaves opposite :
 - 5a. Pappus of 10 or more capillary bristles 13. *Eupatorium*
 - 5b. Pappus of 3-5 scales or clavate hairs :
 - 6a. Pappus of scales 3. *Ageratum*
 - 6b. Pappus of clavate hairs 2. *Adenostemma*
 - 4b. Leaves alternate :
 - 7a. Florets all tubular; style branches subulate, hairy 29. *Vernonia*
 - 7b. Florets all tubuliform; style branches linear, obtuse, truncate or appendicular :
 - 8a. Anther cells tailed or auricled :
 - 9a. Style arms linear, obtuse or styles of sterile florets divided :
 - 10a. Heads homogamous (except *Gnaphalium*) :
 - 11a. Perennials; female florets lesser than the bisexual florets 18. *Helichrysum*
 - 11b. Annuals; female florets more than the bisexual florets 16. *Gnaphalium*
 - 10b. Heads heterogamous :
 - 12a. Heads radiate 23. *Pulicaria*

- 12b. Heads discoid or disciform :
- 13a. Shrubs or undershrubs; involucre bracts broad, scaly 22. *Pluchea*
- 13b. Herbs; involucre bracts not scaly :
- 14a. Heads compound, few flowered aggregated into globose or compact cylindrical mass 25. *Sphaeranthus*
- 14b. Heads solitary, many flowered arranged in lax panicle or corymb :
- 15a. Pappus absent 12. *Epaltes*
- 15b. Pappus present :
- 16a. Leaves decurrent 20. *Laggera*
- 16b. Leaves not decurrent :
- 17a. Anthers tail less 7. *Blumeopsis*
- 17b. Anthers tailed 6. *Blumea*
- 9b. Style arms of hermaphrodite florets truncate or appendaged :
- 18a. Involucre ecalyculate 11. *Emilia*
- 18b. Involucre calyculate 19. *Kleinia*
- 8b. Anther cells not tailed :
- 19a. Involucre bracts 2-many seriate, dry or with scarious tips 26. *Sphaeromorphaea*
- 19b. Involucre bracts uniseriate, herbaceous or foliaceous :
- 20a. Heads non-glomerulate, more than one flowered :
- 21a. Heads unisexual 31. *Xanthium*
- 21b. Heads bisexual :
- 22a. Leaves divided to base or deeply pinnatifid 4. *Bidens*
- 22b. Leaves simple or pinnately compound :
- 23a. Ray achenes only fertile; epappose 1. *Acanthospermum*
- 23b. Ray achenes sterile or fertile; disc achenes always fertile; pappose or epappose :
- 24a. Disc achenes rounded or laterally compressed; pappus absent or of 2 short, weak scales :
- 25a. Receptacle flat, never conical :
- 26a. Pales bristle like 10. *Eclipta*
- 26b. Pales linear or oblanceolate, concave or folded :
- 27a. Pales obtuse, lacerate; flower white; pappus of 2 weak awns 5. *Blainvillea*
- 27b. Pales acute, entire; flower yellow; pappus present or absent. 30. *Wedelia*
- 25b. Receptacle convex or conical 24. *Sclerocarpus*
- 24b. Disc achenes dorsally compressed or angular; pappus present or absent :
- 28a. Pappus absent, if present 2-3 bristles or awns :
- 29a. Margins of achenes lacinate winged; pappus of 2 unbarbed awns 27. *Synedrella*
- 29b. Margins of achenes not lacinate winged 15. *Glossocardia*
- 28b. Pappus consisting of 20 bristles or scales 28. *Tridax*
- 20b. Heads in terminal glomerulate, one flowered 14. *Plaveria*
- 1b. Capitula heterogamous; florets both ray and disc :
- 30a. Pappus short tube with fimbriate mouth 17. *Grangea*
- 30b. Pappus absent. 8. *Cyathocline*

1. *Acanthospermum* Schrank

Acanthospermum hispidum DC., Prodr. 5: 522. 1836; Chowdhery in Fl. India 12: 361. 1993.

Herbs up to 50 cm high, hispidly hairy. Leaves 3-8 x 2-5 cm obovate to spatulate or oblanceolate, margin decurrent obtuse or acute at apex, cuneate at base. Head 1 cm across, yellowish-white, radiate. Achenes of rayflorets black, triangular with numerous

lateral, hooked spinules; Achenes of disc florets glandular. Pappus absent.

Ecology : Weed of fallow lands, frequently distributed on coast.

Fl. & Fr. : January-June.

Distrib. : West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coast.

2. *Adenostemma* J. R. & G. Forster

Adenostemma lavenia (L.) Kuntze, Rev. Gen. Pl. 1: 304. 1891. *A. viscosum* var. *lavenia* Hook. in Hook. f., Fl. Brit. India 3: 242. 1881, *p.p.*; Uniyal in Fl. India 12: 346. 1993.

Herbs; stems decumbent, ascending, pubescent in the upper parts. Leaves up to 25 x 14 cm, variously shaped, entire or serrate, acute or obtuse at apex and

base. Heads corymbose. Achenes smooth, muciculate or tuberculate. Pappus hairs 4-5, ending in a knob.

Ecology : Frequent on roadside and sandy waste places on coast.

Fl. & Fr. : March April

Distrib. : Throughout the coast.

3. *Ageratum* L.

Ageratum conyzoides L., Sp. Pl. 839. 1753; Hook. in Hook. f., Fl. Brit. India 3: 243. 1881; Uniyal in Fl. India 3: 348. 1993.

Herbs; stem terete, pilose. Leaves up to 10 x 7 cm, ovate, sparsely pilose above, glandular punctate beneath, crenate, obtuse at apex, narrowed at base. Heads white or blue, discoid. Achenes 1 mm long, black.

Pappus of 5 scales flattened at base.

Ecology : Weeds of crocdd fields and road side, rarely found on back shore localities.

Fl. & Fr. : Round the year.

Distrib. : Throughout the coast.

4. *Bidens* L.

Bidens pilosa L., Sp. Pl. 832. 1753; *B. chinensis auct. non* Willd.: Hook. in Hook. f., Fl. Brit. India 3: 309. 1881. Chowdhery in Fl. India 12: 372. 1993.

Herbs up to 1.2 m tall. Leaves imparipinnate; terminal pinna lanceolate to ovate, coarsely toothed, acuminate at apex. Heads 5-15 mm across yellow discoid to radiate, in lax corymbose panicles. Achenes

6-10 mm black, fusiform.

Ecology : Common weeds of gardens, waste places, roadsides and agricultural fields. Frequent on sandy and rocky coast.

Fl. & Fr. : March-November.

Distrib. : Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

5. *Blainvillea* Cass.

Blainvillea acmella (L.) Philip., Blumea 6: 350. 1950; *B. latifolia* (L. f.) Hook. in Hook. f., Fl. Brit. India 3: 305. 1881; Chowdhery in Fl. India 12: 377. 1993.

Erect, much-branched, coarsely hairy annual herbs; stems straw-coloured, furrowed, scabrid. Leaves 6-9 x 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, cuniform, compressed. Pappus of 2-5 unequal bristles.

Ecology : Frequently found in the scrub-jungles and along river-banks.

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

Distrib. : Throughout the East coast. Karnataka and Maharashtra in West coast.

6. *Blumea* DC.

KEY TO THE SPECIES

- 1a. Corolla lobes of bisexual florets with multicellular hairs in addition to colleters; leaves serrate dentate 3. *obliqua*
- 1b. Corolla lobes of bisexual florets glabrous or with unicellular hairs in addition to colleters; leaves dentate :
- 2a. Prostrate herb with branches radiating from rootstock; corolla hairy on lobes; leaves irregularly dentate 4. *oxyodonta*
- 2b. Erect herbs; corolla lobes and tubes hairy all over; leaves alternately long and short toothed :
- 3a. Heads purple; leaves not lyrate lobed 2. *mollis*
- 3b. Heads yellow; leaves lyrate lobed 1. *lacera*

1. *Blumea lacera* (Brum.f.) DC., Wt. Cont. Bot. Ind. 14. 1834; Hook. in Hook. f., Fl. Brit. India 3: 263. 1881; Kumar in Fl. India 13: 128. 1993.

Erect herbs, 20-90 cm tall; stems strongly scented, viscid, younger parts villose, with soft glandular hairs. Leaves 1.5-10 x 0.5-5 cm, 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.

Ecology : Common weed along road-sides, river-banks, cultivated fields and sea-shores.

Fl. & Fr. : March-July; September-December.

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka and Maharashtra coast.

2. *Blumea mollis* (D. Don) Merr., Philip. J. Sci. (Bot.) 5: 395. 1910; *B. neilgherrensis* Hook. in Hook. f., Fl. Brit. India 3: 261. 1881; Kumar in Fl. India 13: 135. 1993.

Herbs, up to 90 cm high, softly pilose. Leaves 1-10 x 0.5-5 cm, ovate-oblong, silky villous, loosely serrate, acute to apiculate at apex. Heads 3-4 mm in diam, purple, in dense, terminal, compact spiciform, panicles. Achenes brown, oblong, shining pubescent. Pappus 2-4 mm long.

Ecology : Common in dry open coast, grasslands, on hill slopes and along roadside.

Fl. & Fr. : January - November.

Distrib. : Almost throughout the coast.

3. *Blumea obliqua* (L.) Druce, Bot. Exch. Club Soc. Brit. Isles 4: 609. 1917; *B. amplexans* DC.: Hook. in Hook. f., Fl. Brit. India 3: 260. 1881; Kumar in Fl. India 13: 137. 1993.

Profusely branched herb to 80 cm, branchlets hispid. Leaves 1.5-2.5 x 0.5-1 cm, oblong-spathulate, white pubescent, entire or dentate, semi-amplexicaul at base acute at apex. Flowers in 0.7 cm across head, purple, in axillary or terminal.

Ecology : Frequent on sandy or rocky back coast.

Fl. & Fr. : December-April.

Distrib. : Maharashtra, Gujarat and Karnataka coast.

4. *Blumea oxyodonta* DC., Wight. Contrib. Bot. Ind. 15. 1834; Hook. in Hook. f., Fl. Brit. India 3: 266. 1881; Kumar in Fl. India 13: 139. 1993.

Herbs, 5-40 cm high, procumbent, villous. Leaves lower ones 3-7 x 12-3 cm, obovate-oblong, serrate-dentate with hard spinulose 2 teeth, spinulose-acute or apiculate at apex, narrowed at base; upper ones 0.7-3 x 3-1.5 cm, elliptic or narrowly obovate, rounded at base. Heads 6-9 mm in diam., yellow in few headed corymbose panicles. Achenes oblong, pubescent. Pappus 3-4 mm, white.

Ecology : Frequent in moist sandy places on the sea shore, along stream beds, river banks, paddy fields and along road side.

Fl. & Fr. : October-May.

Distrib. : West Bengal, Orissa, Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala coast.

7. *Blumeopsis* Gagnep.

Blumeopsis flava (DC.) Gagnep., Bull. Mus. Hist. Nat. Paris 26: 76. 1920; *Laggera flava* (DC.) Benth.: Hook. in Hook. f., Fl. Brit. India 3: 270, 1881; Kumar in Fl. India 13: 145. 1993.

Herb, 0.15-1 m tall. Leaves 1.5-8 x 0.5-4 cm obovate, spinulose dentate, rosette at base, rounded at apex, narrowed at base. Heads golden-yellow, in

compound panicle. Achenes very small, glabrous. Pappus 0.25-0.30 cm long, white.

Ecology : Frequent on sand and hill slopes along the sea shore, road sides and river banks.

Fl. & Fr. : Throughout the year.

Distrib. : Karnataka, Andaman and Nicobar Islands.

8. *Cyathocline* Cass.

Cyathocline purpurea (Buch.-Ham. ex D. Don) Kuntze, Rev. Gen Pl. 333. 1891. *C. lyrata* Cass.: Hook. in Hook. f., Fl. Brit. India 3: 246. 1881; Hajra in Fl. India 12: 111. 1993.

Erect or decumbent, aromatic, annual herbs with soft adpressed hairs; stems much branched, striate. Leaves 6-12 x 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.

Ecology : Frequent along the river-banks, cultivated fields, and moist places.

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

Distrib. : Frequently found along the East and West coastal backwards sand.

9. *Echinops* L.

Echinops echinatus Roxb., Fl. India. 3:447. 1832; Hook. in Hook. f., Fl. Brit. India 3:358. 1881; Hajra in Fl. India 12:177. 1993.

Annual herb 30-60 cm high, branched from base. Leaves 7.5-20 cm, pinnatifid, lobes triangular oblong, sinuate, spinescent. Heads 2.5-3.5 cm across, white,

globose, with spines. Achenes 4 mm long, obconic, silky villous.

Ecology : Common weed of open places and cultivated field near the coast.

Fl. & Fr. : March-September.

Distrib. : West Bengal, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

10. *Eclipta* L.

Eclipta prostrata (L.) L., Mant. Pl. 286. 1771; *E. erecta* L.: Hook. in Hook. f., Fl. Brit. India 3: 304. 1881; Chowdhery in Fl. India 12: 381. 1993.

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 x 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.

Ecology : Frequent along river-banks, common along road-sides, in moist places, rice-fields and grassland.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coast.

11. *Emilia* Cass

Emilia sonchifolia (L.) DC., Wight. Contrib. Bot. Ind. 24. 1834. *Cacalia sonchifolia* L.: Hook. in Hook. f., Fl. Brit. India 3: 336. 1881; Mathur in Fl. India 13: 212. 1993.

Herbs, 20-40 cm high, stem pale brown. Leaves 3-10 x 0.5-4 cm, lyrate pinnatifid with triangular ovate terminal lobe and irregularly toothed lateral lobes, membranous, rounded or acute at apex, cuneate at base.

Heads 7-9 mm long, discoid in corymbose inflorescence. Achenes brown, cylindrical, 2.5-3 mm long, 5 ribbed. Pappus of white soft hairs.

Ecology : Frequent on moist sand stones and lateritic caps of backshore hills.

Fl. & Fr. : June-October.

Distrib. : Throughout the coast.

12. *Epaltes* Cass.

Epaltes divaricata (L.) Cass., Bull. Sci. Soc. Philom. Paris 1818; Hook. in Hook. f., Fl. Brit. India 3: 274. 1881; Kumar in Fl. India 13: 147. 1993.

Herbs up to 30 cm high; branches winged. Leaves 3-7 x 0.7-1 cm, lanceolate to oblong, sparsely dentate, acute at apex, cuneate at base. Heads 0.7 cm across, disciform terminal corymbose. Achenes

0.7-0.9 mm long, oblong ribbed. Pappus absent.

Ecology : Frequent on sandy sea shore and lateritic grounds on back shore.

Fl. & Fr. : December-April.

Distrib. : Orissa, Karnataka and Tamil Nadu coast.

13. *Eupatorium* L.

Eupatorium odoratum L., Syst. Nat. ed. 10, 1205. 1759; Hook. in Hook. f., Fl. Brit. India 3:244. 1881; Uniyal in Fl. India 12:354. 1993.

Erect herbs or straggling undershrubs; stems terete, pithy, pubescent in upper parts, woody at base. Leaves 2.5-8 x 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, scabrescent, Pappus 4-5 mm long, 1-seriate, white, barbillate.

Ecology : Obnoxious weed, commonly growing along road-sides and hedges; frequently found along sea-shore.

Fl. & Fr. : November-December; January-February.

Distrib. : Widespread in India, frequent on the back shore of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra.

14. *Flaveria* Juss.

Flaveria trinervia (Spreng.) C. Mohr, Contr. U.S. Nat. Herb. 6: 810. 1901; *F. australasica* Hook. in Gamble, Fl. Madras 2: 711(501). 1921; Uniyal in Fl. India 12: 386. 1993.

Erect herb, 50-75 cm tall. Leaves 2.5-3.5 x 1-1.5 cm, obovate to lanceolate, chartaceous, dentate, acute at apex, cuneate at base. Capitula 1 cm across,

disc florets 1.5 mm across, yellow, ray-florets 2 mm across. Achenes 3 mm, compressed, black.

Ecology : Frequent on sandy sea shore and sea shore waste lands.

Fl. & Fr. : December-March.

Distrib. : Introduced from Australia, now naturalised in the plains and coastal regions.

15. *Glossocardia* Cass.

Glossocardia bosvallea (L. f.) DC. in Wight, Contrib. Bot. Ind. 19. 1834; *G. linearifolia* Cass.: Hook. in Hook. f., Fl. Brit. India 3: 308. 1881; Uniyal in Fl. India 12: 391. 1993.

Herbs up to 15 cm tall, ascending, branches grooved. Leaves pinnatisect; pinnules 7 x 1 mm, narrowly linear, puberulous, apiculate at apex, decurrent at base. Heads radiate, solitary, axillary. Achenes

brownish-black, compressed, densely ciliate at angles with stiff hairs. Pappus awned, spreading, smooth, stiff.

Ecology : Frequent on river banks, sea shore sand and rocky hill slopes along the coast.

Fl. & Fr. : July-December.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka and Maharastra coast.

16. *Gnaphalium* L.

KEY TO THE SPECIES

- 1a. Heads in leafless corymbose clusters 1. *luteo-album*
 1b. Heads in leafy spikes 2. *polycaulon*

1. *Gnaphalium luteo-album* L., Sp. Pl. 851. 1753; Hook. in Hook. f., Fl. Brit. India 3: 288. 1881; Pant in Fl. India 13: 87. 1993.

Herbs, 40-60 cm tall; stems white woolly tomentose. Leaves 2-6 x 0.5-1.2 cm, lower one oblong-spathulate, upper one linear-lanceolate, hairy, obtuse at apex, narrowed at base. Flowers 3-4.5 mm across, yellow, in dense terminal head, woolly pubescent. Achenes 0.5 mm long, linear, papillose. Pappus hairs white, minutely barbed.

Ecology : Frequent an moist sandy places on back shore and near the margins of paddy fields.

Fl. & Fr. : Almost round the year.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

2. *Gnaphalium polycaulon* Pers., Sys. Pl. 2: 421. 1807; Hook. in Hook. f., Fl. Brit. India 3:289. 1881; Pant in Fl. India 13:91. 1993.

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.

Ecology : Common along road-sides, river-banks, dry ditches, and moist sandy places; frequent along sea-shores on waste places.

Fl. & Fr. : December-January; February-March.

Distrib. : Throughout the coastal provinces.

17. *Grangea* Adans.

Grangea maderaspatana (L.) Poir. in Lamk. Encycl. suppl. 2: 825. 1811; Hook. in Hook. f., Fl. Brit. India 3: 247. 1881; Hajra in Fl. India 12: 127. 1993.

Diffused annual or perennial, sticky, pubescent herbs with woody rootstocks and long tap roots; branches radiating from the centre. Leaves 2-6.5 x 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 two in terminal peduncles. Achenes suberect, slightly compressed, glandular. Pappus cupular, fimbriate.

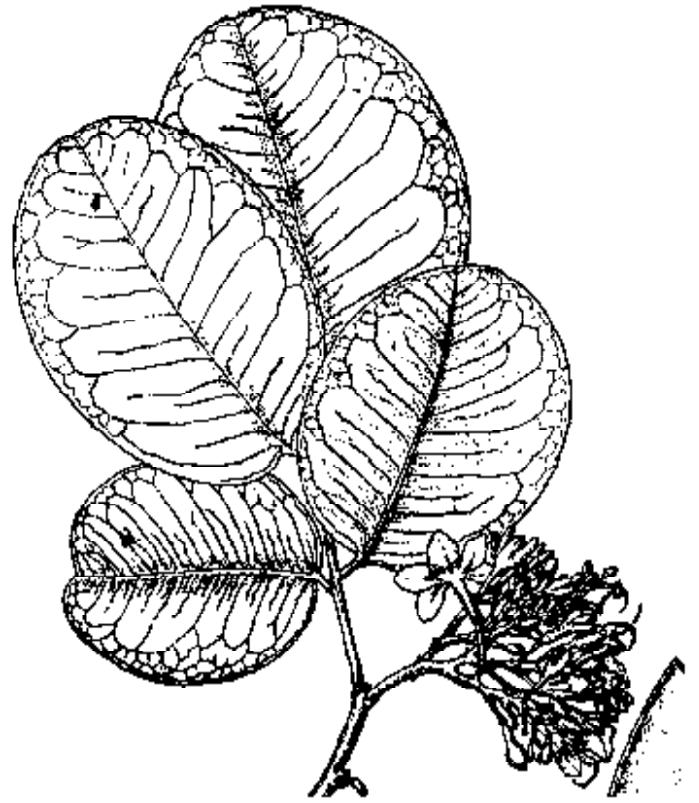
Ecology : Frequent on waste places near the sea-shores; common locally along dry ditches and paddy fields.

Fl. & Fr. : February-March; May-June.

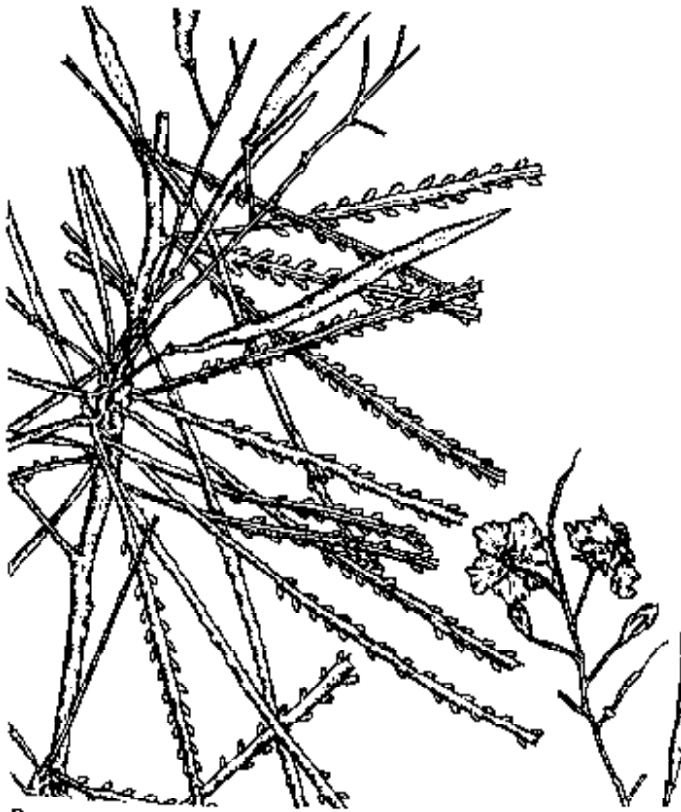
Distrib. : Throughout the coastal districts.



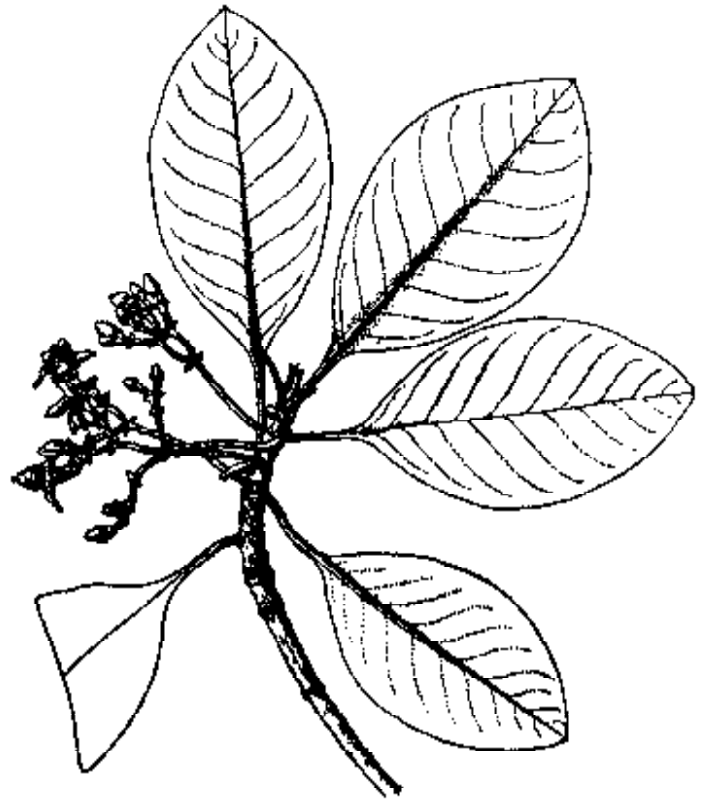
Zornia diphylla (L.) Pers.



Intsia bijuga (Colebr.) O. Kuntze



Parkinsonia aculeata L.



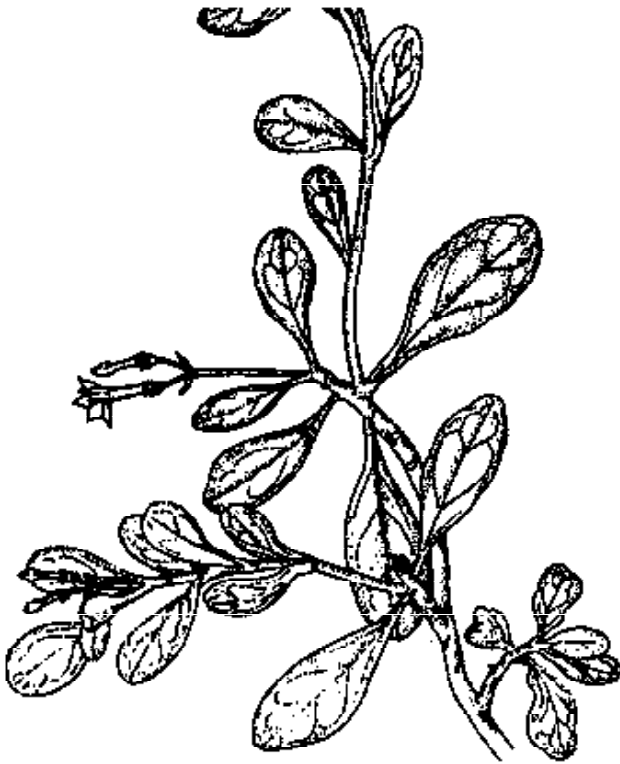
Rhizophora stylosa Griff.



Citrullus lanatus (Thunb.) Matsum. & Nakai



Trichosanthes tricaspidata L.



Scaevola plumieri (L.) Vahl



Hydrophylax maritima L. f.

18. *Helichrysum* Miller.

Helichrysum cutchicum (Clarke) R. Rao *et* Desh., Bull. Bot. Surv. Ind. 10 (2): 227, 1968; *Anaphalis cutchica* Clarke.: Hook. in Hook. f., Fl. Brit. India 3: 284, 1881; Pant in Fl. India 13: 100, 1993.

Herbs, up to 40 cm high, thinly clothed with grey-white cottony wool. Leaves 2.5 x 1-10 cm, linear or spatulate-linear, hairy, acute, mucronate at apex,

narrowed at base. Heads radiate, terminal, subcorymbose. Achenes oblong, verrucose. Pappus hairs uniseriate, barbellate, connate at base.

Ecology : Endemic, confined to semi arid regions on sand stones and sand hills along the coast.

Fl. & Fr. : September-April.

Distrib. : Gujarat coast.

19. *Kleinia* Miller.

Kleinia grandiflora (Wallich ex DC.) N. Rani in Mathew, Fl. Tamilnadu carnatic 2: 801, 1983. *Notonia grandiflora* Wallich ex DC.: Hook. in Hook. f., Fl. Brit. India 3: 337, 1881; Rao in Fl. India 13: 226, 1993.

Herb 0.6-2 m tall, succulent; Stem blackish brown. Leaves 6-22.5 x 2.5 cm, elliptic-oblong, suborbicular or spatulate, entire or narrowly revolute, obtuse at apex, attenuate at base. Heads 5-6 mm in

diam, greenish-white in terminal corymb or lax panicle. Achenes 5-7 mm long, compressed. Pappus 1.5-1.75 cm long, white.

Ecology : Frequent in scrub jungles in the dry regions near the coast.

Fl. & Fr. : August-May.

Distrib. : Karnataka and Tamil Nadu coast.

20. *Laggera* Sch.-Bip. ex Koch.

Laggera aurita L. f., Suppl. 367, 1781; Hook. in Hook. f., Fl. Brit. India 3: 271, 1881; Kumar in Fl. India 13: 150, 1993.

Herbs, up to 90 cm, aromatic, hairy. Leaves 4-9 x 0.5-1.0 cm, obovate or oblanceolate, toothed or lobed or pinnatifid, acute at apex and decurrent at base. Heads pink, in corymbose or diffused panicle. Achenes

dark red, obscurely ribbed, thinly hairy. Pappus white, 4-4.5 mm long.

Ecology : Common on waste sandy areas on back shore, road sides and hill slopes.

Fl. & Fr. : March-April.

Distrib. : West Bengal, Orissa, Andhra Pradesh and Karnataka coast.

21. *Launaea* Cass.

KEY TO THE SPECIES

1a. Stems with stolons or rhizomes :

2a. Leaves with white cartilaginous teeth; stem stoloniferous 1. *procumbens*

2b. Leaves with spinous margin; stem rhizomatous..... 2. *resedifolia*

1b. Stems without stolons or rhizomes 3. *sarmentosa*

1. *Launaea procumbens* (Roxb.) Ramayya & Rajagopal in Kew Bull. 23(3): 465, t.1, 1969. *L. nudicaulis sensu auct.* Plur. Ind. non *L. nudicaulis* (L.) Hook. f. *sensu stricto*. Fl. Brit. India 3: 416, 1881; Mangain & Rao in Fl. India 12: 309, 1993.

Herbs 10-50 cm high with creeping stolons. Leaves 4-25 x 1-4 cm mostly radical, cauline few or absent, sinuate-lobed or pinnatifid. Heads 1-1.8 x

0.3-0.5 cm, yellow, in racemes or panicles. Achene 2.5-4 mm, pale yellow, polymorphous, ribbed. Pappus 6.7 mm long, soft, simple.

Ecology : Frequent in marshy places and wastelands.

Fl. & Fr. : March-September.

Distrib. : West Bengal, Gujarat, Maharashtra, Andhra Pradesh and Tamil Nadu.

2. *Launaea resedifolia* (L.) Kuntz, Rev. Gen. Pl. 351. 1891; *L. chondrillioides* (DC.) Hook. in Hook. f., Fl. Brit. India 3: 415. 1881; Mangain & Rao in Fl. India 12: 309. 1993.

Herbs, 15-45 cm tall, dichotomously branched with creeping rhizomatous stems. Leaves 3-15 x 0.5-1.5 cm, radical leaves rosulate, runcinate-pinnatifid, toothed and spinous margin, cauline leaves auricled. Head yellow in terminal panicles. Achenes 5-6.5 mm, pale or greyish, ribbed. Pappus 11-12.5 mm, smooth, unequal.

Ecology : Rare on sandy and rocky sea shore.

Fl. & Fr. : January-November.

Distrib. : Gujarat coast.

3. *Launaea sarmentosa* (Willd.) Sch. Bip. ex Kuntze, Rev. Gen. 1: 350. 1891. *L. pinnatifida* Cass.: Hook. in Hook. f., Fl. Brit. India 3: 416. 1881; Mangain & Rao in Fl. India 12: 310. 1993.

Herbs; stems procumbent. Leaves 2-7 x 0.4-4.2 cm. Heads 0.8-1.2 x 0.3-0.4 cm, yellow, in terminal racemose or paniculate branches. Achenes 4-6 mm, pale, ribbed. Pappus 6-7 mm, yellowish white, slender.

Ecology : Near sandy river banks and wastelands.

Fl. & Fr. : June-September.

Distrib. : Throughout the coastal region on beaches and dunes.

22. *Pluchea* Cass.

KEY TO THE SPECIES

- 1a. Heads subsolitary 1. *arguta*
 1b. Heads in compound corymb 2. *indica*

1. *Pluchea arguta* Beriss., Diagn. ser. 2, 3: 5. 1856; Hook. in Hook. f., Fl. Brit. India 3: 273. 1881; Pant in Fl. India 13: 154. 1993.

Shrubs up to 1 m high. Succulent, glandular pubescent. Leaves 2.5-4 x 0.4-1.8 cm, oblanceolate or obovate, pungently serrate or lobulate, obtuse at apex, narrowed at base. Heads 0.8-1.2 cm across, purple, solitary. Achenes cylindrical, appressed hairy. Pappus hairs slender, shortly barbellate.

Ecology : Frequent on sand stone and sand ridges on sea shore.

Fl. & Fr. : March-August.

Distrib. : Gujarat coast.

2. *Pluchea indica* (L.) Less., Linnaca 6: 150. 1831; Hook. in Hook. f., Fl. Brit. India 3: 272. 1881; Pant in Fl. India 3: 154. 1993.

Shrubs up to 1 m high, succulent, glandular-pubescent. Leaves 2.5-4 x 0.4-1.8 cm, obovate or oblanceolate, minutely serrate, acute at apex, narrowed at base. Heads 0.6 cm in diam., purple, in compound terminal corymb. Achenes minute, ribbed. Pappus white, scanty, spreading.

Ecology : Common as hedge plant around the villages of the back shore sand and road sides. Highly aromatic shrubs.

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

Distrib. : West Bengal and Andamans & Nicobar Island.

23. *Pulicaria* Gaertn.

KEY TO THE SPECIES

- 1a. Outer row of pappus forming minute toothed cup 2. *foliolosa*
 1b. Outer row of pappus forming a setulose-laciniate cup :
 2a. Heads on stout peduncles 3. *wightiana*
 2b. Heads on slender peduncles 1. *angustifolia*

1. *Pulicaria angustifolia* DC., Prodr. 5: 479, 1836; Hook. in Hook. f., Fl. Brit. India 3: 299, 1881. Kumar in Fl. India 13: 33, 1995.

Herb 6-30 cm high, pubescent. Leaves 1-5 x 0.3-1.5 cm, linear-oblong or obovate, entire or serrulate, pubescent, obtuse at apex, narrowed at base. Head up to 1 cm in diam, yellow, solitary. Achenes 1.5 mm long, terete. Pappus 3 mm long, outer row forming a setulose-laciniate cup; inner row of white barbellate.

Ecology : Very rare on sandy soil, dry river beds, open ground and grazed pastures.

Fl. & Fr. : Throughout the year.

Distrib. : Gujarat and Karnataka coast.

2. *Pulicaria foliolosa* DC., Prodr. 5: 480, 1834; Hook. in Hook. f., Fl. Brit. India 3: 298, 1881. Kumar in Fl. India 13: 35, 1995.

Herbs up to 60 cm, pubescent. Leaves 2-8.5 x 0.6-2.0 cm, linear-oblong or oblanceolate, viscidly hairy, apiculate at apex, broad or semi-amplexicaul at base.

Heads rayed, solitary. Achenes oblong, terete, hairy.

Ecology : Common on river banks, grazed ground and frequently on sandy shore.

Fl. & Fr. : February-March; August-September.

Distrib. : West Bengal, Orissa, Maharashtra coast.

3. *Pulicaria wightiana* (DC.) Clarke, Comp. Ind. 128, 1876; Hook. in Hook. f., Fl. Brit. India 3: 299, 1881. Kumar in Fl. India 13: 40, 1995.

Herbs 30-60 cm high, pubescent. Leaves 2-7 x 0.6-1.5 cm, oblong, entire or serrate, obtuse at apex, clasping at base. Heads 1.2 cm long, terete, shining, sparsely hairy. Pappus in two rows; outer row forming a laciniate, setulose cup; inner of barbellate brownish hairs.

Ecology : Frequent on sandy shore and open ground on back shore.

Fl. & Fr. : August-December.

Distrib. : Maharashtra, Goa, Karnataka, Andhra Pradesh and Tamil Nadu.

24. *Sclerocarpus* Jacq.

Sclerocarpus africanus Jacq., Ic. Pl. Rar. 1: 17, t. 176, 1780-1784; Hook. in Hook. f., Fl. Brit. India 3: 305, 1881. Chowdhery in Fl. India 12: 404, 1995.

Herbs 20-90 cm high, rough pubescent; stems striate. Leaves 5-7 x 1-4 cm, obovate elliptic to ovate, acute at apex, narrowed at base. Heads 8-15 mm across,

radiate, solitary. Achenes curved, ribbed, enclosed in the hundred, paired scale or palea. Pappus absent.

Ecology : Frequent on hill slopes and moist sandy waste places on sea shore.

Fl. & Fr. : March-September.

Distrib. : Maharashtra and Karnataka coast.

25. *Sphaeranthus* L.

KEY TO THE SPECIES

1a. Involucre bracts lanceolate, acuminate..... 1. *africanus*

1b. Involucre bracts ovate-obtuse..... 2. *indicus*

1. *Sphaeranthus africanus* L., Sp. Pl. ed. 2, 1314, 1763; Hook. in Hook. f., Fl. Brit. India 3: 275, 1881. Kumar in Fl. India 13: 158, 1995.

Erect, faintly aromatic herbs, 20-40 cm; stems glabrous, winged, with divaricate branches; wings entire or dentate. Leaves 1.5-5 x 0.3-1 cm, elliptic, lanceolate or oblong-lanceolate, decurrent, minutely repand denticulate, acutely mucronate at apex, tapering towards base. Heads 6-8 mm across, subglobose, purple, solitary,

axillary; involucre 2 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.

Ecology : Frequent on sandy or muddy sea-shores; common on moist places and rice-fields.

Fl. & Fr. : March-July; December-January.

Distrib. : West Bengal, Orissa, Tamil Nadu, Kerala, Maharashtra and Gujarat coast.

2. *Sphaeranthus indicus* L., Sp., Pl. 957. 1753; Hook. in Hook. f., Fl. Brit. India 3: 275. 1881. Kumar in Fl. India 13: 160. 1995.

Strongly aromatic, adpressed pubescent annuals; stems glandular, winged; wings coarsely dentate. Leaves 2-5.5 x 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-obtuse, ciliate at apex. Achenes angular, oblong, tipped by the persistent apically withering corolla. Pappus absent.

Ecology : Frequent along river-banks, dry ditches and moist sandy places near the coast, common in dry rice-fields.

Fl. & Fr. : Throughout the year but mostly during dry season.

Distrib. : Throughout the East coast and Maharashtra.

26. *Sphaeromorphaea* DC.

Sphaeromorphaea australis (Less.) Kitam., Acta Phyto. Geobot. 6: 80. 1937; *S. russeliana* DC.: Hook. in Hook. f., Fl. Brit. India 3: 317. 1881. Naithani in Fl. India 12: 58. 1995.

Herbs 15-30 cm long; rootstock 15-30 cm long; straggling. Leaves 0.6-2.5 cm long obovate or oblanceolate, toothed, obtuse at apex, narrowed at base. Heads 4-6 mm in diam., yellow, globose, axillary,

solitary. Achenes subcylindric, ribbed, hairy at base. Pappus absent.

Ecology : In open fields near the coast.

Fl. & Fr. : May-June.

Distrib. : Orissa coast.

27. *Synedrella* Gaertn.

Synedrella nodiflora (L.) Gaertn. Fruct. Semi. 2: 456, t. 171, f. 7, 1791; Hook. in Hook. f., Fl. Brit. India 3: 308. 1881. Chowdhery in Fl. India 12: 413. 1995.

Erect herbs, 10-60 cm tall; stems subangular, repeatedly branched, adpressed pubescent when young. Leaves 3-12 x 1-5 cm, ovate, elliptic, or ovate-lanceolate, serrate, 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.

Ecology : Rare, on waste place along the sea-shores; common weed of cultivated land.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coast.

28. *Tridax* L.

Tridax procumbens L., Sp. Pl. 900. 1753; Hook. in Hook. f., Fl. Brit. India 3: 311. 1881. Chowdhery in Fl. India 12: 418. 1995.

Decumbent or rambling, branched perennial scabrous herbs with woody root-stock. Leaves 1.5-5 x 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.

Ecology : Common weed, along river-banks, road-sides, railway tracks, especially on dry localities; frequent along sea-shore.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coast.



Syzygium cumini



Memecylon edule



Pemphis acidula



Barringtonia asiatica



Barringtonia racemosa



Sonneratia alba



Sonneratia apetala



Sonneratia caseolaris



Sonneratia griffithii



Opuntia dillenii



Guettarda speciosa



Morinda citrifolia

29. *Vernonia* Schreb

KEY TO THE SPECIES

- 1a. Leaves lanceolate, coarsely serrate 1. *anthelmintica*
 1b. Leaves various, reflexed serrate, undulate or almost entire 2. *cinera*

1. *Vernonia anthelmintica* (L.) Willd., Sp. Pl. 3: 1634. 1803; Hook. in Hook. f., Fl. Brit. India 3: 236. 1881. Uniyal in Fl. India 13: 357. 1995.

Herbs up to 1.5 m tall; stem striate pubescent. Leaves lanceolate to oblanceolate, serrate, pubescent, acute at apex, narrowed at base. Heads purple tipped, corymbose or subcorymbose. Achenes 4.5 mm long, 10 ribbed, pubescent on ribs. Pappus hair reddish, biseriate.

Ecology : Common on sandy beaches, sand dunes, and rocky slopes on coast.

Fl. & Fr. : September-March.

Distrib. : Throughout the coast.

2. *Vernonia cinera* (L.) Less., Linnaea 4: 291. 1889; Hook. in Hook. f., Fl. Brit. India 3: 233. 1881. Uniyal in Fl. India 13: 357. 1995.

Decumbent or suberect, polymorphous, perennial herbs; stems ribbed, finely pubescent, glandular. Leaves 5-20 x 2-5cm, 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.

Ecology : 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*.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coast.

30. *Wedelia* Jack.

Wedelia biflora (L.) DC. in Wight, Contrib. Bot. India. 18. 1834; Hook. in Hook. f., Fl. Brit. India 3: 306. 1881; Chowdhery in Fl. India 12. 422. 1995.

Straggling herbs. Leaves 3-6 x 0.5-3.5 cm, oblong-ovate, finely serrate, appressed hispid, acuminate at apex, cuneate or rounded at base. Heads 5-6 x 2-3 mm, yellow or white, solitary. Achenes 3-4 mm

long, dark brown. Pappus 1-1.5 mm long a minute dentate.

Ecology : Frequent on sandy, coral seashore and adjoining sandy or rocky areas on back shore.

Fl. & Fr. : Throughout the year.

Distrib. : West Bengal, Maharashtra, Lakshadweep and Andaman and Nicobar Islands.

31. *Xanthium* L.

Xanthium indicum Koenig. in Roxb., Fl. Ind. 3: 601. 1832; *X. strumarium* L.: Hook. in Hook. f., Fl. Brit. India 3: 303. 1881; Chowdhery in Fl. India 12. 429. 1995.

Erect coarsely pubescent, monoecious annuals; stems shallowly-furrowed; branches subterete, often purple-tinged. Leaves 3-12 x 2-10 cm, alternate, broadly triangular-ovate or suborbicular, irregularly lobulate, crenate or serrate, appressed, 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 hook or spines. Achenes oblong-ovoid, glabrous, enclosed within enlarged, fused involucre. Pappus absent.

Ecology : Common on waste places, road-sides, river banks and dry ditches; frequently found along the seashore, sometimes forming pure strands in waste soils.

Fl. & Fr. : Mostly during cold season.

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

GOODENIACEAE

Scaevola L.

- 1a. Calyx-lobes conspicuous, nearly equal to the ovary; drupe white 2. *sericea*
 1b. Calyx-lobes very short, much shorter than ovary; drupe purple 1. *plumierii*

1. *Scaevola plumierii* (L.) Vahl, Symp. Bot. 2: 36. 1791;
S. lobelia Murr.: Clarke in Hook. f., Fl. Brit. India 3:
 421. 1881.

Succulent herbs or shrubs. Leaves 5-7 cm long,
 elliptic, fleshy, entire, obtuse at apex and cuneate at
 base. Flowers 0.5-1 cm long, yellow, arranged in axillary
 cymes, drupe 0.7-0.9 cm in diam., smooth, purple.

Ecology : Mostly restricted in coral strand and on coastal
 rocks.

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

Distrib. : Tinnevely, Lakshadweep and Andaman
 Islands.

2. *Scaevola sericea* Vahl, Symp. Bot. 2: 37. 1791; *S.*
koenigii Vahl: Clarke in Hook. f., Fl. Brit. India 3: 421.
 1881.

Stout, glabrous juicy shrub. Leaves 9-11 cm
 long, obovate, entire or minutely crenate, silky,
 glabrescent, obtuse at apex, narrowed at base, tufted
 in the axils. Flowers 1.5-1.9 cm long, elongated, white,
 minutely pubescent in axillary, solitary or dichotomously
 branched cymes. Fruit drupe 1.2-1.5 cm, succulent, lobed
 with bony endocarp. Seed solitary.

Ecology : frequent along the rocky coast and coral strand.

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

Distrib. : Andhra Pradesh, Karnataka and Kerala coast.

SPHENOCLEACEAE

Sphenoclea Gaertn.

Sphenoclea zeylanica Gaertn., Fruct. 1: 173, t. 5, 1788;
 Clarke in Hook. f., Fl. Brit. India 3: 438, 1881.

Erect annual herbs 40-150 cm tall; stems
 somewhat spongy, glabrous, fistular; branches often with
 fibrous roots. Leaves 3-6.5 x 1.5-2.5 cm, elliptic or
 ovate-lanceolate, thin, membranous, acute at apex, obtuse
 at base, flowers white, in condensed terminal spikes.
 Capsules globose, compressed, membranous,

circumscissile. Seeds less than 1 mm long, oblong, many,
 striate or slightly verrucose.

Ecology : Monsoon weeds of low-lying areas and
 bordering paddy fields, occasionally found along the
 banks of back waters, in association with *Aegiceras*
corniculatum and *Excoecaria agallocha*.

Fl. & Fr. : During rainy season; June-August.

Distrib. : Orissa and Tamil Nadu coast.

PLUMBAGINACEAE

Aegialites R. Br.

Aegialites rotundifolia Roxb., Fl. Ind. 2: 111. 1832;
 Clarke in Hook. f., Fl. Brit. India 3: 479. 1881.

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 x 3-9 cm,

alternate, rotund broadly ovate, or orbicular, entire,
 coriaceous, reticulovenous, rounded or cuneate at base,
 acute, slightly obtuse or short protruding at apex.
 Flowers 17-22 mm long, white, bracteate, arranged in
 axillary leafy panicles. Capsule 8-9 x 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.

Ecology : Common along the muddy sea-shores and inside the mangroves and frequent along the sandy sea shores, often forming a pure strand, usually in association with *Excoecaria agallocha*, *Sarcostemma brevistigma*

and *Bruguiera cylindrica*. Along the sandy shores they present a stunted growth.

Fl. & Fr. : February-March; April-July.

Distrib. : Restricted only in Sundarbans and Mahanadi delta Orissa.

MYRSINACEAE

KEY TO THE GENERA

- 1a. Plants without stilt roots. Fruits, globose berries 2. *Ardisia*
 1b. Plants with stilt roots. Fruits, cylindric drupes 1. *Aegiceras*

1. *Aegiceras* Gaertn.

Aegiceras corniculatum (L.) Blanco, in Fl. Filip. 79. 1878. *Rhizophora corniculata* L.: Clarke in Hook. f., Fl. Brit. India 3: 535. 1924.

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 4-3.5 x 2-4.5 cm, alternate at apex, cuncate at base. 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.

Ecology : Common along the intertidal zones of the several creeks and channels in mangroves, often forming pure strands along the muddy sea-shores and replacing communities of *Rhizophora*.

Fl. & Fr. : February-April; June-September.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast on mangroves. Also found in Andaman Islands.

2. *Ardisia* Swartz

Ardisia solunacea Roxb., Pl. Cor. 1: 27, t. 27, 1795; *A. humilis* auct. non. Clarke in Hook. f., Fl. Brit. India 3: 529. 1881.

Erect, evergreen shrubs or small trees, 3-8 m tall; stems glabrous, brownish, marked with fallen leaf-scars. Leaves 6-20 x 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 8-23 mm long, rose-

purple, in axillary pedunculate corymbose cymes. Fruits 6-10 mm across, globose or subglobose berries, black when ripe.

Ecology : Frequent along the sandy back shore, river-banks and scrub jungles.

Fl. & Fr. : April-May; June-August.

Distrib. : Orissa, Tamil Nadu, Karnataka and Maharashtra and Andaman Islands.

SAPOTACEAE

KEY TO THE GENERA

- 1a. Leaf-apex acute to acuminate; calyx lobes and stamens 8 each 2. *Mimusops*
 1b. Leaf apex obtuse to emarginate; calyx lobes and stamens 6 each 1. *Manilkara*

1. *Manilkara* Adanson

KEY TO THE SPECIES

- 1a. Shrubs or trees without buttresses; filaments of stamens up to 0.4 mm long 1. *hexandra*
 1b. Trees with buttresses; filaments of stamens up to 0.5 mm long 2. *littoralis*

1. *Manilkara hexandra* (Roxb.) Dubard, Ann. Mus. Col. Mars. 23: 9. f. 2, 1915; *Mimusops hexandra* Roxb.: Clarke in Hook. f., Fl. Brit. India 3: 540. 1881.

Trees 6-20 m tall, with milky latex; stems much-branched, glabrous; branches whitish-grey, smooth, with many short lateral branchlets. Leaves 12-15 x 3-4 cm, elliptic-oblong or obovate oblong, coriaceous, dark-green above, whitish below with densely approximate lateral nerves, retuse at apex, rounded at base. Flowers 5-7 mm, rusty-white, solitary, axillary or cauliflorous. Fruits 1.5-2 cm long, ovoid. Seed 1, smooth, shining.

Ecology : Frequent in scrub jungles along the river-banks, and coastal thickets in association with *Memecylon umbellatum* and *Carissa spinarum*; sometimes observed as avenue trees.

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

Distrib. : Deccan peninsula, Orissa and West Bengal.

2. *Manilkara littoralis* (Kurz.) Dubard, Lam. C.S. 343. 1941; *Mimusops littoralis* Kurz.: Clarke in Hook. f., Fl. Brit. India 3: 549. 1881.

Evergreen trees, 15-40 m tall, with latex; stems 40-70 cm in diam., smooth, straight-lobed, buttressed; buttresses sometimes produced into knee-like bends, barks whitish-grey, with longitudinal furrows. Leaves 4-16 x 3-9 cm, obovate or pandurate retuse or emarginate at apex, cuneate at base. Flowers rusty brown in bud condition, 3-4 mm across, solitary axillary or cauliflorous. Fruits 2-3 cm long, ovoid. Seeds smooth, shining.

Ecology : Very common representatives of littoral forests. Frequent within the open coastal regions, 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*.

Fl. & Fr. : October-November; November onwards.

Distrib. : Andaman islands.

2. *Mimusops* L.

Mimusops elengi L., Sp. Pl. 349. 1753; Clarke in Hook. f., Fl. Brit. India 3: 548. 1881.

Tree up to 20 m. Leaves 4-12 x 3-5 cm elliptic-ovate to lanceolate, subcoriaceous, acute at apex, attenuate at base. Flowers 1 cm across, cream, solitary or few in upper axils. Berry 1.5 cm across, ovoid, fleshy.

Seeds 1, oblong, black, shiny.

Ecology : Planted along the backshore and all over the plains as an avenue tree.

Fl. & Fr. : March-April; May onwards.

Distrib. : Throughout Indian coast.

E B E N A C E A E

Diospyros L.

KEY TO THE SPECIES

- 1a. Corolla tubular; leaves elliptic 3. *ebenum*
 1b. Corolla campanulate or urceolate; leaves otherwise :
 2a. Corolla campanulate; leaves not oblong :
 3a. Fruiting calyx large, flattened, coriaceous, foliaceous;
 leaves oblong-lanceolate 2. *cordifolia*
 3b. Fruiting calyx small, submembranous; leaves elliptic-ovate 1. *buxifolia*
 2b. Corolla ovoid lanceolate; leaves oblong 4. *malabarica*

1. *Diospyros buxifolia* (Bl.) Hiern., Trans. Camb. Phil. Soc. 12: 218. 1873; *D. microphylla* Bedd.: Clarke in Hook. f., Fl. Brit. India 3: 559. 1882.

Large tree. Leaves 3 cm x 1.2-1.6 cm, ovate-oblong, coriaceous, glabrous above, cuneate at both base and apex. Flowers unisexual; female flower 1-3 together, arranged in minute cyme, male flower in axillary solitary. Fruits short cylindric, 8-18 mm x 4-8 mm, 1-2 seeded.

Ecology : Frequent on sandy hill slopes and river banks near the coast.

Fl. & Fr. : March-October.

Distrib. : Orissa, Karnataka, Maharashtra and Goa coast.

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., 1882.

Dioecious, small trees, 4-8 m tall; stems straight, branches brownish black. Leaves 6-20 x 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, dull-yellow when ripe.

Ecology : Frequent along the lee ward side of sand dunes and sandy scrub jungle along the sea shore and river-banks.

Fl. & Fr. : June-July; August-December, from new shoots.

Distrib. : Through the coastal districts.

3. *Diospyros ebenum* J. Koenig ex Retz., Physiogr. Salsk. Handl. 1: 176. 1780; Clarke in Hook. f., Fl. Brit. India 3: 558. 1882.

Tree 15 m tall. Leaves 6-10 x 3-5 cm, oblong-elliptic, coriaceous, acute to obtuse at apex, rounded to acute at base. Flowers unisexual, female flowers 1 cm across, arranged in umbellate axillary clusters, male flowers 3 mm across, solitary, cream coloured. Fruits berry, globose 1.5-2 cm across, white with axillary short apical beak and persistent calyx, velvety when young and dark green later.

Ecology : Frequent on rocky slopes and ghats along the coast.

Fl. & Fr. : March July.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

4. *Diospyros malabarica* (Desr.) Kostel. Allg. Med. Pharm. Fl. III. 1099. 1834; *D. embryopteris* Pers.: Clarke in Hook. f., Fl. Brit. India 3: 556. 1880.

Evergreen, dioecious trees 5-16 m tall; stems smooth, black, usually straight. Leaves 10-20 x 2.5-6.5 cm, oblong-lanceolate, coriaceous, dark-green, flesh-coloured when young, obtuse at apex, truncate or rounded at base. Flowers 1 cm across, in axillary, pedunculate cymes; female flowers solitary, axillary. Fruits 4-7 cm across, subglobose, covered with brownish-rusty scurf. Seeds 5-8 or more.

Ecology : Frequent in scrub-jungles along sandy river-banks, sand bars within the mangroves and along the sides of ditches and streams.

Fl. & Fr. : March-May; June-July.

Distrib. : Throughout India.

SYMPLOCACEAE

Symplocos L.

Symplocos cochinchinensis ssp. *laurina* (Retz.) Nootboom, Leiden Bot. Ser. 1: 156. 1975; *S. spicata* Roxb.: Clarke in Hook. f., Fl. Brit. India 3: 573. 1882.

Tree, 8-12 m tall, with glabrous branchlets. Leaves 6-15 x 3-6 cm, elliptic-obovate, coriaceous, crenate-serrate, acute to acuminate at apex, acute to attenuate at base.

Flowers 1 cm across, white, shortly tubular. Drupes ampuliform, 5 mm across with an apical ring. Seeds oblong.

Ecology : Common along the rocky coast.

Fl. & Fr. : June-October.

Distrib. : Mostly in west coast.

OLEACEAE

KEY TO THE GENERA

- 1a. Climbing shrubs 1. *Jasminum*
 1b. Erect trees 2. *Olea*

1. *Jasminum* L.

KEY TO THE SPECIES

- 1a. Scandent shrubs 2. *sambac*
 1b. Climbing shrubs 1. *auriculatum*

1. *Jasminum auriculatum* Vahl, Symb. Bot. 3:1, 1794; Clarke in Hook. f., Fl. Brit. India 3: 600. 1882.

A climbing shrubs. Leaves 1.5-5 x 1-3 cm, 3-foliolate, deltoid, chartaceous, acute at apex, truncate at base. Flowers 1.2 cm across in terminal 3-chootomous cymes. Berry globose 7 mm across, clustered.

Ecology : Frequent in coastal scrub jungles and on thickets beside the sand dunes.

Fl. & Fr. : July-December.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Rameswaram island and Karnataka coast.

2. *Jasminum sambac* (L.) Ait., Hort. Kew. 1: 8, 1789; Clarke in Hook. f., Fl. Brit. India 3: 591. 1882.

Scandent, straggling shrubs; stems terete, glabrous, pubescent when young. Leaves 2-6.5 x 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.

Ecology : Frequent in sandy scrubs and thickets along the river-banks; often the single-flowered forms are cultivated in the gardens.

Fl. & Fr. : April-July; August-September.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

2. *Olea* L.

Olea dioica Roxb., Fl. Ind. 1: 105. 1820; Clarke in Hook. f., Fl. Brit. India 3: 612. 1882.

Tree up to 15 m. Leaves 6-10 x 3-4 cm, elliptic obovate, dentate, acute at apex and base, nerves usually red or brown. Flowers 4 mm across, in panicles. Drupe 0.8 x 0.5 cm.

Ecology : Frequent along the hill slope of rocky sea shore probably restricted on west coast.

Fl. & Fr. : January-March; March onwards.

Distrib. : Karnataka and Kerala coast.

SALVADORACEAE

KEY TO THE GENERA

- 1a. Corolla polypetalous 1. *Azima*
 1b. Corolla gamopetalous 2. *Salvadora*

1. *Azima* Lamk.

Azima tetraacantha (Salisb.) Lamk., Encl. Meth. 1: 343. 1783; Clarke in Hook. f., Fl. Brit. India 3: 620. 1880.

Rambling, bushy, spinous shrubs; branches quadangular, slightly pubescent, with 2-3-paired spines in the leaf-axils. Leaves 4-8.5 x 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.

Ecology : Frequent along sandy scrubs and coastal thickets; common as hedge plants.

Fl. & Fr. : March-April; July-August.

Distrib. : East coast, Maharashtra and Gujarat coast.

2. *Salvadora* L.

KEY TO THE SPECIES

- 1a. Leaves ovate-lanceolate; flowers pedicellate; fruit red when ripe 2. *persica*
 1b. Leaves linear-lanceolate; flowers sessile; fruits yellow when ripe 1. *oleoides*

1. *Salvadora oleoides* Dene. in Jacquem. Voy. Bot. 140, t. 144; Clarke in Hook. f., Fl. Brit. India 3: 620. 1882.

Shrubs or small trees. Leaves 5 x 1 cm, lanceolate, glabrous, acute at apex and narrowed at base. Flowers sessile, white, 1-2 mm long, arranged in paniced spikes or racemes. Fruits yellow when ripe. Drupes 4 mm across, clustered.

Ecology : Common in dry places from Punjab and Rajasthan. Frequent on Gujarat coast.

Fl. & Fr. : February-March; August-September.

Distrib. : Gujarat coast.

2. *Salvadora persica* L., Sp. Pl. 112. 1753; Clarke in Hook. f., Fl. Brit. India 3: 619. 1882.

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 x 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. Fruits 4-6 mm across, globose, smooth, red when ripe, 1-seeded drupes with pungent smell.

Ecology : Frequently common along the back mangroves, and sand-bars in between the mangrove swamps, usually found in associations with *Achrosticum* and *Tamarix* species.

Fl. & Fr. : February-March; April-June.

Distrib. : Throughout the coastal provinces.

APOCYNACEAE

KEY TO THE GENERA

- 1a. Armed; fruit a berry 2. *Carissa*
 1b. Unarmed; fruit a follicle, drupe or capsule :
 2a. Lianes :
 3a. Cymes dichasials, stamens exerted 7. *Parsonsia*
 3b. Cymes paniculate, stamens included 5. *Ichnocarpus*
 2b. Trees, shrub or herb :
 4a. Leaves whorled :
 5a. Barks grey, papery 4. *Cerbera*
 5b. Barks not papery :
 6a. Seeds linear, ciliate at both ends 1. *Alstonia*
 6b. Seeds broad, attached to placenta 6. *Ochrosia*
 4b. Leaves opposite 3. *Catharanthus*

1. *Alstonia* R. Br.

Alstonia scholaris (L.) R. Br., Mem. Wern. Nat. Hist. Soc. 1: 76. 1811; Hook. in Hook. f., Fl. Brit. India 3: 642. 1882.

Tree 20-30 m. Leaves 5-15 x 2-7 cm, obovate-elliptic, whorled, subcoriaceous, obtusely acute at apex, attenuate to cuneate at base. Flower 1.5 cm across, in superposed umbels. Mericarp 15-30 x 0.5-0.8 cm,

divaricate, cylindric. Seeds 4 x 1.5 mm compressed, coma at both ends.

Ecology : Frequently found along the sandy and rocky beach forests.

Fl. & Fr. : June; July.

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka, Maharashtra and Kerala coast. Also in Andamans.

2. *Carissa* L.

KEY TO THE SPECIES

- 1a. Corolla tube over 1.0 cm long :
 2a. Corolla large, tube over 1.5 cm long 1. *carandas*
 2b. Corolla medium sized, tube 1.0 cm to 1.5 cm long 3. *spinarum*
 1b. Corolla small sized, tube less than 1.0 cm long 2. *paucinervia*

1. *Carissa carandas* L., Mant. Pl. 52. 1767; Hook. in Hook. f., Fl. Brit. India 3: 630. 1882.

Shrub up to 3 m with spines. Leaves 2.5-6 x 2-3 cm, obovate or oblanceolate, obtuse or emarginate apex, acute to cuneate at base. Flower 2 cm across, white 2-3 crotomous, terminal or axillary cymes. Berry 1.5 cm across, ellipsoid.

Ecology : Common in coastal scrub jungles and along river banks and streams.

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

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Rameswaram and Maharashtra coast.

2. *Carissa paucinervia* L., DC. 8: 333. 1866; Hook. in Hook. f., Fl. Brit. India 3: 631. 1882.

Erect, spiny shrubs; spines straight, often forked. Leaves 2.5-6.5 x 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.

Ecology : Common along the back regions of mangroves, coastal back water, hills and sand-bars within the mangrove.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Karnataka coast.

3. *Carissa spinarum* L., Mant. 559. 1771; Hook. in Hook. f., Fl. Brit. India 3: 631. 1882.

Bushy, spinescent shrubs, erect or sometimes scandent; branches glabrous, with divaricate, forked spines. Leaves 2-5.5 x 1.5-2.5 cm, ovate or ovate-oblong, coriaceous, apiculate at apex, obtuse at base. Flowers 1.5-2 cm, long, white in terminal corymbose cymes. Fruits 5-9 mm across, ellipsoid, 4-seeded berries.

Ecology : Common along the littoral regions, river-banks and coastal thickets.

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

Distrib. : Throughout the coastal provinces.

3. *Catharanthus* G. Don.

KEY TO THE SPECIES

- 1a. Leaves lanceolate; apex acute 1. *pussillus*
 1b. Leaves obovate to oblanceolate 2. *roseus*

1. *Catharanthus pussillus* (Murray) Don, Gen. Hist. 4: 95. 1837; *Vinca pusilla* Murray; Hook. in Hook. f., Fl. Brit. India 3: 640. 1882.

Annual glabrous herb, 30-40 cm. Leaves 2-6 x 1-1.5 cm, elliptic lanceolate, chartaceous, entire, acute at apex, attenuate at base. Flowers 7-8 mm across, white or pink in axillary few flowered corymbs. Mericarp 4.5 x 0.3 cm, cylindrical ribbed. Seeds without coma oblong.

Ecology : Sometimes common along sandy backshore and at the base of the hill slope.

Fl. & Fr. : July-September; August-December.

Distrib. : All along the peninsular coast.

2. *Catharanthus roseus* (L.) Don., Gen. Hist. 4: 95. 1837; *Vinca rosea* L.: Hook. in Hook. f., Fl. Brit. India 3: 640. 1882.

Perennial herb up to 75 cm. Leaves 4-10 x 2-4 cm, elliptic-obovate, glabrous, obtusely apiculate at apex, acute at base. Flowers 4 cm across, white or pink, axillary, solitary or paired. Mericarps 3-4 x 0.3 cm puberulous.

Ecology : Frequent in coastal scrub jungles, waste land, fallow fields.

Fl. & Fr. : Throughout the year.

Distrib. : Introduced from Madagascar. Widely naturalized in the coastal plains.



Scyphiphora hydrophyllacea



Scaevola sericea



Aegialitis rotundifolia



Aegiceras corniculatum



Manilkara littoralis



Diospyros buxifolia



Diospyros malabarica



Symplocos cochinchinensis



Olea dioica



Salvadora persica



Cerbera manghas



Ochrosia oppositifolia

4. *Cerbera* L.

Cerbera manghas L., Sp. Pl. 208. 1753; *C. odollam* Gaertn.: Hook. in Hook. f., Fl. Brit. India 3: 638. 1882.

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 x 3-6.5 cm, alternate, closely set or whorled at the end of branchlets, ovate-oblong to oblanceolate, coriaceous, acuminate at apex, narrowed into the petioles. Flowers 3.5-4 cm long, bracteate, white with yellow throat, turning purple, in terminal paniculate cymes. Fruits 7-9 x 4-6 cm, subglobose, smooth, dull-

green, drupaceous with fibrous woody pericarp. Seeds one, 2-2.5 cm across, smooth, glabrous.

Ecology : Common along the intertidal zones of creeks and channels in the tidal forests, usually in association with *Sonneratia apetala*, *Amoora cucullata* and *Heritiera fomes*.

Fl. & Fr. : January-March; April-August.

Distrib. : Tidal forests of West Bengal, Orissa, Karnataka, Kerala and back waters of Malabar coast. Also in Andamans.

5. *Ichnocarpus* R. Br.

Ichnocarpus frutescens (L.) R. Br., Mem. Wern. Soc. 1: 62. 1809; Hook. in Hook. f., Fl. Brit. India 3: 669. 1882.

Laticiferous, rusty-tomentose, twining shrubs; stems much-branched, brownish, woody below. Leaves 2.5-6.5 x 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 folicles. Seeds 0.5-1 cm, brownish, flat, comose.

Ecology : Frequent, forming littoral thickets, common in the evergreen forests.

Fl. & Fr. : September-October, November-December.

Distrib. : Throughout the coastal provinces.

6. *Ochrosia* Juss

Ochrosia oppositifolia (Lamk.) Schum., Pfamilien 4(2): 156. 1895. *O. borbonica auct. non* Gmel.: Hook. in Hook. f., Fl. Brit. India 3: 638. 1880.

Tree 4.5-5 m tall. Leaves 15-35 x 5-15 cm, obovate, coriaceous, smooth above, obtuse at apex, narrowed at base. Flowers 5-7 mm across, white, in axillary corymbs. Fruit a spreading drupe with hard and

dorsally compressed grooved endocarp. Seed solitary, rarely two.

Ecology : Rare along the tidal forests and found only in Andaman Islands.

Fl. & Fr. : June-August; August-October.

Distrib. : Mostly restricted in Little Andaman island.

7. *Parsonsia* R. Br.

Parsonsia alboflavescens (Dennst.) Mabb., Taxon 26: 532. 1977; *P. spiralis* Wall. ex Don, Hook. f., Fl. Brit. India 3: 650. 1882.

Climbing shrub attaining 4-6 m. Leaves 8-16 x 5-10 cm, elliptic-ovate, chartaceous, acuminate at apex and rounded at base. Flower 1.8 cm across, salver-form, greenish white, arranged in axillary dichasial cyme.

Folicles 10-16 x 1 cm, 2 connate, cylindric mericarp. Seeds oblong, depressed, comma apical, silky white.

Ecology : Rarely found along rocky shores of Western Ghats and sea facing Eastern Ghats.

Fl. & Fr. : April-May; May onwards

Distrib. : Mainly in west coast, Kerala.

ASCLEPIADACEAE

KEY TO THE GENERA

- 1a. Pollinia pendulous :
 2a. Erect shrubs 1. *Calotropis*
 2b. Twining shrubs :
 3a. Leaves absent 6. *Sarcostemma*
 3b. Leaves present 4. *Pentatropis*
 1b. Pollinia erect :
 4a. Seeds comose 2. *Hoya*
 4b. Seeds not comose 5. *Sarcolobus*
 5a. Corona single, tubercle-like 7. *Tylophora*
 5b. Corona double, not tubercle-like 3. *Leptadenia*

1. *Calotropis* R. Br.

KEY TO THE SPECIES

- 1a. Corona shorter than the staminal column; auricle two, below the apex 1. *gigantea*
 1b. Corona longer than the staminal column; auricle absent 2. *procera*

1. *Calotropis gigantea* (Willd.) Dryand. ex Ait. f. in Hort. Kew. ed 2, 2: 78. 1811; Hook. in Hook. f., Fl. Brit. India 4: 17. 1883. *Asclepias gigantea* Willd. Sp. Pl. 1: 1262. 1798.

Laticiferous, powdery tomentose, erect shrubs, 1-2 m tall; stems soft, woody with many ascending branches. Leaves 5-15 x 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.

Ecology : Common along roadsides, hedges and open fields; often found to form pure strands along the sandy seashore.

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

Distrib. : East coast.

2. *Calotropis procera* (Aiton) R. Br. in W.T. Aiton, Hortus Kew. ed. 2(2): 78. 1811; Hook. f., Fl. Brit. India 4: 18. 1883.

Small trees or shrubs, 1.5 - 2 m tall. Leaves ovate-oblong, 12-16 x 7-8 cm, glabrescent above, Cottony beneath, acute or acuminate at apex, cordate at base. Flowers 2.5 cm across, purple, arranged in umbelliform cymes; corona lobes 6 mm long. Follicles 8-10 cm long, recurved; comma white.

Ecology : Frequent on sandy beaches, waste places and road sides.

Fl. & Fr. : March-May.

Distrib. : Both East and West coast.

2. *Hoya* R. Br.

Hoya parasitica (Roxb.) Wall. in Wt. Contr. 37. 1834; Hook. in Hook. f., Fl. Brit. India 4: 57. 1883. *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. Leave variable, 7-10.5 x 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 up to 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.

Ecology : Frequent along the intertidal regions of several creeks and channels in the mangrove forests, usually climbing on *Xylocarpus* species and *Avicennia officinalis*.

Fl. & Fr. : June-July.

Distrib. : East coast and Andamans.

3. *Leptadenia* R. Br.

KEY TO THE SPECIES

- 1a. Plants usually leafless; follicles not curved 1. *pyrotechnica*
 1b. Plants with leaves; follicles curved 2. *reticulata*

1. *Leptadenia pyrotechnica* (Forssk.) Deene, in Ann. Sci. Nat. Ser. 2(9): 269. 1838; *L. spartium* Wight & Arn.: Hook. f., Fl. Brit. India 4: 64. 1883.

A straggling, much branched, slender shrub. Leaves usually absent, only found in young branches; linear, fleshy, glabrous, acuminate at apex. Flowers small, greenish yellow in lateral umbelliform cymes. Follicle 7-10.5 cm long, terete, tapering into long beak. Seeds ovoid, comma 4 cm long.

Ecology : Frequent in coastal scrubs on sandy areas.

Fl. & Fr. : October-January.

Distrib. : West coastal districts.

2. *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. *Cynanchum reticulatum* Retz. Obs. 2: 15. 1781

Climbing shrubs with watery sap; stems much-branched, puberulous, woody towards base. Leaves 5.5-9.5 x 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.

Ecology : Frequent along the sandy sea shores and coastal thickets; usually in association with *Spinifex littoralis* and others.

Fl. & Fr. : July-August ; September-December.

Distrib. : East coastal districts.

4. *Pentatropis* Wt. & Arn.

Pentatropis capensis (Linn. f.) Bullock in Kew Bull. 284, 1955. *Cynanchum capense* Linn. f. Suppl. 168, 1781. *Pentatropis microphylla* (Roxb.) Wt. & Arn.: Hook. in Hook. f., Fl. Brit. India 4: 20. 1883.

Slender, glabrous twining herbs. Leaves 1-2.5 x 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.

Ecology : Common on hedges along scrubs and coastal thickets.

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

Distrib. : Throughout the East coast.

5. *Sarcobus* R. Br.

KEY TO THE SPECIES

- 1a. Corolla glabrous within; follicles ellipsoid, keeled 1. *carinatus*
 1b. Corolla pubescent within; follicles globose, not keeled 2. *globosus*

1. *Sarcobus carinatus* Wall. in Asiat. Res. 12: 570, t. 5, 1816; Hook. in Hook. f., Fl. Brit. India 4: 28. 1883.

Glabrous, twining shrubs with fleshy-rhizomes bearing roots. Leaves fleshy, variable, 3-7.5 x 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 x 2.5-3 cm, ellipsoid, keeled along the dorsal suture; seeds flattened, shortly-winged, not comose.

Ecology : More or less restricted to the muddy seashore and mangroves, usually in association with *Phoenix paludosa* and *Aegialitis rotundifolia*.

Fl. & Fr. : March-July; August-September.

Distrib. : East coast and Andamans.

2. *Sarcolobus glaberrimus* Wail. in *Asiat. Res.* 12: 568, t. 5, 1816; Hook. in Hook. f., *Fl. Brit. India* 4: 27. 1883.

Twining glabrous shrubs; stems lenticillate, much branched. Leaves 4-10.5 x 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.

Ecology : Frequent along the muddy sea shore, tidal forest and back mangroves.

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

Distrib.: East coast and Andamans.

6. *Sarcostemma* R. Br.

Sarcostemma acidum (Roxb.) Voigt, *Hort. Sub. Calc.* 342, 1845. *Asclepias acida* Roxb. *Fl. Ind.* (ed. Carey) 31. 1832. *Sarcostemma brevistigma* Wt. & Arn.: Hook. in Hook. f., *Fl. Brit. India* 4: 26. 1883.

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.

Ecology : Frequent in sandy scrubs and coastal thickets.

Fl. & Fr. : May-September; October-December.

Distrib.: East coast.

7. *Tylophora* R. Br.

KEY TO THE SPECIES

- 1a. Flowers scarlet, glabrous 2. *tenuis*
 1b. Flowers yellow, pubescent 1. *indica*

1. *Tylophora indica* (Burm. f.) Merr. in *Philip. J. Sci.* 19: 373. 1921. *Cynacchum indicum* Burm. f., *Fl. Ind.* 70. 1768. *Tylophora asthmatica* (Roxb.) Wight & Arn. in *Wt. Contr.* 51. 1834; Hook. in Hook. f., *Fl. Brit. India* 4: 44. 1883.

Perennial twining shrubs; stems terete, glabrous or puberulous with watery sap. Leaves 3-15 x 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.

Ecology : Common along the lee side of the seashore sanddunes, river banks, scrubs and on the edges of open field.

Fl. & Fr. : March-May; August-September.

Distrib.: Throughout the East coast.

1. *Tylophora tenuis* Bl. *Bijdr.* 1062. 1862; Hook. in Hook. f., *Fl. Brit. India* 4: 42. 1883.

Slender twining shrubs; stems terete, much branched, glabrous. Leaves 2-6 x 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.

Ecology : Common along the intertidal regions in mangrove forests and estuarine island, usually twining on *Kandelia candel* and *Xylocarpus* species, often found in coastal thickets and scrubs along the river banks.

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

Distrib.: Throughout the East coast and Andamans.

PERIPLOCAEAE

Finlaysonia Wall.

Finlaysonia obovata Wall., Pl. Asiat. Rar. 2: 48, t. 162, 1831; Hook. in Hook. f., Fl. Brit. India 4: 7. 1883.

Glabrous, twining shrubs with milky latex; stems brownish, rigid, much-branched; bark thin, verrucose. Leaves variable, 4.5-16.5 x 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, trichotomously branched cymes. Follicles 7-9 x 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 margin.

Ecology : Rare along intertidal zones of creeks and channels in the mangroves and estuarine islands.

Fl. & Fr. : September-November; December-March.

Distrib. : Restricted in the Sundarbans of West Bengal, Mahanadi delta in Orissa and Andaman Islands.

LOGANIACEAE

Strychnos L.

Strychnos nux-vomica L., Sp. Pl. 189. 1753; Clarke in Hook. f., Fl. Brit. India 4: 90. 1883.

Trees 3-10 m tall; stems glabrous; young branches pubescent, with axillary thorns, old branches without thorns. Leaves 4-12 x 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 short branched subumbellate cymes.

Fruits 5-6 cm across, globose, smooth, bright-orange when ripe. Seeds 2-2.5 x 1-1.5 cm, discoid, depressed in centre.

Ecology : Frequent in sandy scrub-jungles, river-banks and road-sides along the coast.

Fl. & Fr. : March-June; September-October.

Distrib. : Throughout the coastal provinces.

GENTIANACEAE

KEY TO THE GENERA

- 1a. Ovary 2-celled; flowers blue or lilac 3. *Exacum*
 1b. Ovary 1-celled; flowers pink, yellow or white :
 2a. Corolla regular; flower white, in sessile axillary cluster 2. *Encostema*
 2b. Corolla irregular; flowers not white, in axillary or terminal cymes :
 3a. Flowers yellow; stigma subentire 4. *Hoppea*
 3b. Flowers pinkish or white; stigma deeply 2-lobed 1. *Canscora*

1. *Canscora* Lam.

KEY TO THE SPECIES

- 1a. Calyx not winged, stem 4-angled 2. *diffusa*
 1b. Calyx prominently winged, stem narrowly 4-winged 1. *decussata*

1. *Canscora decussata* Schul. & Sch. f., Mant. Syst. Veg. 3: 229. 1827; Clarke in Hook. f., Fl. Brit. India 4: 104. 1883.

Herb up to 15-35 cm tall. Leaves 2-3 x 1-1.5 cm., elliptic lanceolate, herbaceous, acute at apex, rounded or obtuse at base. Flowers 6 mm across, white arranged in dichasial, axillary or terminal cymes. Capsule 1.5 x 0.4 cm, obscurely 2-valved. Seeds angular.

Ecology : Rare on sandy or rocky crevices along the coast.

Fl. & Fr. : November-March; December onwards.

Distrib. : Tamil Nadu and Kerala coast.

2. *Canscora diffusa* (Vahl) R. Br., Prodr. 451. in

Obs. 1810; Clarke in Hook. f., Fl. Brit. India 4: 103. 1883.

Much branched slender herb up to 30 cm tall. Leaves 2-4.5 x 1-2 cm, broadly ovate, membranous, acute at apex, rounded to subcordate or cordate at base. Flowers 2.5-3 mm across, pinkish white arranged in terminal or axillary panicles. Capsule 6.5 x 2 mm, oblong-compressed, Seeds 0.1 mm, rounded or angular.

Ecology : Common along the estuaries, moist and shady places and the back side of coastal dunes.

Fl. & Fr. : January-April; March onwards.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Karnataka coast.

2. *Enicostema* Bl.

Enicostema hyssopifolium (Willd.) Verdoorn, Bothalia 7: 462. 1961; *E. littorale* Bl.: Clarke in Hook. f., Fl. Brit. India 4: 101. 1883.

Erect herb up to 40-50 cm tall. Leaves 3-4.5 x 0.5-1 cm, lanceolate oblong, glabrous, acute at apex, cuneate at base. Flowers 2-2.5 mm across, subsessile, in axillary clusters. Capsule 3.5 x 3 mm septically 2-

valved. Seeds circular, minute, reticulate.

Ecology : Frequent on sandy or gravelly areas along the back shore and coastal beaches and dunes.

Fl. & Fr. : August-November; December-March.

Distrib. : Orissa, Tamil Nadu, Pondicherry and Saurashtra coast.

3. *Exacum* L.

Exacum pedunculatum L., Sp. Pl. 112. 1753; Clarke in Hook. f., Fl. Brit. India 4: 97. 1883.

Erect stout, much branched herb up to 7.5-45 cm tall. Leaves 1-3.5 x 0.5-1.5 cm oblanceolate, glabrous, acute at apex, cuneate at base. Flowers 2.5 cm, across, blue or lilac, in dichasial cymes. Capsule 0.5 x 0.4 cm, globose, smooth. Seeds circular, minute.

Ecology : Occasional along the sandy river banks and on alluvial deposit near the estuaries.

Fl. & Fr. : January-March; February onwards.

Distrib. : Alluvial deposits on the river Ganga in West Bengal and Mahanadi delta in Orissa, away from the coast.

4. *Hoppea* Willd

Hoppea dichotoma Willd., Ges. Naturf. Freunde Berlin New Schriften 3: 435. 1801; Clarke in Hook. f., Fl. Brit. India 4: 100. 1883.

Branched herb up to 7-12 cm tall. Leaves 6-8 x 2.5-4 cm, elliptic-ovate, herbaceous, apiculate at apex, cuneate at base. Flowers 2-3 mm across, greenish yellow.

Capsule 4 mm across, globose. Seeds minute, faintly reticulate.

Ecology : Frequent on moist sandy areas near the coast.

Fl. & Fr. : January-March. February onwards.

Distrib. : Midnapore coast in West Bengal, Orissa and Andhra Pradesh.

M E N Y A N T H A C E A E

Nymphoides Seguiér

KEY TO THE SPECIES

- 1a. Petal lobes densely fimbriate with cotton like out growth on the inner surface 1. *indicum*
 1b. Petal lobes not fimbriate, smooth with undulating crest along the centre on the inner surface 2. *hydrophylla*

1. *Nymphoides indicum* (L.) Kuntz., Ravis. Gen. Pl. 429. 1891; *Limnanthemum indicum* (L.) Griseb.: Clarke in Hook. f., Fl. Brit. India 4: 131. 1883.

Perennial aquatic herbs, floating with runner like stem. Leaves 15-20 x 12-22 cm, orbicular, thick, glabrous, sinuate, deeply cordate at base; pedicels long, fasciated at nodes. Flowers 14.5-15 cm across, white with yellow centre, arranged in umbellate clusters at proximal or distal nodes, petal lobes densely fimbriate. Capsule 8 x 6 mm, ellipsoid, 6-seeded. Seeds 1.5 mm, smooth.

Ecology : Common near the margins of tanks and pools near coast.

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

Distrib. : Throughout the coastal districts in India.

2. *Nymphoides hydrophylla* (Lour.) Kuntz., Rev. Gen. Pl. 429. 1891; *Limnanthemum cristatum* Roxb.: Clarke in Hook. f. Fl. Brit. India 4:131. 1883.

Rhizomatous aquatic herbs; stems slender, floating and producing tuft of roots at the node. Leaves floating, 3-16 x 2-10 cm, suborbicular, thick, rounded at apex, cordate at base. Flowers white, yellow towards base, clustered at the nodes, petal lobes smooth. Capsules 5 mm across, subglobose, 10-20 seeded. Seeds orbicular, thick, scabrous.

Ecology : Frequent in fresh-water ponds, paddy fields, ditches and shallow channels.

Fl. & Fr. : September-October; December-January.

Distrib. : Throughout the fresh water ditches on back shore plains.

H Y D R O P H Y L L A C E A E

Hydrolea L.

Hydrolea zeylanica (L.) Vahl, Symb. Bot. 2: 46. 1791; Clarke in Hook. f., Fl. Brit. India 4: 133. 1883.

Subsucculent, spreading herb, rooting at nodes. Leaves 3 x 1 cm, elliptic-oblong, chartaceous, glabrous above, pubescent below, acute at apex, truncate at base. Flowers 2 cm across, deep-blue, arranged in axillary or terminal racemes. Capsule 4 mm, globose, septicidal,

hispid. Seeds minute, wrinkled.

Ecology : Frequent along the border of coastal wetlands, rice fields and shallow ditches, mostly under fresh water influence.

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

Distrib. : West Bengal, Orissa, Tamil Nadu and Pondichery.

BORAGINACEAE

KEY TO THE GENERA

- 1a. Ovary entire or slightly 4-lobed; style terminal :
- 2a. Styles not depressed, conical at apex or with a horizontal ring below stigma :
- 3a. Style twice bipartite; tree or shrubs 4. *Cordia*
- 3b. Style once forked or styles 2; trees, shrubs or herbs :
- 4a. Styles usually bipartite; drupe with, 2 seeded pyrenes; trees or shrubs 5. *Ehretia*
- 4b. Styles 2; drupe of four 1 seeded pyrenes; prostrate herbs 3. *Coldenia*
- 2b. Styles depressed, conical at apex or with a horizontal ring below the stigma :
- 5a. Styles shortly 2-lobed; pyrenes 2 seeded; shrubs, often small trees 2. *Argusia*
- 5b. Style elongated, dilated above, usually in a ring; pyrenes four 1 seeded; herbs or undershrub 6. *Hellotropium*
- 1b. Ovary deeply 4-lobed; styles subterminal or gynobasic :
- 6a. Style subterminal; carpophore pyramidal, excavated to hold the nutlets 8. *Trichodesma*
- 6b. Style gynobasic; carpophore conical; nutlets glochidiate :
- 7a. Nutlets prominently by margined, margins recurved, conically attached to the carpophore 1. *Adelocaryum*
- 7b. Nutlets not margined, carpophore short and flat 7. *Sericostoma*

1. *Adelocaryum* Brand.

Adelocaryum caelestinum (Lindl.) Brand., Fedde. Repert. 13: 549. 1915 & in Engl. Pflanzenr. 78: 78. f. 8. 1921. *Paracaryum caelestinum* (Lindl.) Benth. & Hook. f.: Clarke in Hook. f., Fl. Brit. India 4: 160. 1883.

Herb 0.5-1.5 m, sparsely hairy. Radical leaves 15-20 x 10-15 cm, ovate, entire, acute at apex and cuneate

at base; cauline leaves 5-7.5 x 2-3 cm. Flowers 0.8 cm across, blue, in divaricate racemes. Nutlets 4, pyramidal.

Ecology : Frequent on the crevices of seashore rocks and inward hilly regions.

Fl. & Fr. : July-October.

Distrib. : Along west coast in Karnataka and Kerala.

2. *Argusia* Boehmer

Argusia argentea (L.f.) Heine in Fl. Nouv. Caled. ed., Depend. 7: 109. Pl. 24.1976. *Tournefortea argentea* L. f. Suppl. 133. 1781; Hook. f., Fl. Brit. India 4: 145. 1883

Shrub or small tree, densely hairy. Leaves 10-15 x 3-5 cm, obovate-lanceolate, acute at apex, narrowed at base, glossy green above, silvery tomentose below. Flower sessile in dense cymes. Drupe 0.8 cm diam, subglobose.

Ecology : Restricted in the coral strands and rocky sandstone on seashore islands.

Fl. & Fr. : March-April; June-September.

Distrib. : Ameni Island, Androth Island, Agathi Island in Lakshadweep, Talmugri and Boat islands in Andaman & Nicobar Islands.

3. *Coldenia* L.

Coldenia procumbens L., Sp. Pl. 125.1753; Clarke in Hook. f., Fl. Brit. India 4: 144. 1883.

Densely scabrous, prostrate annuals; branches somewhat compressed, ascending. Leaves 1-4.5 x 0.3-1.5 cm, thick, obovate or ovate-oblong, whitish, scabrous between the impressed nerves and pillose beneath. Flowers small, white, solitary, extra axillary

sessile or shortly pedicellate. Fruits 3 mm across, pyramidal, hairy, separating into 4, 1-seeded pyrenes.

Ecology : Common along road sides, river-banks, and reclaimed soils near rice fields or ditches.

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

Distrib. : Throughout the reclaimed soils near coastal embankments.

4. *Cordia* L.

KEY TO THE SPECIES

- 1a. Corolla tube not exceeding calyx, stamens 4-5 1. *dichotoma*
 1b. Corolla tube exceeding calyx, stamens 6-8 2. *subcordata*

1. *Cordia dichotoma* Forst. f., Prodr. 18. 1786; *C. myxa auct non* Clarke in Hook. f., Fl. Brit. India 4: 136. 1883.

Trees 5-10 m tall, with many drooping branches. Leaves 3-10.5 x 2-8.5 cm, alternate, elliptic-oblong or broadly obovate, subcoriaceous, 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 branchelets; styles twice bipartite. Drupes 10-15 mm across, globose, pyrenous.

Ecology : Frequent in scrubs along river-banks and road sides; sometimes planted as a road side tree.

Fl. & Fr. : March-April; September-October.

Distrib. : Throughout the coastal districts.

2. *Cordia subcordata* Lamk., Ill. 2: 421. 1899; Clarke in Hook. f., Fl. Brit. India. 4: 140. 1883.

Tree. Leaves 7.5-15 cm long, ovate, acute at apex, rounded or subcordate at base. Flower 2 cm across, orange or red, arranged in lateral corymbs. Drupe 2.5 cm, ellipsoid, 1 seeded. Seed subspinose.

Ecology : Frequent along the lee side sand dunes and river banks and planted in coastal garden.

Fl. & Fr. : April-May; June-August.

Distrib. : Coastal districts of Tamil Nadu, Gujarat, Krusedi island and Andaman islands.

5. *Ehretia* P. Br.

KEY TO THE SPECIES

- 1a. Leaves serrate, elliptic-ovate; flowers in axillary or terminal panicles 1. *acuminata*
 1b. Leaves entire, elongate-elliptic; flowers in axillary, lateral or terminal 2. *canarensis*

1. *Ehretia acuminata* R. Br., Prodr. 497. 1810; Clarke in Hook. f., Fl. Brit. India 4: 141. 1883.

Trees 6-12 m tall. Leaves 6-12.5 x 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.

Ecology : Rarely found on the banks of river towards the coast.

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

Distrib. : West Bengal, Orissa, Maharashtra and Karnataka coast.

2. *Ehretia canarensis* (Clarke) Gamble, Fl. Pres. Madras 891. 1923; *E. laevis* Roxb. var. *canarensis* Clarke in Hook. f., Fl. Brit. India 4: 142. 1883.

Shrub, glabrous. Leaves broadly oblong, glabrous above and rugose with distinct scabrous nerves. Flowers white in axillary corymbs. Drupe subglobose,

4 seeded. Seeds straight.

Ecology : Common along coastal hills slopes and lateritic upland.

Fl & Fr : January-April; April-June.

Distrib. : West coast, Karnataka.

6. *Heliotropium* L.

KEY TO THE SPECIES

- 1a. Flowers pale to bright rose or violet; fruit mitriform, 4-beaked 4. *indicum*
 1b. Flowers usually white seldom yellow; fruits of 2-4 nutlets, not beaked :
 2a. Calyx divided up to 1/4th of its length; lobes short; fruit enclosed by the calyx 7. *supinum*
 2b. Calyx divided nearly to base; lobes free, long; fruits not enclosed by the calyx :
 3a. Plants glabrous 3. *curassavicum*
 3b. Plants hairy:
 4a. Inflorescence bracteate, sometimes bracts much reduced :
 5a. Plants decumbent or prostrate; leaves lanceolate or elliptic. Flowers sessile, closely set on the inflorescence 5. *marifolium*
 5b. Plants erect; leaves linear to lanceolate; flowers sub-sessile to pedicellate, distinctly set on inflorescence :
 6a. Inflorescence bracteate throughout :
 7a. Leaves linear, fruit depressed subdivaricately 4-lobed 8. *zeylanicum*
 7b. Leaves lanceolate, fruit distinctly 4 lobed 1. *bracteatum*
 6b. Inflorescence bracteate in the upper region, bracts much reduced 6. *strigosum*
 4b. Inflorescence ebracteate 2. *crispum*

1. *Heliotropium bracteatum* R. Br., Prodr. 493. 1810; Clarke in Hook. f., Fl. Brit. India 4: 151. 1883.

Erect herb; branchlets softly sericeous. Leaves 2-4 x 0.3-0.5 cm, linear-lanceolate chartaceous, appressed sericeous on both sides, revolute, acute at apex, cuneate at base. Flower 2.5 mm across, white in terminal raceme. Drupe of 4 nutlets. Nutlets 1 mm in diam., rounded smooth.

Ecology : Common on sandy beaches and seashore cliffs.

Fl. & Fr. : March; July.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka and Kerala coast.

2. *Heliotropium crispum* Desf., Fl. Atlant. 1: 151, t. 41. 1798; *H. undulatum* sensu Clarke in Hook. f., Fl. Brit India 4: 150. 1883.

Suberect herb, 15-60 cm, pubescent. Leaves 1-3.5 cm long ovate-lanceolate, acute at apex and narrowed at base. Flowers 4 mm, white in spikes. Nutlets 4, bristly.

Ecology : Rare on coastal sand and sandy shores.

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

Distrib. : Restricted on Saurashtra coast.

3. *Heliotropium curassavicum* L., Sp. Pl. 130. 1753. Burt. Notes. R. Bot. Gdns. Edinb. 26: 357. 1966.

Fleshy, glabrous perennial herbs with long tap root. Leaves 2.5-4.5 x 0.5-0.7 cm, linear spatulate, rounded or shallowly retuse at apex, tapering to base. Flowers 2-3 mm long, white, in axillary or terminal single or one-forked cincinni, 5-8 cm long. Fruits 2 mm across, globose, breaking up into 4-rugulose nutlets.

Ecology : Frequent on the embankments near the mangrove swamps and along the border of the salt marshes. Occasionally found in the cultivated fields.

Fl. & Fr. : March-August; December-January.

Distrib. : Throughout the coastal salt marshes in West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat.

4. *Heliotropium indicum* L., Sp. Pl. 130. 1753; Clarke in Hook. f., Fl. Brit. India 4:152. 1883.

Erect annual herbs; stems terete, densely hirsute. Leaves 4-10.5 x 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.

Ecology : Common along road sides, moist places and river banks.

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

Distrib. : Throughout the coastal provinces.

5. *Heliotropium marifolium* Retz., Obs. Bot. 2: 8. 1781; *H. scabrum* Clarke in Hook. f., Fl. Brit. India 4:152. 1883.

Prostrate, much-branched, scabrid herbs with strong tap root. Leaves 1-3 x 0.1-0.2 cm, narrowly lanceolate, or linear, acute at apex, subsessile at base. Flowers 2-2.5 mm, white, one to many-flowered, leafy cincinni. Nutlets 4, stiffly pubescent.

Ecology : Common in sandy scrubs, dry sandy places along the river banks and sandy seashores, locally common on dry habitat and road sides.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the East coast and Maharashtra coast.

6. *Heliotropium strigosum* Willd., Sp. Pl. 743. 1798; Clarke in Hook. f., Fl. Brit. India 4: 151. 1883.

Strigosely hirsute, much-branched, suffruticose herbs; branches terete, procumbent or ascending from woody rootstock. Leaves 6-8 x 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. Nutlets subglobose, hirsute, 4-6-seeded.

Ecology : Common along the river banks, sandy scrubs, coastal thickets and sandy seashores.

Fl. & Fr. : All through the year.

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka and Maharashtra coast.

7. *Heliotropium supinum* L., Sp. Pl. 130. 1753; Clarke in Hook. f., Fl. Brit. India 4: 149. 1883.

Prostrate villose herbs with many spreading branches from woody rootstock; branches terete, clothed with soft, adpressed hairs. Leaves 1-1.5 x 0.5-0.8 cm, ovate-elliptic, acute at apex, obtuse at base. Flowers 4-5 mm long, white, sub-sessile, in terminal cymes. Fruits 5-6 mm across, ellipsoid, warted. Seeds 2:3.

Ecology : Frequent along the river-banks and sandy scrubs, occasionally found along sandy sea-shores.

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

Distrib. : Throughout the East coastal plains.

8. *Heliotropium zeylanicum* (Burm.f.) Lam., Encycl. 3: 94. 1789; *H. paniculatum* R. Br.: Clarke in Hook. f., Fl. Brit. India 4: 151. 1883.

Erect herb up to 60 cm; branchlets glabrescent. Leaves 1-2 x 0.3-0.4 cm, linear lanceolate, chartaceous, minutely scabrous above, strigose below, revolute, acute at apex, cuneate at base. Flower 5 mm across on profusely branched axillary or terminal racemes. Drupe of 4 nutlets. Nutlets 1 mm, sparsely hairy.

Ecology : Frequent on the lee side of coastal sand dunes, scrub jungles and fallow grounds.

Fl. & Fr. : December-February & August-September; Fruits all year round.

Distrib. : Saurashtra, Tamil Nadu, Andhra Pradesh, Kerala and Orissa coast.

7. *Sericostoma* Stocks.

Sericostoma pauciflorum Stocks., Wight Ic. t. 1377; Clarke in Hook. f., Fl. Brit. India 4: 175. 1883.

Shrubs, 30-45 cm high. Leaves 3.1 x 0.6-0.8 cm, oblong, hispid, obtuse-mucronate at apex, narrowed at base. Flowers 6 mm in diam, white in solitary axillary.

Nutlets 2.5 mm, 4, ovoid.

Ecology : Rare and restricted along the sand stone and calcareous sandy soils on sea shore.

Fl. & Fr. : April-May; July-August.

Distrib. : Gujarat coast.

8. *Trichodesma* R.Br.

Trichodesma indica R.Br., Prodr. 496. 1810; Clarke in Hook. f., Fl. Brit. India 4: 153. 1883.

Coarsely hispid, much-branched, erect herbs. Leaves 4.5-6.5 x 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.

Ecology : Frequent along the river banks, road sides and dry places.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat coast.

CONVOLVULACEAE

KEY TO THE GENERA

- 1a. Parasitic leafless twining herbs, corolla lobes imbricate 2. *Cuscuta*
- 1b. Non parasitic, erect or climbing plants with leaves; corolla lobes various :
- 2a. Pollen grains spinulose :
- 3a. Corolla salver shaped; stigma lobes linear-oblong 8. *Rivea*
- 3b. Corolla funnel shaped; stigma bilobose :
- 4a. Fruit dehiscent, not fleshy; corolla campanulate; ovary 2-celled 6. *Ipomoea*
- 4b. Fruit indehiscent, fleshy; corolla funnel shaped; ovary 4-celled 1. *Argyrea*
- 2b. Pollen grains not spinulose :
- 5a. Styles 2, free or partly united below :
- 6a. Corolla lobes imbricate; flowers usually axillary; stamens exerted 3. *Cressa*
- 6b. Corolla lobes induplicate-contorted; flowers cymose; stamens not exerted 4. *Evolvulus*
- 5b. Styles entire; sometimes separating :
- 7a. Ovary 1-celled; capsule 4-valved, 3 seeded; stigma lobe oblong 5. *Hewittia*
- 7b. Ovary 2-4 celled; capsule 4-valved, 4 seeded; stigma lobes globose 7. *Merremia*

1. *Argyrea* Lour.

Argyrea cymosa (Roxb.) Sweet, Hort. Brit. (ed.2) 373. 1830; Clarke in Hook. f., Fl. Brit. India 4: 190. 1883.

Scandent shrub. Leaves 6-8 x 4-6 cm, deltoid-cordiform, entire, chartaceous thinly pubescent on both sides, acute or shortly acuminate at apex, truncate to cordate at base. Flowers 2.5-3 cm across, pinkish shortly pedicillate, in corymbose cyme. Fruit 1.5 cm, across globose.

Ecology : Common in coastal thickets and sandy backshore.

Fl. & Fr. : September-November onwards.

Distrib. : Sundarban, Digha (West Bengal coast), Gopalpur (Orissa coast) and Andhra Pradesh coastal region.

2. *Cuscuta* L.

Cuscuta reflexa Roxb. Pl. Corom. 2: 3, t. 104. 1798; Clarke in Hook. f., Fl. Brit. India 4: 225. 1884.

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. Capsules 1-1.5 cm in diam., ellipsoid or subglobose, pale brownish,

circumscissile at base.

Ecology : Frequent in sandy scrubs, river banks, mostly parasitic on woody plants; sometimes spreading as a forest undergrowth.

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

Distrib. : Throughout the coastal districts.

3. *Cressa* L.

Cressa cretica L., Sp. Pl. 223. 1753; Clarke in Hook. f., Fl. Brit. India 4: 225. 1883.

Erect dwarf shrub up to 15-30 cm. Leaves 5-8 x 2-3 mm, elliptic, pubescent on both sides, acute at apex, truncate at base. Flower 1.5 - 2 mm across, white, solitary or clustered in upper axils. Fruit 5 x 3 mm, ellipsoid-globose. Seeds glabrous.

Ecology : Widely distributed in coastal salt marsh; gregarious on sandy plains and black cotton soil.

Fl. & Fr. : March-May onwards.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Gujarat and Rann of Kutch.

4. *Evolvulus* L.

KEY TO THE SPECIES

- 1a. Creeping herbs; leaves suborbicular 2. *nummularius*
 1b. Ascending herbs; leaves elliptic-oblong 1. *alsinodes*

1. *Evolvulus alsinodes* L., Sp. Pl. ed. 2: 392. 1762; Clarke in Hook. f., Fl. Brit. India 4: 220. 1883.

Ascending herbs, sometimes decumbent; stems usually covered with adpressed silky hairs. Leaves 6-15 x 2-6 mm elliptic-oblong or linear lanceolate, sessile, acute at apex, narrowed at base. Flowers 4-5 mm across, blue rarely white, axillary, solitary. Capsules 3-4 mm in diam., globose, 2-loculed, 4-valved,

4-seeded. Seeds 4, pale-brown.

Ecology : Frequent, along seashores, river banks, and dry grasslands; not uncommon along road sides.

Fl. & Fr. : July-October.

Distrib. : Throughout the East coast, Tamil Nadu and Maharashtra coast.

2. *Evolvulus nummularius* (L.) L., Sp. Pl. ed.2: 391. 1762.

Perennial creeping herbs; stems prostrate, rooting at nodes. Leaves 4-12 x 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. Capsules 4-5 mm in diam., globose, 1-loculed, 4-seeded. Seeds globose, brown.

Ecology : Frequent along roadsides, river banks, grasslands and sandy waste places near the seashore.

Fl. & Fr. : May-September.

Distrib. : Throughout the coastal provinces in West Bengal, Orissa, Tamil Nadu and Maharashtra coast.

5. *Hewittia* Wight & Arn.

Hewittia scandens (Milne) Mabberley, Bot.Hist.Hort. Mal. 84. 1980; *H. bicolor* (Vahl) Wight & Arn.: Clarke in Hook. f., Fl. Brit. India 4 : 216. 1883.

A monotypic twining herbs. Leaves 4-9 x 3-6 cm broadly or narrowly cordiform, entire, chartaceous, puberulous, acute, apiculate at apex, cordate at base.

Flower yellowish with purple throat, solitary, axillary. Fruit 0.8 cm across, globose, Seeds trigonous, glaucous.

Ecology : Rare, mostly restricted to the coral strand and sand deposited crevices of Bay islands.

Fl. & Fr. : December-March.

Distrib. : Lakhsadweep and Gulf of Mannar.

6. *Ipomoea* L.

KEY TO THE SPECIES

1a. Ovary 4-celled :

2a. Sepals elliptic; corolla crimson or white 7. *quamoclit*

2b. Sepals orbicular-oblong; corolla purple 3. *mauritiana*

1b. Ovary 2-3 celled :

3a. Flowers sessile or sub-sessile in heads or clusters; leaves rotundate in outline deeply palmately 5 to 9 lobed 6. *pes-tigridis*

3b. Flowers pedicelled arranged various forms but not in heads; leaves various shaped :

4a. Creeping aquatic or marshland herb 1. *aquatica*

4b. Erect or trailing, terrestrial herb :

5a. Leaves stipulate, deeply digitately or pedately 5 to 9 partite 2. *cairica*

5b. Leaves exstipulate, entire, angular or some what lobed but never digitately 5 to 9 partite :

6a. Leaves emarginate or deeply 2-lobed from the apex midway downwards 5. *pes-caprae*

6b. Leaves otherwise :

7a. Stems mucronated; corolla white 9. *tuba*

7b. Stem glabrous to hairy, not mucronated; corolla various :

8a. Flowers in umbels, pink with purple tube 8. *sepiaria*

8b. Flowers in cymes or solitary; yellow or white with purple tube 4. *obscura*

1. *Ipomoea aquatica* Forsskal, Fl. Aegypt. Arab. 44. 1775; Clarke in Hook. f., Fl. Brit. India 4: 225. 1883.

A trailing herb. Leaves 5-9 x 2-5 cm lanceolate to hastate, entire chartaceous, acuminate at apex, triangular acute or obtuse with basal lobes. Flowers purple or purplish blue, solitary or in cyme. Fruit a capsule, 0.8 cm across with persistent calyx, embracing the fruit.

Ecology : Frequent along the margin of ponds, tanks and puddles under fresh water condition behind the coastal sand dunes.

Fl. & Fr. : December - March.

Distrib. : Throughout the coastal district.

2. *Ipomoea cairica* (L.) Sweet, Hort. Brit. 287, 1827; *I. palmata* Forsskal: Clarke in Hook. f., Fl. Brit. India 4: 214. 1883.

Climbing shrubs, profusely branched. Leaves 3-5 x 1-2 cm, palmately foliolate, lobes elliptic to obovate, entire, chartaceous, acute to apiculate at apex, decurrent at base. Flowers 5-6 cm across, funnel shaped, pink, solitary or in lax cymes. Fruit capsule 0.7 cm across, globose. Seeds white, pubescent.

Ecology : Frequent on back shore sand and hill slopes, probably introduced as ornamental plants.

Fl. & Fr. : January-April.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka and Kerala coast.

3. *Ipomoea mauritiana* Jacq., Collect. 4: 216. 1781; *I. digitata auct non L.*: Clarke in Hook. f., Fl. Brit. India 4: 202. 1883.

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. Capsules 6-8 mm long, ovoid. Seeds 5-6 mm long, woolly hairy.

Ecology : Frequent on sand bars in between the creeks and channels of the mangroves.

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

Distrib. : Orissa, Tamil Nadu and Saurashtra coast.

4. *Ipomoea obscura* (L.) Ker., Bot. Reg. 3: t. 239, 1817; Clarke in Hook. f., Fl. Brit. India 4: 207. 1883.

A slender twiner. Leaves 3-4 x 2.5-4 cm, cordiform entire, chartaceous acuminate at apex, cordate at base. Flower 2.5-3 cm across, yellowish, funnel shaped arranged in solitary or subumbellate cyme. Capsule subglobose, 7 mm across, apically beaked. Seeds thinly pubescent.

Ecology : Rare along the sandy coastal areas, probably use for fencing.

Fl. & Fr. : December - March.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka and Saurashtra coast.

5. *Ipomoea pes-caprae* (L.) R. Br., Tuckey, Narr. Exped. Zaire 477, March 1818; *I. biloba* Forsk.: 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. Flowers 5-7 cm long, pinkish or reddish violet, in 1-few flowered cymes. Capsules 1-1.5 cm in diam., globose, 4-seeded. Seeds brownish, tomentose.

Ecology : Common along the seashore, often forming pure strands as a pioneer vegetation. They serve as beautiful sand binder and sand stabiliser.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the East and West coast and Andaman islands.

6. *Ipomoea pes-tigridis* L., Sp. Pl. 162. 1753; Clarke in Hook. f., Fl. Brit. India 4: 204. 1883.

Twiner, branchlets hispid. Leaves 3-5 x 1.5-2.5 cm, palmately 5-9 lobed, lobes obovate, chartaceous, sericeous on either side, shortly acuminate at apex, decurrent at base. Flowers 4-5 cm across, white or pink, aggregated in capitate clusters. Capsule globose 0.8 cm across. Seeds pubescent, hair in small tuft.

Ecology : Frequent on the lee side of the coastal dune, crevices and sand stones habitat.

Fl. & Fr. : Throughout the year.

Distrib. : Saurashtra Tamil Nadu, Karnataka and Kerala coast.

7. *Ipomoea quamoclit* L., Sp. Pl. 159.1753; Clarke in Hook. f., Fl. Brit. India 4: 199.1883.

A twining vine, branchlet slender. Leaves pinnatifid. Leaflets linear, acute. Flowers 2-3 cm long, salver-formed, deep red, arranged in solitary cyme. Capsule 0.5 cm across. Seeds oblong.

Ecology : Frequent in coastal thickets, gardens and hill slopes.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Karnataka coast.

8. *Ipomoea sepiaria* J. Koenig ex Roxb., Fl. Ind. 2: 90. 1824; Clarke in Hook. f., Fl. Brit. India 4: 209. 1883.

A slender climber, branchlet hirsute. Leaves 2-4 x 2-3 cm, triangular-cordiform, entire, chartaceous, glabrous, gradually acute at apex, cordate at base. Flower 4-4.5 cm across salver form, whitish purple, arranged in cymes. Capsule 0.8 cm across, globose. Seed white velvety.

Ecology : Common towards the inland coastal plains,

frequently found on sand deposited crevices along the back shore.

Fl. & Fr. : December-February.

Distrib. : West Bengal, Orissa, Tamil Nadu, Kerala, Tellicherry.

9. *Ipomoea tuba* (Schld.) G. Don., Gen. Syst. 4: 271. 1838. *I. grandiflora* Lamk.; Clarke in Hook. f., Fl. Brit. India 4: 198. 1883.

Glabrous, perennial twiners; stems more or less woody, longitudinally wrinkled, straw-coloured. Leaves 7-14 x 6-11 cm, broadly ovate or orbicular, entire, cordate at base, acuminate at apex. Flowers 6-15 cm long, white, axillary, solitary or rarely in 2-flowered cymes. Fruits 2-3 cm in diam., globose, pale brown. Seeds 4, hairy along margins.

Ecology : Common along the intertidal regions of creeks and channels in the mangroves, usually in association with *Hibiscus tiliaceus* and *Sonneratia apetala*.

Fl. & Fr. : June-August; September-December.

Distrib. : Orissa, Tamil Nadu, Kerala and Saurashtra coast.

7. *Merremia* Dennst.

KEY TO THE SPECIES

1a. Stems not winged; leaves occasionally 1-3 lobed :

2a. Inner sepals 2-lobed at apex; leaves reniform broader than long 1. *gangetica*

2b. Inner sepals not lobed at apex; leaves distinctly longer than broad 2. *tridentata*

1b. Stems winged; leaves not lobed 3. *surpethrum*

1. *Merremia gangetica* (L.) Cufo., Bull. Jard. Bot. Brux. Suppl. 31: 743. 1961; *Convolvulus parviflora* Vahl; Clarke in Hook. f., Fl. Brit. India 4: 220. 1883.

Climbing vine. Leaves 5-9 x 4-6 cm, cordiform, entire, chartaceous, pubescent, shortly acuminate at apex and subcordate at base. Flowers 1-1.5 cm across, campanulate, white, arranged in axillary cymes. Capsule

in dense cluster, 0.6 cm across, subglobose, 4-valved, Seeds sub-trigonus, margin slightly winged.

Ecology : Rare along the backshore, on hill slopes.

Fl. & Fr. : December-February.

Distrib. : Coastal plains of West Bengal, Tamil Nadu and Kerala.

2. *Merremia tridentata* (Linn.) Hall. f., E. J. 16: 552. 1893; *Ipomoea tridentata* Roth: Clarke in Hook. f., Fl. Brit. India 4: 205. 1883.

Prostrate or twining variable perennial herbs; stems glabrous or hairy, spreading, from woody root-stock. Leaves 4-25 x 2-8 mm variable, linear-lanceolate or oblong, acuminate, emarginate, or mucronulate at apex, truncate, hastate 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. Capsules globose, 4-valved, 4-seeded. Seeds glabrous.

Ecology : Common in dry sandy places, coastal scrubs, thickets and sea shore.

Fl. & Fr. : June-September; October-December.

Distrib. : Orissa, Tamil Nadu and Karnataka coast.

3. *Merremia turpethrum* (L.) G. L. Shah & R.G. Bhat., J. Bombay Nat. Hist. Soc. 74: 567. 1978. *Ipomoea turpethrum* (L.) R. Br.: Clarke in Hook. f., Fl. Brit. India 4: 212. 1883.

A vine with winged branchlet. Leaves 8-12 x 7-13 cm, ovate to cordate, entire, chartaceous, puberulous, subacute at apex, truncate at base. Flowers 3-4 cm across, funnel shaped, white arranged in corymbose cymes. Capsule 2.5 x 2 cm enclosed in enlarged woody calyx lobes. Seed solitary, glabrous.

Ecology : Frequent along the coastal plains and lee side of the sand dune and river bank

Fl. & Fr. : December - February.

Distrib. : West Bengal, Andhra Pradesh (Cauvery delta) and Tamil Nadu coast.

8. *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.

Annual or perennial large creeping herbs; stems pubescent, rooting at nodes. Leaves 4-8.4 x 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. Capsules 1-2 cm in diam., globose, 4-seeded.

Ecology : Frequent, along sandy river banks, coastal scrubs and open dry land.

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

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat coast.

S O L A N A C E A E

KEY TO THE GENERA

- 1a. Fruit a dehiscent or semi-indehiscent capsule :
 - 2a. Flowers solitary, axillary capsule spiny 2. *Datura*
 - 2b. Flowers in cymose panicles or corymbs capsule not spiny 3. *Nicotiana*
- 1b. Fruit a berry :
 - 3a. Calyx inflated into a membranous bladder enclosing the fruit :
 - 4a. Flowers in fascicles, corolla rotate; lobes valvate in bud 6. *Withania*
 - 4b. Flowers solitary, corolla campanulate lobes contorted in bud; yellow 4. *Physalis*
 - 3b. Calyx persistent, but never inflated into bladder and not enclosing the fruit :
 - 5a. Anthers opening by pores at the apex 5. *Solanum*
 - 5b. Anthers dehiscing longitudinally 1. *Capsicum*

1. *Capsicum* L.

Capsicum frutescens L., Sp. Pl. 189. 1753; Clarke in Hook. f., Fl. Brit. India 4: 239. 1883.

Herbs or shrubs, up to 1 m. tall. Leaves 5-10 x 4-6 cm thin chartaceous; elliptic-ovate, entire acuminate at apex, obliquely rounded to acute at base. Flower 1.2 cm across, white axillary, solitary or paired. Berry elongate, cylindric, gradually tapering below. Seeds compressed, circular.

Ecology : Frequent along the rocky substrate of sea shore island.

Fl. & Fr. : January-May; Fruits through the year.

Distrib. : Widely cultivated, found wild in Chetlaj, Androth, Agatbi islands of Lakshadweep and some parts of the west coastal region.

2. *Datura* L.

Datura metel L., Sp. Pl. 179. 1753; Clarke in Hook. f., Fl. Brit. India 4: 243. 1884.

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.

Ecology : Frequent along the sandy seashores and river banks. Common along the road sides and waste places.

Fl. & Fr. : Mostly during January-April.

Distrib. : Throughout the coastal provinces.

3. *Nicotiana* L.

Nicotiana plumbaginifolia Viv., Elench. Pl. Hort. Dinagro 26. t. 5. 1802; Clarke in Hook. f., Fl. Brit. India 4: 246. 1883.

Viscid-pubescent herbs. Leaves 20-25 x 10-15 cm, ovate-spathulate, obtuse at apex, cuneate at base; cauline leaves lanceolate. Flowers 0.8-1 cm across,

pinkish or white, arranged in terminal panicles. Capsule 1 x 0.5 cm, ellipsoid.

Ecology : Frequently found along the sandy beach or in dune vegetation.

Fl. & Fr. : February-March; March-May.

Distrib. : Naturalised weed along East and West coastal areas.

4. *Physalis* L.

Physalis minima L., Sp. Pl. 183. 1753; Clarke in Hook. f., Fl. Brit. India 4: 238. 1884.

Erect herbs, 50-100 cm tall; stem much-branched, spreading sticky-glandular. Leaves 2-8 x 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, turns orange when ripe.

Ecology : Frequent in sandy waste places along the coast, hedges and coastal scrubs.

Fl. & Fr. : September-March.

Distrib. : Throughout the East and West coast.

5. *Solanum* L.

KEY TO THE SPECIES

1a. Plants armed with prickles :

2a. Flowers pale purple or violet; peduncles paired, one with solitary bisexual

flower and other with many male flower in a racemose cyme 1. *incanum*

2b. Flowers blue; peduncles otherwise :

3a. Diffused herb; berries yellow when ripe 3. *surattense*

3b. Trailing or subcaudant under shrubs; berries scarlet when ripe 4. *trilobatum*

1b. Plants unarmed :

4a. Stellately tomentose undershrubs; berries 1.0 - 1.5 cm in diam. 5. *torvum*

4b. Glabrous or pubescent herbs; berries 5 - 7 mm in diam. 2. *nigrum*

1. *Solanum incanum* L., Sp. Pl. 188. 1753; *S. coagulans* Forsk.: Clarke in Hook. f., Fl. Brit. India 4: 236. 1884.

Erect herbs 30-70 cm tall, armed with recurved prickles. Leaves 4-5.5 x 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.

Ecology : Frequent on sandy places and in thickets along the river-banks and sandy sea shores.

Fl. & Fr. : January-April.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Kerala coast.

2. *Solanum nigrum* L., Sp. Pl. 186. 1753; Clarke in Hook. f., Fl. Brit. India 4: 229. 1884.

Erect, unarmed herbs; stems much-branched, spreading or rarely climbing. Leaves 8-9.5 x 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.

Ecology : Frequent along road side, hedges and waste places.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra coast.

3. *Solanum surattense* Burm. f., Fl. Indica 57. 1768; *S. xanthocarpum* Schrad. & Wendl.: Clarke in Hook. f. Fl. Brit. India 4: 236. 1884.

Decumbent, much-branched, prickly herbs. Leaves 7-9.5 x 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.

Ecology : Frequent along the river-banks and sandy sea-shores. Locally common in sandy places and reclaimed soils along the road-sides.

Fl. & Fr. : Throughout the year.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Gujarat coast and Andaman islands.

4. *Solanum trilobatum* L., Sp. Pl. 188. 1753; Clarke in Hook. f., Fl. Brit. India 4: 287. 1884.

Climbing undershrubs; stems slender, covered with recurved prickles. Leaves 2.5-3.5 x 2-2.5 cm, ovate or ovate-elliptic, glabrous or sparsely prickly along mid-veins, irregularly lobed, obtuse at apex, truncate or subcordate at base. Flowers violet, leaf-opposed or in extra-axillary racemes. Berries 7-8 mm across, globose, green, turn red when ripe.

Ecology : Frequent along river banks and seashores.

Fl. & Fr. : February-April; June-July.

Distrib. : Throughout the coastal provinces.

5. *Solanum torvum* Sw. Nov. Gen. Sp. 47. 1788; Clarke in Hook. f., Fl. Brit. India 4: 234. 1883.

Armed shrub up to 2.4 m with scattered prickles. Leaves 8-15 x 6-12 cm, chartaceous, sparsely stellate-pubescent above, densely pubescent below, acute at apex, obliquely sub-cordate to truncate at base. Flower 2.5 cm across, arranged in corymbose cyme, white. Berry globose. Seeds circular, smooth.

Ecology : Common in plains and in hills, frequent along the leeward side of the coastal dunes.

Fl. & Fr. : February-April; August-November.

Distrib. : West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coast.

6. *Withania* Pauq.

Withania somnifera (L.) Dunal, DC. Prodr. 13(1): 453. 1852; Clarke in Hook. f., Fl. Brit. India 4: 239. 1883.

Much branched shrub up to 1.5 m; branches hoary tomentose. Leaves 5-8 x 3-5 cm elliptic-ovate, entire chartaceous, softly oppressed-pubescent, acute at apex, truncate at base. Flowers 6 cm across, yellow, axillary fascicled. Berry globose, 0.8 cm across, overtopped by

the inflated accrescent calyx. Seeds discoid, trigonous.

Ecology : Common along inland road sides and hill slope, rarely found on seashore sand and sand dunes in waste places.

Fl. & Fr. : April-July; Most part of year.

Distrib. : Andhra Pradesh, Tamil Nadu, Rameswaram island, Maharashtra and Gujarat coast.

SCROPHULARIACEAE

KEY TO THE GENERA

- 1a. All leaves alternate; corolla rotate, actinomorphic 13. *Verbasum*
- 1b. Lower leaves opposite or whorled, upper leaves opposite, whorled or sometimes alternate; corolla not rotate :
 - 2a. Corolla saccate, gibbose or spurred at the base or throat :
 - 3a. Capsules loculicidal on both sides 7. *Lindenbergia*
 - 3b. Capsule loculicidal on one side and porous on the other side 5. *Kickxia*
 - 2b. Corolla slightly zygomorphic with subequal lobes or distinctly bilabiate; not with spur :
 - 4a. Fertile stamens 2; staminodes 2 or absent :
 - 5a. Anther 2 celled; cells parallel 3. *Dopatrium*
 - 5b. Anther 1-celled or if 2 celled the cells divergent at least at the base :
 - 6a. Calyx 3-lobed 4. *Glossostigma*
 - 6b. Calyx 5-lobed 8. *Lindernia*
 - 4b. Fertile stamens 4; staminodes absent :
 - 7a. Anthers 1-celled, if 2 celled then one cell empty :
 - 8a. Calyx spatheaceous split down the front 2. *Centranthera*
 - 8b. Calyx campanulate or tubular :
 - 9a. Leaves always pinnatisect 10. *Sopubia*
 - 9b. Leaves entire or toothed 12. *Striga*
 - 7b. Anthers 2-celled both fertile :
 - 10a. Corolla with lower lobes outside in bud 9. *Scoparia*
 - 10b. Corolla with upper lobes outside in bud :
 - 11a. Lower pair of stamens inserted in corolla-throat; upper pair inserted in the corolla-tube 8. *Lindernia*
 - 11b. All four inserted within the corolla tube :
 - 12a. Corolla campanulate 1. *Bacopa*
 - 12b. Corolla distinctly bilabiate :
 - 13a. Placentae either separating in fruit or, if conjoined in a column, the column not winged; seeds terete 11. *Stemodia*
 - 13b. Placentae always conjoined in a column which is winged by the remains of the septa; seeds angular 6. *Limnophila*

1. *Bacopa* Aubl.

Bacopa monnieri (L.) Pennell, Proc. Acad. nat. Sci. Phil. 98: 94. 1946; *Herpestis monniera* (L.) H.B.K.: Hook. in Hook. f., Fl. Brit. India 4: 272. 1884.

Creeping or often floating herbs; stems succulent, solid, with many air-ducts, rooting at nodes. Leaves 3-16 x 2-4 mm, sessile, obovate or oblong-spathulate, obtuse or rounded at apex, cuneate at base. Flowers pale-blue or whitish-blue, solitary axillary. Capsules ovoid,

septicidally dehiscent, 2-loculed. Seeds ribbed.

Ecology : Frequent in moist and swampy places around cultivated fields, along the edges of sandy ditches and sandy-lakes, often found forming dense mat near the sandy shores.

Fl. & Fr. : March-September.

Distrib. : Throughout the East coastal plains.

2. *Centranthera* R. Br.

KEY TO THE SPECIES

- 1a. Leaves oblong, corolla funnel shaped 1. *indica*
 1b. Leaves linear, corolla tubular 2. *tranquebarica*

1. *Centranthera indica* (L.) Gamble, Fl. Madras, 971. 1924; *C. hispida* R. Br.: Hook. in Hook. f., Fl. Brit. India 4: 301. 1883.

Erect herbs 7-15 cm long. Leaves 1.25-2.5 cm long, oblong to linear-elliptic, hispid, entire or toothed, acute at apex, obtuse at base. Flowers 1.6-2.7 cm long whitish yellow, arranged in solitary axillary. Capsules 1 cm long oblong, loculicidal. Seeds numerous, light brown.

Ecology : Frequent on sandy riverbeds, and sandy beaches.

Fl. & Fr. : October-November.

Distrib. : Kerala coast.

2. *Centranthera tranquebarica* (Spreng.) Merr., Trans. Amer. Phil. Soc. N. S. 24(2): 55. 1935; *C. humifusa* Wall.

ex Benth.: Hook. in Hook. f., Fl. Brit. India 4: 301. 1884.

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, sessile 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.

Ecology : Common in dry sandy places near the sea-shores and river-beds. Occasional along back mangroves on sand-bars.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

3. *Dopatrium* Buch-Ham ex Benth

Dopatrium junceum (Roxb.) Buch.-Ham. ex Benth., Scrop. Ind. 31. 1835; Hook. in Hook. f., Fl. Brit. India 4: 274. 1883.

Branched fleshy herb, 15-30 cm high, leaves 1.3-2.5 cm long, oblong fleshy, obtuse at apex, narrowed at base. Flowers 1.5-2 cm long, rose coloured, arranged in axillary pairs. Capsule 0.23 cm. in diam. globose. Seeds

ellipsoid, transversely rugose.

Ecology : Common on moist sandy sea shore and waste places.

Fl. & Fr. : August onwards.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Karnataka, Maharashtra and Kerala coast.

4. *Glossostigma* Wight. & Arn. ex Arn.

Glossostigma dlandra (L.) Kuntze, Revis. Gen. Pl. 2: 461. 1891; *G. spathulatum* (Hook.) Arn.: Hook. in Hook. f., Fl. Brit. India 4: 288. 1884.

Prostrate herb. Leaves 0.5-1 cm long, 1.5 mm broad, succulent, entire, obtuse at apex, narrowed at base. Flowers 2.7-3 mm across, pinkish-white, arranged in solitary axillary. Capsule globose, lucidicidal, enclosed

by calyx. Seeds ellipsoid.

Ecology : Frequent on moist sandy places and sand dunes along the coast.

Fl. & Fr. : December-March.

Distrib. : Orissa, Tamil Nadu, Karnataka and Saurashtra coast.

5. *Kickxia* Dumort

Kickxia ramosissima (Wall.) Janchen, Oest. Bot. Zeist. 82: 152. 1933; *Linaria ramosissima* Wall.: Hook. in Hook. f., Fl. Brit. India 4: 251. 1884.

Herbs 30-50 cm long. Leaves 1.5-2.5 x 0.5-0.7 cm, ovate-cordate or triangular, membranous, lobed, acute or obtuse at apex, cordate at base. Flowers 3.5-4.5 cm

across, yellow, axillary solitary. Capsule 0.4 cm across, ovoid. Seeds many, echinulate.

Ecology : Frequent on rocky slopes in moist sandy pockets and along the walls of sand hills.

Fl. & Fr. : June-October.

Distrib. : Maharashtra, Karnataka and Saurashtra coast.

6. *Limnophila* R. Br.

KEY TO THE SPECIES

- 1a. Flower sessile 1. *heterophylla*
 1b. Flower pedicellate 2. *indica*

1. *Limnophila heterophylla* (Roxb.) Benth., Scroph. Ind. 25, 1835; Hook. in Hook. f., Fl. Brit. India 4: 270. 1884.

Erect submerged herbs up to 40 cm high. Leaves dimorphic, submerged ones long capillaceous-multifid; aerial ones 1.5-5 x 0.5-1 cm, lanceolate or oblong, glabrous, serrulate, acute at apex, cuneate at base. Flowers 8-13 mm across, pinkish white in solitary axillary. Capsule 2 mm. Seeds minute.

Ecology : Common in dried up wet lands, moist sandy places and river banks.

Fl. & Fr. : January-May.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Saurashtra coast.

2. *Limnophila indica* (L.) Druce, Bot. Exch. Club Soc. Brit. Isles 3: 420. 1914; *L. gratioloides* R. Br.: Hook. in Hook. f., Fl. Brit. India 4: 271. 1884.

Prostrate herb. Leaves 0.5-2 x 0.1-0.4 cm, linear-lanceolate, chartaceous, glabrous, serrulate, acute at apex, cuneate or decurrent at base; lower leaves capillaceous-multifid, submerged. Flowers 1.1 cm across, creamish yellow with purple throat, in axillary solitary. Capsule 3 mm. Seeds truncate at both ends.

Ecology : Frequent in coastal pools, ditches and moist places.

Fl. & Fr. : November-February.

Distrib. : West Bengal, Orissa, Tamil Nadu and Maharashtra coast.

7. *Lindenbergia* Lehm.

Lindenbergia muraria (Roxb. ex D. Don) P. Bruehl, Journ. Dept. Sci. Cal. Univ. 2 (Bot.) 27, 1920; *L. urticaefolia* Lehm.: Hook. in Hook. f., Fl. Brit. India 4: 262. 1884.

Erect herb, 1-25 m high. Leaves 1.8 cm long, ovate-elliptic, villose or glabrous, crenate serrate, obtuse

at apex, narrowed at base. Flowers 1.25 cm long, yellow in axillary racemes. Capsule 0.6 cm long, pubescent. Seeds numerous minute.

Ecology : Rare in moist sandy area on sea shore.

Fl. & Fr. : May-November.

Distrib. : Saurashtra coast.

8. *Lindernia* All.

KEY TO THE SPECIES

- 1a. Fertile stamens 2; staminodes 2 :
 2a. Leaves palmately nerved; lower leaves lanceolate, acute at base 5. *parviflora*
 2b. Leaves pinnately nerved; lower leaves not lanceolate :
 3a. Leaf-serrations acute or aristate; flowers white with red streaks 3. *ciliate*
 3b. Leaf serration obtuse; flowers violet or purple 2. *antipoda*
 1b. Fertile stamens 4; staminodes absent :
 4a. Capsule not exceeding the length of calyx; calyx divided halfway down 4. *crustacea*
 4b. Capsule much exceeding the length of calyx; calyx divided nearly to the base 1. *anagallis*

1. *Lindernia anagallis* (Burm. f.) Pennell, J. Arnold Arbor. 24: 252. 1943. *Vandellia pedunculata* Benth.: Hook. in Hook. f., Fl. Brit. India 4: 282. 1884.

Spreading herb. Leaves 1-2.5 x 0.5-1.5 cm, elliptic deltoid, glabrous, serrate, acute at apex, truncate at base. Flowers 2 cm across, violet, in terminal racemes. Capsule 1 x 0.2 cm, lanceolate. Seeds minute.

Ecology : Rare in moist sandy grass field, river banks and lee side of the sand dunes.

Fl. & Fr. : December-March; Throughout the year.

Distrib. : West Bengal, Orissa, Tamil Nadu and Kerala coast.

2. *Lindernia antipoda* (L.) Alston, Trim. Handb. Fl. Ceyl. 6, Suppl. 214. 1931; *Bonnaya veronicifolia* (Retz.) Spreng.: Hook. in Hook. f., Fl. Brit. India 4: 285. 1884.

Annual decumbent herbs; stems quadrangular, slender, much-branched, rooting from nodes. Leaves 0.8-3.2 x 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. Capsules 5-12 mm long, cylindrical. Seeds many.

Ecology : Frequent around ditches and sandy river-beds, locally abundant.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra coast.

3. *Lindernia ciliata* (Colsm.) Pennell, Brittonia 2: 182. 1936; *Bonnaya brachiata* Link & Otto.: Hook. in Hook. f., Fl. Brit. India 4: 284. 1884.

Erect herb. Leaves 2.5-3.5 x 0.5-1 cm, elliptic-ovate, somewhat thickened, aristate-dentate, acute at apex, cuneate at base. Flowers 2.5-2.8 cm across, white with

pink throat, in terminal racemes. Capsule 1.5 cm, linear-lanceolate. Seeds minute.

Ecology : Frequent in sandy areas under fresh water condition and riverbanks.

Fl. & Fr. : November-March.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

4. *Lindernia crustacea* (L.) F. V. Muell., Syst. Cens. Aust. Pl. 1: 97. 1882; *Vandellia crustacea* (L.) Benth.: Hook. in Hook. f., Fl. Brit. India 4: 279. 1884.

Partly decumbent, glabrous, low annual herbs; stems quadrangular, diffused, often rooting from nodes. Leaves 0.5-3 x 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. Capsules 4-5 mm long, 2-valved, ovoid. Seeds minute, alveolate.

Ecology : Frequent along sandy river beds, ditches within the mangroves, moist low-lying areas and lawns.

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

Distrib. : Throughout the East coast.

5. *Lindernia parviflora* (Roxb.) Haines, Bot. Bihar, Orissa 2: 635 (665). 1922; *Ilysanthes parviflora* (Roxb.) Benth.: Hook. in Hook. f., Fl. Brit. India 4: 283. 1884.

Erect herb, 15-30 cm long. Leaves 1.5 x 0.5 cm, oblong-elliptic, entire, upper leaves serrate, acute at apex, rounded at base. Flowers 1.5-1.8 cm long, pinkish white. Capsules 4.5 x 2.5 mm, oblong-globose. Seeds minute.

Ecology : Common on moist sandy areas and river banks.

Fl. & Fr. : November-January.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Karnataka coast.

9. *Scoparia* L.

Scoparia dulcis L., Sp. Pl. 116. 1753; Hook. in Hook. f., Fl. Brit. India 4: 289. 1884.

Erect herb, 50-75 m tall. Leaves 1-3.5 x 0.5-1.5 cm, ovate, glabrous, serrate, acute at apex, cuneate at base. Flowers 1 cm long, white, in axillary solitary. Capsule 3.5 x 3 mm, ellipsoid-globose, septicidal. Seeds

trunked, reticulate.

Ecology : Common on road side, lateritic hill slopes and waste sandy places on coast.

Fl. & Fr. : August-October.

Distrib. : Throughout the coastal districts.

10. *Sopubia* Buch-Ham. ex D. Don.

Sopubia delphinifolia (L.) G. Don., Gen. Hist. 4: 560. 1837; Hook. in Hook. f., Fl. Brit. India 4: 302. 1884.

Herb up to 75 cm tall. Leaves 2.5 cm long, linear to pinnatifid, entire, acute at apex, decurrent at base. Flowers 1.5-1.7 cm across, pinkish-purple in axillary solitary. Capsule 7 x 3 mm, oblong. Seeds truncate, longitudinally striate.

Ecology : Frequent in coastal scrub jungles, river banks and coastal slacks.

Fl. & Fr. : October-March.

Distrib. : Orissa, Karnataka, Mysore, Kerala and Maharashtra coast.

11. *Stemodia* L.

Stemodia viscosa Roxb. Pl. Coromandel t. 163, 1802; Hook. in Hook. f., Fl. Brit. India 4: 265. 1884.

Glandular hairy ascending herb, 50-100 cm tall. Leaves 3-7 x 1-1.5 cm, elliptic-oblong, pubescent, serrate, acute at apex, auriculate at base. Flowers 8.5 x 6.5 mm across, bluish, violet, in terminal raceme. Capsule 4 mm, oblong-globose. Seeds oblong, terete.

Ecology : Frequent on river beds, moist sandy places and coastal highlands.

Fl. & Fr. : November-March.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Kerala and Maharashtra coast.

12. *Striga* Lour.

KEY TO THE SPECIES

1a. Calyx-tube 5 ribbed; leaves reduced to scales; stem much branched; corolla

lilac 3. *gesnerioides*

1b. Calyx-tube 10-15 ribbed; leaves not reduced scales; stem not much branched;

corolla variously coloured :

2a. One calyx rib terminating the tip of each lobe and other in the sinus 2. *asiatica*

2b. Three calyx-ribs terminating the tip of each lobe 1. *angustifolia*

1. *Striga angustifolia* (D. Don) C.J. Saldanha, Bull. Bot. Surv. India 5: 70. 1963. *S. euphrasioides auct non* Benth. excl. basionym : Hook. in Hook. f., Fl. Brit. India 4: 299. 1884.

Herb up to 40 cm tall. Leaves 1-5 x 0.2-0.5 cm, narrowly oblong to pinnatifid, thick, entire, acute at apex,

decurrent at base. Flowers 1.5 cm across, white in solitary axillary. Capsule 6 x 5 mm. Seeds oblong, cuneate.

Ecology : Frequent as root parasite on coastal wasteland and grass field.

Fl. & Fr. : March-April, September-October.

Distrib. : Andhra Pradesh, Tamil Nadu and Kerala.

2. *Striga asiatica* (L.) O. K. Rev. Gen. Pl. et Sp. Pl. 466, 1891; *S. lutea* Lour.: Hook. in Hook. f., Fl. Brit. India 4: 299. 1884.

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. Capsules 1-1.5 cm long, oblong, loculicidally 2-valved; valves entire.

Ecology : Frequent on waste humas as root parasite, along sandy seashores, grass fields, river banks and road sides.

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

Distrib. : Throughout the coastal districts.

3. *Striga gesnerioides* (Willd.) Vatke, Oesterr. Bot. Z. 25: 11. 1875; *S. orobanchoides* (Endl.) Benth.: Hook. in Hook. f. Fl. Brit. India 4: 299. 1884.

Herb up to 20 cm tall. Leaves 0.5 x 0.4 mm, scaly, acute at apex, truncate at base. Flowers 1.5 mm long, pinkish purple, in spikes. Capsule 4 mm, obovoid-globose. Seeds oblong or elliptic.

Ecology : Common root-parasite along the grassland and lee side of the coastal dunes.

Fl. & Fr. : December-January.

Distrib. : West Bengal, Orissa, Tamil Nadu, Kerala and Saurashtra coast.

13. *Verbascum* L.

Verbascum chinense (L.) Sant. Fl. Pur. 90, 1958. *Celosia coromandeliana* Vahl: Hook. in Hook. f., Fl. Brit. India 4: 251. 1884.

Erect pubescent herbs 20-50 cm tall; stems terete, unbranched except towards the 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. Flowers 10-12 mm across, yellow, in terminal simple or branched, loose racemes. Capsules

4-5 mm across, ovoid, 2-valved, many seeded; valves often bifid, separating from the axis.

Ecology : Frequent along sandy river beds, lee ward seashores, sand dunes and newly deposited sands in moist places.

Fl. & Fr. : April-June; August-September.

Distrib. : West Bengal, Orissa, Maharashtra and Kerala coast.

LENTIBULARIACEAE

Utricularia L.

KEY TO THE SPECIES

- 1a. Aquatic herbs; leaves divided into capillary segments :
 - 2a. Float-leaves present at the base of the scape 10. *stellaris*
 - 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 5. *gibba* ssp. *exoteta*
 - 3b. Leaves repeatedly forked into many segments; segments setulose; peduncles and pedicels stout; seeds polygonal with narrow entire wings 1. *aurea*
- 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 8. *polygaloides*
 - 6b. Pedicels not recurved in fruit; flowers bluish; spurs curved; seeds ovoid, reticulate with elongated aereoles 6. *graminifolia*

5b. Scapes twining, filiform :

7a. Capsule wall thickened along margin; calyx lobes not rounded :

8a. Flowers yellow; testa cell smooth within 9. *scandens*

8b. Flowers not yellow; testa cell striated within 4. *foveolata*

7b. Capsule wall membranous; calyx lobes rounded 2. *bifida*

4b. Flowers sessile :

9a. Scales and bracts medi-fixed; scapes 10-30 cm long, not coloured 3. *caerulea*

9b. Scales and bracts attached by their base; scapes 4-6cm tall, usually coloured 7. *minutissima*

1. *Utricularia aurea* Lour., Fl. Cochinch. 26, 1790.
U. flexuosa Vahl, Enum.: Clarke in Hook. f., Fl. Brit. India 4: 329, 1884.

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. Capsules 5-6 mm in diam., globose. Seeds fabulus prismatic, polygonal with narrow entire wings.

Ecology : Frequent in ditches, tanks and rice-fields.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

2. *Utricularia bifida* L., Sp. Pl. 18, 1753; Clarke in Hook. f., Fl. Brit. India 4: 332, 1884.

Branched herbs. Foliar organs 10 x 0.5 mm, linear, on stolons, rounded at apex. Traps 1 mm across, globose or vegetative organs. Flowers 5-13 mm long, yellow in racemes. Capsules 2-3 x 1.5-2.5 mm, ovoid, slightly compressed. Seeds 0.25-0.4 mm long, ovoid or ellipsoid-ovoid, numerous.

Ecology : Frequent in marshy areas of coastal lagoons, streams and pools.

Fl. & Fr. : July-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Karnataka coast.

3. *Utricularia caerulea* L., Sp. Pl. 18, 1753; *U. recemosa* Wall.: Clarke in Hook. f., Fl. Brit. India 4: 333, 1884.

Terrestrial herbs; roots numerous, fasciculated at base of scapes. Leaves 8-15 mm long, linear-spathulate. 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. Capsules 1-2 mm in diam., globose, Seeds ovoid; testa reticulate.

Ecology : Frequent in paddy fields, moist sandy places and road-side humus.

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

Distrib. : Throughout the coastal plains.

4. *Utricularia foveolata* Edgew., Proc. Linn. Soc 1: 351, 1847; *S. scandens* Oliver: Clarke in Hook. f., Fl. Brit. India 4: 332, 1884.

Aquatic herbs up to 4 mm long. Foliar organs up to 3 cm long, linear, acute or rounded at apex. Traps 0.8-1.2 mm across, globose on vegetative organs. Flowers 2 mm long, pale blue or mauve in racemes. Capsules 2 x 1.5 mm, ovoid. Seeds 0.2-0.35 mm, ellipsoid.

Ecology : Frequent in fresh water of coastal lagoon, ditches, pools and other marshy places.

Fl. & Fr. : September.

Distrib. : Andhra Pradesh, Tamil Nadu and Karnataka coast.

5. *Utricularia gibba* L. ssp. *exoleta* (R. Br.) Taylor, Kew Bull. 18: 204, 1964; *U. exoleta* R. Br.: Clarke in Hook. f., Fl. Brit. India 4: 329, 1884.

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 base of leaf-segments. Flowers 2-4 mm across, yellow in 2 - 4 flowered racemes. Capsules 4-5 mm in diam., globose. Seeds lenticular, surrounded by crenulate corky wing.

Ecology : Frequent in tanks and ditches, not uncommon in the rice-fields along river banks.

Fl. & Fr. : August-September, October-December.

Distrib. : West Bengal, Orissa, Tamil Nadu, Kerala and Maharashtra coast.

6. *Utricularia graminifolia* Vahl., Enum. 1: 195. 1895; *U. caerulea* (non L.): Clarke in Hook. f., Fl. Brit. India 4: 331. 1884.

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. Capsules 1-2 mm in diam., globose, smooth. Seeds ellipsoid; testa reticulate with elongated areoles.

Ecology : Frequent on moist humus along the lee side of seashore; moist hill slopes and sometimes edges of small ditches along road side.

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

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka, Kerala and Maharashtra coast, Western ghats.

7. *Utricularia minutissima* Vahl, Enum. 1: 204. 1804; Clarke in Hook. f., Fl. Brit. India 4: 334. 1884.

Minute terrestrial herbs with many roots. Leaves 2-3 mm long, linear or linear spatulate; traps 1-2 mm across, subglobose, attached on stolons or on petioles. Flowers 2-3 mm long, bluish-purple, in 2-6 flowered racemes. Capsules 1-2 mm across, globose. Seeds minute, reticulate.

Ecology : Common on sandy slacks and moist sandy places along sea-shore; sometimes common under *Casuarina* plantation.

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

Distrib. : West Bengal, Orissa, Gujarat, Maharashtra and Karnataka.

8. *Utricularia polygaloides* Edgeworth, Proc. Linn. Soc. 1: 351. 1847. *U. reticulata* Smith var. *uliginosa* Clarke in Hook. f. Fl. Brit. India 4: 331. 1884.

Terrestrial herbs; roots numerous, in fascicles at base of scape. Leaves 6-8 x 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, eccentrically attached on stolons and petioles. Flowers 6-8 mm across, purple, in 6-8 flowered racemes. Capsules 2-3 mm in diam., ellipsoid, enclosed within calyx-lobes. Seeds obovoid, testa finely striate, scorbiculate.

Ecology : Common on moist sandy places and edges of sandy slacks along the coast; sometimes common under the *Casuarina* plantation.

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

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka, Kerala, Gujarat and Maharashtra coast.

9. *Utricularia scandens* Benj., Linnæa 20: 309. 1874; *U. wallichiana* Wt. Ic. t. 1572. 1850; Clarke in Hook. f., Fl. Brit. India 4: 332. 1884.

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. Capsules 2-2.5 mm in diam., subglobose. Seeds ellipsoid testa reticulate.

Ecology : Frequent in moist sandy areas and along road side humus.

Fl. & Fr. : August-October.

Distrib. : Hills of Deccan peninsula and coastal plains of Maharashtra, Tamil Nadu, Karnataka and Kerala.

10. *Utricularia stellaris* L. f., Suppl. 86, 1781; Clarke in Hook. f., Fl. Brit. India 4: 328. 1884.

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; pinnae 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, racemosely arranged on emerged scapes. Capsules 3-4 mm in diam., globose. Seeds tubular-prismatic, testa elongated.

Ecology : Frequent in sandy slacks along the coast; common in tanks and ditches.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Maharashtra coast.

GESNERIACEAE

KEY TO THE GENERA

- 1a. Seeds tipped with one or more hairs from hilum, one from the apex; epiphytic
under shrubs; leaves fleshy or leathery; stamens 4, usually perfect 1. *Aeschynanthus*
- 1b. Seeds not tipped with hairs; erect herbs; leaves with unequal bases;
stamens 2 perfect 2. *Rhynchoglossum*

1. *Aeschynanthus* Jack.

Aeschynanthus perrottetii DC. Prodr. 9: 261. 1845;
Clarke in Hook. f. Fl. Brit. India 4: 339. 1884.

Epiphytic climbers 1 m high. Leaves 6-9 x
1.5-2.5 cm linear lanceolate, fleshy, subcoriaceous, entire,
acuminate at apex, narrowed at base. Flowers scarlet with
purple line in solitary cymose. Capsule 12 cm long,

papery, linear, 2-valved. Seeds hairy at the end.

Ecology : Frequent on trees and rocks near moist hill
slopes and ghats facing seashore.

Fl. & Fr. : October-November; January-March.

Distrib. : Karnataka and Kerala coast.

2. *Rhynchoglossum* Blume.

Rhynchoglossum obliquum Bl. var. *parviflorum* Clarke
in Hook. f., Fl. Brit. India 4: 367. 1884.

Succulent herbs 50 cm high. Leaves 5-15 x
2-7 cm, elliptic-oblong, scabrid-pubescent or nearly
glabrous, acuminate at apex, unequal at base. Flowers
1 cm long, blue, in solitary or paired racemes. Capsules

0.4 cm long, ovoid. Seeds minute, ellipsoid.

Ecology : Frequent on moist, sandy pockets of the hill
slopes near the coast.

Fl. & Fr. : October-December.

Distrib. : Tamil Nadu, Mangalore and Karnataka coast.

BIGNONIACEAE

Dolichandrone (Fenzl) Seem.

Dolichandrone spathaceae (L. f.) Schum., Fl. Kais. Wilh.
Land 123. 1889; Clarke in Hook. f., Fl. Brit. India 4: 379.
1883. *D. rheedii* Seem, J. Bot. 8: 381. 1870.

Trees 6-10 m tall with large, handsome crown.
Leaves 16-20 cm, pinnately compound; leaflets 5-7,
opposite, each 5-6.5 x 1.5-2.5 cm, ovate-lanceolate,
glabrous, whitish brown beneath, entire, acute at apex,
unequal at base. Flower 2.5 cm long, white, fragrant,
opening at night arranged in terminal few flowered
racemes or panicles. Fruit 25-30 cm capsule, falcately

curved. Seeds many, rectangular with corky wings.

Ecology : Frequent along the tidal forests towards the
back side of mangroves. It prefers higher elevated lands
and less salinity in the mangrove forests.

Fl. & Fr. : April-June; July-September.

Distrib. : Sundarbans in West Bengal, Mahanadi delta in
Orissa and Andaman islands.

HYDROPHYLLACEAE

Hydrolea L.

Hydrolea zeylanica (L.) Vahl., Symb. Bot. 2: 46. 1791; Hook. f., Fl. Brit. India 4: 133. 1883.

Subsucculent, spreading herb, rooting at nodes. Leaves 3 x 1 cm, elliptic-oblong, chartaceous, glabrous above, pubescent below, acute at apex, truncate at base. Flowers 2 cm across, deep-blue, arranged in axillary or terminal racemes. Capsule 4 mm, globose, septicidal, hispid. Seeds minute, wrinkled.

Ecology : Frequent along the border of coastal wetland, rice fields and shallow ditches, mostly under fresh water influence.

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

Distrib. : West Bengal, Orissa (Cuttack), Tamil Nadu and Pondichery.

PEDALIACEAE

KEY TO THE GENERA

- 1a. Flowers axillary; stamens 4, didynamous, perfect; fruit hard or capsular :
 2a. Fruit indchiscent, with 4 spines on the margin; seeds 2 in each cell 2. *Petalium*
 2b. Fruit capsular, 2-valved, not spinous; seeds many in each cell 3. *Sesamum*
 1b. Flowers terminal racemes; stamens 4, 2 only perfect; fruit drupaceous 1. *Martynia*

1. *Martynia* L.

Martynia annua L., Sp. Pl. 618. 1753; Clarke in Hook. f., Fl. Brit. India 4: 386. 1884.

Erect herbs or under shrubs 50-150 cm tall, densely and viscidly covered with patent glandular hairs. Leaves 10-25 x 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.

Ecology : Frequent in waste places along the lee side of the seashore dunes, occasionally seen in the soil of old buildings and along road sides.

Fl. & Fr. : July-August, September-October.

Distrib. : Naturalised throughout Indian coast.

2. *Petalium* L.

Petalium murex L., Syst. Nat. ed 10, 1123, 1759; Clarke in Hook. f., Fl. Brit. India 4: 386. 1884.

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.

Ecology : Common along sandy shores, dry sandy places and scrubs along the river-banks.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

3. *Sesamum* L.

KEY TO THE SPECIES

- 1a. Erect herbs; leaves very variable 1. *indicum*
 1b. Prostrate branching herbs: leaves orbicular or obovate 2. *prostratum*

1. *Sesamum indicum* L., Sp. Pl. 634. 1753; *S. orientale* L.: Clarke in Hook. f., Fl. Brit. India 4: 387. 1884.

Herb, 75-150 cm high. Leaves 12 x 6 cm, elliptic to lanceolate, chartaceous, pubescent, lobed or serrate, subacute at apex, attenuate at base. Flowers 2.5 x 1.8 cm across, pink or white, in solitary axillary. Capsule 2 x 0.8 cm, oblong, bilateral, beaked. Seeds cream, brown or black.

Ecology : Commonly cultivated for oil seeds. Frequent on coastal dunes.

Fl. & Fr. : July-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Kerala coast.

2. *Sesamum prostratum* Retz., Obs. Bot. 4: 28. 1779; Clarke in Hook. f., Fl. Brit. India 4: 387. 1884.

Prostrate herb. Leaves 1.25-3.75 cm, orbicular or obovate, pubescent, entire, obtusely lobed, obtuse at apex, narrowed at base. Flowers 2.5 cm long, purple, axillary solitary. Capsule ovoid, compressed. Seeds black, reticulate.

Ecology : Frequent on road side and waste places along the coastal track.

Fl. & Fr. : July-December.

Distrib. : Tamil Nadu, Maharashtra and Karnataka coast.

ACANTHACEAE

KEY TO THE GENERA

- 1a. Upper lip of corolla obsolete :
 2a. Armed erect shrubs; leaves spiny; disc absent 1. *Acanthus*
 2b. Unarmed prostrate herbs or shrubs; leaves not spiny; disk present 5. *Biepharis*
 1b. Upper lip of corolla well developed :
 3a. Stamens 4, didynamous :
 4a. Flowers in condensed spike; capsule 2-4 seeded 12. *Lepidagathis*
 4b. Flowers in axillary whorls; capsule 8-10 seeded :
 5a. Calyx 5 partite; corolla-tube not cylindrical below :
 6a. Corolla distinctly 2-lipped 9. *Hygrophila*
 6b. Corolla subequally 5-lipped 8. *Hemigraphis*
 5b. Calyx 4 partite; corolla tube cylindrical below :
 7a. Flowers 1-sided; anther cells not mucronate 3. *Asystasia*
 7b. Flowers not 1-sided; anther cells mucronate 7. *Dyschoriste*
 3b. Stamens 2, equal :
 8a. Corolla tube as long as the lip; bracts present :
 9a. Calyx 4-partite, the anterior lobe bifid 4. *Barleria*
 9b. Calyx 5-partite, the anterior lobe not as above :
 10a. Inflorescence a disc spike; corolla crested :
 11a. Bracts 4-farious; placenta separating elastically 14. *Rungia*
 11b. Bracts not 4-farious; placenta not separating elastically 11. *Justicia*

- 10b. Inflorescence a cyme; corolla blotched within :
 12a. Seeds glabrous; anther cell bearded :
 13a. Capsule 4-seeded; flowers 1-sided on the peduncles 10. *Indoneesiella*
 13b. Capsule 8-seeded; flowers on all sides of peduncle 2. *Andrographis*
 12b. Seeds glochidiate; anther cells separated 13. *Peristrophe*
 8b. Corolla tube twice as long as the lip; bracts absent 6. *Dipteracanthus*

1. *Acanthus* L.

Acanthus ilicifolius L., Sp. Pl. 639. 1753; Clarke in Hook. f., Fl. Brit. India 4: 481. 1884.

Erect, ascending or scandent, thistly herbs or undershrubs, 0.3-2 m tall; stems terete, often provided with aerial roots, glabrous, except with two sharp spines in leaf axils. Leaves 5-11 x 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. Capsules 2-3 cm in diam., ovoid-oblong, compressed, apiculate, shining green or brown. Seeds reniform.

Ecology : More or less common in and around the mangroves along the banks of creeks and channels. Sometimes found gregarious along the bank of fresh water rivers. Usually shows a capacity for tolerating various ecological parameters.

Fl. & Fr. : April-June; September-December.

Distrib. : West Bengal, Andhra Pradesh, Orissa, Tamil Nadu, Karnataka, Maharashtra, Gujarat, Andaman and Nicobar island.

2. *Andrographis* Nees

Andrographis paniculata (Burm. f.) Wall. ex Nees, Wall Pl. As. Rar. 3: 116. 1832; Clarke in Hook. f., Fl. Brit. India 4: 501. 1884.

Much-branched, erect or often creeping perennial herbs, sometimes rooting at nodes; stems quadrangular, grooved, swollen at nodes. Leaves 3-7 x 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.

Ecology : Rare, along the seashores, river banks and scrub forests. Common along road sides and cultivated fields.

Fl. & Fr. : January-March.

Distrib. : Throughout the coastal plains.

3. *Asystasia* Blume.

Asystasia gangetica (L.) T. Anders., Thwaites, Enum 235. 1860. *A. coromandeliana* Nees.: Clarke in Hook. f., Fl. Brit. Ind. 4: 493. 1884.

A procumbent, perennial herb, of 30-60 cm high, usually dusky pubescent. Leaves 2-4.5 x 1-3 cm, ovate-gabrescent, rounded or suddenly narrowed at base, acute at apex. Flowers 3 cm across, yellow or white with purple

streaks, arranged in terminal racemes. Capsule 1.5 x 0.5 cm, beaked. Seed angular, 4 mm across.

Ecology : Fairly common in moist shaded places and rocky crevices near the coast.

Fl. & Fr. : October-November.

Distrib. : Andhra Pradesh, Tamil Nadu and Kerala Coast.

4. *Barleria* L.

Barleria prionitis L., Sp. Pl. 636. 1753; Clarke in Hook. f. Fl., Brit. Ind. 4: 482. 1884.

A thorny and prickly undershrub up to 1 m tall, armed with vertically branched axillary spines. Leaves 10.5 x 4 cm, elliptic, entire, acuminate or spine tipped apex. Flower 3 cm long, yellow, arranged on axillary or terminal spike, bracts 1-2 cm long, foliaceous. Capsule

ovoid, 1 seeded. Seed compressed.

Ecology : Common along the coastal scrubs and rocky crevices on sea shore.

Fl. & Fr. : December - June.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Saurashtra coast and Minicoy Island.

5. *Blepharis* A.L. Juss.

KEY TO THE SPECIES

1a. Under shrubs; outer calyx lobes 2-fid; flowers not white :

2a. Leaves ovate, not recurved; margin entire 2. *repens*

2b. Leaves linear, recurved; margin toothed 3. *indica*

1b. Prostrate herbs; outer calyx lobes undivided; flowers white 1. *maderaspatensis*

1. *Blepharis maderaspatensis* (L.) Heyne ex Roth, Nov. Pl. Spec. 320. 1821. *B. boerhavifolia* Pers.: Clarke in Hook. f., Fl. Brit Ind. 4: 478. 1884.

A prostrate herb, stem hairy. Leaves whorled, 2.5-7.5 x 1-2.5 cm, oblong-lanceolate, membranous, glaucous beneath, entire or distantly toothed in upper part, acute or acuminate at apex, cuneate at base. Flower 1.2 cm across, white with pink nerves, axillary solitary or 2-4 together. Capsule 8 x 4 mm, glossy, 2 seeded. Seeds orbicular, flattened, 4 x 3.5 mm.

Ecology : Frequent on calcareous sandy coast and on sea shore boulders.

Fl. & Fr. : November-December.

Distrib. : Tamil Nadu: Rameswaram island, Kanya Kumari, Trinavelly and Ramanathapuram coastal areas.

2. *Blepharis repens* (Vahl) Roth, Nov. Pl. Sp. 321. 1821. *B. molluginifolia* Pres.: Clarke in Hook. f., Fl. Brit India 4: 479. 1884.

A undershrub with creeping rootstock and diffuse stem of 6-1 m long. Leaves 1 x 0.5 cm, ovate-oblong, coriaceous, entire, pubescent. Flower solitary, pale blue

with white bracteoles. Capsule 6 mm long, compressed, glabrous, closely surrounded by bracteoles and sepals, 2 seeded. Seeds 4 mm long, ellipsoid, compressed.

Ecology : Common on the lee side of sand dunes and rocky crevices near the sea.

Fl. & Fr. : August-September.

Distrib. : Andhra Pradesh, Tamil Nadu and Kerala coast.

3. *Blepharis indica* T. Anders., Journ. Linn. Soc. 9: 500. 1867; Clarke in Hook. f., Fl. Brit Ind. 4: 479. 1884.

A small dichotomously branched undershrub, stems very short, slender, subterete, clothed. Leaves 3-5 x 0.2-0.4 cm, linear or narrowly oblong, pubescent, recurved, toothed. Flower 8-12 mm long, arranged in strobilate spike, 2-8 cm long. Capsule 7 mm long, compressed, ellipsoid, glabrous, 2 seeded. Seeds 5 mm in diam., hairy.

Ecology : Rare on dry calcareous rocks along the coast and on sand stones near the sea.

Fl. & Fr. : July-October.

Distrib. : Maharashtra, Gujarat and Tamil Nadu coast.

6. *Dipteracanthus* Nees

KEY TO THE SPECIES

- 1a. Erect herbs. Leaves adpressed hairy 1. *patulus*
 1b. Prostrate herbs. Leaves strigose 2. *prostratus*

1. *Dipteracanthus patulus* (Jacq.) Nees., Wall. Pl. As. Rar. 3: 81. 1832; *Ruellia patula* Jacq.: Clarke in Hook. f., Fl. Brit Ind. 4: 412. 1885.

Erect or suberect much branched herb up to 50 cm, rooting at lower nodes, pubescent. Leaves 1-3 x 0.5-2 cm, ovate-elliptic, subentire, acute at apex, narrowed at base. Flower 3 cm long purple, axillary, solitary or 2-3 together arranged in cyme. Capsule 1.7 x 0.6 cm, elliptic, acute.

Ecology : Common on moist sands and river banks.

Fl. & Fr. : June-November.

Distrib. : Andhra Pradesh, Tamil Nadu and Kerala coast. Divi island, Lakshadweep and Andaman islands.

2. *Dipteracanthus prostratus* (Poir.) Nees, Wall., Pl. As. Rar. 3: 81. 1832; Clarke in Hook. f., Fl. Brit Ind. 4: 412. 1884.

A small procumbent herb up to 50 cm. Leaves 2.5-4.4 x 1-2.1 cm, ovate-elliptic, sparsely hairy, entire, truncate at base, subacute at apex. Flower 2.5 x 1.3 cm across, blue or violet, axillary, solitary. Capsule 1.5 x 0.7 cm, pubescent. Seeds 4 mm across.

Ecology : Common along the backshore forests and arable lands as well as in coastal scrubs.

Fl. & Fr. : April-June.

Distrib. : Coral islands of Lakshadweep and Andaman, Tamil Nadu, Kerala and Saurashtra coast.

7. *Dyschoriste* Nees.

Dyschoriste madurensis (Burm. f.) O. Kuntze, Rev. Gen. Pl. 486. 1891. *Calophanes littoralis* (L. f.) T. Anders.: Clarke in Hook. f., Fl. Brit. Ind. 4: 410. 1884.

Undershrub up to 75 cm tall with whitish bark. Leaves 1.5-0.7 cm oblong-spathulate, glabrescent to grey-pubescent cuneate at base, emarginate at apex. Flower

1.2 cm across, pinkish purple, solitary. Fruit 1.2 x 0.3 cm. Seed 3 mm.

Ecology : Frequent on coastal plains, gravelly wastelands.

Fl. & Fr. : December-March.

Distrib. : Andhra Pradesh, Tamil Nadu and Pondichery coast.

8. *Hemigraphis* Nees

Hemigraphis hirta (Vahl) T. Anders., J. L. Soc. 9: 462. 1867; Clarke in Hook. f., Fl. Brit. Ind. 4: 422. 1884.

Erect or prostrate herb. Stem up to 60 cm long, 4-gonous, hirsute-villous. Leaves 2.5 x 1.5 cm, ovate or elliptic, crenate, rounded at base, acute or obtuse at apex. Flower pale lavender-blue, 2-6 flowers arranged in heads. Capsule up to 1 cm, linear cylindric, glabrous, about

12 seeded. Seeds compressed.

Ecology : Common in dry wastelands and along the margins of roads near the coast.

Fl. & Fr. : March-July.

Distrib. : West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coast.

9. *Hygrophila* R. Brown

KEY TO THE SPECIES

- 1a. Armed, strigose-hispid herbs; calyx lobes 4; ovules 8 1. *auriculata*
 1b. Unarmed, erect or prostrate herbs; calyx lobes 5; ovules more than 8 :
 2a. Procumbent herbs; flowers in terminal spike 2. *polysperma*
 2b. Erect herbs; flowers in axillary whorls 3. *quadrivalvis*

1. *Hygrophila auriculata* (Schumach.) Heine., Kew Bull. 16(2): 172. 1962. *H. spinosa* T. Anders.: Clarke in Hook. f., Fl. Brit Ind. 4: 408. 1884.

Stout erect, less branched herb 30-60 cm, with white, hispid quadrangular stem. Leaves 12-17 x 1.2-2.3 cm, oblong-lanceolate or linear-lanceolate, scabrous, margin minutely dentate, narrowed down at base, acute or subacute at apex, thorns curved or straight. Flowers 3-6 mm across, purple, about 8, arranged in axillary whorls. Capsule 6-8 mm long, linear-oblong, apex pointed, 4-8 seeds.

Ecology : Common on the margins of wetland, moist sandy places and marshy ground near the coast.

Fl. & Fr. : October-November.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala and Saurashtra coast.

2. *Hygrophila polysperma* (Roxb.) Ander., J. L. Soc. Bot. 9: 456. 1867; Clarke in Hook. f., Fl. Brit Ind. 4: 406. 1884.

Erect, suberect or procumbent, pubescent or glabrous, rooting at the basal nodes, branches 15-50 cm

long. Leaves 3 x 1.3 cm, elliptic-oblong or elliptic-ovate, glabrous, entire, acute or narrowed down at base, acute or obtuse or round at apex. Flowers pale blue or white, 0.6 cm, arranged in terminal spike. Capsule 0.6-0.8 cm long, narrowly oblong, 20-32 seeded.

Ecology : Common on margins of paddy fields, channels, ditches and other damp places near the coast.

Fl. & Fr. : October-February.

Distrib. : West Bengal, Orissa and Tamil Nadu coast.

3. *Hygrophila quadrivalvis* (Buch. -Ham.) Nees, Wallich, Pl. As. Rar. 3: 80. 1832; Clarke in Hook. f., Fl. Brit. India 4: 408. 1884.

Erect herb up to 50 cm tall. Leaves 14 x 2.5 cm, obovate or lanceolate, abruptly cuneate, decurrent, margin entire to crenate, base rounded, obtuse at apex. Flower 7 x 0.3 mm across, pink or violet, arranged in axillary whorls. Capsule 2.5 x 1.5 mm, narrowly oblong, glabrous.

Ecology : Common in moist sandy places near the coast.

Fl. & Fr. : November-February.

Distrib. : Karnataka and Kerala coast.

10. *Indoneesiella* Sreemadhavan

Indoneesiella echioides (L.) Sreemadh., Phytologia 16: 466. 1968. *Andrographis echioides* (L.) Nees.: Clarke in Hook. f., Fl. Brit Ind. 4: 505. 1885.

Erect annual herb of 20-60 cm high, hirsute. Leaves 2-7 x 0.7-2 cm, sessile, elliptic-oblong or elliptic-pubescent, cuneate at base, obtuse at apex. Flower 1.3 cm long, white or pink arranged in axillary racemes.

Capsule 10 x 3.5 mm, elliptic-oblong, acute at both ends glandular, pubescent. Seeds twice as long as broad.

Ecology : Frequent along the back shore waste land, fallow ground and coastal rocks.

Fl. & Fr. : July-August.

Distrib. : Tamil Nadu, Karnataka, Saurashtra and Kerala coast.

11. *Justicia* L.

KEY TO THE SPECIES

- 1a. Shrub; anther cells parallel, connective narrow 1. *adhatoda*
 1b. Diffuse herbs or under shrubs; anther cells divergent; connectives broad :
 2a. Bracteoles as long as calyx, lobes not linear :
 3a. Bracts obovate, hairs simple 4. *procumbens*
 3b. Bracts ovate-oblong; hairs jointed 3. *japonica*
 2b. Bracteoles shorter than calyx, lobes linear :
 4a. Inflorescens long up to 5 cm, capsule hairy, seeds not hispid 5. *prostrata*
 4b. Inflorescens long up to 12.5 cm, capsule glabrous, seeds hispid 2. *glauca*

1. *Justicia adhatoda* L., Sp. Pl. 15. 1753. *Adhatoda vasica* Nees.: Clarke in Hook. f., Fl. Brit. Ind. 6: 540. 1885.

Shrub or small tree, 1-2.5 m tall, young part tomentose. Leaves 12-15 x 3-5 cm, elliptic or elliptic-lanceolate, thin coriaceous, entire to minutely crenate, obtuse or acute at base, acuminate at apex. Flower 1.5 x 1 cm across, cream-white, arranged in dense leafy bracts on axillary spikes. Capsule 2 cm long, basally beaked, pubescent, seeds 4, orbicular, rugose.

Ecology : Frequent along the back shore bushes and coastal rocky crevices.

Fl. & Fr. : November-March (Plains); October (Hills)

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

2. *Justicia glauca* Rottler, Ges. Naturf. Ferunde Berlin Schriften 4: 219. 1803; Clarke in Hook. f., Fl. Brit. Ind. 4: 529. 1885.

A diffuse herb of 0.3-0.6 m tall with purple stems and pubescent branches swollen at bases. Leaves 3-5 x 2-3 cm, ovate-elliptic pubescent, acute at base and apex. Flowers 8 x 3 mm, solitary, whitish-pink, arranged on spike. Capsule 1 x 0.5 cm, glabrous, 4 seeded.

Ecology : Occasional on sandy coast and rocky crevices along the sea.

Fl. & Fr. : November-December.

Distrib. : Orissa, Andhra Pradesh and Tamil Nadu coast.

3. *Justicia japonica* Thunb., Fl. Jap. 20. 1784. *J. simplex* D. Don.: Clarke in Hook. f., Fl. Brit. Ind. 4: 539. 1885.

A prostrate or suberect hairy herb, branches slender, 4-angular, up to 30 cm long. Leaves up to 2 x 0.6 cm, elliptic or ovate, scabrous above, glabrescent to strigose below, obtuse at base, subacute at apex.

Flowers 4 x 2 mm across, pink arranged on terminal spike. Capsule 4 x 1.5 mm, oblong, sparsely hairy, pointed, seeds 1 mm across.

Ecology : Frequent on rocky slopes on sea shore.

Fl. & Fr. : December-March.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka and Saurashtra coast.

4. *Justicia procumbens* L., Sp. Pl. 15. 1753; Clarke in Hook. f., Fl. Brit. Ind. 4: 539. 1885.

A diffuse herb. Branchlets strigose-hispid, 20-30 cm. Leaves 1-2 x 0.7-1 cm, elliptic, scabrous above, glabrescent to strigose below, acute at both ends. Flower pink, 6 x 3 mm across, arranged on terminal spike. Capsule 4 x 1.5 mm oblong, sparsely hairy, pointed, seeds 1 mm across.

Ecology : Common on sandy beaches and rocky crevices along the shore.

Fl. & Fr. : December-March.

Distrib. : West Bengal, Orissa, Saurashtra, Karnataka and Kerala coast.

5. *Justicia prostrata* (Cl.) Gamble, Fl. Pres. Mad. 2: 108. 1924. *J. diffusa* L. var. *prostrata* Clarke in Hook. f., Fl. Brit. India 4: 538. 1885.

Diffuse, creeping herbs with quadrangular, puberulose stems. Leaves 3-20 x 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. Capsules 3 mm across, ellipsoid. Seeds suborbicular, curved.

Ecology : Frequent along sea-shores in waste places, locally common along road sides, and grass fields.

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

Distrib. : Throughout the coastal districts.

12. *Lepidogathis* Willd.

Lepidogathis cristata Willd., Sp. Pl. 3: 400. 1800; Clarke in Hook. f., Fl. Brit. Ind. 4: 516. 1885.

A procumbent herb with branched stem of 15-45 cm tall, stem 4 angular puberulous. Leaves 4-6 x 0.5-0.8 cm linear-lanceolate, scabrid-pubescent, entire to serrulate, acute at apex. Flower 8 x 4 mm across, pinkish, arranged in condensed ovoid spikes. Capsule 6 x 2 mm

oblong, compressed, seeds 2, 3 x 6.5 mm.

Ecology : Common on rocky and gravelly coast land and in waste places.

Fl. & Fr. : November-February.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat coast, Lakshadweep and Andaman island.

13. *Peristrophe* Nees

Peristrophe paniculata (Forsk.) Brummitt, Kew Bull. 38: 451. 1983; *P. bicalyculata* (Retz.) Nees: Clarke in Hook. f., Fl. Brit. Ind. 4: 554. 1885.

An erect hispid herb up to 1.5 m tall, stem hairy towards the apex, 4 angular. Leaves 5 x 2.8 cm, ovate, entire, rounded at base, acuminate at apex. Flower rose or purple, 2-5 arranged in cymose panicle. Capsule

1.2 x 3 mm ellipsoid, acuminate, 4 seeded. Seeds orbicular 2.5 mm across, papilose.

Ecology : Frequent along the river banks and moist sandy wastelands near the coast.

Fl. & Fr. : November - February.

Distrib. : Maharashtra, Gujarat and Saurashtra coast.

14. *Rungia* Nees

KEY TO THE SPECIES

1a. Barren bracts and flowering bracts similar; flowers violet 2. *repens*

1b. Barren bracts and flowering bracts very different; flowers bluish 1. *pectinata*

1. *Rungia pectinata* (L.) Nees, DC. Prodr. 11: 469. 1847; *R. perviflora* Nees var. *pectinata* (L.) Clarke in Hook. f., Fl. Brit. India 4: 550. 1884.

Much-branched, diffuse or often erect herbs; stems quadrangular, puberulent, sometimes rooting at lower nodes. Leaves 0.6-4.5 x 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. Capsules 3 mm long, oval, shortly acuminate. Seeds discoid, compressed.

Ecology : Frequent in sandy waste places near the coast, common in fields and along road sides.

Fl. & Fr. : November-December; January-March.

Distrib. : Throughout the coastal plains.

2. *Rungia repens* (L.) Nees in Wallich, Pl. As. Rar. 3 : 110. 1832; Clarke in Hook. f., Fl. Brit. India 4: 549. 1885.

A spreading procumbent or erect herb, rooting at lower nodes. Leaves 1-7 x 0.5-2.3 cm, opposite, elliptic-oblong, entire. Flower 8 mm long, violet with dark maroon spots, arranged in terminal spike. Capsule 5 x 2 mm, ovoid-oblong, pale brown, compressed, acute and pubescent.

Ecology : Common in moist sandy beaches, river banks and coastal scrubs.

Fl. & Fr. : March-April; September-October.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Gujarat coast.

VERBENACEAE

KEY TO THE GENERA

1a. Flowers in spikes; actinomorphic :

2a. Trailing herbs, rooting at nodes 3. *Phyla*

2b. Erect herbs or undershrubs, not rooting at nodes :

3a. Stamens 4; anthers ovate 2. *Lippia*

3b. Stamens 2; anthers divaricated 5. *Stachytarpheta*

1b. Flowers not in spikes; zygomorphic :

4a. Leaves digitately compound 6. *Vitex*

4b. Leaves simple :

5a. Drupes ovoid, 4-lobed, breaking into 4-pyrenes 1. *Clerodendrum*

5b. Drupes globose, 1-lobed with 1-pyrene 4. *Premna*

1. *Clerodendrum* L.

KEY TO THE SPECIES

- 1a. Straggling shrubs; calyx minutely toothed 2. *inerme*
 1b. Erect undershrubs or shrubs; calyx deeply lobed :
 2a. Leaves glabrous, linear lanceolate 1. *indicum*
 2b. Leaves tomentose, broadly ovate 3. *petasites*

1. *Clerodendrum indicum* (L.) O. Kuntze, Rev. Gen. et Sp. Pl. 506, 1891. *C. siphonanthus* R. Br.: Clarke in Hook. f., Fl. Brit. India 4: 595. 1885.

Erect, perennial shrubs, 1-3 m tall; stems sparingly branched, glabrous, fistular with subterraneous stolons. Leaves 4-18 x 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.

Ecology : Frequent along the embankments and borders of low-lying areas; cultivated for medicinal value.

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

Distrib. : Throughout the coastal plains and hill slopes.

2. *Clerodendrum inerme* (L.) Gaertn., Fruct. 1: 271, t. 75. 1788; Clarke in Hook. f., Fl. Brit. India 4: 589. 1885.

Straggling, much branched shrubs 1-3 m tall; branches adpressed pubescent when young. Leaves 1.5-6 x 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. Drupes 1.5-2 cm long, obovoid, 4-lobed, breaking into 4-pyrenes.

Ecology : Common along the intertidal zones of creeks and channels, sporadic towards back mangroves.

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

Distrib. : Throughout the wet coastal plains and backwaters. Sometimes it is used as good inland hedges.

3. *Clerodendrum petasites* (Lour.) Moore, J. Bot. 63: 285. 1925; *C. infortunatum auct. non L.*: Clarke in Hook. f., Fl. Brit. India 4: 594. 1885.

Erect perennial undershrubs; stems pithy, quadrangular, sulcate, tomentose when young. Leaves 15-20 x 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.

Ecology : Common, along the river-sides and road-sides, rare along the coast line.

Fl. & Fr. : February-March; April-May.

Distrib. : Throughout the East coastal districts.

2. *Lippia* L.

Lippia alba (Mill.) N. E. Br. ex Britton & Wilson, Sc. Surv. Porto Rico 6: 141. 1925; *L. geminata* H. B. & K.: Clarke in Hook. f., Fl. Brit. India 4: 563. 1885.

Erect, aromatic shrubs up to 2 m tall; stems loosely branched, puberulose, quadrangular. Leaves 7.5-9 x 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.

Ecology : Frequent in low-lying areas and waste places specially along the border of tanks and ditches.

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

Distrib. : Throughout the coastal districts, introduced and naturalised in India.

3. *Phyla* Lour.

Phyla nodiflora (L.) Green, Pitt. 4: 46. 1899; *Lippia nodiflora* (L.) A. Rich.: Clarke in Hook. f., Fl. Brit. India 4: 563. 1885.

Creeping perennial herbs with long tap root; stems quadrangular, sparsely adpressed-pubescent, rooting at nodes. Leaves 2.5-3 x 1.5-2 cm, subsessile, 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.

Ecology : Frequent on moist sandy places forming dense mats along the sea-shore; common on reclaimed soil.

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

Distrib. : Throughout the coastal plains and islands

4. *Premna* L.

KEY TO THE SPECIES

- 1a. Shrubs leaf apex acuminate; stamens included within corolla 1. *corymbosa*
- 1b. Trees, leaf apex acute; stamens exserted :
 - 2a. Leaves softly pubescent below, entire 2. *latifolia*
 - 2b. Leaves glabrous below, crenate 3. *serratifolia*

1. *Premna corymbosa* (Burm. f.) Rottl. & Willd., Ges. Nat. Fr. Neusch. 4: 87. 1803; Clarke in Hook. f., Fl. Brit. India 4: 573. 1885.

Shrubs or small trees, 2-10 m tall; stems glabrous, lenticellate; branches smooth, aromatic. Leaves very variable, 1.5-9 x 1-5.5 cm, oblong or ovate-oblong, glabrous or puberulose, 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.

Ecology : Frequent along the intertidal regions of creeks and channels, sometimes found along the lee sides of seashore and in cultivated land.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra coast.

2. *Premna latifolia* Roxb., Fl. Ind. 3: 76. 1832; Clarke in Hook. f., Fl. Brit. India 4: 577. 1885.

Small tree up to 4 m. Leaves 4-6 x 3-6 cm, ovate, chartaceous, glabrous above, softly pubescent below,

acute at apex, rounded at base. Flowers white, 4 mm across in terminal or axillary corymbs. Drupe 3-5 mm across, red when ripe.

Ecology : Frequent on back mangroves, coastal hill slopes and river banks.

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

Distrib. : Tamil Nadu, Karnataka and Maharashtra coast.

3. *Premna serratifolia* L., Mant. Pl. 253. 1771; *P. integrifolia* L.: Clarke in Hook. f., Fl. Brit. India 4: 574. 1885.

Small bushy tree. Leaves 5-10 x 3-6 cm, elliptic oblong, thin coriaceous, crenate, shortly acute at apex, cordate at base. Flowers 3.5 mm across, greenish white in terminal corymbs. Drupe 3-4 mm across with accrescent calyx.

Ecology : Frequent on back mangroves, coastal scrubs and river banks.

Fl. & Fr. : January-April; July-September.

Distrib. : Maharashtra, Gujarat, Tamil Nadu and Karnataka coast. Also in Andaman islands.

5. *Stachytarpheta* Vahl

Stachytarpheta jamaicensis (L.) Vahl, Enum. Pl. 1: 206. 1804; *S. indica auct. non* (L.) Vahl: Clarke in Hook. f., Fl. Brit. India 4: 564. 1885.

Undershrub up to 50 cm; branchlets glabrescent. Leaves 4-9 x 2.5-5 cm, obovate-elliptic, serrate, apex and base acute. Flowers 0.8-1 cm, bluish to violet in terminal spikes. Fruits cylindrical, 2 or 1 seeded, hard

pyrenes. Seeds oblong.

Ecology : Widespread along stream banks, fallow fields and scrub forest along the coastal plains and hills.

Fl. & Fr. : December-March.

Distrib. : Throughout the west coastal district.

6. *Vitex* L.

KEY TO THE SPECIES

- 1a. Leaves 1-3 foliolate; leaflets obovate, oblong, sessile 2. *trifolia*
 1b. Leaves 3-5 foliolate; leaflets lanceolate with petioles 1. *negundo*

1. *Vitex negundo* L., Sp. Pl. 638. 1753; Clarke in Hook. f., Fl. Brit. India 4: 583. 1885.

Shrubs or small trees 2-4 m tall; branches densely tomentose when young. Leaves decussate opposite, aromatic, 3-5 foliolate; leaflets 5.5-7 x 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.

Ecology : Frequent along the river banks and road sides near the coast.

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

Distrib. : Throughout the Eastern coast. Maharashtra, Gujarat and Kerala coastal plain.

2. *Vitex trifolia* L., Sp. Pl. 638. 1753 & Syst. Ved (ed. 13) 483. 1774; Clarke in Hook. f., Fl. Brit. India 4: 583. 1885.

Shrubs 1-2 m tall. Leaves 1-3 foliolate; leaflets 5-9 x 2-4 cm ovate oblong, gray-pubescent, entire, cuneate at base, subobtusate or acute at apex. Flowers 5-6 mm across, white, arranged in terminal panicles. Fruit globose or ovoid drupe supported by enlarged calyx.

Ecology : Frequent along margin of coastal bankwater, back mangroves and roadside of salt marshes.

Fl. & Fr. : September-December.

Distrib. : Mostly throughout the West coast, Karnataka, Goa and Kerala coastal region.

AVICENNIACEAE

Avicennia L.

KEY TO THE SPECIES

- 1a. Inflorescences spiciform; leaves lanceolate; capsules ellipsoid 1. *alba*
 1b. Inflorescences umbellate; leaves obovate or elliptic; capsules ovoid :
 2a. Trees 10-30 m tall; leaves obovate; capsules beaked 4. *officinalis*
 2b. Shrubs or trees 0.5-6 m tall; leaves elliptic; capsules apiculate :
 3a. Trees 3-6 m tall, not bushy; leaves with distinct petioles, acute or obtuse at apex 2. *marina*
 3b. Shrubs, 0.5-1 m tall, bushy; leaves sessile or subsessile, sharply acuminate at apex 3. *marina* var. *acutissima*

1. *Avicennia alba* Blume, Bijdr. Fl. Neder. Ind. 821, 1826.
A. officinalis (L.) var. *alba* (Bl.) Clarke in Hook. f., Fl. Brit. India 4: 604. 1885.

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 x 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. Capsules 3-4 cm long, ovoid or ellipsoid, narrowly acuminate, slightly curved at apex, densely tomentellous throughout.

Ecology : 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*.

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

Distrib. : Throughout the East coastal areas specially mouth of the rivers and in Andamans.

2. *Avicennia marina* (Forsk.) Vierh., Denkschr. Akad. Wien. Math. Nat. 71, 435. 1907.

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. Capsules ovoid, half the size of *Avicennia officinalis*, apiculate at apex.

Ecology : Common along the eu-estuarine borders and muddy coast, under the influence of high salinity and silty-soils, usually in association with *A. alba*, *Bruguiera parviflora* and *Sonneratia crassularis*. Sometimes they are found as a pure stands in the inhabited regions near the coast which forms a climax with spontaneous regeneration. Commonly this species marks the first pioneer stage in the development of the littoral forests and ending of the mangroves to the sea-shore proper.

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

Distrib. : Throughout the coastal wetlands specially along the river mouth and Andamans.

3. *Avicennia marina* (Forsk.) Vierh. var. *acutissima* Stapf & Moldenke in Phytologia 1: 411. 1940 et Phytologia 7(4): 225. 1960.

Shrubs, 50-100 cm tall, bushy; stem glabrous, yellowish-white. Leaves 6-7.5 x 2.5-3 cm, elliptic, dark green, shining above, white pulverulent beneath, sharply acute or acuminate at apex, cuneate at base; petioles absent or very short (1-3 mm). Flowers 2-3 mm across, yellow in terminal cymes. Capsules ovoid, apiculate at apex.

Ecology : Common in degraded mangrove swamps or in salt marshes along the estuarine bay.

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

Distrib. : Throughout the coastal wetlands specially along the mud flats of Gujarat and Mumbai.

4. *Avicennia officinalis* L., Sp. Pl. 110. 1753; Clarke in Hook. f., Fl. Brit. India 4: 604. 1885.

Trees, 10-30 m tall, 70-150 cm in diam.; stems glabrous, much-branched; bark thin, ash-coloured, taproot absent; pneumatophores 10-50 cm long, straight, pointed, lenticellate, often forked with hook-like bending at apex. Leaves 6-10 x 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. Capsules broadly ovoid, almond-shaped, densely silvery papillose, beaked at apex.

Ecology : 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 being usually found in association with *Sonneratia apetala*, *Heritiera fomes* and *Ceriops decandra*.

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

Distrib. : Throughout the coastal areas and islands in Andamans.



Ehretia acuminata



Argusa argentea



Utricularia stellaris



Acanthus ebracteatus



Acanthus ilicifolius



Ipomoea pes-caprae



Avicennia alba



Avicennia marina



Avicennia marina var. *acutissima*



Avicennia officinalis

LAMIACEAE

KEY TO THE GENERA

- 1a. Stamens erect or ascending :
- 2a. Corolla not 2-lipped; stamens 4, equal or subequal :
- 3a. Corolla equally 4-fid, spreading; stamens not exerted 9. *Pogostemon*
- 3b. Corolla subequally 4-fid, not spreading; stamens exerted 10. *Eusteralis*
- 2b. Corolla 2-lipped; stamens 2, if 4, then didynamous :
- 4a. Calyx limb 5 lobed; lobes acuminate at apex; mouth uniformly level. Upper lip of corolla nearly flat 3. *Anisomeles*
- 4b. Calyx limb 8 to 10 toothed; lobes aristate or spinose at the apex; mouth generally oblique. Upper lip of corolla hooded 7. *Leucas*
- 1b. Stamens declinate :
- 5a. Lower lip of corolla deflexed, concave or boat shaped :
- 6a. Corolla 5-lobed, lowest lobe shorter or equalling the lobes, abruptly deflexed, saccate, contracted at base 6. *Hyptis*
- 6b. Corolla distinctly 2-lipped; lower lip longer than the upper, concave or boat-shaped 2. *Anisochilus*
- 5b. Lower lip of corolla declinate, flat or nearly so :
- 7a. Fruiting calyx deflexed, upper lobe recurved; the margins decurrent on the tube 8. *Ocimum*
- 7b. Fruiting calyx sub-erect or declinate; upper lobe not recurved; margins not decurrent :
- 8a. Corolla lobes subequally 4 lobed 1. *Acrocephalus*
- 8b. Corolla 2 lipped :
- 9a. Upper lip distinctly 4 fid, lower declinate entire 5. *Geniosporum*
- 9b. Upper lip shortly 4 fid, lower with 4 flat lobes 4. *Basilicum*

1. *Acrocephalus* Benth.

Acrocephalus indicus (Burm.f.) O. Kuntze, Rev. Gen.Pl. 511. 1891; *A. capitatus* Benth.: Hook.in Hook. f., Fl. Brit. India 4: 611.1885.

Slender annual herb up to 30 cm tall. Leaves 2-4 x 0.6-1.2 cm, ovate or lanceolate, glabrous, serrate, acute or subacute at apex, narrowed at the base. flowers 4-5 mm long, pale purple, in terminal globose or cylindrical

heads. Nutlets 1 mm long, oblong-ellipsoid, smooth, brownish-black.

Ecology : Frequent on hill slopes, coastal scrubs and coral strands.

Fl. & Fr. : October onwards.

Distrib. : Mysore, Kerala, Minicoy Island, Androth Island.

2. *Anisochilus* Wall. ex Benth.

Anisochilus carnosus Wall., Pl. As. Rar. 2:18.1831; Hook. in Hook. f., Fl. Brit. India 4: 627.1885.

Erect annual herb, 30-60 cm high. Leaves 5-7 x 4 cm, broadly ovate, fleshy, glabrous above, puberulous below, crenate, obtuse at apex, cordate or rounded at base. Flowers 8 mm long, pale-purple, in dense cylindrical spike.

Nutlets 1 mm long, orbicular, smooth, glossy, brown.

Ecology : Common on back shore sand and coastal sand bars.

Fl. & Fr. : August-October.

Distrib. : Kerala coast.

3. *Anisomeles* R. Br.

Anisomeles indica (L.) O. Kuntze, Rev. Gen. Pl. et Sp. Pl. 512. 1891; *A. ovata* R. Br.: Hook. in Hook. f., Fl. Brit. India 4: 672. 1885.

Aromatic, tomentose herbs or undershrubs; stems quadrangular, often spreading. Leaves 5-8 x 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. Nutlets ovoid, smooth, shining.

Ecology : Frequent on waste sandy places along the river banks, coastal thickets and road sides.

Fl. & Fr. : September-October; December-January.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

4. *Basilicum* L.

Basilicum polystachyon (L.) Moench, Suppl. Meth. 143. 1802; *Moschosma polystachyum* (L.) Benth.: Hook. in Hook. f., Fl. Brit. India 4: 612. 1885.

Annual erect herbs, 5-7.5 cm tall. Leaves 2.5-5 cm long, ovate-deltoid, membranous, crenate, acuminate at apex, truncate at base. Flowers 1.6 mm long,

pale pink, in axillary and terminal paniculate raceme. Nutlets ellipsoid, smooth, black.

Ecology : Frequent in Bay islands and back shore scrubs.

Fl. & Fr. : October-November; January-March.

Distrib. : Throughout the west peninsular coast.

5. *Geniosporum* Wall ex Benth.

Geniosporum tenuiflorum (L.) Merr., Philip. J. Sci. 19: 379.1921; *Geniosporum prostratum* (L.) Benth.: Hook. in Hook. f., Fl. Brit. India 4: 610. 1885.

Prostrate, much-branched, hirsutely hairy herbs, Leaves 1.5-2 x 0.2-0.3 cm, linear or linear-lanceolate, hairy on both the surface, acute at apex, obtuse at base. Flowers 1-1.5 cm long, reddish purple or bluish white in axillary verticillasters. Nutlets 2 mm across, brown.

Ecology : Common along sandy sea shore and sand dunes in association with *Hydrophyllax maritima*

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

Distrib. : Starts from Orissa coast, Andhra Pradesh, Tamil Nadu, Maharashtra, Gujarat and Saurashtra coast.

6. *Hyptis* Jacq.

Hyptis suaveolens (L.) Poit., Ann. Mus. Hist. Nat. Paris 7: 472, t. 29, f. 2, 1806; Hook. in Hook. f., Fl. Brit. India 4: 630.1884.

Erect aromatic herbs, 30-150 cm tall; stems hispid, quadrangular. Leaves 4-6.5 x 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, fasciated on the top of 8-25 mm long peduncles; bracts

filiform or spatulate with long hairs. Nutlets ovoid, dark brown.

Ecology : Frequent in waste places along the lee side of the sand dunes; common along road sides and forests.

Fl. & Fr. : October-November; December-February.

Distrib. : Throughout the coastal plains.

7. *Leucas* R. Br.

KEY TO THE SPECIES

- 1a. Longer side of the calyx mouth anterior, tube prominently ribbed 5. *urticaefolia*
 1b. Longer side of the calyx mouth posterior, tube various :
 2a. Mouth of the calyx-tube very oblique, the upper tooth long, the rest smaller :
 3a. Bracts linear, finely pubescent, not long ciliate corolla with lower lip long and broad 2. *lavandulifolia*
 3b. Bracts linear, villous and long ciliate, corolla various :
 4a. Calyx-tube uniform, prominently nerved; corolla small, upper and lower lip equal 6. *wightiana*
 4b. Calyx-tube glabrous in the lower half, hairy upper half; not prominently nerved; corolla large, upper lip half as long as lower lip 3. *plukenetii*
 2b. Mouth of the calyx tube slightly oblique, teeth subequal :
 5a. Calyx teeth subulate, the tube white villous, ribbed and bristly near mouth, glabrous below 4. *stricta*
 5b. Calyx teeth triangular, the tube curved, ribbed, hispid and bristly throughout 1. *diffusa*

1. *Leucas diffusa* Benth., Labiat. Gen. Sp. 615. 1834; Hook. in Hook. f., Fl. Brit. India 4: 689. 1885.

Hirsute herb up to 40 cm high. Leaves 1-3 x 0.4-0.8 cm, oblong, chartaceous, hispid below, entire, subacute-obtuse at apex, cuneate at base. Flowers 11 x 2 mm, white in terminal verticillasters. Nutlets erect, subtriangular.

Ecology : Rare on coastal hill slopes and back shore sand.

Fl. & Fr. : January onwards.

Distrib. : Throughout the peninsular coastal plains.

2. *Leucas lavandulifolia* J.E. Sm., Rees. Cyclop. 20(2): 1812. 1899; *L. linifolia* (Roth) Spreng: Hook. f., Fl. Brit. India 4: 690. 1885.

Erect, much-branched herbs; stems 4-grooved, softly pubescent. Leaves 5-6 x 1.5-2 cm, lanceolate or linear-oblong, pubescent, serrate, acute or obtuse at apex, tapering at base. Flowers white, subsessile clustered in upper axils. Nutlets oblong, brown.

Ecology : Common winter-crops weeds, frequent on waste sandy places along the lee side of the sand dunes.

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

Distrib. : West Bengal, Orissa, Tamil Nadu and Maharashtra coast.

3. *Leucas plukenetii* (Roth) Spreng., Syst. veg. 2. 743. 1825; *Leucas aspera* Link.: Hook. in Hook. f., Fl. Brit. India 4: 690. 1885.

Erect or diffuse scabrid herb up to 50 cm tall. Leaves 2-6 x 0.3-0.8 cm, linear-lanceolate, chartaceous, puberulous, entire or serrate, acute at apex cuneate at base. Flowers 4.5 x 1 mm across, white, in terminal and axillary verticillasters. Nutlets erect, subtriangular.

Ecology : Frequent on back shore sands, coastal scrubs and coral strands.

Fl. & Fr. : November-February; Fruits throughout the year.

Distrib. : West Bengal, Orissa and Kerala coasts. Islands of Agathi, Androth, Ameni, Kalpeni and Kiltan.

4. *Leucas stricta* Benth., Wall. Pl. As. Rar. 1: 61. 1830; Hook. in Hook. f., Fl. Brit. India 4: 688. 1885.

Erect, slender herbs; stems hispidly hairy, with many branches from woody root-stock. Leaves 2-3.5 x 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. Nutlets 2.5 mm across, smooth, brown.

Ecology : Frequent along the seashores, scrubs and river banks. Sometimes locally common along road sides.

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

Distrib. : Throughout the coastal plains.

5. *Leucas urticaefolia* (Vahl) R. Br., Prodr. 504.1810; Hook. in Hook. f., Fl. Brit. India 4: 680.1885.

Puberulous herb up to 50 cm tall. Leaves 2-4 x 1-2 cm, oblanceolate, chartaceous, serrate, acute at both base and apex. Flowers 3.5 x 0.5 mm across, white, in globose axillary verticillasters. Nutlets, erect, subtrigonus.

Ecology : Frequent on backshore sands and coastal scrubs.

Fl. & Fr. : December onwards.

Distrib. : Andhra Pradesh, Karnataka and Gujarat coast.

6. *Leucus wightiana* Benth., Wall. Pl. As. Rar. 1: 60.1830; Hook. in Hook. f., Fl. Brit. India 4: 690.1885.

Herb or bushy shrub up to 1 m high. Leaves 3-8 x 0.4-0.7 cm, linear-lanceolate, chartaceous, puberulous, entire to distantly serrate, subacute at apex, attenuate at base. Flowers 1 x 1 cm across, white, in terminal verticillasters. Nutlets erect, subtrigonus.

Ecology : Rare on sandy or rocky coast.

Fl. & Fr. : March-April; August-September.

Distrib. : Tamil Nadu, Karnataka and Gujarat coast.

8. *Ocimum* L.

KEY TO THE SPECIES

- 1a. Shrub; leaves membranous, ovate, coarsely crenate-serrate with long petioles 3. *gratissimum*
 1b. Herbs; leaves various shape, not crenate-serrate, and not so long petioles :
 2a. Racemes elongate, whorls close; two lower teeth of calyx longest; fruiting calyx not papery :
 3a. Fruiting calyx large, hairy or glabrous, the upper lip saucer shaped 2. *basilicum*
 3b. Fruiting calyx small, villous and pilose, the upper lip recurved 4. *tenuiflorum*
 2b. Racemes lax, whorls distant; lower calyx teeth equal; fruiting calyx papery 1. *adscendens*

1. *Ocimum adscendens* Willd., Sp. Pl. 3: 166.1800; Hook. in Hook. f., Fl. Brit. India 4: 609.1885.

Annual erect or prostrate herb, 15-35 cm tall. Leaves 1.5-2.5 x 0.6-1.6 cm, oblong or ovate, glabrous, much gland-dotted, entire or sparingly toothed, obtuse at apex, cuneate at base. Flowers 4 mm long, pale pink in lax whorls. Nutlets subglobose, compressed, smooth, reddish brown.

Ecology : Frequent on sandy and rocky sea beaches.

Fl. & Fr. : May-June.

Distrib. : Chennai, Karnataka and Kerala coast.

2. *Ocimum basilicum* L., Sp. Pl. 597. 1753; Hook. in Hook. f., Fl. Brit. India 4: 608.1885.

Herbs 60-75 cm tall. Leaves 5-7 x 2.5-3.5 cm, elliptic-ovate or lanceolate, glabrous, entire or dentate, acute or subacuminate at apex, cuneate or tapering at base. Flowers 8 x 1.5 mm across, white, in elongate racemes. Nutlets large, mucilaginous.

Ecology : Frequent on backshore sands and rocky crevices.

Fl. & Fr. : Throughout the year.

Distrib. : Orissa, Tamil Nadu, Andhra Pradesh.

3. *Ocimum gratissimum* L., Sp. Pl. 1197. 1753; Hook. in Hook. f., Fl. Brit. India 4: 609.1884.

Erect, much-branched aromatic herbs or shrubs; stems quadrangular, puberulent when young. Leaves 4-9 x 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 aranged in terminal racemes. Nutlets subglobose.

Ecology : Very rare along the sandy sea-shores.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

4. *Ocimum tenuiflorum* L., Sp. Pl. 597. 1753; Hook. in Hook. f., Fl. Brit. India 4: 609.1885.

Pungent odoured perennial herb, 30-75 cm high. Leaves, 1.4-4 x 0.5-2 cm ovate or elliptic-oblong, aromatic hairy and closely gland-dotted, serrate, obtuse or subacute at apex, annulate or narrowed at base. Flowers 4 mm long, light purple, in verticillate racemes. Nutlets 4, 1 mm long, ellipsoid, brown covered with minute yellow and black spots.

Ecology : Common along inland coastal sands and road side.

Fl. & Fr. : September to March.

Distrib. : Throughout Indian coast.

9. *Pogostemon* Desf.

Pogostemon paniculatus (Willd.) Benth., Wall. Pl. As. Rar. 1: 30. 1830; Hook. in Hook. f., Fl. Brit. India 4: 631. 1885.

Herb up to 1 m tall. Leaves 4-10 x 2-5 cm, ovate-oblongate, chartaceous, irregularly incisoserrate, acute at apex, acute or attenuate at base. Flowers 6.5 mm across,

violet, in verticillate spike. Nutlets ovoid or oblong, smooth.

Ecology : Frequent on moist sand hills and rocky hill slopes and sand bars along the coast.

Fl. & Fr. : February-April.

Distrib. : Karnataka and Kerala coast.

10. *Eusteralis* Rafin.

Eusteralis stellata (Lour.) Panig., Phytologia 32: 474. 1976; *Dysophylla verticillata* Benth.: Hook. in Hook. f., Fl. Brit. India 4: 639. 1885.

Much branched herbs. Leaves 0.6-12 cm long, linear, upper most often pubescent, lower glabrous, revolute, obtuse at apex, narrowed at base. Flowers

0.5-1 cm long, in spikes. Nutlets ovoid-oblong, 1 mm long, glossy.

Ecology : Frequent on backshore sands and coastal scrubs.

Fl. & Fr. : August-November.

Distrib. : Kerala coast.

NYCTAGINACEAE

KEY TO THE GENERA

- 1a. Herbs, not scandent; anthocarp not cylindrical :
 - 2a. Flowers showy, more than 2 cm long; bracts prominent sepeloid; fruits ovoid 3. *Mirabilis*
 - 2b. Flowers not showy, less than 8 mm long; bracts normal; fruits various, not ovoid:
 - 3a. Fruits 10 - ribbed 2. *Commicarpus*
 - 3b. Fruits 5 - ribbed 1. *Boerhaavia*
- 1b. Scandent shrub; anthocarp cylindrical 4. *Pisonia*

1. *Boerhaavia* L.

KEY TO THE SPECIES

- 1a. Fruits glandular along the ribs not at crown; flowers pink or purple in small umbels 1. *diffusa*
- 1b. Fruits with large glands at the crown; flowers white in panicles 2. *verticillata*

1. *Boerhaavia diffusa* L., Sp. Pl. 3. 1753. *B. repens* L.: Hook. in Hook. f., Fl. Brit. India 4: 709. 1885.

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. Fruits about 3 mm across, clavate, 4-5 ribbed, viscidly glandular along ribs.

Ecology : Frequent in coastal thickets, river banks and dry places near sea-shores, locally common along road sides, pastures and old walls.

Fl. & Fr. : February-March; May-June.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Kerala and Gujarat coast.

2. *Boerhaavia verticillata* Poir, Encyl. Method. 5: 56. 1804; Hook. in Hook. f., Fl. Brit. India 4: 710. 1885.

Diffuse or climbing herb. Leaves 3-6 x 3-6 cm, broadly ovate or rounded, glabrous, thick, entire, obtuse at apex, cordate at base. Flowers 0.5-1.1 mm long, white, in axillary panicles. Fruits 3-4 x 1-2 mm, club shaped with fine gland at top. Seeds white, shining.

Ecology : Common on coastal sand stone, brick walls and rocky crevices.

Fl. & Fr. : June-January.

Distrib. : Maharashtra, Karnataka and Saurashtra coast.

2. *Commicarpus* Standley.

Commicarpus chinensis (L.) Heimertl., Engler & Prantl., Nat. Pflanzenf. "ed.2" 16: 117. 1934; *Boerhaavia repanda* Willd.: Hook. in Hook. f., Fl. Brit. India 4: 709. 1885.

Subscandent herbs. Leaves 4-7 x 2-4 cm, triangular ovate or cordate, glabrous above, pubescent below, repand-sinuate, acute or acuminate at apex, rounded or cordate or truncate at base. Flowers 0.5 cm long, pink, in axillary or terminal umbel. Fruits 6 mm

long, linear oblong, covered with numerous glands. Seeds minute.

Ecology : Frequent on hard beaches and on rocky crevices near the coast.

Fl. & Fr. : April-November.

Distrib. : Orissa, Tamil Nadu, Karnataka and Cochin in Kerala coast.

3. *Mirabilis* L.

Mirabilis jalapa L., Sp. Pl. 177. 1753.

Herb up to 75 cm high. Leaves 4-10 x 3-6 cm, triangular-ovate to elliptic, thick-chartaceous, entire, acute or acuminate at apex, shortly decurrent at base. Flowers 5.5 cm long, funnel shaped, white, yellow or red, arranged in terminal corymb. Anthocarp 6 mm across, globose, ribbed, black at maturity.

Ecology : Commonly cultivated as ornamental plant, sometimes wild in oceanic islands.

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

Distrib. : Throughout India; Kalpeni Island, Andaman island.

4. *Pisonia* L.

Pisonia aculeata L., Sp. Pl. 1026. 1753; Hook. in Hook. f., Fl. Brit. India 4: 711. 1885.

Scandent shrub. Leaves 4-7 x 3-4 cm, elliptic ovate, thick-chartaceous, entire, acute at apex, rounded at base. Flowers 4.5-5 mm across, funnel shaped, greenish or cream colour, arranged in axillary stalked umbel.

Anthocarp 1.2 x 0.5 cm, oblong cylindrical stipitate with 5 viscid ribs or with rows of viscid glands.

Ecology : Rare on pocket beaches and rocky crevices on backshore.

Fl. & Fr. : January-June.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

AMARANTHACEAE

KEY TO THE GENERA

- 1a. Leaves alternate :
- 2a. Flowers unisexual 5. *Amaranthus*
- 2b. Flowers bisexual :
- 3a. Fruits ending at the top with two hornlets; not circumscissile 7. *Digera*
- 3b. Fruits without hornlets; circumscissile :
- 4a. Flower capitate; fruits with one seed 3. *Allmania*
- 4b. Flower in dense racemes; fruits with more than one seed 6. *Celosia*
- 1b. Leaves opposite, or fascicled :
- 5a. Flowers clustered, surrounded by perfect and imperfect flowers :
- 6a. Filaments free, shortly connate at base 11. *Pupalia*
- 6b. Filaments connate into a tubular seath 8. *Gomphrena*
- 5b. Flowers all perfect :
- 7a. Staminodes absent :
- 8a. Flowers in spike; anthers 2 celled :
- 9a. Perianth segments ribbed; stamens 5 10. *Psilotrichum*
- 9b. Perianth segments hyaline; stamens 1 or 2 9. *Nothosaerva*
- 8b. Flowers in small clusterd; anthers 1 celled 4. *Alternanthera*
- 7b. Staminodes present :
- 10a. Spikes wooly tomentose; bracts soft 2. *Aerva*
- 10b. Spikes glabrous; bracts spinescent 1. *Achyranthes*

1. *Achyranthes* L.

KEY TO THE SPECIES

- 1a. Plants glabrous; leaves membranous 2. *porphyristachya*
- 1b. Plants pubescent; leaves villose beneath 1. *aspera*

1. *Achyranthes aspera* L., Sp. Pl. 204. 1753; Hook. in Hook. f., Fl. Brit. India 4: 730. 1885.

Erect or scandent perennial herbs; stems angular, rigid, strongly ribbed, adpressed-pubescent. Leaves 1.5-11 x 1-7 cm, decusate, obovate or elliptic-lanceolate, sparsely pubescent, villose beneath, acute or acuminate at apex, attenuate at base. Flowers 2-3 mm, greenish white, in axillary or terminal, many-flowered elongated spikes. Utricles 2 mm across, enclosed by persistent perianth and bracteoles.

Ecology : Frequent in waste places along the seashore, river banks, road sides and gardens.

Fl. & Fr. : March-June; September-December.

Distrib. : Throughout the coastal plains.

2. *Achyranthes porphyristachya* Wall. ex Moquin, DC. Prodr. 13(2): 316. 1849; *A. aspera* var. *porphyristachya* (Wall.) Hook. in Hook. f., Fl. Brit. India 4: 730. 1885.

Erect herb up to 2 m tall. Leaves 7-25 cm long, elliptic or elliptic-lanceolate glabrous or pubescent, membranous, entire, acute or acuminate at apex, obtuse or cuneate at base. Flowers 3-5 mm in diam., red, in dense axillary or terminal spikes. Utricles 3-5 mm long, cylindric-oblong, straw coloured. Seeds 2 mm long, oblong, black.

Ecology : Common on coastal thickets, rocky crevices and lee sides of coastal dunes.

Fl. & Fr. : September-May.

Distrib. : Throughout Indian coastal plains.

2. *Aerva* Forsk.

KEY TO THE SPECIES

- 1a. Leave decussate; flowers bisexual 2. *lanata*
 1b. Leaves alternate; flowers unisexual 1. *javanica*

1. *Aerva javanica* (Burm.f.) Juss. ex Schultes, Linn. Syst. Veg. 5: 565. 1819; Hook. in Hook. f., Fl. Brit. India 4: 727. 1885.

Erect or scandent shrub 75-100 cm tall. Leaves 5-9 x 1-2.5 cm, oblanceolate or spatulate, chartaceous, entire, obtusely apiculate at apex, attenuate at base. Flowers 1.7 mm across, white, in terminal paniculate spikes. Utricle thin-walled, irregularly rupturing. Seed lenticular, uniform.

Ecology : Frequent on coastal sands and back shore sand ridges.

Fl. & Fr. : December-February.

Distrib. : Maharashtra, Karnataka and Saurashtra coast.

2. *Aerva lanata* (L.) Juss., Ann. Mus. Paris 11: 131. 1808; Hook. in Hook. f., Fl. Brit. India 4: 728. 1885.

Erect, perennial herbs; stems terete woolly-tomentose when young. Leaves 0.5-4.5 x 0.3-3 cm, usually alternate, opposite or fascicled, spirally arranged, often purple, ovate-elliptic or 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.

Ecology : Frequent along river sides, sandy waste places and road sides.

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

Distrib. : Throughout the coastal plains.

3. *Allmania* R. Br. ex Wight.

Allmania nodiflora (L.) R. Br. ex Wight, Hook. J. Bot. 1: 226, t. 128, 1834; *A. 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 x 0.3-0.5 cm, linear-oblong, oblong or spatulate, glabrous, acute, obtuse, rounded or abruptly mucronate at apex, narrowed at base. 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.

Ecology : Frequent on sandy seashores and sand bars, in between the creeks and channels of the mangroves.

Fl. & Fr. : February-March; April-July.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Karnataka, Maharashtra and Gujarat coast.

4. *Alternanthera* Forsk.

KEY TO THE SPECIES

- 1a. Utricles longer than tepals; tepal 1-nerved 2. *sessilis*
 1b. Utricles shorter than tepals; tepals 3-nerved 1. *paronychoides*

1. *Alternanthera paronychoides* St., Hil. Voy. Distr. Diam. 11, 2: 439. 1833.

Prostrate, perennial, glabrous or pubescent herbs; stems much branched, rooting at nodes. Leaves variable, 0.5-2.5 x 0.2-1 cm, spatulate or oblanceolate, glabrous, acute or obtuse at apex, tapering into short petioles. Flowers white, sessile, in axillary, dense, globose or spreading heads. Utricles 1 mm across, orbicular, brownish.

Ecology : 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; while in disturbed areas, it is found to grow as deformed, carpet-like mat.

Fl. & Fr. : April-December.

Distrib. : Throughout the coastal plains.

2. *Alternanthera sessilis* (L.) DC., Cat. Hort. Monspel. 77, 1813; Hook. in Hook. f., Fl. Brit. India 4: 731. 1885.

Creeping or often floating perennial herbs; stems more or less soft, fleshy, glabrous, swollen at nodes. Leaves variable, 0.5-7 x 0.3-2 cm, linear-oblong or oblanceolate, glabrous, acute or obtuse at apex, attenuate at base. Flowers sessile, whitish purple, clustered, in axillary globose heads. Utricles obovate or obreniform,

corky, 2 mm long, yellowish-brown.

Ecology : Common in swampy places, ditches, rice-fields and road sides. Frequently found floating along creeks and canals under fresh water conditions.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coastal plains.

5. *Amaranthus* L.

KEY TO THE SPECIES

- 1a. Armed; tepals and stamens 5 each 2. *spinosus*
 1b. Unarmed; tepals and stamens 3 each :
 2a. Prostrate herbs; perianth segments shorter than capsules :
 3a. Perianth segments not mucronate; capsule with green longitudinal ribs 3. *tenuifolius*
 3b. Perianth segments mucronate; capsule not ribbed 1. *gracizans*
 2b. Erect herbs; perianth segments longer than capsules 4. *tricolor*

1. *Amaranthus gracizans* L., Sp. Pl. 990. 1753. ssp. *thellungianus* (Nevski) Gusev, Bot. Zurn. (Moscow & Leningrad) 57: 462. 1972; *A. polygamus* auct. non L.: Hook. in Hook. f., Fl. Brit. India 4: 721. 1885, in part.

Prostrate herb. Leaves 0.8-1.5 x 0.5-1 cm, herbaceous, entire, emarginate at apex, attenuate at base. Flowers unisexual; male-2 mm across, female-1 mm across, greenish, in axillary fascicles. Urticle 2 mm, subglobose-globose, rugose. Seeds 1 mm across, orbicular.

Ecology : Common on sandy back shore and on rocky crevices.

Fl. & Fr. : December-April.

Distrib. : West Bengal, Andhra Pradesh, Tamil Nadu and Saurashtra coast.

2. *Amaranthus spinosus* L., Sp. Pl. 991. 1753; Hook. in Hook. f., Fl. Brit. India 4: 718. 1886.

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, in axillary clustered or terminal panicles; axillary clusters entirely female, those of panicles entirely or partly male. Utricles 2 mm across, ovoid, rugose.

Ecology : Rare, in waste sandy places, near seashores and coastal thickets, common along road sides and gardens.

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

Distrib. : Throughout the coastal plains.

3. *Amaranthus tenuifolius* Willd., Sp. Pl. 4: 381. 1805; Hook. in Hook. f., Fl. Brit. India 4: 722. 1885.

Annual herbs. Leaves 1.25-2.5 cm long, linear-oblong, herbaceous, entire, obtuse or bilobed at apex, narrowed at base. Flowers 2.5-3 mm across, whitish green, in axillary spikes. Urticle compressed, indehiscent. Seeds 0.6-0.8 mm in diam., brown, lenticular.

Ecology : Frequent on rocks and backward sand dunes along the seashores.

Fl. & Fr. : December-March.

Distrib. : Karnataka, Maharashtra and Saurashtra coast.

4. *Amaranthus tricolor* L., Sp. Pl. 989. 1753; *A. gangeticus* L.: Hook. in Hook. f., Fl. Brit. India 4: 719. 1885.

Erect or ascending herb, 1-2 m tall. Leaves 1.5-15 x 0.5-10 cm, ovate-obovate or rhomboid, herbaceous, entire, acute or retuse at apex, shortly cuneate at base. Flowers 3 mm across, greenish white in axillary

fascicles or terminal spiciform racemes. Utricle 1.5 mm across, circumscissile.

Ecology : Rare on coastal rocks and sand ridges.

Fl. & Fr. : December- March.

Distrib. : Maharashtra, Karnataka and Saurashtra coast.

6. *Celosia* L.

KEY TO THE SPECIES

- 1a. Leaves linear-lanceolate; spike glabrous.....1. *argentea*
 1b. Leaves ovate-deltoid; spike puberulous.....2. *polygonoides*

1. *Celosia argentea* L., Sp. Pl. 205. 1753; Hook. in Hook. f., Fl. Brit. India 4: 714. 1885.

Erect, glabrous herbs; stems simple or often branched, angular, strongly ribbed. Leaves 2.5-9.5 x 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. Utricles 3-4 mm long, ellipsoid, circumscissile at the middle.

Ecology : Frequent on moist sandy places along the lee wards of the seashore sand dunes, common on moist places along nullahs, gardens and cultivated fields.

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

Distrib. : Orissa, Tamil Nadu, Karnataka, Kerala, Maharashtra and Gujarat coast.

2. *Celosia polygonoides* Retz., Obs. Bot. 2: 12. 1781; Hook. in Hook. f., Fl. Brit. India 4: 715. 1885.

Erect herbs up to 50 cm tall, Leaves 2.5-3 x 1.5-2 cm, deltoid ovate, chartaceous, entire, subacute or acute at apex, truncate at base. Flowers 2 mm across, pink, in lax spikes, puberulous. Utricle 3 mm, urceolate. Seeds 0.6 mm across, smooth.

Ecology : Occasional on moist sandy places on back shore.

Fl. & Fr. : November-February.

Distrib. : Tamil Nadu, Rameswaram, Karnataka and Maharashtra coast.

7. *Digera* Forssk.

Digera muricata (L.) Mart., Beitr. Amar. 77, No.2, 1825; *D. arvensis* Forsk.: Hook. in Hook. f., Fl. Brit. India 4: 717. 1885.

Erect or ascending annuals; stems often branched, glabrous, Leaves 1.5-5.5 x 1-3 cm, variable, ovate-elliptic or ovate-lanceolate, glabrous, acute or acuminate at apex, truncate at base. Flowers 2-3 mm long, in axillary, peduncled, spiciform racemes. Utricles

2 mm across, globose, compressed, with two hornlets at the top.

Ecology : Rare, along road-sides and sea-shore; common on dry waste places, grasslands and embankments.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coastal plains.

8. *Gomphrena* L.

KEY TO THE SPECIES

- 1a. Bracts crested only at apex; anthers included 2. *serrata*
 1b. Bracts crested throughout; anthers exerted..... 1. *globosa*

1. *Gomphrena globosa* L., Sp. Pl. 224.1753; Hook. in Hook. f., Fl. Brit. India 4: 732. 1885

Erect or ascending herb. Leaves 5-10 x 1.5-4 cm, obovate-lanceolate, scaberulous, entire, apiculate at apex, cuneate or attenuate at base. Flowers 4 mm across, faint purple in terminal spikes. Utricle 2 mm thin walled. Seed lenticular, shiny.

Ecology : Cultivated. Frequent on sea shore rocks and backward sand ridges.

Fl. & Fr.: July onwards.

Distrib.: West Bengal, Orissa, Andhra Pradesh; Maharashtra and Kerala coast.

2. *Gomphrena serrata* L., Sp. Pl. 224. 1753; Mears in Taxon 29: 86.1980.

Ascending or erect herb up to 40 cm high. Leaves 1-6 x 0.5-2 cm, lanceolate or obovate-spathulate, chartaceous, entire obtusely apiculate at apex, cuneate or attenuate at base. Flowers 1.5 mm across, white in terminal and axillary spikes. Utricle 2 mm thin walled. Seed faintly reticulate, spiny.

Ecology : Frequent on the back side of seashore dunes and moist sandy places near the coast. Cultivated as ornamental plant.

Fl. & Fr. : Throughout the year.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Cochin and Kerala coast.

9. *Nothosaerva* Wight.

Nothosaerva brachiata (L.) Wight., Icon, Pl. Ind. Orient. 6:1.1853; Hook. in Hook. f., Fl. Brit. India 4.726. 1885.

Erect herb up to 60 cm tall. Leaves 2-4 x 1-2 cm, elliptic lanceolate, membranous, glabrous or puberulous, entire, apiculate at apex, acute or attenuate at base. Flowers 0.8 mm across, creamy white or pinkish in

axillary dense spikes. Capsule 0.7 mm, pyriform. Seeds globose, shiny.

Ecology : Rare along the rocky crevices of the sea shore.

Fl. & Fr. : August-February.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

10. *Psilotrichum* Hassk.

Psilotrichum sericeum (Koen. ex Roxb.) Dalz., Dalz. & Gibson, Bombay Fl. 216. 1861; *Psilostachys sericea* (Koen. ex Roxb.) Hook. in Hook. f., Fl. Brit. India 726.1885.

Slender, erect herb. Leaves 15-25 x 10-20 mm, broadly ovate or ovate orbicular, thick, villous above, silky below, entire, acute at apex, rounded or cordate at base. Flowers 2-3 mm long, whitish, arranged in slender spikes.

Utricle subglobose or ovoid, membranous. Seeds minute, globose, brown.

Ecology : Frequent in moist sandy areas on back shore and on rocky crevices along the sea shore.

Fl. & Fr. : January-April.

Distrib. : Andhra Pradesh, Tamil Nadu, Maharashtra and Saurashtra coast.

11. *Pupalia* Juss.

Pupalia lappacea (L.) Juss., Ann. Mus. 2: 132.1803; Hook. in Hook. f., Fl. Brit. India 4: 724.1885.

Erect or rambling much-branched perennial herbs; stems quadrangular, glabrous, swollen at noded with woody root stock. Leaves 2-8 x 1-4 cm, ovate-oblong or ovate-elliptic, glabrous or pubescent, acute or acuminate at apex, obtuse at base. Flower 3-5 mm, pale-green or pink, sessile, clustered in terminal spiciform racemes; imperfect flowers reduced to fasciated reddish-

brown hook-like bristles, villous at base. Utricles 2 mm across, 1-seeded. Seeds shining brown.

Ecology : Frequent in sandy scrub-jungles and coastal thickets, common on hedges and gardens.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra, Kerala and Gujarat coast.

C H E N O P O D I A C E A E

KEY TO THE GENERA

- 1a. Stems jointed; leaves obscure; flowers irregular; stamens 1:
 2a. Perianth trigonous; seed albuminous 1. *Arthrocnemum*
 2b. Perianth pyramidal; seed exalbuminous 4. *Salicornia*
 1b. Stems not jointed; leaves well developed; flowers regular; stamens 5:
 3a. Leaves fleshy, terete or subterete 5. *Suaeda*
 3b. Leaves not fleshy; herbaceous:
 4a. Flowers dimorphic; male with 3-5 sepals; females without sepals 2. *Atriplex*
 4b. Flowers hermaphrodite, not as above 3. *Chenopodium*

1. *Arthrocnemum* Moq.

Arthrocnemum indicum (Willd.) Moq., Chenop. Monogr. Enum. 113. 1840; Hook. in Hook. f., Fl. Brit. India 5: 12. 1886.

Perennial succulent herbs up to 10-30 cm tall. Leaves 0.5-0.8 x 0.4-0.6 cm, obscure, thin towards margin, tightly enclosing the internodes, 2 lobed, shortly attenuate at base. Flowers 0.5-0.7 cm long, pink, arranged in spike.

Fruits small, ovoid, enclosed in swollen perianth. Seeds free, erect, orbicular yellow.

Ecology : Common on coastal salt marshes.

Fl. & Fr. : December-May.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Pondichery, Gujarat, Dwarka and Rann of Kuchchh.

2. *Atriplex* L.

KEY TO THE SPECIES

- 1a. Woody prostrate herbs or shrubs; fruit ovoid; bracteoles ovate 1. *repens*
 1b. Perennial erect herbs; fruit rhomboid; bracteoles orbicular 2. *stocksii*

1. *Atriplex repens* Roth, Nov. Sp. 377. 1821; Hook. in Hook. f., Fl. Brit. India 5: 7. 1886.

Woody prostrate shrubs. Leaves 0.6-2.5 cm long, oblong-elliptic, thick, rounded or retuse at apex, cuneate at base. Flowers small, dimorphic; male ebracteolate, female with 2 bracteoles, without sepals. Fruit ovate on herbaceous bracts. Seed with upwardly pointing radicle.

Ecology : Mostly on dry coastal sands and on rocky crevices.

Fl. & Fr. : October-January.

Distrib. : Andhra Pradesh, Tamil Nadu and Rameswaram islands.

2. *Atriplex stocksii* Boiss., Diagn. Ser. 2, 4: 73. 1849; Hook. in Hook. f., Fl. Brit. India 5: 7. 1886.

Perennial herb, 20-50 cm tall. Leaves 10-25 x 6-20 mm, oblong, elliptic or suborbicular, fleshy, glabrous, entire, obtuse at apex, acute at base. Flowers unisexual 0.3-0.5 mm across, sessile, in axillary clusters or in simple spikes. Fruits rhomboid, ovate or orbicular with a thick convex disk at base. Seeds suborbicular, compressed, smooth, pale-brown.

Ecology : Common mostly on rocky coast, sandy sea shore, rocky crevices and coral strands.

Fl. & Fr. : October-January.

Distrib. : Tamil Nadu, Pondichery, Gujarat and Saurashtra coast.

3. *Chenopodium* L.

KEY TO THE SPECIES

- 1b. Aromatic glandular herbs; leaves sinuate-dentate; stigma 5 2. *ambrosioides*
 1b. Scentless herbs; leaves entire or toothed; stigma 2 :
 2a. Flowers in axillary spike; seeds keeled 3. *murale*
 2b. Flowers in clusters in paniced spike; seeds not keeled 1. *album*

1. *Chenopodium album* L., Sp. Pl. 219. 1753; Hook. in Hook. f., Fl. Brit. India 5: 3.1886.

Erect herb or shrub, 50-75 cm tall, branched. Leaves 2.5-6 x 1-2 cm, ovate-lanceolate, thin, entire or lobed, acute or obtuse at apex, rounded or tapering at base. Flowers 2 mm across, greenish white, in axillary cymes. Utricles 0.5-1.0 mm in diam., green, brown at maturity. Seeds 1, orbicular, black smooth.

Ecology : Commonly found along the margins of cultivated field near coast.

Fl. & Fr. : November-March.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, cultivated in some parts along the Indian coast.

2. *Chenopodium ambrosioides* L., Sp. Pl. 219. 1753; Hook. in Hook. f., Fl. Brit. India 5: 4.1886.

Erect or ascending, aromatic annuals; stems ribbed, glandular-pubescent. Leaves 4-10 x 1-3 cm, oblong-lanceolate, sinuately dentate, glabrous above, deeply gland-dotted beneath, acute or obtuse at apex, narrowed at base. Flowers greenish-white, 1-2 mm across

membranous. Seeds 1-1.5 mm in diam., orbicular, shining red or brown.

Ecology : Frequent along the river banks, waste places and moist sandy areas.

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

Distrib. : Throughout the coastal saltmarshes.

3. *Chenopodium murale* L., Sp. Pl. 219. 1753; Hook. in Hook. f., Fl. Brit. India 5: 4. 1886.

Subglabrous foetid herb, 15-40 cm tall. Leaves 3-10 x 2-7 cm, rhomboid or deltoid ovate, glaucous, irregularly lobed and more or less sharply toothed at margin, acute or obtuse at apex, cuneate at base. Flowers 1.5 mm long, white, utricle enclosed in herbaceous tepals. Seeds orbicular, brownish-black, smooth, rugose.

Ecology : Frequent on sandy beaches under moist condition and backside of seashore dunes.

Fl. & Fr. : May-September.

Distrib. : West Bengal, Orissa, Tamil Nadu and Saurashtra coast. Probably an introduced weed.

4. *Salicornia* L.

Salicornia brachiata Roxb., Fl. Ind. ed. Carey 28, 1832; Hook. in Hook. f., Fl. Brit. India 5: 12.1886.

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.

Ecology : Common in salt marshes near the coast, often found gregarious in rice-fields when flooded with saline water.

Fl. & Fr. : October-November; January-March.

Distrib. : Throughout the coastal wetlands.

5. *Suaeda* Scop.

KEY TO THE SPECIES

- 1a. Leaves terete, 5-12 mm long; bracteoles pectinate 4. *nudiflora*
 1b. Leaves not terete, more than 12 mm long; bracteoles entire :
 2a. Flowers clustered in slender spikes; stigmas included 2. *maritima*
 2b. Flowers axillary or adnate to the subtending leaves; stigma exerted :
 3a. Bracteoles entire; stigma 2; seeds horizontal 3. *monoica*
 3b. Bracteoles toothed; stigma 3; seeds erect 1. *fruticosa*

1. *Suaeda fruticosa* (L.) Forsk., Fl. Aegypt. Arab. 70. 1775; Hook. in Hook. f., Fl. Brit. India 5: 13. 1886.

Erect or diffuse, perennial herb, up to 5 m tall. Leaves 0.6-1.5 cm long, linear-oblong or elliptic-oblong, fleshy, glabrous, glaucous green, subterete, obtuse or acute at apex, narrowed at base. Flowers 2.5-5 mm long, deep-green, in dense axillary globose clusters, utricles minute, ovoid, deep green to black, smooth. Seeds obovoid, beaked, shining.

Ecology : Common on salt marshes near the estuaries and back mangrove regions.

Fl. & Fr. : June-November.

Distrib. : Andhra Pradesh, Krishna delta and throughout the Gujarat coast.

2. *Suaeda maritima* (L.) Dum., Fl. Belg. 22, 1827; Hook. in Hook. f., Fl. Brit. India 5: 14. 1886.

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 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.

Ecology : Common in saline embankments and salt marshes near the coast and estuaries; sometimes found within the mangrove forests when the areas become suddenly elevated and devoid of regular tidal influences; usually in association with *Suaeda nudiflora*, often found to form pure strands.

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

Distrib. : Throughout the wet coastal salt marshes.

3. *Suaeda monoica* Forsk. ex Gmel., Syst. Nat. ed. 13, 2(1): 503. 1791; Hook. in Hook. f., Fl. Brit. India 5: 13. 1886.

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 x 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 or 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 1-1.3 mm in diam., horizontally arranged; testa lenticulate, shining, black.

Ecology : 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.

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

Distrib. : West Bengal, Orissa, Tamil Nadu, Tinnevely, Tuticorin and Gujarat salt marshes.

4. *Suaeda nudiflora* (Willd.) Moq., Ann. Sc. Nat. Ser. 23: 316. 1831; Hook. in Hook. f., Fl. Brit. India 5: 14. 1886.

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, obovoid, transparent, with transverse thickenings apex; stamens included. Fruits ovoid, pericarp membranous. Seeds 1-1.2 mm in diam., horizontally arranged; testa black, shining; embryo coiled.

Ecology : Common in salt marshes and saline embankments near the coast and estuaries; usually in association with *Suaeda maritima*, often found as a pure strand behind the estuaries.

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

Distrib. : Throughout the coastal provinces.

BASELLACEAE

Basella L.

Basella alba L., Sp. Pl. 227. 1753; Hook. in Hook. f., Fl. Brit. India 5: 20. 1886.

Succulent creeping or winding herbs; stems green-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. Fruits depressed globose.

Ecology : Frequent in low-mangroves and coastal thickets usually winding on *Salvadora persica* and *Salacia prinoides*.

Fl. & Fr. : February-March; April-May.

Distrib. : West Bengal, Orissa, Chilka, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

POLYGONACEAE

KEY TO THE GENERA

- 1a. Climbing herbs, inflorescence tip tendrilar 1. *Antigonon*
- 1a. Herbs not climbing, inflorescence tip not tendrilar :
 - 2a. Ocreae hyaline, flowers axillary fascicles 3. *Polygonum*
 - 2b. Ocreae membranous, flowers in racemes or capitate clusters 2. *Persicaria*

1. *Antigonon* Endl.

Antigonon leptopus Hook. & Arn., Bot. Beach. Voy. 308, t. 69. 1841.

Much branched, perennial, herbaceous climbers. Leaves 4.5-14 x 2.8-10.8 cm, ovate-triangular or ovate cordate, glabrous, entire or undulate, acuminate with short spiny end at apex, cordate or sagittate at base. Flowers 0.8-1.8 cm across, dark to pale pink, in solitary or several

axillary or terminal panicles, rachis often ending in a tendril.

Ecology : Frequent on hedges and lawn near the coast, grown as an ornamental plant.

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

Distrib. : West Bengal, Orissa, Tamil Nadu and Karnataka coast.

2. *Persicaria* (L.) P. Miller.

KEY TO THE SPECIES

- 1a. Inflorescence in capitate clusters 2. *chinensis*
- 1b. Inflorescence in racemes:
 - 2a. Bracts and ocreae glabrous 3. *glabra*
 - 2b. Bracts and ocreae ciliate 1. *barbata*

1. *Persicaria barbata* (L.) H. Hara, in H. Hara, Fl. E. Himal. 1: 70. 1966; *Polygonum barbatum* L.: Hook. in Hook. f., Fl. Brit. India 5: 37. 1886.

Erect, gregarious herbs. Leaves 10-17 cm long, linear-lanceolate, glabrous, ciliate at margin, acuminate at apex, cuneate at base. Flowers 3.5-4 mm long, white in long racemes. Nuts trigonous.

Ecology : Common on the margin of coastal slacks and ditches.

Fl. & Fr. : August-November.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

2. *Persicaria chinensis* (L.) Gross, Bot. Jahrb. Syst. 49:269, 277 & 315. 1913; *Polygonum chinense* L.: Hook. in Hook. f., Fl. Brit. India 5: 44. 1886.

Scandent undershrubs. Leaves 7.5-12.5 cm long, elliptic or ovate, membranous, pubescent below, crenulate, acute at apex, truncate at base. Flowers white in 0.5-0.8 mm across in corymbose panicles. Nutlets trigonous.

Ecology : Common along the sandy beaches and lee side of coastal sand dunes.

Fl. & Fr. : October-April.

Distrib. : West Bengal, Orissa, Tamil Nadu, Maharashtra and Karnataka coast.

3. *Persicaria glabra* (Willd.) M. Gomez, Ann. Inst. Segunda Enseñ. Habana 2: 278. 1896; *Polygonum glabrum* Willd.: Hook. in Hook. f., Fl. Brit. India 5: 34. 1886.

Erect herb 0.6-1.2 m high. Leaves 10-20 cm long, linear-lanceolate, gland-dotted, obtuse or acute at apex, flowers very variable in size, pink in terminal racemes. Nuts biconvex, orbicular.

Ecology : Frequent along the margin of coastal slacks and ditches.

Fl. & Fr. : October-March.

Distrib. : West Bengal, Orissa, Tamil Nadu, Maharashtra and Karnataka coast.

3. *Polygonum* L.

Polygonum plebeium R. Br., Prodr. 420. 1810; Hook. in Hook. f., Fl. Brit. India 5: 27. 1886.

Deep rooting, decumbent or ascending annuals. Leaves 6-12 x 2-3 mm, alternate, sessile, linear or linear-oblong often lanceolate, glabrous, acute at apex, narrowed at base. Flowers 2 mm across, pink, axillary, solitary or 1-5, clustered together to form a leafy raceme. Nuts 2 mm across, trigonous, shining black.

Ecology : Polymorphous species, frequent along the edges of moist sandy slacks near the coast or in dry sands along the lee sides of seashore sand dunes, common around tanks and ditches and sandy river-beds.

Fl. & Fr. : December-January.

Distrib. : Throughout the coastal plains.

ARISTOLOCHIACEAE

KEY TO THE GENERA

- 1a. Erect undershrubs or shrubs; perianth regular 1. *Apama*
 1b. Trailing or climbing shrubs; perianth irregular 2. *Aristolochia*



Suaeda fruticosa



Salsola kali



Aristolochia bracteolata



Hernandia ovigera



Solanum surattense



Dischidia nummularia



Sarcolobus carinatus



Excoecaria agallocha



Sapium insigne



Dolichondron spathacea



Hopea parviflora

1. *Apama* Lamk.

Apama siliquosa Lamk., Encycl. 1: 91. 1783; *Bragantia wallichii* Br.: Hook. in Hook. f., Fl. Brit. India 5: 73. 1886.

Branched shrubs. Leaves 12.5-20 x 3.5-5 cm, oblong-lanceolate, glabrous above, puberulous beneath, acuminate at apex, narrowed or rounded at base. Flowers

2.5 cm in diam., in axillary cymes. Capsules 7.5-12 cm long, straight. Seeds 2.5 mm, oblong, trigonous.

Ecology : Frequent on scrub jungles near the coast.

Fl. & Fr. : November onwards.

Distrib. : Karnataka coast, South Kanara.

2. *Aristolochia* L.

KEY TO THE SPECIES

- 1a. Leaves oblong, truncate at base, 3-nerved 2. *indica*
- 1b. Leaves cordiform or reniform cordate or sagitate at base, 5-7 nerved :
 - 2a. Bracts cordate, not ciliate 1. *bracteolata*
 - 2b. Bracts lanceolate, ciliate 3. *tagala*

1. *Aristolochia bracteolata* Lam., Encycl. 1: 258. 1783; *A. bracteata* Retz.: Hook. in Hook. f., Fl. Brit. India 5: 75. 1886.

Perennial, slender, much branched, prostrate herb. Leaves 4-7 x 5-9 cm cordiform, reniform or broadly ovate, glabrous above, glaucous beneath, repund, subacute or obtuse at apex, obtusely cordate at base. Flowers 3-4.5 cm long, bright or dark purple, solitary axillary. Capsule 1.4-2 x 0.7-1.0 cm, oblong-ellipsoid, ribbed. Seed 5-6 x 2-3 mm, triangular covered with glands.

Ecology : Frequent on coastal beaches, lee side dunes and rocky crevices.

Fl. & Fr. : August-November.

Distrib. : West Bengal, Orissa, Tamil Nadu, Mahabalipuram, Cape Comorin and Pondicherry coast.

2. *Aristolochia indica* L., Sp. Pl. 960. 1753; Hook. in Hook. f., Fl. Brit. India 5: 75. 1886.

Woody glabrous, perennial, twining or creeping herbs; stems ribbed, often purple-coloured. Leaves 5-15 x 3-6 cm, variable, obovate-oblong or sub-panduriform, 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 dehiscent into 6 valves from below upwards at the same time pedicels splitting into 6-fids. Seeds many, 5-8 mm across, ovate-deltoid, winged throughout.

Ecology : Frequent in open sandy areas along the shores, river-banks and scrubs.

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

Distrib. : Throughout the coastal districts.

3. *Aristolochia tagala* Cham., Linnaea 7: 207. 1832; *A. roxburghiana* Klotz.: Hook. in Hook. f., Fl. Brit. India 5: 75. 1886.

Climbing shrub. Leaves 20 x 9 cm, ovate, entire or lobed, acute or acuminate at apex, cordate at base. Flowers 3-4 cm long, purple with greenish yellow tube, arranged in racemes. Capsules long-stalked, winged. Seeds 7.5 mm long, flattened, winged, glands on the middle.

Ecology : Rare in rocky crevices along the coastal scrubs.

Fl. & Fr. : July-August; September-December.

Distrib. : Tamil Nadu, Somankadu and Karnataka coast.

PIPERACEAE

KEY TO THE GENERA

- 1a. Scandent shrubs; berry exerted, leaves with prominent nerves 2. *Piper*
1b. Erect herbs; berry partly embedded, leaves with obscure nerves 1. *Peperomia*

1. *Peperomia* Ruiz & Pavon.

Peperomia pellucida (L.) H. B. K., Nov. Gen. Sp. 1: 64. 1816; *P. exigua* (Bl.) Miq.: Hook. in Hook. f., Fl. Brit. India 5: 97. 1886.

Slender, succulent herb. Leaves 1.5-2.5 cm long, ovate-deltoid, thin, glabrous, glaucous at upper surface, entire, acute at apex, rounded or cordate at base. Flowers

1.5-2 mm long, greenish-white, arranged in axillary spikes. Nutlets globose, ribbed, reticulate.

Ecology : Introduced from S. America. Naturalised in many parts as ornamental herbs, frequent on sandy back shore.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the Indian coast.

2. *Piper* L.

Piper nigrum L., Sp. Pl. 28. 1753; Hook. in Hook. f., Fl. Brit. India 5: 90. 1886.

Vinc. Leaves 10-20 x 6-9 cm, ovate, coriaceous, flattened, glabrous, entire, shortly acuminate at apex, rounded or acute at base. Flowers 4.5-6 mm long, arranged in spikes. Berries globose, black when dry.

Ecology : Frequent on coastal thickets along the ghats. Cultivated for spice and condiment.

Fl. & Fr. : December-July.

Distrib. : Kerala coast, Tellichery.

LAURACEAE

KEY TO THE GENERA

- 1a. Leafless twiner 1. *Cassytha*
1b. Leafy trees or shrubs 2. *Litsea*

1. *Cassytha* L.

Cassytha filiformis L., Sp. Pl. 35. 1753; Hook. in Hook. f., Fl. Brit. India 5: 188. 1886.

Filiform, twining leafless herb with greenish stem. Flowers 3 mm across, in terminal or axillary spikes. Drupe globose, green enclosed within inflated perianth, crowned by lobes. Seed 1, globose.

Ecology : Common on coastal beaches and sandy scrubs.

Fl. & Fr. : Two peaks: September-October and January - March.

Distrib. : West Bengal, Orissa, Tamil Nadu and Kerala coast.

2. *Litsea* Lamk.

KEY TO THE SPECIES

- 1a. Perianth incomplete, involucre arranged in corymbose-like racemes 1. *glutinosa*
 1b. Perianth complete, involucre in racemose few-flowered umbel-like 2. *nitida*

1. *Litsea glutinosa* (Lour.) C. B. Robins., Philip. J. Sci. Bot. 6: 321. 1911; *L. sebifera* Pers.: Hook. in Hook. f., Fl. Brit. India 5: 157. 1886.

Evergreen dioecious trees or shrubs 5-10 m tall; stems smooth, branched. Leaves 4-20 x 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. Fruits 7-6 mm across, globose berries.

Ecology : Frequent in scrubs along the river-bank, shrubberies around the tanks and ditches.

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

Distrib. : Orissa, Tamil Nadu, Maharashtra and Karnataka coast.

2. *Litsea nitida* (Roxb. ex Wall.) Hook. in Hook. f., Fl. Brit. India 5: 174. 1886. *Cylicodaphne nitida* Nees in Wall. Pl. As. Rat. 2: 67. 1832.

Evergreen dioecious trees 5-15 m tall; stems glabrous, bark reddish brown. Leaves 6.5-20 x 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 turbinate, silky hairy. Fruits ellipsoid, yellowish, 1-1.5 cm across, enclosed completely within the cupular perianth when young.

Ecology : Rare in sandy scrub-jungles along the river banks and coastal thickets in association with *Strychnos nux-vomica* and *Antidesma* sp.

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

Distrib. : New record for Orissa coast, western peninsula.

H E R N A N D A C E A E

KEY TO THE GENERA

- 1a. Fruits enclosed in involucre except at the apex 1. *Hernandia*
 1b. Fruits crowned by 2 spatulate wings 2. *Gyrocarpus*

1. *Hernandia* L.

Hernandia peltata Meisn., DC. Prodr. 15.1. 263. 1836; Hook. f., Fl. Brit. India 5: 188. 1886.

Evergreen tree. Leaves 15-30 cm long, rounded-ovate, coriaceous, obtuse or acute at apex, narrowed at base. Flowers unisexual yellowish white. Male flowers 8 mm diam., female flowers 4-5 mm diam., arranged in

long peduncled corymb. Fruits 3.6 cm diam., enclosed in involucre, except at the apex. Seeds hard.

Ecology : Rare on rocky coast in littoral formation.

Fl. & Fr. : January-April.

Distrib. : Restricted in the Andaman Islands, endemic.

2. *Gyrocarpus* Jacquin

Gyrocarpus asiaticus Willd., Sp. Pl. "ed 4", 4: 982. 1806.
G. jacquini Roxb.: Clarke in Hook. f., Fl. Brit. India 2: 461. 1878 p.p.

Tree, 8-20 m tall. Leaves 10-18 x 9-15 cm, broadly ovate, chartaceous, glabrous above, pubescent below, entire, acute or acuminate at apex, truncate or subcordate at base. Male flowers 5 mm across, female flowers 3 mm across, greenish to yellowish in paniculate

cyme. Samara obovoid globose, ribbed. Seed exalbuminous.

Ecology : Frequent along the backward region of coastal plain.

Fl. & Fr. : January - February; March onwards.

Distrib. : West Bengal, Orissa, Pondicherry, Andaman coast.

LORANTHIACEAE

KEY TO THE GENERA

- 1a. Plants with dichotomous leafy branches; flowers unisexual 3. *Viscum*
 1b. Plants without dichotomous leafy branches; flowers bisexual :
 2a. Young parts rusty tomentose; flowers 4-merous 2. *Scurrula*
 2b. Young parts glabrous; flowers; 5-merous 1. *Dendrophoe*

1. *Dendrophoe* Mart.

Dendrophoe falcata (L.f.) Eting., Denkschr. Akad. Wiss. Math. Naturw. Cl. 32: 52, 58, t. 13, f. 14, 1872;
Loranthus longiflorus Desr. Hook. in Hook. f., Fl. Brit. India 5: 214. 1886.

Large, semi-parasitic woody shrubs. Leaves mostly 7-15 x 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.

Ecology : Frequently found parasitizing several tree species in the scrub jungles along river banks and coastal swamps.

Fl. & Fr. : December-March; May-June.

Distrib. : Throughout the coastal plains.

2. *Scurrula* L.

Scurrula philippensis (Cham. & Schl.) G. Don., Gen. Hist. 3: 442. 1834; *L. cordifolius* Wall.: Hook. in Hook. f., Fl. Brit. India 5: 209. 1886.

Rusty tomentose, bushy parasitic herbs or undershrubs; stems woody, brownish, lenticellate. Leaves opposite, 3-9.5 x 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,

racemosely fasciated, brownish-pubescent; corolla-tube splitting into 4-short lobes, often dentate, 9-11 mm long, tomentose, pyriform.

Ecology : Frequently found growing on *Hibiscus tiliaceus* in the low mangroves near the estuaries.

Fl. & Fr. : December-February, March-May.

Distrib. : Orissa, Tamil Nadu, Pichavaram and Maharashtra coast.



Epaltes divaricata (L.) Cass.



Tridax procumbens L.



Heliotropium indicum L.



Cressa cretica L.



Hygrophila auriculata (Schum.) Heine



Acanthus volubilis Wall.



Finlaysonia obovata Wall.

3. *Viscum* L.

KEY TO THE SPECIES

- 1a. Leafy shrub; internode of branchlets not flattened :
 2a. Leaves obliquely ovate or falcate, acute or acuminate 2. *monoicum*
 2b. Leaves elliptic or oblong, obtuse 3. *ovalifolium*
 1b. Leafless shrub; internode of branchlets flattened 1. *articulatum*

1. *Viscum articulatum* Burm. f. var. *dichotomum* Kurz., Forest Fl. Burma 2: 325, 1877; Hook. in Hook. f., Fl. Brit. India 5: 226, 1886.

Pendulous, much branched leafless parasitic shrub. Male flower 1.5 mm across. Female flower 1.2 mm across, green in solitary cymes. Berry 0.4 mm across, ovoid globose, glossy-white.

Ecology : Frequent on trees along the coastal scrubs and lee sides of sand dunes.

Fl. & Fr. : December-February.

Distrib. : Andhra Pradesh, Tamil Nadu and Karnataka coast and Andaman Islands.

2. *Viscum monoicum* Roxb. ex DC., Prodr. 4: 277, 1830; Hook. in Hook. f., Fl. Brit. India 5: 224, 1886.

Large pendulous parasitic shrubs. Leaves 2.5-12.5 cm long, leathery, ovate or falcate, acute or acuminate at apex, oblique at base. Flowers 1.4-1.6 mm across, greenish, in axillary fascicles. Berry truncate smooth, yellowish or blackish brown.

Ecology : Frequent on trees along the river banks and coastal scrubs.

Fl. & Fr. : December-February.

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka coast and Andaman Islands.

3. *Viscum ovalifolium* Wall. ex DC., Prodr. 4: 278, 1830; Hook. in Hook. f., Fl. Brit. India 5: 225, 1886.

Semi-parasitic, much-branched, glabrous herbs or undershrubs; branches more or less stout, angular, grooved at internodes. Leaves 1.5-5.5 x 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 around. Fruits oblong-ellipsoid, 5-6 mm across, narrowed at both ends.

Ecology : Frequently found on *Excoecaria agallocha* in the mangroves and *Pongamia pinnata* near back mangrove.

Fl. & Fr. : March-April; May-August.

Distrib. : Throughout the coastal plains and islands.

SANTALACEAE

Santalum L.

Santalum album L., Sp. Pl. 349, 1753; Hook. in Hook. f., Fl. Brit. India 5: 231, 1886.

Tree usually semiparasitic up to 8 m tall. Leaves 4-7 x 2.5-4 cm, elliptic-ovate to lanceolate, subcoriaceous, glabrous, entire, subacute or acute at apex, narrowed at base. Flowers 6 mm across, brownish purple, in paniculate

cymes. Drupe 1 x 0.8 cm, globose, purple black.

Ecology : Frequent on dry hills along the coast and open coastal scrubs, often cultivated.

Fl. & Fr. : December-April.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

EUPHORBIAEAE

KEY TO THE GENERA

- 1a. Inflorescence a cyathium; tepals minute 8. *Euphorbia*
 1b. Inflorescence other than cyathium; tepals conspicuous :
 2a. Leaf margin serrulate 7. *Drypetes*
 2b. Leaf margin entire :
 3a. Stamens connate :
 4a. Anthers on a gonophore 17. *Sauropus*
 4b. Anthers not on a gonophore :
 5a. Fruit berry; ovary 5-12 locular 14. *Phyllanthus*
 5b. Fruit capsule; ovary 3 locular 3. *Breynia*
 3b. Stamens free :
 6a. Ovary 1-locular, pistilode 0; inflorescence in spike 2. *Antidesma*
 6b. Ovary 2-3 locular, pistilode 2-3 forked; inflorescence pediculate in axillary cluster :
 7a. Tree; ovary half-inferior 2-locular; pistilode 2-forked 4. *Bridelia*
 7b. Shrub; ovary not 1/2 inferior, 3-locular, pistilode 3-forked 19. *Securingia*
 8a. Perianth 2-seriate; tepals petaloid :
 9a. Leaf blade with 2-glands at base; filaments inflexed in bud 6. *Croton*
 9b. Leaf blade with no glands; filaments straight :
 10a. Plant with watery latex; stamens 2 bundles on a raised receptacle 10. *Jatropha*
 10b. Plant with no watery latex; stamens free not on a raised receptacle 5. *Chrozophora*
 8b. Perianth 1-seriate; tepals sepaloid:
 11a. Leaves pellucid-punctate; flowers in axillary fascicles; style minute; seeds arillated 20. *Suregada*
 11b. Leaves not as above; flowers in spike; style well developed; seeds not arillated:
 12a. Tepals inconspicuous :
 13a. Herbs with linear-lanceolate leaves; spikes slender; epicarp prickly; seeds carunculate 18. *Sebastiania*
 13b. Trees with otherwise leaves; spikes stout; epicarp smooth; seeds not carunculate :
 14a. Monoecious; male flowers sunken; tepals 2; plant with no latex 16. *Sapium*
 14b. Dioecious; female flowers exerted; tepals 3; plant with acrid latex 9. *Excoecaria*
 12b. Tepals conspicuous :
 15a. Stamens definite :
 16a. Whole plant and fruiting, perianth with stinging hairs; a vine; seeds not carunculate 21. *Tragia*
 16b. Whole plant and fruiting, perianth not as above; shrubs; seeds carunculate 12. *Manihot*

- 15b. Stamens indefinite :
- 17a. Monoecious herbs or shrubs :
- 18a. Leaves palmatifid; capsule prickly;
seeds carunculate 15. *Ricinus*
- 18b. Leaves not as above; capsule smooth; seeds not carunculate :
- 19a. Spike continuous; stamens 8;
styles 6-15, filiform 1. *Acalypha*
- 19b. Spikes interrupted; stamens 5; styles 3, linear 13. *Micrococca*
- 17b. Dioecious trees :
- 20a. Fruit an ellipsoid drupe, indchiscent,
leaves chartaceous 22. *Trewia*
- 20b. Fruit a capsule, dehiscent, leaves coriaceous 11. *Mallotus*

1. *Acalypha* L.

KEY TO THE SPECIES

- 1a. Bracts 3-5 fid, glandular, hairy 1. *brachystachya*
- 1b. Bracts entire, not glandular, not hairy :
- 2b. Bracts longer than capsule :
- 3a. Leaf base rounded 2. *indica*
- 3b. Leaf base acute 4. *malabarica*
- 2b. Bracts shorter than capsules 3. *lanceolata*

1. *Acalypha brachystachya* Hornem., Hort. Bot. Hafn. 909, 1815; Hook. in Hook. f., Fl. Brit. India 5: 416, 1887.

Herb up to 2 m high. Leaves 4-7 x 3-4 cm, ovate-obovate, flaccid when dry, serrate, acuminate at apex, rounded-subcordate at base. Flowers unisexual, 1 mm across, green, in axillary spikes. Capsule bivalved cocci hard. Seeds globose or subglobose.

Ecology : Rare on rocky sea shore and coral strand.

Fl. & Fr. : December-February.

Distrib. : Krasadi Islands, Tamil Nadu and Kerala.

2. *Acalypha indica* L., Sp. Pl. 1003, 1753; Hook. in Hook. f., Fl. Brit. India 5: 416, 1887.

Erect glabrous herbs with many angular branches. Leaves 1.6-6 x 1-4 cm, ovate-rhomboid, crenate-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.

Ecology : Frequent on sandy seashores, river banks, along road sides, old buildings and hedges.

Fl. & Fr. : March-July; September-November.

Distrib. : Throughout the coastal regions.

3. *Acalypha lanceolata* Willd., Sp. Pl. 4: 524, 1805; *A. fallax* Muell. & Arg., Hook. in Hook. f., Fl. Brit. India 5: 416, 1887.

Herb, 1-5 m high. Leaves 3-11 x 2-8 cm, broadly ovate, thin crenate-serrate, acuminate at apex, truncate or rounded at base. Flower 1-1.5 mm across, whitish green, in unbranched axillary spikes. Capsule bivalved. Seeds subglobose.

Ecology : Common on sandy beach shore, river banks and road side.

Fl. & Fr. : December onwards.

Distrib. : Kadmind Islands, Tamil Nadu, Kerala and Karnataka.

4. *Acalypha malabarica* Muell. & Arg. in Linnaea. 34: 42.1865; Hook. in Hook. f., Fl. Brit. India 5: 416.1887.

Erect annual herb, 15-60 cm high. Leaves 1.5-4.5 x 1-2.5 cm, elliptic, ovate or lanceolate, hispid on both sides, crenate-serrate, subacute or rounded at apex, acute or cuneate at base. Flowers 1-1.4 mm across, whitish green in axillary spikes. Capsules 2 mm in diam., with

bivalved cocci covered by hairs. Seeds ovoid, reddish brown.

Ecology : Frequent on sandy seashore, sandy waste places and road side.

Fl. & Fr. : July-October.

Distrib. : Kerala and Saurashtra coast.

2. *Antidesma* L.

KEY TO THE SPECIES

- 1a. Stamens inserted in hollows of the disk; flowers in slender, glabrous racemes 1. *acidum*
 1b. Stamens inserted within the disk; flowers in stout villous spikes 2. *ghaesembilla*

1. *Antidesma acidum* Retz., Obs. Bot. 5: 30.1788; *A. diandrum* (Roxb.) Roth.: Hook. in Hook. f., Fl. Brit. India 5: 361.1887. in part.

Tree, 10-15 m tall. Leaves 4-8 x 1.5-3.5 cm, obovate, thin, slightly pubescent, acute at both apex and base. Flowers 0.7 mm across arranged in terminal racemes. Drupe 7 x 4 mm, oblong.

Ecology : Rare on coastal scrubs and river banks.

Fl. & Fr. : July-October.

Distrib. : Orissa and Tamil Nadu coast.

2. *Antidesma ghaesembilla* Gaertn., Fruct. 1: 189. t. 39. 1788; Hook. in Hook. f., Fl. Brit. India 5: 357. 1887.

Diocious 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 x 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 volutinose; males usually yellow, females brownish. Fruits 4-6 mm across, sub-globose drupes, reddish-black when ripe.

Ecology : Frequent along the river banks, scrubs, back mangroves and around tanks and ditches.

Fl. & Fr. : March-September.

Distrib. : Throughout the coastal districts.

3. *Breynia* J. R. & G. Forst.

Breynia vitis-idaea (Burm.f.) C. Fischer, Bull. Misc. Inform. 65. 1932; *B. rhamnoides* (Retz.) Muell. & Arg.: Hook. in Hook. f., Fl. Brit. India 5: 330.1887.

Shrub, 2-3 m high. Leaves 2-4 x 1.5-3 cm, membranous, glabrous, entire, subacute at apex, rounded at base. Flowers: male 2.5 mm across, yellow, female 1.5 mm across, reddish in axillary solitary. Capsule

0.6 cm, across, globose lobed.

Ecology : Frequent on moist sandy areas along the back shore, river banks and back waters.

Fl. & Fr. : February onwards.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra coast.

4. *Bridelia* Willd.

KEY TO THE SPECIES

- 1a. Tree or shrubs; fruits globose, pyrenes furrowed 1. *retusa*
 1b. Climbers; fruits oblong, pyrenes smooth 2. *stipularis*

1. *Bridelia retusa* (L.) Spreng., Syst. Veg. 3: 48. 1826; Hook in Hook. f., Fl. Brit. India 5: 268. 1887.

Deciduous trees, 4-8 m tall. Leaves 4.5-18 x 2.5-8 cm, elliptic-oblong or elliptic-lanceolate, coriaceous, shiny above, finely tomentose below, entire, acute or shortly acuminate at apex, subacute or rounded at base. Flowers 4-6 mm across, white or pinkish, in terminal spicate panicles. Drupes 5-10 mm in diam., ovoid, grooved, dark purple. Seeds minute, greyish green, wrinkled.

Ecology : Rare on coastal rocks and cliffs, common as dry deciduous element on inland forests.

Fl. & Fr. : July-October.

Distrib. : Saurashtra coast.

2. *Bridelia stipularis* (L.) Bl., Bijid. 597, 1826; Hook. in Hook. f., Fl. Brit. India 5: 271. 1887.

Woody scandent shrubs; branchlets many, pendent, glabrous or puberulous when young, often with deflexed spines. Leaves 3-15 x 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 or 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.

Ecology : Frequent in sandy scrubs, sand-bars within the mangroves, back mangroves and coastal thickets.

Fl. & Fr. : September-December.

Distrib. : Throughout the coastal districts.

5. *Chrozophora* Juss.

Chrozophora rattleri (Geis.) Juss. ex Spreng, Syst. 3: 850. 1826; *C. plicata* auct. non Juss.: Hook. in Hook. f., Fl. Brit. India 5: 410. 1887.

Annual or perennial herbs or undershrubs; stems branched, densely stellate hairy. Leaves 4-8 x 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.

Ecology : Frequent in waste sandy places near the shores, river banks, road sides, embankments and on reclaimed soils.

Fl. & Fr. : March-September.

Distrib. : Throughout the Indian coast.

6. *Croton* L.

Croton bonplandinum Baill. in Adansonia 4: 339. 1864; Croizat in J. Bombay Nat. Hist. Soc. 41: 573. 1940.

Aromatic bushy herbs or small undershrubs, 20-60 cm, tall; stems much branched, terete, striate. Leaves 2-5.5 x 0.5-2.5 cm, ovate-lanceolate, glabrous, crenate or serrate, acute at apex, rounded at base. Flowers unisexual, in terminal racemes; females mostly soli-

tary from nodes, males usually clustered from succeeding nodes. Capsules oblong, 3-lobed, stellately hairy.

Ecology : Common weeds along river sides, sea shores, road sides and cultivated fields.

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

Distrib. : Throughout the coastal regions.

7. *Drypetes* Vahl.

Drypetes sepiaria (Wight & Arn.) Pax & Hoffm., Engl. Pflanzenr. IV. 147 XV: 271. 1992. *Hemicyclia sepiaria* Wight & Arn.: Hook. in Hook. f., Fl. Brit. India 5: 337. 1887.

Shrub, 3-6 m tall. Leaves 5-10 x 2-4 cm, elliptic-oblong, thick-chartaceous, entire, subacute or acute at apex, rounded at base. Flowers unisexual, 6 mm across, greenish

in axillary fascicles. Drupe 0.8 cm across, globose. Seeds ovoid, arillate.

Ecology : Frequent on rocky seashores and sandy back shores.

Fl. & Fr. : January-May.

Distrib. : Tamil Nadu, Pondicherry and Goa coast.

8. *Euphorbia* L.

KEY TO THE SPECIES

- 1a. Herbs or shrubs, usually unarmed :
- 2a. Mostly erect herbs or shrubs :
- 3a. Mostly shrubs :
- 4a. Leaves absent or small and linear oblong, deciduous; branches articulate; involucre glands 5 12. *tirucalli*
- 4b. Leaves fleshy, elliptic; branches not articulate; involucre glands very small or absent 1. *atoto*
- 3b. Mostly herbs :
- 5a. Limbs of involucre glands pink, unequal; capsules glabrous 9. *rosea*
- 5b. Limbs of involucre glands green, equal; capsules hairy 6. *hypericifolia*
- 2b. Mostly prostrate or ascending herbs :
- 6a. Leaves alternate below, opposite or whorled above; appendage of glands absent; glands capular 3. *heterophylla*
- 6b. Leaves opposite, decussate; appendage of glands present; glands not capular :
- 7a. Cyathia in glomerules 5. *hirta*
- 7b. Cyathia in axillary solitary :
- 8a. Leaves subquadrate, apex retuse 10. *serpens*
- 8b. Leaves elliptic oblong, apex obtuse :
- 9a. Capsule adpressed :
- 10a. Pubescent throughout 11. *thymifolia*
- 10b. Stem and capsule glabrous 4. *heyneana*
- 9b. Capsule stiff-hairy, only along angles 8. *prostrata*
- 1b. Trees usually armed with stipular spines :
- 11a. Main stems practically none; leaves small suborbicular 2. *caducifolia*
- 11b. Main stems present; leaves large oblanceolate 7. *nivulia*

1. *Euphorbia atoto* Forst. Prodr. 207, 1786; Hook. in Hook. f., Fl. Brit. India 5: 248, 1887.

A dwarf, glabrous shrub with long tap root. Leaves 2-3 x 0.5-1 cm, elliptic oblong, entire, obtuse at apex, rounded at base; stipules fimbriate. Involucres in axillary or in terminal cymes. Capsules glabrous with 2 fid styles. Seeds smooth.

Ecology : Restricted on rocky coast and coral reefs.

Fl. & Fr. : September-December.

Distrib. : Probably indigenous in Mumbai coast but found common in Lakshadweep island, also reported from Kundapur in South Karnataka.

2. *Euphorbia caducifolia* Haines, Indian For. 40: 154.1914 et Bot. Bihar & Orissa 2: 143.1921; Santapau, Bull. Bot. Soc. Beng. 8: 6. 1954.

Perennial fleshy shrub, glabrous, 1.2-2 m high, spinous on the upper part. Leaves 0.8-1.2 cm long, sub-orbicular, fleshy, deciduous glabrous, undulate along the margin, acute at apex. Capsule 8 mm in diam., red, acutely trigonous, compressed, glabrous. Seeds 3 mm in diam., glabrous, brownish.

Ecology : Rare on sand stone and rocky slopes near the coast.

Fl. & Fr. : January-April.

Distrib. : Rare along the Gujarat coast.

3. *Euphorbia heterophylla* L., Sp. Pl. 453.1753; *E. geniculata* Ortega: Hook. in Hook. f., Fl. Brit. India 5: 239.1886 & 266.1887.

Annual herb, 50-80 cm high, Leaves 5-9 x 2-5 cm, obovate-rhomboid or oblanceolate, somewhat succulent, entire or serrate, acute at apex, narrowed at base. Flowers 1-3 mm long, greenish yellow, arranged in terminal clustered cyathia. Capsule 6 mm across, bivalved cocci. Seeds 2 mm across, angled.

Ecology : Rare on seashore sand and sandy debris in the crevices.

Fl. & Fr. : September-May.

Distrib. : Tamil Nadu, Saurashtra coast.

4. *Euphorbia heyneana* Spreng. Sys. Veg. 3: 791.1826; Panigrahi in Kew Bull. 29: 695.1974; *E. microphylla* Heyne: Hook. in Hook. f., Fl. Brit. India 2: 252.1887.

Annual herb. Leaves 4-6 mm long, oblong, coriaceous, thick, entire or minutely toothed, obtuse at apex, oblique at base. Flowers 1.5-3.5 mm long, in terminal or axillary cyathia. Capsule 1.5-2 cm in diam, globose. Seeds smooth, bluish.

Ecology : Rare on sandy seashores and lateritic hill slopes.

Fl. & Fr. : June onwards.

Distrib. : West Bengal, Andhra Pradesh and Tamil Nadu.

5. *Euphorbia hirta* L., Sp. Pl. 454. 1753; *E. pilulifera* L.: Hook. in Hook. f., Fl. Brit. India 5: 250.1887.

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 x 0.2-1.2 cm, inequilateral, oblong, elliptic or lanceolate, pubescent, serrulate, acute or obtuse at apex, rounded or cuneate at base. Cythia in axillary and terminal leafless glomerules, strigosely hirsute; glandular appendages inconspicuous or obsolete. Capsules ovoid, 3-lobed hairy.

Ecology : Common along road sides, gardens, waste sandy places and river banks.

Fl. & Fr. : July-August; September-December.

Distrib. : Throughout the Indian coast.

6. *Euphorbia hypericifolia* L., Sp. Pl. 454. 1753; Hook. in Hook. f., Fl. Brit. India 5: 249.1887.

Erect or decumbent ascending annuals; stems cylindrical, glabrous, crispid hairy or patently pubescent. Leaves 0.4-3 x 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 or puberulous.

Ecology : Common weeds along river banks, waste sandy places near the seashore and road sides.

Fl. & Fr. : August-December.

Distrib. : Throughout the Indian coast.

7. *Euphorbia nivulia* Buch. & Ham., Trans. Linn. Soc. London 14: 286. 1824; Hook. in Hook. f., Fl. Brit. India 5: 255.1887.

Small trees with cylindrical branches, Leaves 8.5-20 x 3.5-6 cm, obovate, spatulate, fleshy, retuse at apex. Inflorescence consist of 3-flowered cymes, axillary or from above the leaf scar. capsules trigonous. Seeds globose, smooth.

Ecology : Frequent on the crevices and exposed rocks along the coast.

Fl. & Fr. : February-July.

Distrib. : Gujarat and Maharashtra coast.

8. *Euphorbia prostrata* Ait., Hort. Kew 2: 139. 1789; Hook. in Hook. f., Fl. Brit. India 5: 252.1887.

Prostrate annuals; stems slender, branched, forming mat often up to 20 cm, crisp or puberulous. Leaves 2-8 x 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.

Ecology : Frequent along river banks, road sides and open sandy places.

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

Distrib. : Throughout the coastal districts.

9. *Euphorbia rosea* Retz. Obs. Bot. Fasc. 4: 26. 1786; Hook. in Hook. f., Fl. Brit. India 5: 251.1887.

Perennial glabrous herbs with many spreading branches from long woody rootstock. Leaves 4-8 x 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 pink, upper two larger than the lower two. Capsules glabrous. Seeds transversely wrinkled.

Ecology : Common along the beaches and sandy seashores, rarely found along sandy river-beds.

Fl. & Fr. : December-February.

Distrib. : Throughout the coastal regions.

10. *Euphorbia serpens* Kunth., Nov. Gen. Sp. 2: 52.1817; Hook. in Hook. f., Fl. Brit. India 5: 253.1887.

Prostrate herbs. Leaves 6 x 5 mm, subquadrate, ovate, fleshy, entire serrulate, retuse at apex, obliquely truncate at base. Flowers 1-3 mm long, whitish green, arranged in axillary solitary or few clustered cyathia. Capsule 1.5 mm across. Seeds 1 mm long, 4-angular.

Ecology : Frequent on sandy seashore, river banks and road side.

Fl. & Fr. : December-March.

Distrib. : West Bengal, Orissa and Tamil Nadu.

11. *Euphorbia thymifolia* L., Sp. Pl. 454, 1753; Hook. in Hook. f., Fl. Brit. India 5: 252.1887.

Prostrate or often ascending annuals; stems slender, diffusely branched, glabrous or often adpressed pubescent. Leaves 3-10 x 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.

Ecology : Frequent along the lee side of the sand dunes, road sides and dry open places.

Fl. & Fr. : January-April.

Distrib. : Throughout the coastal districts.

12. *Euphorbia tirucalli* L., Sp. Pl. 452. 1753; Hook. f., Fl. Brit. India 5: 254.1887.

Shrub or tree, 2-4 m high. Leaves 1 x 0.4 cm, linear-lanceolate, somewhat succulent, minutely pubescent when young and glabrous when old, entire, obtuse or subacute at apex, cuneate at base. Flowers 1.5-3 mm long, green, arranged in terminal cyathia. Capsule 0.6 x 0.8 cm, globose. Seeds 4 mm across, globose, smooth, carunculate.

Ecology : Frequent on back shore sand and sea facing rocky slopes.

Fl. & Fr. : June-August.

Distrib. : Andhra Pradesh, Tamil Nadu and Saurashtra coast.

9. *Excoecaria* L.

Excoecaria agallocha L., Syst. Nat. ed. 10, 1288, 1759; Hook. in Hook. f., Fl. Brit. India 5: 472.1888.

Evergreen trees with milky acid juice, 4-20 m tall, 10-80 cm in diam.; barks greyish-white, smooth, lenticellate; woods soft, light. Taproot insignificant, lateral roots spreading like snakes intermingled with each other, supraterranean bends produce elbow-shaped pegs instead of pneumatophores. Leaves 2-8 x 1.5-3 cm, ovate, ovate-elliptic or ovate-oblong, coriaceous, shining dark-green, turns 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, 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.

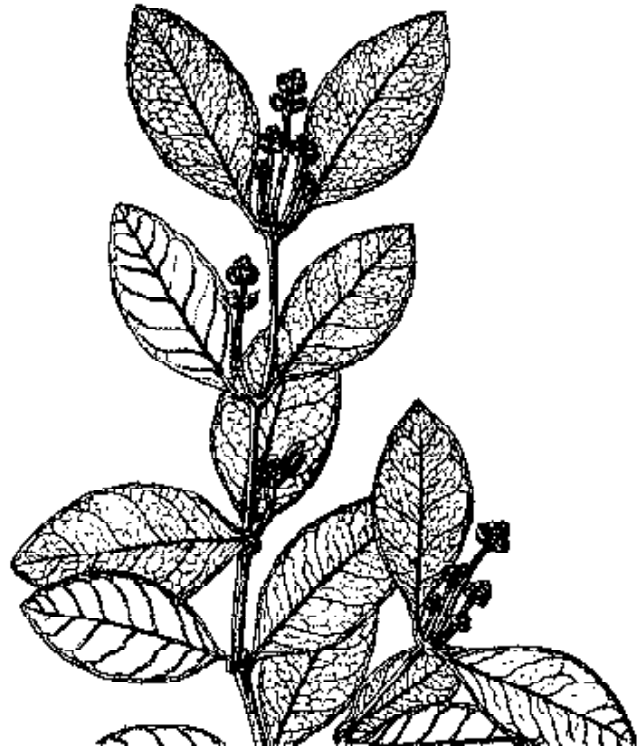
Ecology : Common along the intertidal zones of creeks and channels in the mangroves, estuaries and muddy seashores, usually in association with *Avicennia officinalis*, *Bruguiera parviflora* and *Aegialitis roundifolia*. It can tolerate high salinity near the estuaries and also fresh-water condition which occurs along the banks of fresh water river.

Fl. & Fr. : February-September.

Distrib. : Throughout the mangrove forests of the wet coastal system in India.



Lindernia antipoda (L.) Alston



Avicennia marina (Forsk.) Vierh.



Avicennia officinalis L.



Aegiceras corniculata (L.) Blanco



Anisomeles indica (L.) O. Kuntze



Celosia argentea L.

10. *Jatropha* L.

KEY TO THE SPECIES

- 1a. Plants mostly purple-red coloured with glandular dissected stipules :
 2a. Leaves entire 3. *gossypifolia*
 2b. Leaves serrate 2. *glandulifera*
 1b. Plants mostly greenish-yellow coloured with obsolete stipules 1. *curcus*

1. *Jatropha curcus* L., Sp. Pl. 1006, 1753; Hook. in Hook. f., Fl. Brit. India 5: 383.1887.

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 x 4-16 cm, broadly ovate or 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.

Ecology : Frequent in sandy waste places along back mangroves, and river banks, locally common along road sides and hedges.

Fl. & Fr. : March-September.

Distrib. : Throughout the Indian coast.

2. *Jatropha glandulifera* Roxb., Fl. Ind. 3: 688.1832; Hook. in Hook. f., Fl. Brit. India 5: 382.1887.

Shrub, 2-3 m high. Leaves 6-9 x 6.5-8 cm, cordiform, or peltate, glandular, serrate, shortly acuminate at apex, cordate at base. Flowers 8 mm across, arranged in axillary or terminal cymes. Capsule 2 x 1.5 cm, 3-lobed. Seeds ovoid or oblong, carunculate.

Ecology : Rare on waste sandy back shore, hill slopes and cliffs.

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

Distrib. : Ramcswaram, Tamil Nadu coast.

3. *Jatropha gossypifolia* L., Sp. Pl. 1006, 1753; Hook. in Hook. f., Fl. Brit. India 5: 383.1887.

Erect shrubs with watery juice, 1-3 m tall; stems soft, branched, greenish or reddish-purple with brown lenticells. Leaves 3.5-12 x 4.5-15 cm, viciid, broadly obovate or orbicular, palmately 3-5-lobed, purple gradually becoming dark-green, glandular or 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, sulcate, glabrescent. Seeds 4-6 mm long, ellipsoid, carunculate, smooth.

Ecology : Frequent and scattered in dry sandy areas along the lee sides of seashores sand dunes, common along road sides, river banks and hedges.

Fl. & Fr. : March-April; September-October.

Distrib. : West Bengal and Orissa coast.

11. *Mallotus* Lour.

Mallotus philippenensis (Lam.) Muel. & Arg. in Linnaea 34: 196. 1865; Hook. in Hook. f., Fl. Brit. India 5: 442. 1887.

Trees, 3-6 m high. Leaves 4.7-17 x 3-9 cm, ovate-lanceolate, glabrescent above, pubescent with minute red glands beneath, subcoriaceous, entire or serrate, acute or acuminate at apex, rounded or truncate at base. Flowers 4-4.5 mm across, greenish yellow, arranged in axillary or

terminal panicles. Capsule 1 cm across, subglobose, glandular hairy, deep red. Seeds 3-4 mm in diam., globose, smooth, black.

Ecology : Frequent in dry coastal scrubs and hill slopes.

Fl. & Fr. : Flowers in two peaks, June-September and December-March. Fruits throughout the year.

Distrib. : Tamil Nadu and Saurashtra coast.

12. *Manihot* Mill.

Manihot esculenta Crantz, Inst. Rei. Herb. 1.167.1766, *M. utilisima* Pohl.: Hook. in Hook. f., Fl. Brit. India 5: 239.1887.

Shrubs, 1.5-2 m high. leaves 7-10 x 2.5-3.5 cm, oblanceolate-rhomboid, thin, acuminate at apex, shortly decurrent at base. Flowers 1 cm across, pinkish outside, cream inside, arranged in subterminal panicles. Capsule

3 cm across, winged when young, smooth later. Seeds biconvex.

Ecology : Introduced from South America, cultivated for starchy tuber.

Fl. & Fr. : February-June; December-March.

Distrib. : Tamil Nadu, Kerala and Lakshadweep island.

13. *Micrococca* Benth.

Micrococca mercurialis (L.) Benth., Hook. Niger Fl. 503, 1849; *Claoxylon mercurialis* (L.) Thw.: Hook. in Hook. f., Fl. Brit. India 5: 412. 1887.

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.

Ecology : Rare in sandy waste places and embankments near the coast. Common along road sides and hedges.

Fl. & Fr. : June-August.

Distrib. : Andhra Pradesh, Tamil Nadu.

14. *Phyllanthus* L.

KEY TO THE SPECIES

- 1a. Shrubs or trees; berry dark blue 3. *reticulatus*
- 1b. Herbs or subshrub; berry other than blue :
 - 2a. Leaves orbicular 4. *rotundifolius*
 - 2b. Leaves oblong-lanceolate :
 - 3a. Tepals 5; disc glands 5; styles erect, recurved 1. *amarus*
 - 3b. Tepals 6; disc glands 6; styles horizontal, spreading :
 - 4a. Leaf base cuneate; capsule smooth 2. *maderaspatensis*
 - 4b. Leaf base truncate or obtuse; capsule verrucose :
 - 5a. Filaments free 6. *virgatus*
 - 5b. Filaments connate 5. *urinaria*

1. *Phyllanthus amarus* Schum. & Thonn. in Danske Vidensk. Selsk. Skr. 4: 195. 1829; *P. niruri* auct. non. L.: Hook. in Hook. f., Fl. Brit. India 5: 298.1887.

Herb, up to 75 cm tall. Leaves 9 x 4 mm, oblong, thin glaucous below, entire, apiculate at apex, obtuse at base. Flowers 1 mm across, whitish green, in axillary solitary. Capsule 2 mm across, dry. Seeds vertically

muriculate.

Ecology : Frequent on moist sands, road side and river banks.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala and Minicoy Island.

2. *Phyllanthus maderaspatensis* L., Sp. Pl. 982. 1753; Hook. in Hook. f., Fl. Brit. India 5: 292. 1887.

Annual, glabrous herbs; stems erect with long ascending branches from woody rootstock, variable in habit. Leaves 4-6 x 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.

Ecology : Frequent along river banks, lee sides of the seashore sand dunes, and open scrubs. Common in cultivated fields.

Fl. & Fr. : December-March.

Distrib. : Throughout the coastal districts.

3. *Phyllanthus reticulatus* Poir., Lam. Encycl. 5: 298. 1804; Hook. in Hook. f., Fl. Brit. India 5: 288. 1887.

Shrub, 2-6 m high. Leaves 2-3 x 1-1.5 cm, oblong elliptic, thin, glabrous, entire, acute at apex and base. Flowers 2.5-3 mm long, reddish, arranged in axillary fascicles. Berry 0.7 cm across, globose, dark blue. Seeds 2 mm long, trigonous, brown.

Ecology : Frequent on river banks, back shore embankments, back waters and back mangroves.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

4. *Phyllanthus rotundifolius* Klein ex Willd., Sp. Pl. 4: 584. 1805; Hook. in Hook. f., Fl. Brit. India 5: 299. 1887.

Deep-rooted, much-branched, glabrous herbs; stems rigid, spreading from woody rootstock. Leaves 4-6 x 1-2 mm distichous, subsessile, thick, in axillary clusters; female flowers with larger pedicels than the

males. Capsules depressed-globose, pale, sparingly 3-lobed. Seeds with thin ribs.

Ecology : Common along the sandy seashores, more or less restricted along the dry coast.

Fl. & Fr. : July-September.

Distrib. : Orissa, Andhra Pradesh and Tamil Nadu coast.

5. *Phyllanthus urinaria* L., Sp. Pl. 982. 1753; Hook. in Hook. f., Fl. Brit. India 5: 293. 1887.

Herb up to 80 cm high. Leaves 0.5-2 x 0.2-0.5 cm, oblong, thin, minutely ciliate, apiculate at apex obtuse at base. Flowers 1.5-2 mm across, greenish white, in axillary solitary. Capsule 4 mm across, globose, valved. Seeds trigonous.

Ecology : Frequent on river banks, back waters and moist sandy places and seashore.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Lakshadweep islands.

6. *Phyllanthus virgatus* Forst. f., Fl. Ins. Austr. 65. 1786; *P. simplex* Retz. Observ. Bot. 5: 29. 1788; Hook. in Hook. f., Fl. Brit. India 5: 295. 1887.

Deep-rooted perennial herbs; stems glabrous, much-branched, compressed, spreading radially from rootstock. Leaves 0.5-3.5 x 0.3-0.6 cm, elliptic-oblong, subsessile, 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.

Ecology : Frequent along river banks, embankments, cultivated fields and road sides.

Fl. & Fr. : June-December.

Distrib. : Throughout Indian coastal provinces.

15. *Ricinus* L.

Ricinus communis L., Sp. Pl. 1007. 1753; Hook. in Hook. f., Fl. Brit. India 5: 457. 1887.

Shrub, 4 m tall. Leaves palmatifid, 6-10 lobed, lobes 10-18 x 3-7 cm, lanceolate, thinly pubescent below, serrate, acuminate at apex. Flowers 1.5-6 cm across, greenish yellow, in terminal paniculate racemes. Capsule 2 cm across, spiny. Seeds oblong, shiny, carunculate.

Ecology : Commonly found in croded lands, coastal sandy waste places and back shore land. Cultivated and wild.

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

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Lakshadweep islands.

16. *Sapium* P. Br.

Sapium insigne (Royle) Trimen, Cat. Pl. Ceylon 83, 1885; Hook. in Hook. f., Fl. Brit. India 5: 471.1888.

Monocious, deciduous tree, 12-20 m high. Leaves 10-20 x 5-7 cm, obovate, elliptic-oblong, subcoriaceous, bluntly crenate, acuminate at apex, cuneate at base. Flowers 2-2.5 mm across arranged in terminal or dichotomously forked spikes. Capsule 0.8 cm across,

globose, fleshy, loculicidal. Seeds globose,

Ecology : Frequent on rocky sea shores, ghats and back waters.

Fl. & Fr. : January-April.

Distrib. : West Bengal, Tamil Nadu, Karnataka and Kerala coast.

17. *Sauropus* Bl.

KEY TO THE SPECIES

- 1a. Leaves fleshy; glabrous 1. *bacciformis*
 1b. Leaves membranous; tomentose 2. *quadrangularis*

1. *Sauropus bacciformis* (L.) Airy Shaw, Kew Bull. 35: 685. 1980; *Agyneia bacciformis* (L.) Hook. in Hook. f., Fl. Brit. India 5: 285. 1887.

Much-branched, glabrous, perennial herbs with long woody taproot; stems angular, climbing or prostrate. Leaves 0.5-3 x 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 fascioled in lower axils, females solitary in higher axils. Fruits 5-6 mm across, ovoid, contracted at apex. Seed oblong, tuberculate.

Ecology : Common along the muddy sea-shores, river-banks and grass-lands.

Fl. & Fr. : January-June.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu.

2. *Sauropus quadrangularis* Muell. & Arg. in Linnæa 32: 73. 1863; Hook. f., Fl. Brit. India 5: 335. 1887.

Shrubs. Leaves 1.2-2 cm long elliptic, membranous, subacute at apex, narrowed at base. Flowers 2-3 mm across, red, in axillary solitary. Capsule globose.

Ecology : Frequent on the sea side sand dunes, sea shore hill slopes and cliff.

Fl. & Fr. : July onwards.

Distrib. : Kerala, Maharashtra and Gujarat coast.

18. *Sebastiania* Spreng.

Sebastiania chamaelea (L.) Muell. & Arg. in DC. Prodr. 15: 1175. 1866; Hook. in Hook. f., Fl. Brit. India 5: 475. 1887.

Woody herbs. Leaves 2.5-6.5 x 0.6-1.2 cm linear-oblong, glabrous, serrate, acute at both apex and base. Flowers 2.5-4 mm across, pale yellow, in axillary spikes. Capsules 6-8 mm in diam., subglobose-oblong, red. Seeds oblong.

Ecology : Rare on sandy seashores and along the road side of back mangroves.

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

Distrib. : Frequent along the East and West coast, specially in Kerala coast.

19. *Securinega* Comm. ex Juss.

KEY TO THE SPECIES

- 1a. Unarmed; pistillodes 3, connate below 2. *virosa*
 1b. Armed; pistillodes 2, free 1. *leucopyrus*

1. *Securinega leucopyrus* (Willd.) Muell. & Arg., DC. Prodr. 15(2): 451. 1866; *Flueggea leucopyrus* Willd., Sp. Pl. 4: 757. 1806; Hook. f., Fl. Brit. India 5: 328. 1887.

Straggling shrubs, 1-2.5 m high. Leaves 1-3.5 x 1-2.5 cm, obovate or elliptic obovate, glabrous on both sides, entire, obtuse or emarginate at apex, cuneate or narrowed at base. Flowers 1.5-2.5 mm long, pale green or white, in axillary fascicles. Berries 4-8 mm in diam., spherical or subglobose, lobed, white, smooth. Seeds 4 mm long, trigonous, dark yellowish brown, smooth.

Ecology : Frequent on river banks, back waters and back shore cliffs.

Fl. & Fr. : June-November.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Saurashtra coast.

2. *Securinega virosa* (Willd.) Baill, Adansonia 6: 334. 1865-66; *Flueggea microcarpa* Blume.: Hook. in Hook. f., Fl. Brit. India 5: 328. 1887.

Shrubs, 1-3 m high. Leaves 2-6.5 x 1-5 cm, elliptic-oblong or obovate, glabrous on both sides, entire, truncate or emarginate at apex, cuneate or narrowed at base. Flowers 1.5-3 mm across, greenish yellow, in axillary fascicles. Capsule 4-5 mm diam., subglobose or spherical, white. Seeds rounded at back, minutely punctate.

Ecology : Frequent on back shore sands and rocky cliffs.

Fl. & Fr. : June-November.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Gujarat coast.

20. *Suregada* Roxb. ex Rottl.

Suregada multiflora (Juss.) Baill. Etude Gen. Euph. 396, 1856; *Gelonium multiflorum* Juss.: Hook. in Hook. f., Fl. Brit. India 5: 459. 1888.

Dioecious evergreen trees 4-12 m tall, 40-60 cm in diam., branches pale, marked with stipular scars. Leaves 5.5-14 x 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.

Ecology : Frequent in sandy scrubs around tanks and ditches, gardens and road sides.

Fl. & Fr. : March-August.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra coast.

21. *Tragia* L.

Tragia involucrata L., Sp. Pl. 980. 1753; Hook. in Hook. f., Fl. Brit. India 5: 465. 1888.

Vine. Leaves 5-10 x 2-5 cm, elliptic ovate or obovate, hairy on both side, serrate, acuminate at apex, acute at base. Flowers 1.5-3 mm across, greenish white in axillary spike. Capsule 1 cm across, 3 lobed. Seeds globose.

Ecology : Frequent on sand dunes and seashore hill slopes and coral reef.

Fl. & Fr. : Throughout the year.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu coast and Lakshadweep island.

MORACEAE

KEY TO THE GENERA

- 1a. Inflorescence a syconium; flowers enclosed within the receptacle 2. *Ficus*
 1b. Inflorescence other than syconium; flowers exposed on the receptacle :
 2a. Armed shrubs or tree; leaf margin toothed 3. *Streblus*
 2b. Unarmed tree; leaf margin entire 1. *Artocarpus*

1. *Artocarpus* J. R. & G. Forst.

Artocarpus communis J. R. & G. Forst., Char. Gen. 101. t. 51a. 1776; *A. incisus* (Thunb.) L. f.: King in Hook. f., Fl. Brit. India 5: 539. 1888.

Tree up to 10 m tall. Leaves 10-40 x 8-30 cm, pinnatifid, chartaceous, coriaceous-pubescent along the nerve above, puberulous below, entire, acuminate at apex, decurrent at base. Flowers unisexual, 2.5 mm across

arranged in head. Syncarps 15-20 x 10-15 cm, oblong or rounded. Seed 1.5-2.5 x 1-2 cm, oblong.

Ecology : The bread fruit, native of the Pacific islands, grown along the west coast as good vegetable.

Fl. & Fr. : January-April; July-September.

Distrib. : Maharashtra, Karnataka and Kerala coast and Minicoy Island.

2. *Ficus* L.

KEY TO THE SPECIES

- 1a. Leaves decussate; figs on special shoot 2. *hispida*
- 1b. Leaves alternate; figs on branchlets :
 - 2a. Figs sessile; leaf broadly ovate or elliptic-ovate :
 - 3a. Leaves broadly ovate; apex abruptly acuminate 4. *religiosa*
 - 3b. Leaves elliptic-ovate; apex acute or rounded :
 - 4a. Figs 0.8-1 cm across; intercostal absent 3. *microcarpa*
 - 4b. Figs 1.3-1.8 cm across; intercostal transverse, zigzag 1. *benghalensis*
 - 2b. Figs stalked; leaves oblong or ovate-oblong 5. *virens*

1. *Ficus benghalensis* L., Sp. Pl. 1059. 1753; King in Hook. f., Fl. Brit. India 5: 499. 1888.

Tree up to 15-20 m tall. Leaves 10-17 x 7-12 cm, elliptic-ovate, coriaceous, glabrous above, puberulous below, entire, obtuse or subacute at apex, subcordate at base. Hypanthodium 1.5-2 cm across depressed-globose, reddish, axillary. Achenes 2 x 1.5 mm, globose, ellipsoid, dark-brown.

Ecology : Frequent on road sides and inland forest tracts, much planted as shade tree.

Fl. & Fr. : May-August.

Distrib. : Throughout the Indian coast.

2. *Ficus hispida* L. f., Suppl. Pl. 442. 1781; King in Hook. f., Fl. Brit. India 5: 522. 1888.

Tree up to 8-10 m tall. Leaves 10-20 x 6-10 cm, broadly oblong to elliptic lanceolate, scabrid, entire to minutely toothed, acute at apex, truncate to rounded at base. Hypanthodium 1.5-2.5 cm across, ripening yellow, ribbed. Achenes 1.5 mm, lenticular with hilum.

Ecology : Occasional along the polluted areas towards habitation on back shore.

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

Distrib. : Throughout the coastal districts.

3. *Ficus microcarpa* L. f., Suppl. Pl. 442. 1781; *F. retusa* auct. non L., King in Hook. f., Fl. Brit. India 5: 511. 1888.

Tree up to 18 m tall. Leaves 5-7 x 3-4.5 cm, elliptic-ovate to obovate, thick coriaceous, entire or undulate, rounded or acute at apex, cuncate at base. Hypanthodium 0.7-1 cm across, globose, often paired, axillary. Achene smooth.

Ecology : Frequent on coastal scrubs and back mangrove areas along the river bank.

Fl. & Fr. : November-January.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

4. *Ficus religiosa* L., Sp. Pl. 1059. 1753; King in Hook. f., Fl. Brit. India 5: 513. 1888.

Tree, 8-30 m tall. Leaves 5-13 x 4.5-12 cm, broadly ovate, subcoriaceous, glandular at the apex below, sinuate, acuminate at base. Hypanthodium 4-8 mm across, obovoid or globose, pink-purple or black, sessile, axillary. Achenes smooth.

Ecology : Mostly found as avenue tree along the back-shore.

Fl. & Fr. : November-January.

Distrib. : Throughout the Indian coast.

5. *Ficus virens* Dryander in Ait., Hort. Kew 3: 451, 1789; *F. infectoria* Roxb. non Willd.: King in Hook. f., Fl. Brit. India 5: 515. 1888.

Laticiferous deciduous trees 10-30 m tall. Leaves 10-18 x 3-5.5 cm, ovate-oblong or oblong, glabrous, entire or wavy, suddenly tapering into an acuminate apex, rounded, truncate or slightly acuminate at base. Syconia globose, pale-red, paired, in leaf axils or fallen leaves.

Ecology : Frequent in sand-bars situated in between the creeks and back mangroves. Common along river banks and open forests near villages.

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

Distrib. : West Bengal, Orissa, Tamil Nadu and Karnataka coast.

3. *Streblus* Lour.

Streblus asper Lour., Fl. Cochinch. 615. 1790; Hook. in Hook. f., Fl. Brit. India 5: 489. 1888.

Unarmed or frequently armed tree, monoecious or dioecious, up to 10 m tall. Leaves 4-9 x 2-3.5 cm, elliptic-obovate or rhomboid, scabrid, bluntly toothed, acute at apex, cuneate at base. Flowers 1.2 cm long white, clustered in stalk. Drupe enclosed by fleshy perianth,

yellow when ripe.

Ecology : Frequent along the margin of sandy back shore, river banks and edges of coastal scrubs.

Fl. & Fr. : January-March; July-September.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Gujarat coast.

URTICACEAE

KEY TO THE GENERA

- 1a. Plants with stinging hairs; flowers not clustered 1. *Laportea*
 1b. Plants without stinging hairs; flowers in sessile clusters in axils of leaves
 or bracts 2. *Pouzolzia*

1. *Laportea* Gaud.

Laportea interrupta (L.) Chew., Gaud. Bull. S. Straits Settle 21: 200. 1965 & 25: 145. 1969. *Fleurya interrupta* (L.) Gaud.: Hook. in Hook. f., Fl. Brit. India 5: 548. 1888.

Herb up to 30 cm tall with stinging hairs. Leaves 4-7 x 2-4 cm, elliptic-ovate membranous, hairy, serrate, shortly acuminate at apex, acute at base. Flowers male 4 mm across, female 2.5 mm across, greenish yellow,

in axillary clusters. Achene 3 mm across, ovoid, compressed. Seeds flattened.

Ecology : Frequent on coastal scrubs and lee side of the sand dunes.

Fl. & Fr. : July-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka coast and Kalpeni Island in Lakshadweep.

2. *Pouzolzia* Gaud.

Pouzolzia zeylanica (L.) Bennett & Brown, Pl. Jav. Rar. 67. 1883; *P. indica* (L.) Gaud.: Hook. f., Fl. Brit. India 5: 581. 1888.

Shrubs up to 30 cm tall. Leaves 2-5 x 1.5-2.5 cm, elliptic-ovate, sparsely strigose, entire, acute at apex, rounded at base. Flowers male 4 mm across; female 1.5 mm in axillary subsessile clusters. Achenes 2 winged.

Ecology : Frequent along the back side of coastal dunes and coastal scrubs.

Fl. & Fr. : January-March.

Distrib. : West Bengal, Tamil Nadu, Orissa, Cochin and Rameswaram Island.

C A S U A R I N A C E A E

Casuarina Forst.

Casuarina equisetifolia Forster & Forster f., Char. Gen. Pl. 104. f. 53. 1776; Hook. in Hook. f., Fl. Brit. India 5: 598. 1888.

Tree up to 12 m tall. Leaves 7 in a node, 0.5-1 mm long, scaly, acute. Flowers unisexual, 1-1.5 mm across arranged in bracteate spikes. Fruit ovoid or oblong-cylindric with carpophore and

winged nutlets. Seeds exalbuminous.

Ecology : Mostly planted along the seashore for wind breaker and sand binder.

Fl. & Fr. : August-January.

Distrib. : Throughout the Indian coast.

S A L I C A C E A E

Salix L.

Salix tetrasperma Roxb., Cor. Pl. 1: 66, t. 97, 1796; Hook. in Hook. f., Fl. Brit. India 5: 626. 1888.

Small, evergreen trees or shrubs 3-8 m tall; twigs densely pillose; bark greyish-brown, fissured. Leaves variable, 5-20 x 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.

Ecology : Very rare along the river and streams towards the fresh-water condition near the coast.

Fl. & Fr. : January-February.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Karnataka coast. Also in Andamans.

C E R A T O P H Y L L A C E A E

Ceratophyllum L.

Ceratophyllum demersum L., Sp. Pl. 992. 1753; Hook. in Hook. f., Fl. Brit. India 5: 639. 1888.

Slender, submerged, monoecious aquatic herbs; stems much-branched, root-less. 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.

Ecology : Fresh water plants, frequently found within sandy slacks along the seashores.

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

Distrib. : Throughout the Indian coast.

CYCADACEAE

Cycas L.

Cycas rumphii Miq., Bull. Sc. Phys. et Nat. Neerl. 1839; Dyer in Hook. f. Fl. Brit. India 5: 657. 1888.

Shrubs or small trees; trunk covered with woody bases of the petiole. Leaves 1.5-3.0 m long; petioles 30-60 cm long; leaflets 15-30 x 0.5-0.7 cm, smooth, glabrous, acute at apex, obtuse at base, margin flat, male cones terminal; scales closely imbricate, anthers ellipsoid in groups of 3-7. Ovules 3-7 on either side of the carpophyle below the blade. Seeds ellipsoid 5-7 cm long.

Ecology : Very common along the sandy coast at Andamans. It is endemic in this islands.

Fl. & Fr. : Male cone throughout the year, ovules mature during March-April.

Distrib. : Restricted only in Andaman and Nicobar islands.

Notes : Along the coast of Baratang islands in Andaman near Jaroa creek numerous mature ovules are seen germinating successfully under the tree on sands.

HYDROCHARITACEAE

KEY TO THE GENERA

- 1a. Leaves differentiated into petiole and blade :
- 2a. Leaves not more than 3 cm, blade ovate or flat, thin and translucent; perianth uniscriate or absent; grows in marine water 3. *Hulophila*
- 2b. Leaves more than 3 cm, blade quilt-like, cordate; perianth biseriata with sepals and petals; grows in fresh water 6. *Ottelia*
- 1b. Leaves not differentiated into petiole and blade :
- 3a. Plant rhizomatus; leaf veins in 2 series; marine 2. *Enhalus*
- 3b. Plant non-rhizomatus; leaf veins not in two series; not marine :
- 4a. Leaves confined to basal rosettes; stem truncated, corn-like :
- 5a. Plants monoecious or dioecious; leaves spirally arranged, ribbon-like, gradually attenuate to fine part at apex 1. *Blyxa*
- 5b. Plant dioecious; leaves distichous, strap-shaped abruptly become rounded at apex 7. *Vallisneria*
- 4b. Leaves arranged along elongated stems; stems not truncated, bearing apical tubers :
- 6a. Leaves in two rows, arranged irregularly; squamulae smooth; stigma otherwise 5. *Nechamandra*
- 6b. Leaves in whorls of 3 or more arranged in regular pattern; squamulae hairy; stigma club shaped 4. *Hydrilla*

1. *Blyxa* Noronha.

Blyxa aubertii L.C. Richard var. *echinosperma* (Clarke) C.D.K. Cook et R. Luond in C.D.K. Cook 217. 1996. *B. echinosperma* (Clarke) Hook. f., Fl. Brit. India 5: 661. 1888.

Aquatic submerged, acaulescent herb up to 20 cm high. Leaves 8-20 x 0.3-0.8 cm, whorled, linear, entire, acute at apex. Flower white, pink at throat, bisexual,

solitary. Fruit linear, ribbed. Seed oblong, tuberculate, tailed.

Ecology : Common in still water.

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

Distrib. : East and West coast, Kerala, Karnataka.

2. *Enhalus* Rich.

Enhalus acoroides (L.f.) Royle, Illustr. 453, 1840; *E. koenigii* Rich.: Hook. in Hook. f., Fl. Brit. India 5: 663. 1888.

Submerged robust, seagrasses up to 2 m long. Leaves from the rhizome with sheath and lamina; sheath 10-23 x 2-3 cm, obconical, convolute, white to pale-brown; lamina 40-102 x 1.2-1.7 cm, linear, ribbon like, entire, serrulate in young, thickened along the margins, obtuse at apex. Male flowers 3-6 mm long, globose, white, enclosed by two spathes arranged on conical central axis; Female flowers 2.2-3.5 x 0.6-1 cm, across, with reddish

brown streaks. Fruits 2.5-6 x 1.5-3.5 cm, ovoid, green, with many branched black appendages. Seeds 10-12, 9-12 mm long, obconical-obovoid.

Ecology : Restricted in shallow and sheltered marine environment where the substratum is sandy to muddy with coral flat. Generally it is noted in tidal and subtidal zones.

Fl. & Fr. : April-June; September-December.

Distrib. : Tamil Nadu coast, Rameswaram, Gulf of Mannar and Andamans.

3. *Halophila* Thouars.

KEY TO THE SPECIES

- 1a. Lamina hairy, linear-oblong, margin serrulate 2. *stipulacea*
 1b. Lamina glabrous, ovate, margin entire 1. *ovata*

1. *Halophila ovalis* (R. Br.) Hook. f., Fl. Tasman. 2: 45, 1858. *H. ovata auct. non* Gaud.: Hook. in Hook. f., Fl. Brit. India 5: 663. 1888.

Creeping and under water, slender, aquatic dioecious herbs. Leaves 4-12.6 long, oblong-elliptic or oblanceolate, entire or undulate, glabrous, transparent, obtuse or acute at apex, oblique or subtruncate at base. Male flowers 4 cm long, stalks 3.5 cm, brownish at outer and whitish at in, arranged in solitary axillary with spathe, Fruits 2-5 x 1.4-4 mm, ovoid-ellipsoid, white to pale yellow. Seeds 18-27, 0.5 x 0.4 mm across, globose-ellipsoid, bluntly beaked at both ends.

Ecology : It occurs in fine sand, coral debris and muddy substratum of tidal and subtidal maritime environment.

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

Distrib. : Coromandel coast, Orissa, Andhra Pradesh and

Tamil Nadu coast. Also found in Andaman islands.

2. *Halophila stipulacea* (Forsk.) Asch., Bot Zeitung (Berlin) 25: 95, 1867. *H. ovata auct. non* Gaud.: Hook. in Hook. f., Fl. Brit. India 5: 663. 1888.

Slender aquatic, dioecious herbs up to 7.5 cm long. Leaves 1-3.5 x 1.5-5 mm, linear-oblong, hairy, serrulate, obtuse at apex cuneate or gradually decurrent at base. Male flowers not seen. Female flowers 17 mm long, solitary axillary, subtended by spathes. Fruits 3 mm across, ovoid subglobose. Seeds globose, beaked at both ends.

Ecology : Commonly found on muddy and sandy bottom of shallow brackish water coastal lagoon and back waters.

Fl. & Fr. : Female flowers and fruits from February to April.

Distrib. : Andhra Pradesh and Tamil Nadu coast.

4. *Hydrilla* L. C. Rich.

Hydrilla verticillata (L. f.) Royle, Illustr. Bot. Himal. t. 376, 1839; Hook. in Hook. f., Fl. Brit. India 5: 659. 1888.

Slender, much-branched, submerged perennial herbs. Leaves 4-14 x 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.

Ecology : Frequent in ponds and puddles under fresh water along the shores.

Fl. & Fr. : October-December.

Distrib. : Throughout the Indian coast.

5. *Nechamandra* Planch.

Nechamandra alternifolia (Roxb. ex Wight) Thwaites, Enum. Pl. Zeyl. 332. 1864; *Lagarosiphon roxburghii* (Planch.) Benth.: Hook. in Hook. f., Fl. Brit. India 5: 659. 1888.

Caulescent aquatic herb. Leaves 1.5-7.5 x 0.2-0.5 cm, oblong-linear or elliptic-oblanccolate, membranous, serrulate or subentire, obtuse or acute at apex, amplexicant at base. Flowers: male flowers 0.5 mm, subglobose axillary, solitary, female flowers 8-9 mm,

solitary axillary. Fruit 9-11 mm long, ovoid. Seeds many ellipsoid.

Ecology : Common on fresh water pools, ditches and jhills near the coast.

Fl. & Fr. : October-February.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Gujarat coastal districts.

6. *Ottelia* Pers.

Ottelia alismoides (L.) Pers., Syn. Pl. 1: 400. 1805; Hook. in Hook. f., Fl. Brit. India 5: 662. 1888.

Submerged, flacid, annual aquatic herbs. Leaves submerged and floating; submerged ones oblong, 5-8 x 0.8-3 cm, thin, entire, acute at apex, narrowed at base; floating ones 5.5-25 x 4-21 cm, broadly ovate-suborbicular or cordate, chartaceous, undulate, obtuse at

apex, cordate or rounded at base. Flowers 2-2.5 x 1.5 cm, white with yellow spots, sessile, solitary.

Ecology : Common in fresh water on coastal slacks, lagoons and shallow water bodies near the coast.

Fl. & Fr. : November-March.

Distrib. : Throughout the Indian coastal districts.

7. *Vallisneria* L.

Vallisneria spiralis L., Sp. Pl. 1015. 1753; Hook. in Hook. f., Fl. Brit. India 5: 660. 1888.

Submerged aquatic herb. Leaves 6-12 cm long, linear, ribbon like, thin, membranous, serrate acute or obtuse at apex, narrowed at base. Male flowers 0.6 mm across, whitish, enclosed in spathes; Female flowers 15-20 cm long with long spirally coiled pedicel, whitish

enclosed in spathes. Fruit 1.5-2.8 cm long, oblong, green.

Ecology : Frequent in coastal lagoons, ditches and canals in submerged fresh or brackish water condition.

Fl. & Fr. : December-April.

Distrib. : Throughout the Indian coastal districts.

BURMANNIACEAE

Burmannia L.

Burmannia coelestis D. Don., Prodr. Fl. Nepal. 44. 1825; Hook. in Hook. f., Fl. Brit. India 5: 665. 1888.

A saprophytic herb, up to 15 cm tall. Leaves 2-3.5 x 0.2-0.5 mm, rosulate ones linear, cauline ones narrow-elliptic or linear, glabrous. Flowers 7 mm across,

violet in terminal cluster. Capsule oblong-ovoid dehiscent.

Ecology : Frequent on coastal scrubs and rocky crevices.

Fl. & Fr. : December-April.

Distrib. : Tamil Nadu, south Kanara and Karnataka coast.

ORCHIDACEAE

KEY TO THE GENERA

- 1a. Terrestrial :
- 2a. Leafless, either during flowering time or throughout 13. *Nervilia*
- 2b. Leafy plant :
- 3a. Lip neither saccate nor spurred 2. *Acanthephippium*
- 3b. Lip distinctly saccate nor spurred :
- 4a. Lip with saccate base 5. *Chelostylis*
- 4b. Lip spurred :
- 5a. Spur long cylindric 12. *Habernaria*
- 5b. Spur scrotiform, conical or vermiform :
- 6a. Bulbous caespitose herbs; inflorescence lateral 11. *Eulopia*
- 6b. Tuberous simple herbs; inflorescence terminal 15. *Peristylis*
- 1b. Epiphytic :
- 7a. Leaves absent (only roots green and assimilatory) 6. *Chiloschista*
- 7b. Leaves present :
- 8a. Leaves equitant, ensiform 14. *Oberonia*
- 8b. Leaves otherwise :
- 9a. Plants with pseudobulb :
- 10a. Pseudobulbs with single leaf :
- 11a. Pseudobulbs in clusters; inflorescence terminal on pseudobulbs, pendulous; perianth more or less equal in size 16. *Pholidata*
- 11b. Pseudobulbs on creeping stems; inflorescence lateral to the pseudobulb, erect; perianth very unequal :
- 12a. Scapes from the base of pseudobulb 4. *Bulbophyllum*
- 12b. Scapes lateral to the pseudobulb 18. *Trias*
- 10b. Pseudobulbs with two or more leaves :
- 13a. Flowers with lateral sepals adnate to the foot of the column to form mentum 10. *Eria*
- 13b. Flowers without a mentum 8. *Cymbidium*
- 9b. Plants without pseudobulbs :
- 14a. Lip without spur :
- 15a. Leaves ovate-lanceolate, obtuse or acute at tip 9. *Dendrobium*
- 15b. Leaves linear, equally forked at tip 7. *Cotonia*
- 14b. Lip with spur :
- 16a. Leaves praemorse at apex 19. *Vanda*
- 16b. Leaves retuse or cleft at apex :
- 17a. Inflorescence drooping; lip deeply cleft at tip 17. *Rhynchostylis*
- 17b. Inflorescence erect; lip trilobed :
- 18a. Inflorescence corymbose; spur gibbous 1. *Acampe*
- 18b. Inflorescence racemose; spur conical or cylindrical 3. *Aerides*

1. *Acampe* Lindl.

Acampe praemorsa (Roxb.) Blatt. & McCann, Jr. Bom. Nat. Hist. Soc. 35: 495. 1932; *Saccolabium praemorsa* (Roxb.) Hook. f., Fl. Brit. India 6: 62. 1890.

Epiphytic herbs; stem stout, monopodial, covered by persistent leaf bases; root thick, spreading. Leaves alternate, distichous, coriaceous, oblong, unequally cleft at apex or bilobulate. Flowers with transverse purplish

streaks, pleasantly scented, in leaf opposed corymbose panicles up to 10 cm long. Fruit almost sessile, longitudinally ribbed, about 6 cm long.

Ecology : Epiphytic on trees of *Syzygium* and *Terminalia*.

Fl. & Fr. : April-July; May onwards.

Distrib : Throughout the Indian coast.

2. *Acanthephippium* Bl.

Acanthephippium bicolor Lindl., Edwards' Bot. Reg. 20:1730.1835; Hook. f. in Hook. f., Fl. Brit. India 5: 815. 1890.

Tall terrestrial, leafy herbs, 1 m high; pseudobulbs stout fleshy, narrowly conical with persistent sheathy scales or sheath fibre. Leaves 2 or 3, unequal in size, 23-55 x 6.0-11.5 cm, broadly elliptic, ovate-oblong, plicate, apex acuminate, base narrow. Flower large,

fleshy, yellowish white with pink dots in short raceme of 3-7 flower. Fruit ellipsoid, ridged.

Ecology : Terrestrial herb, rare in moist grassland and semi-evergreen forest.

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

Distrib. : Tamil Nadu, Kerala, Karnataka coast.

3. *Aerides* Lour.

Aerides crispa Lindl., Gen. Sp. Orch. 239.1833; Hook. f. in Hook. f., Fl. Brit. India 6: 45. 1890.

Robust epiphytic herb; stem sheathed with old leaves; woody. Leaves coriaceous, linear-oblong, bilobed at apex. Flowers white in long branched racemes. Capsules pear shaped.

Ecology : Epiphytic on large tree on hill slopes along the coast.

Fr. & Fl. : May-November; November-February.

Distrib : Kerala, Karnataka, Maharashtra.

4. *Bulbophyllum* Thouars.

KEY TO THE SPECIES

- 1a. Flowers in very short racemes (2-3 fl.) :
 - 2a. Scape capillary, lip small, pale yellow 5. *protractum*
 - 2b. Scape not capillary, lip winged, purple 4. *mysorensis*
- 1b. Flowers in long racemes (6-many fl.) :
 - 3a. Scape equaling to leaves 1. *acutiflorum*
 - 3b. Scape shorter than the leaves :
 - 4a. Lip membranous 3. *lepidum*
 - 4b. Lip tumid 2. *fimbriatum*

1. *Bulbophyllum acutiflorum* A. Rich., Ann. Sci. Nat. 2, s. 15: 18. t. 7. 1841; *B. albidum* (Wight) Hook. f. in Hook. f., Fl. Brit. India 5: 757. 1890.

Rhizome creeping with conical pseudobulbs at intervals. Leaves 1.5-8.0 x 0.5-2.0 cm, linear-oblong, obtuse, sessile or subsessile. Flowers yellowish green with reddish streaks on lip in umbels.

Ecology : Epiphytic on old tree, frequent in swamp forests.

Fl. & Fr. : November-December.

Distrib. : West coast and Andamans.

2. *Bulbophyllum fimbriatum* (Lindl.) Reichb. f., Walp. Ann. 6: 260. 1861; *Cirrhopetalum fimbriatum* Lindl.: Hook. f. in Hook. f., Fl. Brit. India 5: 774. 1890.

Rhizomatous pseudobulbous epiphytes. Leaves usually 2, sessile, oblanceolate. Flowers greenish yellow with reddish lines and maroon pedicels in erect umbels. Capsules obpyriform.

Ecology : Disjointed endemic in western ghats. Flowers with a foetid smell.

Fl. & Fr. : March-May.

Distrib : Western Ghats.

3. *Bulbophyllum lepidum* (Bl.) J.J. Sm., Fl. Butzg. 6: 471. 1905; *Cirrhopetalum gamosepalum* Griff.: Hook. f. in Hook. f., Fl. Brit. India 5: 774. 1890.

Pseudobulbs 2.5-3 cm; leaf 5-12 cm, linear-oblong or oblanceolate, obtuse, sub-petioled; scape 10 cm, slender; umbels many fid; bracts setaceous, pedicels 0.8 cm, dorsal sepal and petals bright red, lateral sepals 10 cm, linear-oblong or lanceolate, purple in colour,

sometimes longer than the dorsal one, petal longer than the dorsal sepal, caudate, 3 nerved, ciliate, lip membranous, 3-nerved, columnar arms rounded.

Ecology : Terrestrial herb growing on humid, moist, ever-green forest floor.

Fl. & Fr. : November-December.

Distrib : Andaman islands.

4. *Bulbophyllum mysoreense* (Rolfe) J. Sm., Bull. Jard. Butz. ser. 2, 8: 26. 1912.

Robust epiphyte; rhizomes stout; pseudobulb quadrangularly conical. Solitary leaf when in flower, oblong, retuse. Flower white and purplish in centre in umbellate racemes. Pollinia 4.

Ecology : Terrestrial herb growing on dense moist, ever-green forest.

Fl. & Fr. : June-August.

Distrib : Andaman Islands.

5. *Bulbophyllum protractum* Hook. f. in Hook. f., Fl. Brit. India 5: 758. 1890.

Pseudobulbs 2-2.5 cm; leaf 5-7.5 cm, linear-lanceolate, acute, rather thin; scape 2.5 cm, sheath slender; pedicels 0.25 cm, much shorter than the leaf, flowers very small, umbelled, bracts setaceous, sepals subequal, lanceolate, acute, 3 nerved, petals nearly as long, 3 nerved, lip very small, subsessile, columnar spurs slender.

Ecology : Rare on trees in moist forests.

Fl. & Fr. : July - December.

Distrib : Karnataka coast.

5. *Cheirostylis* Bl.

Cheirostylis flabellata Wight, Phil. Jr. Sci. 5(1): 16. t. 1757. 1851; Hook. f. in Hook. f., Fl. Brit. India 6: 105. 1890.

Slender, semi-succulent herbs, 12-22 cm tall with decumbent rhizome. Leaves 1.5-3.5 x 1.5 cm, ovate, apex acute, base sheathing. Flowers white-light purple in racemes 9-16 cm long.

Ecology : Terrestrial, rare in semi evergreen forests and moist hill slopes.

Fl. & Fr. : February-March.

Distrib. : Karnataka, Kerala coast and Andamans.

6. *Chiloschista* Lindl.

Chiloschista glandulosa Blatt. & McCann, J. Bom. Nat. Hist. Soc. 35: 488. 1932. *Sarcoshilus luniferus* (Reichb. f.) B. Th. ex Hook. f. in Hook. f., Fl. Brit. India 6: 37. 1890.

Slender, semi-succulent herbs, 12-22 cm tall with decumbent rhizome. Leaves 1.5-3.5 x 1.5 cm, ovate, apex acute, base sheathing. Flowers white-light purple in

racemes 9-16 cm long.

Ecology : Epiphytic on old trees in moist and evergreen forests near coastal hill slopes.

Fl. & Fr. : February-March.

Distrib : Karnataka, Kerala and Andaman coast.

7. *Cottonia* Wight

Cottonia peduncularis (Lindl.) Reichb. f., Cat. Orch. Schilters 52. 1857. *Sarcoshilus macrostachya* Wight: Hook. f. in Hook. f., Fl. Brit. India 6: 26. 1890.

Robust profusely branched epiphytes; stem with short internodes covered by leaf sheaths. Leaves lorate, channelled, unequally bilobed. Flowers 1 cm across,

brownish, in paniculate racemes. Fruits fusiform, ridged.

Ecology : In opened areas, moist and semievergreen forest along the coast.

Fl. & Fr. : December-March.

Distrib : Orissa, Kerala and Maharashtra.

8. *Cymbidium* Swartz.

KEY TO THE SPECIES

- 1a. Epichile equaling or shorter than the hypochile 1. *aloefolium*
 1b. Epichile longer than the hypochile 2. *bicolor*

Cymbidium aloefolium (L.) Sw., Nov. Act. Sc. Upsal 6: 73. 1799; Hook. f. in Hook. f., Fl. Brit. India 6: 10. 1890, *p.p.*

Tufted robust epiphyte; pseudobulb large covered with leafsheath. Leaves distichous, lorate, coriaceous, linear-lanceolate, irregularly bilobed or cleft at apex. Flowers large, yellow with purple streaks in pendulous lateral racemes. Capsule ellipsoidal, shallowly grooved.

Ecology : Rare in moist and swamp forest on old trees.

Fl. & Fr. : April-July.

Distrib : Tamil Nadu, Kerala.

Cymbidium bicolor Lindl., Gen. Sp. Orch. 164. 1833; Hook. f. in Hook. f., Fl. Brit. India. 6: 11. 1890.

Tufted robust epiphyte; pseudobulb large covered with leafsheath. Leaves distichous, lorate, coriaceous, linear-lanceolate, irregularly bilobed or cleft at apex. Flowers with central prominent brown patch with yellow margins in pendulous lateral racemes. Capsule ellipsoidal, shallowly grooved.

Ecology : Rare in moist forests and coastal cliffs on old trees.

Fl. & Fr. : April-August.

Distrib : Karnataka and Kerala coast.

9. *Dendrobium* Swartz.

KEY TO THE SPECIES

- 1a. Flowers few to many on a long racemes :
 2a. Racemes very slender, usually few flowered 6. *heyneanum*
 2a. Racemes stout, many flowered :
 3a. Mid lobe ovate, disk hairy 3. *barbatulum*
 3b. Mid lobe sub-orbicular, disk crenate ridges 4. *crumenatum*

1b. Flowers solitary or fasciated on a short racemes :

- 4a. Flowers axillary 1. *anceps*
 4b. Flowers terminal :
 5a. Lip deep yellow, ciliate 2. *aphyllum*
 5b. Lip pale yellow, gland dotted 3. *herbaceum*

1. *Dendrobium anceps* Swartz in Vet. Acad. Hand. Stockh. 246. 1800; Hook. f. in Hook. f., Fl. Brit. India 5: 724. 1890.

Stems compressed, 20-35 cm long, leafy. Leaves lanceolate or ovate-lanceolate, acute, 2.5-3.5 cm long, fleshy; flowers 1.7 cm long, greenish or yellowish, axillary, pedicel very short, mentum longer than the sepals, lip cuneately oblong, obscurely 3 lobed, membranous veined, margin crisped.

Ecology : Epiphyte with pseudobulbs frequently found on trees of moist forests near the bay.

Fl. & Fr. : January-March.

Distribution : Gangetic delta and Andaman islands.

2. *Dendrobium aphyllum* (Roxb.) Fischer in Gamble, Fl. Pres. Madras 1416. 1928; *D. pierardi* Roxb.: Hook. f. in Hook. f., Fl. Brit. India 5: 738. 1890.

Epiphytes, stem slender, pendulous. Leaves lanceolate, apex acuminate, base imbricate. Flowers yellow in leaf opposed racemes.

Ecology : Epiphyte on old tree trunk in moist deciduous forest.

Fl. & Fr. : April-June.

Distribution : West Bengal, Karnataka.

3. *Dendrobium barbatulum* Lindl., Gen. Sp. Orch. 84. 1830; Hook. f. in Hook. f., Fl. Brit. India 5: 719. 1890.

Epiphytic herb, leafless when flowering; pseudobulb 1 to several noded, nodes purplish-brown with longitudinal streaks. Leaves alternate, distichous, ovate lanceolate. Flowers 4 cm across, white, with pink lilac. Capsule 2 cm long, ellipsoid.

Ecology : Epiphytic on trees and on rocky substratum.

Fl. & Fr. : January-March; June.

Distrib : Gujarat, Maharashtra, Karnataka, Kerala and Tamil Nadu coast.

4. *Dendrobium crumenatum* Swartz in Act. Holm. 1800. 246; Hook. f. in Hook. f., Fl. Brit. India 5: 729. 1890.

Stem tall branched, 2-3 ft, base fusiform; leaves oblong, obtuse or notched, 5-7.5 cm, coriaceous; flowers many on the leafless ends of the branches, 2.5-3 cm long; white, dorsal sepal ovate-lanceolate, 7 nerved, petals linear-oblong, 5 nerved, mentum equaling the lateral sepals, conical, acute, incurved, side lobes of lip narrow, mid lobe much larger, suborbicular crisped, disk with crenate ridges.

Ecology : Epiphyte on moist forest.

Fl. & Fr. : January-April.

Distribution : Andaman Islands, Tenasserim and Malay peninsula.

5. *Dendrobium herbaceum* Lindl., Bot. Misc. 69. 1840; Hook. f. in Hook. f., Fl. Brit. India 5: 719. 1890.

Tufted, erect or pendulous epiphyte with grooved, slender, much branched stem; leafless when in flower. Leaves sessile, caducous, distichous, linear-oblong. Flowers 5 cm across, creamy white, 3-4 in terminal racemes. Capsule fusiform, ribbed with 3 flat and 3 narrow ones.

Ecology : Frequent on old tree trunk in the mangrove forests.

Fl. & Fr. : March-April.

Distrib : Kerala, Karnataka, Maharashtra and Tamil Nadu.

6. *Dendrobium heyneanum* (Wall.) ex Lindl., Gen & Sp. Orch. 78. 1830; Hook. f. in Hook. f., Fl. Brit. India 5: 718. 1890.

Epiphytes 20 cm tall, stem erect, stout, bereft of leaves but with scale fibres. Leaves 1.0-12.0 x 0.3-0.8 cm, linear-lanceolate, acute, base sheathing. Flowers white with pinkish lip. Fruit ovoid with marcescent perianth.

Ecology : Occasional on tree trunks in semi-evergreen forests.

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

Distrib. : Throughout the west coastal districts.

10. *Eria* Lindl.

KEY TO THE SPECIES

- 1a. Pseudobulbs discoid-ovoid, many in spreading clusters, with two well developed leaves 1. *albiflora*
 1b. Pseudobulbs oblong, a few caespitose with two or more well developed leaves :
 2a. Flowers open well, petal with 5 nerved 2. *bractescens*
 2b. Flowers not well open, petal with 3 nerved 3. *mysorensis*

1. *Eria albiflora* Rolfe, Kew Bull. 170. 1893.

Herbs, pseudobulbs aggregate, globose-ovoid, 4-12 mm across with small white scaly spots. Leaves 2.0-6.0 x 0.7-1.3 cm, elliptic lanceolate, apex acute, base sheathing. Flowers white, in lax terminal racemes.

Ecology : Epiphytic on old tree trunks and branches in moist forests.

Fl. & Fr. : July-August

Distrib. : Western Ghats.

2. *Eria bractescens* Lindl. in Bot. Reg. 1841, Misc. 18: 184, t. 29; Hook. f. in Hook. f., Fl. Brit. India 5: 796. 1890.

Pseudobulbs 2.5-3.5 cm. Leaves 2-3, oblong, obliquely bifid; racemes long slender, pedicelled, flowers white, glabrous or puberulous, bracts large, lateral sepals 0.6-0.9 cm, ovate-lanceolate, acuminate, falcate and linear-oblong, petals 5 nerved, mentum conical sub-acute,

hypochile cuneate-obovate with 3 thickened ridges, the lateral short, side lobe pink rounded, midlobe quadrate.

Ecology : Epiphytic on old tree trunk of evergreen forests.

Fl. & Fr. : April-June.

Distrib : Andaman islands.

3. *Eria mysorensis* Lindl., Jr. Linn. Soc. Bot. 3: 54. 1858; Hook. f. in Hook. f., Fl. Brit. India 5: 793. 1890.

Aggregated pseudobulbous epiphyte; pseudobulb sheathed. Leaves arising terminally from pseudobulb, oblong-lanceolate or elliptic-lanceolate, acute. Flowers white, fragrant, on slightly pendulous racemes.

Ecology : Epiphytic on tree trunks in semi-evergreen and moist forests.

Fl. & Fr. : August-September.

Distrib : Tamil Nadu, Kerala, Karnataka, Maharashtra.

11. *Eulopia* Br.

KEY TO THE SPECIES

- 1a. Leafless when flowering; leaves only 3 or 4, broadly elliptic 2. *spectabilis*
 1b. Leafy when flowering; leaves many, linear 1. *epidendrabea*

1. *Eulopia epidendrabea* (J. Koenig) Schltr., Die Orchideen 346. 1915; *E. virens* (Roxb.) R. Br. ex Lindl.: Hook. f. in Hook. f., Fl. Brit. India 6: 1. 1890.

Terrestrial glabrous herb with green pseudobulb. Scape 1.5-2 m long, slender. Leaves 70-80 cm long, linear. Flowers dark green, lip white with pink veins, in paniculate raceme.

Ecology : Frequent in coastal scrub jungles.

Fl. & Fr. : April-June.

Distrib. : Tamil Nadu.

2. *Eulopia spectabilis* (Dennst) Suresh, Regnum Vegetabile; *E. nuda* Lindl.: Hook. f. in Hook. f., Fl. Brit. India 6: 5. 1890.

Terrestrial herb with creeping underground (hypogean) tubers. Leaves 50 x 9 cm, alternate, distichous, broad elliptic, apex acute-acuminate. Flowers greenish white in racemes. Capsule fusiform.

Ecology : Rare, growing on moist forest floor.

Fl. & Fr. : May-July.

Distrib. : Kerala.

12. *Habenaria* Willd.

KEY TO THE SPECIES

- 1a. Lip 3-lobed or partite, side lobes broad, petaloid 2. *plantaginea*
 1b. Lip 3-partite, side lobes very narrow, filiform :
 2a. Stem leafy upwards 3. *viridiflora*
 2b. Stem with leaves clustered towards the middle or base 1. *heyneana*

1. *Habenaria heyneana* Lindl., Gen. Sp. Orch. 320. 185; Hook. f. in Hook. f., Fl. Brit. India 6: 148. 1890.

Terrestrial herb, up to 30 cm high; tubers ovoid-oblong, hairy; stem erect, cylindric, sheathed at base. Leaves 3 x 5 cm, ovate, becoming linear. Flowers white or greenish yellow, in secund terminal spikes, up to 10 cm long.

Ecology : Amidst grasses in montane places.

Fl. & Fr. : June-October.

Distrib. : Tamil Nadu, Kerala, Karnataka, Maharashtra.

2. *Habenaria plantaginea* Lindl., Gen. Sp. Orch. 323: 1835; Hook. f. in Hook. f., Fl. Brit. India 6: 141. 1890.

Tuberous herb, 20-30 cm tall. Leaves 3.4-6.0 x 0.9-3.0 cm, prostrate on ground, lanceolate-oblong or elliptic, apex mucronate. Flowers 12 mm across, bright white in many flowered racemes. Capsule turgidly fusiform.

Ecology : Among grasses and on rocky hill slopes.

Fl & Fr. : October-December.

Distrib. : West coast from Konkan southwards.

3. *Habenaria viridiflora* Roenl. ex R. Br., Gen. Prodr. Fl. N. Holl. 312. 1810; Hook. f. in Hook. f., Fl. Brit. India 6: 150. 1890.

Terrestrial leafy herb. Leaves 5-10 x 0.8-1.2 cm, linear-lanceolate, apex acuminate. Flowers 0.8 cm diam., greenish-yellow in many fid racemes. Capsule 1.8 cm, fusiform, straight or curved.

Ecology : Rare in rice field and moist places along the coast.

Fl. & Fr. : August-October.

Distrib. : West Bengal, Tamil Nadu, Kerala, Karnataka and Maharashtra.

13. *Nervilia* Commers. ex Gaud

Nervilia aragoana Gaud. in Freycinet, Voy. Bot. 422. t.35 1829. *Pogonia flabelliformis* Lindl.: Hook. f. in Hook. f., Fl. Brit. India 6: 121. 1890.

Hysteranthous tuberous terrestrial herbs; leafless when in flower. Leaf 1 raised above the ground, 8-12 cm

wide, petiole purple. Flowers greenish, solitary, resupinate, not opening fully.

Ecology : Terrestrial herb on moist humid grassland.

Fl. & Fr. : June-July.

Distrib. : Tamil Nadu, Kerala, Maharashtra, Gujarat.

14. *Oberonia* Lindl.

KEY TO THE SPECIES

- 1a. Flowers brown in dense erect or recurved flattened spike 1. *brunoniana*
 1b. Flowers golden yellow in dense, subverticillate, decurved racemes 2. *mucronata*

1. *Oberonia brunoniana* Wight. Icon. 3. t.1622. 1851; Hook. f. in Hook. f., Fl. Brit. India 5: 681. 1890.

Erect or pendulous epiphyte. Leaves linear-oblong, fleshy, subfalcate, olive-brown in colour. Flowers brown in dense erect or recurved flattened spike. Capsule sessile.

Ecology : Rare, epiphytic on tree trunks on semi-evergreen forests.

Fl. & Fr. : July-September.

Distrib. : Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra.

2. *Oberonia mucronata* (Don) Ormerod & Scidenfaden 1997; *O. iridifolia* (Roxb.) Lindl.: Hook. f. in Hook. f., Fl. Brit. India 5: 676. 1888.

Robust, erect or pendulous epiphyte. Leaves fleshy, broadly ensiform. Flower golden yellow in dense, subverticillate, decurved racemes. Capsule sessile.

Ecology : Rare. Epiphytic on tree trunks in moist semi-evergreen forests.

Fl. & Fr. : August-December.

Distrib. : Kerala, Karnataka.

15. *Peristylus* Blume

Peristylus lawii Wight, Ann. Sci. Nat. 2.5.15: 69 t.2e 1841. *Habenaria lawii* Hook. f. in Hook. f., Fl. Brit. India 6: 162. 1890.

Stem slender up to 25 cm tall, loosely sheathed below the leaves, leaves few, elliptic or lanceolate, membranous 10 cm x 5 cm, spike up to 15 cm long, terete, green bear few or many flowers. Flowers small, sessile, white tinged with greenish yellow bracteate, sepals obtuse,

dorsal sepal elliptic, lateral linear-oblong. Petals obovate, in outline, reflex, lip broadly or obtusely trifid as long as the sepals.

Ecology : Rare, epiphytic on trees in moist and swamp forests.

Fl. & Fr. : July- September.

Distrib. : West Bengal and Karnataka coast.

16. *Pholidota* Lindl.

Pholidota imbricata Lindl. in Hook., Fl. Exot. Fl. 2. t.138. 1825; Hook. f. in Hook. f., Fl. Brit. India 5: 845. 1890.

Epiphytic herbs, up to 10 cm tall. Pseudobulbs in clusters on slender, creeping rhizomes. Leaves in pairs, narrowly lanceolate, 4-8.5 x 0.5-0.6 cm, subsessile. Flowers white in terminal inflorescence. Capsule subglobose, ridged.

Ecology : Frequent. Epiphytic on tree trunks of mangrove forests.

Fl. & Fr : June-August.

Distrib : Kerala, Karnataka coast and Andaman islands.

17. *Rhynchostylis* Blume.

Rhynchostylis retusa (L.) Bl., Bijdr. 286. t. 49. 1825; Hook. f. in Hook. f., Fl. Brit. India 6: 32. 1890.

Sturdy, epiphytic herb; shortly stemmed, covered at base by persistent leaf bases. Leaves alternate, distichous, articulate, lorate, bilobed apex. Flowers pale pink or white with deep pink spots in axillary dense, pendulous, simple or branched racemes. Fruit 2 cm long, obovoid.

Ecology : Frequent on tree trunks in moist and semi-evergreen forests.

Fl. & Fr. : April-September.

Distrib. : Tamil Nadu, Kerala, Karnataka, Orissa and West Bengal coastal plains.

18. *Trias* Lindl.

Trias stocksii Benth. ex Hook. f. in Hook. f., Fl. Brit. India 5: 781. 1890.

Small epiphytes with brown creeping rhizomes; pseudobulb conically ovoid. Leaf 1, elliptic oblong, erect, coriaceous. Flowers 2 to 3, orange-red with numerous red dots in few flowered racemes.

Ecology : Rare, growing on old tree trunk of evergreen forests.

Fl. & Fr. : July-September.

Distrib. : Tamil Nadu, Kerala, Karnataka.

19. *Vanda* Br.

Vanda tessellata (Roxb.) Hook. ex G. Don in Loud. Hort. Brit. 372. 1830; Hook. f. in Hook. f., Fl. Brit. India 6: 52. 1890.

Epiphytic, robust dense herbs. Leaves alternate, distichous, linear, falcate, unequally lobed at apex. Flower yellowish-brown, large, sweet scented, fleshy, in about

8-flowered axillary racemes. Capsules about 6 cm long, clavate, ribbed.

Ecology : Epiphyte, commonly found on old tree trunks in moist evergreen forests.

Fl. & Fr. : April-August; October.

Distrib. : Throughout the coastal districts.

L I L I A C E A E

KEY TO THE GENERA

- 1a. Rootstock tuberous; leaves not radical :
 - 2a. Leaves well developed, terminating in a tendril 2. *Gloriosa*
 - 2b. Leaves not well developed, cladodes, needle-like; tendrils absent 1. *Asparagus*
- 1b. Rootstock bulbs or corns; leaves radical 3. *Scilla*

1. *Asparagus* L.

KEY TO THE SPECIES

- 1a. Flowers solitary; stem woody, grooved, branches stout 1. *dumosus*
- 1b. Flowers racemed; stem scandent, not grooved, branches thin :
 - 2a. Cladodes triquetrous, falcate-divaricate; stem scandent woody 3. *racemosus*
 - 2b. Cladodes flat, falcate-ensiform; stem sub scandent, terete 2. *gonocladus*

1. *Asparagus dumosus* Baker, J. Linn. Soc. 14: 608. 1875; Hook. in Hook. f., Fl. Brit. India 6: 315. 1892.

Branched spreading undershrubs up to 60 cm. Leaves deltoid-ovate, cuspidate, spurred at base. Cladodes 0.6-1.2 cm long stout, channeled, mucronate. Flowers 0.5-0.7 cm long, funnel-shaped in axillary clusters. Berry 0.4 cm in diam.

Ecology : Common on rocky crevices and coastal thickets.

Fl. & Fr. : May-October.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Gujarat coast.

2. *Asparagus gonocladus* Baker, J. Linn. Soc. 14: 627. 1875; Hook. in Hook. f., Fl. Brit. India 6: 318. 1892.

Much branched undershrubs. Leaves spurred at the base with hard spines, cladodes 2-6 at node, 0.5-1.3 cm long, flat, narrowed at both ends, finely spinuous. Flowers 5.5-6.5 cm long, white, arranged in racemes. Berry globose.

Ecology : Frequent along the sand stone and rocky crevices on seashore.

Fl. & Fr. : October-January.

Distrib. : Gujarat coast, Saurashtra and Kuchchh.

3. *Asparagus racemosus* Willd., Sp. Pl. 5(2): 152. 1799; Hook. in Hook. f., Fl. Brit. India 6: 316. 1892.

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.

Ecology : Frequent on sandy scrubs and coastal thickets, often found common along the sandy banks of river.

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

Distrib. : Throughout the coastal provinces.

2. *Gloriosa* L.

Gloriosa superba L., Sp. Pl. 305. 1753; Hook. in Hook. f., Fl. Brit. India 6: 358. 1892.

Glabrous scrambling or climbing shrubs with tuberous rootstock; stems leafy, 20-60 cm or often more long, sometimes forked. Leaves 6-15 x 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. Fruits 4-6 cm, oblong, ovoid. Seeds orange-red.

Ecology : Frequent along the back mangroves and sandy scrubs, common in dry forests.

Fl. & Fr. : June-July; August-December.

Distrib. : Throughout Indian coastal provinces.

3. *Scilla* L.

Scilla hyacinthina (Roth.) Macbride, Back. & Bakh. Fl. Java 3: 91. 1968; *S. indica* Baker; Hook. in Hook. f., Fl. Brit. India 6: 348. 1892.

Herbs with subterraneous tunicated bulbs. Leaves 10-20 x 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.

Ecology : Very frequent along the sandy seashores.

Fl. & Fr. : July-September.

Distrib. : Orissa coast on sea beaches.

PONTEDERIACEAE

KEY TO THE GENERA

- 1a. Perianth distinctly tubular at the base; anther subequal, dorsifixed 1. *Eichhornia*
 1b. Perianth lobed almost to the base; anther unequal, basifixed 2. *Monochoria*

1. *Eichhornia* Kunth.

Eichhornia crassipes (C. Martias) Solms-Lauback., DC. Monogr. Phan. 4: 527. 1883.

Free floating herbs. Leaves 5-10.5 cm long, broadly ovate-rhomboid, thin coriaceous, glabrous, entire, obtuse at apex, cuneate at base, petiole spongy bulbous. Flowers 5 cm across, bluish violet in terminal spike. Fruits not observed.

Ecology : Abundant in ditches, pools and lakes of fresh water, mainly in eutropicated swamps near the coast.

Fl. & Fr. : January-April.

Distrib. : Introduced from tropical south America, common in all coastal districts.

2. *Monochoria* C. Presl.

Monochoria vaginalis (Burm. f.) Kunth. C. Presl. Rel. Haenk. 1: 128. 1827; Hook. in Hook. f., Fl. Brit. India 6: 363. 1892.

Aquatic herb, 20-70 cm long. Leaves 3-8.5 x 1.5-5 cm ovate, thin-coriaceous, glabrous, entire, obscurely lobed, acuminate or caudate at apex, cordate at base. Flowers 2 cm across, blue, arranged in raceme.

Capsule 1 x 0.8 cm, oblong. Seeds 0.8 mm, numerous.

Ecology : Frequent in stagnant water and marshy field of the coast.

Fl. & Fr. : November-March.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Mangalore and Kerala coast.

X Y R I D A C E A E

Xyris L.

KEY TO THE SPECIES

- 1a. Culms terete with 6-15 longitudinal ridges; leaf blade unifacial, flat 1. *indica*
 1b. Culms not terete, unridged, leaf blade bifacial, terete 2. *pauciflora*

1. *Xyris indica* L., Sp. Pl. 42. 1753; Hook. in Hook. f., Fl. Brit. India 6: 364. 1892.

Erect annual herbs, 10-30 cm tall. Leaves 5-20 x 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.

Ecology : Occasionally found in moist sandy places near the shore; common in paddy-fields adjacent to the coast.

Fl. & Fr. : June-August.

Distrib. : Native to West Bengal, found throughout the coastal swamps in India.

2. *Xyris pauciflora* Willd. Phytographia 2. t. 1. f. 1. 1794; Hook. in Hook. f., Fl. Brit. India 6: 365. 1892.

Erect scapigerous herb. Leaves 3-25 x 0.1-0.2 cm, linear, papillose, acute or acuminate at apex, sheathing at base. Flowers 6 x 4 mm across, yellow, arranged in globose head.

Ecology : Frequent on moist sandy places of beaches and coastal slacks.

Fl. & Fr. : January-February, February onwards.

Distrib. : West Bengal, Orissa, Tamil Nadu and Kerala coast.

C O M M E L I N A C E A E

KEY TO THE GENERA

- 1a. Flowers and fruit open; fertile stamens 3; staminodes 2-4:
 2a. Cymes 1-2, subtended by spathaceous bracts 1. *Commelina*
 2b. Cymes paniculate, without spathaceous bracts 3. *Murdannia*
 1b. Flowers and fruits hidden; fertile stamens 6; staminodes absent 2. *Cyanotis*

1. *Commelina* L.

KEY TO THE SPECIES

- 1a. Ovary with two ovules :
- 2a. Spathes complicate, margins free or connate at the base :
- 3a. Capsule 3 celled; leaves not linear-lanceolate; seeds without appendages :
- 4a. Seeds tuberculate and reticulate, oblong-cylindric, dark brown 4. *diffusa*
- 4b. Seeds smooth, truncate at one end :
- 5a. Branches of cymes equal; seeds ovoid or subglobose 7. *longifolia*
- 5b. Branches of cymes unequal; seeds cylindric 6. *hassikarlui*
- 3b. Capsule 2 celled; leaves linear-lanceolate; seeds pale with white appendage 2. *attenuata*
- 2b. Spathes funnel shaped or cucullate; margin united below 3. *benghalensis*
- 1b. Ovary with one ovule :
- 6a. Capsule 3 celled, 2 valved; seeds adnate to the cell; spathes subsessile, strongly recurved hooded, auricled on one side falcately hooked on the other 1. *albescens*
- 6b. Capsule 2 celled; seeds not adnate; spathes very shortly peduncled, broadly ovate, acute, cucullate 5. *ensifolia*

1. *Commelina albescens* Hassk., Schweinf. Beitr. Fl. Aethiopia 210. 1867; Hook. f., Fl. Brit. India 6: 373. 1892.

Prostrate or suberect herb. Leaves 9-14 x 0.8-2.2 cm, linear-lanceolate broadened at little above the base, margin undulate, acute at apex, narrowed at base. Flowers 1-1.3 cm. across, pale blue, in 3-4 flowered cyme. Capsules 1.2-1.6 cm, indehiscent. Seeds obliquely obovoid dark brown.

Ecology : Frequent on backshore sand, in moist places and margin of fresh water swamps near the coast.

Fl. & Fr. : August-October.

Distrib. : Tamil Nadu, Karnataka, Kerala, Maharashtra and Saurashtra coast.

2. *Commelina attenuata* Koen. ex Vahl, Enum. 2: 168. 1806; Hook. in Hook. f., Fl. Brit. India 6: 372. 1892.

Slender, much-branched, creeping herbs, rooting at nodes. Leaves 1.5-3.5 x 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 spathe. Capsules 4-6 mm, oblong, compressed. Seeds 1-2 brownish with white appendages.

Ecology : Frequent on moist sandy places along the shores and river-beds.

Fl. & Fr. : July- August.

Distrib. : Throughout the coastal districts.

3. *Commelina benghalensis* L., Sp. Pl. 41. 1753; Hook. in Hook. f., Fl. Brit. India 6: 370. 1892.

Decumbent-ascending annual herbs Leaves 2.5-5 x 2-3 cm, ovate-oblong, membranous, glabrescent, margin ciliate, acute or obtuse at apex, subtruncate at base. Flowers cleistogamous 8 mm across, blue, in terminal or axillary cymes. Capsule 6 mm, ellipsoid. Seeds anterior ones subquadrate 2 mm and posterior one oblong 3 mm.

Ecology : Frequent in coastal scrub jungles and margins of pools and ditches.

Fl. & Fr. : July-October.

Distrib. : Throughout the Indian coastal districts.

4. *Commelina diffusa* Burm. f., Fl. Indica 18. t. 7. f. 2. 1768; *C. nudiflora auct. non L.*; Hook. in Hook. f., Fl. Brit. India 6: 369. 1892.

Straggling annual herbs. Leaves 4.5-6.5 x 0.5-0.8 cm, ovate-lanceolate, chartaceous, entire, acuminate at apex, subcordate at base. Flowers 1.2-1.6 cm across, pale blue, in axillary cymes. Capsules 8 mm long, oblong, 3-celled, beaked at apex. Seeds 3 mm, tuberculate, reticulate.

Ecology : Common on sandy swamps and margins of backshore ditches.

Fl. & Fr. : August-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh and Kerala coast.

5. *Commelina ensifolia* R. Br., Prodr. 269. 1810; Hook. in Hook. f., Fl. Brit. India 6: 374. 1892.

Spreading herbs. Leaves 4-11 x 0.6-0.8 cm, linear-lanceolate, glabrous above, puberulous below, entire, acute or obtuse at apex, narrowed at base. Flowers 1.3-1.6 cm across, bluish, in terminal or axillary cyme. Capsule 6 mm long, 2 celled. Seeds 3-4 mm, smooth.

Ecology : Frequent on moist sandy areas and rocky crevices near the coast.

Fl. & Fr. : August-November.

Distrib. : Tamil Nadu, Kerala, Maharashtra and Gujarat coast.

6. *Commelina hassikarltii* Clarke, Comm. & Cyrt. Beng. 13. t. 5, 1874; Hook. f., Fl. Brit. India 6: 370. 1892.

Much branched herbs. Leaves 3.8-8.2 x 1-2 cm, ovate-lanceolate, entire, acute at apex, narrowed at base. Flowers 1.4-1.7 cm across, blue in axillary or terminal cymes. Capsule 5 mm long, quadrate, apiculate, membranous. Seeds cylindrical.

Ecology : Frequent on moist sandy beaches and margins of pool and rice fields near the coast.

Fl. & Fr. : August-November.

Distrib. : West Bengal, Andhra Pradesh, Tamil Nadu, Kerala and Gujarat coast.

7. *Commelina longifolia* Lam., Encycl. 1: 129. 1783; *C. salicifolia* Roxb; Hook. f., Fl. Brit. India 6: 370. 1892.

Erect or decumbent slender herbs. Leaves 3-8 x 0.5-1 cm, linear-lanceolate, chartaceous, glabrous, entire, acute or acuminate at apex, obtuse at base. Flowers 1.3-1.6 mm across, dark blue, in branched cymes. Capsules 6 mm long, quadrate, membranous. Seeds ovoid-subglobose, black, smooth, membranous.

Ecology : Common along moist sandy beaches, and margins of coastal fresh water swamps.

Fl. & Fr. : August-November.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Gujarat coast.

Cyanotis D. Don

KEY TO THE SPECIES

1a. Cymes not enclosed in leaf-sheath; Seeds shallowly pitted :

2a. Not cottony or silk-cobwebby; seeds black, striate 2. *cristata*

2b. Cottony or silk-cobwebby; seeds pale, faintly rugose 3. *fasciculata*

1b. Cymes enclosed in leaf sheathes; seeds deeply pitted 1. *axillaris*

1. *Cyanotis axillaris* (L.) Schultes & Schultes, Syst. Veg. 7(2): 1154. 1830; Hook. f., Fl. Brit. India 6: 388. 1892.

Creeping or suberect herb. Leaves 4-9 x 0.5-0.8 cm, narrow-lanceolate, succulent, plicate or flat, entire, acuminate at apex, obtuse at base. Flowers 7 mm across, pinkish purple, in axillary cymes, Capsule 6 mm long, ellipsoid, beaked at apex. Seeds 6, 2 mm, oblong.

Ecology : Common on moist sandy places along the lee side of coastal dunes and margins of slacks and ditches.

Fl. & Fr. : August-December.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

2. *Cyanotis cristata* (L.) Schult. f., Syst. 7: 1150. 1830; Hook. in Hook. f., Fl. Brit. India 6: 385. 1892.

Ascending, erect or creeping herbs, rooting at nodes; branches slender, terete, with patent hairs. Leaves 2-6 x 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, biseriata cincinni, enclosed by conspicuous, foliaceous bracts. Fruits 3-4 mm long, ellipsoid, trigonous.

Ecology : Frequent on moist sandy places along the shores, river-beds, and moist fields amidst grasses. Common along road sides and on brick walls.

Fl. & Fr. : Mostly July-September.

Distrib. : West Bengal, Orissa and Tamil Nadu.

3. *Cyanotis fasciculata* (Heyne ex Roth.) Schult. f., Roem and Schult. Syst. 7(2): 1152, 1830; Hook. in Hook. f., Fl. Brit. India 6: 387. 1892.

Erect herb. Stem branched cottony. Leaves 1-3 x 0.4-0.8 cm, linear or oblong-lanceolate, chartaceous, silky-cobwebby, entire, subacute at apex, cordate at base. Flowers 5 mm across, rose in colour arranged in axillary or terminal cymes. capsule 3 mm

long oblong. Seeds 6, 1.5 mm, oblong.

Ecology : Frequent on moist sands and margins of coastal swamps.

Fl. & Fr. : August-December.

Distrib. : West Bengal, Tamil Nadu, Orissa, Ramnswaram, Kerala and Saurashtra coast.

3. *Murdannia* Royle.

KEY TO THE SPECIES

- 1a. Ovary 2 to many ovuled; stem and seeds of various forms :
 2a. Ovary 3-7 ovuled; stem decumbent; capsule trigonous; seeds straw coloured 2. *spirata*
 2b. Ovary 2, rarely 3 ovuled; branches decumbent, rooting; seed furrows and pitted 1. *nudiflora*
 1b. Ovary 1 ovuled; stem long slender; seed hemispheric, rugose 3. *vaginata*

1. *Murdannia nudiflora* (L.) Brenan, Kew Bull. 7: 189. 1952. *Aneilema nudiflorum* (L.) R. Br.: Hook. f. in Hook. f., Fl. Brit. India 6: 378. 1892.

Simple or branched herbs with fibrous root. Leaves 3-8 x 0.3-0.5 cm, linear-lanceolate, chartaceous, glabrous, entire, acuminate at apex, subcordate at base. Flowers 8-10 mm across, pink to bluish, in terminal or axillary cyme. Capsule 4 mm, subglobose glabrous. Seeds 1 mm, cuboid.

Ecology : Frequent in the moist field and on the thin layer of soil on exposed rock along the coast.

Fl. & Fr. : August-November.

Distrib. : West Bengal, Orissa, Tamil Nadu, Mysore, Kerala, Maharashtra and Gujarat coast.

2. *Murdannia spirata* (L.) Brueck., Engl. Nat. Pflanzenfam. (ed. 2) 15a: 173. 1930; *Aneilema spiratum* R. Br.: Hook. in Hook. f., Fl. Brit. India 6: 377. 1892.

Herbs. Leaves 1.5-3.5 x 0.5-0.7 cm, ovate-lanceolate, chartaceous, glabrous, entire, acute at apex, amplexicant at base. Flowers 7 mm across, pinkish, in

terminal panicles. Capsule 5 mm, oblong, angled. Seeds 1 mm, cuboid.

Ecology : Common on moist sandy areas along the back shore and lee side of sand dunes.

Fl. & Fr. : August-November.

Distrib. : West Bengal, Orissa, Tamil Nadu, Kerala Maharashtra and Gujarat coast.

3. *Murdannia vaginata* (L.) Brueck., Engl. & Prantl., Pflanzenfam (ed. 2) 15a: 173. 1930. *Aneilema vaginata* R. Br.: Hook. in Hook. f., Fl. Brit. India 6: 381. 1892.

Slender, erect, fleshy herbs. Leaves 5.0-14.0 x 0.6-1.0 cm, linear, glabrous or sparsely hairy, flat, acuminate at apex, rounded or subcordate at apex, rounded or subcordate at base. Flowers 6.5-8 mm across, blue, in axillary fascicles. Capsule, globose, cuspidate 3 celled. Seeds trigonously conical, black:

Ecology : Frequent on moist sandy areas on beaches and along the margin of coastal swamps.

Fl. & Fr. : August-September.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Gujarat coast.

FLAGELLARIACEAE

Flagellaria L.

Flagellaria indica L., Sp. Pl. 333. 1753; Hook. in Hook. f., Fl. Brit. India 6: 391. 1892, incl. var. *minor*.

Perennial climbers, 2-8 m tall; stems terete, woody smooth, glabrous, turning yellow when dry. Leaves bifarious, 8-25 x 2-3 cm, ovate-lanceolate, shining glabrous with prominent longitudinal veins, tapering into long, coiled tendrils at apex, rounded or subcordate at base; leaf-sheath terete. Flowers 1-1.5 mm across, cream-coloured, fragrant, arranged in densely packed terminal panicles, subtended by bracts. Drupes 5-7 mm across,

globose, apiculate bright red when ripe. Seed one, globose with white powdery endosperm.

Ecology : Common along the banks of creeks and channels in the mangroves, frequently found inside the forests.

Fl. & Fr. : September-January.

Distrib. : Throughout the coastal wetlands of West Bengal, Orissa, Kerala, Maharashtra and Andaman.

ARECACEAE

KEY TO THE GENERA

- 1a. Leaves simple, palmate; leafstalks shortly spinous to a short distance 1. *Borassus*
 1b. Leaves compound, pinnate; leafstalks not as above :
 2a. Stem sunken, not developed on the ground; leaflets not modified into spines 2. *Nypa*
 2b. Stem not sunken, well developed on the ground; lowest leaflets modified into spines 3. *Phoenix*

1. *Borassus* L.

Borassus flabellifer L., Sp. Pl. 1187. 1753. Beccari and Hook. in Hook. f., Fl. Brit. India 6: 482. 1893.

Tree up to 40 m tall; stem obscurely hooked. Leaves simple, palmate, plicately multifid; leaflets 40-60, petiole stout, spinous, base broad, apex acuminate. Flower dioecious, spadix very large branched, sheathed with numerous open spathe, female flower large, globose brown. Drupe 15 cm in diam. or more, with 1-3 obovate

fibrous pyrenes, enclosed by enlarged perianth. Seeds oblong, 3 lobed.

Ecology : Common along the dry coastal sand and coastal plains.

Fl. & Fr. : April-March, September-October.

Distrib. : All through the coastal district. Very dominant in Andhra Pradesh.

2. *Nypa* Wurm.

Nypa fruticans Wurm. in Verh. Batav. Gen. 1: 349. 1779. *Nypa fruticans* Thunb., Vet. Acad. Myx. Handl. Stockh. 3: 231. 1782; Hook. f., Fl. Brit. India 6: 424. 1892; Prain Bengal Plants 2: 824. 1903. (Rep. ed. 1963).

Unbranched, sunken stemmed palm; leaves pinnatisect large, midrib woody, round Flowers monoecious on the terminal spadix, erect, branched; fruits large 10-15 cm, ovoid, glossy brown, 1 seeded.

Ecology : It is found gregariously growing towards the inner parts of creeks and canals under the influence of

more fresh water flow on the tidal forests. Throughout India healthy growth of this palus is found only in Andaman & Nicobar Islands. Except some poor growth of this palm along the Sundarbans in West Bengal, it is surprisingly absent from the all other mangrove regions of the east and west coast of India.

Fl. & Fr. : Throughout the year.

Dist. : Sundarbans in West Bengal, Andaman & Nicobar Islands.

3. *Phoenix* L.

KEY TO THE SPECIES

- 1a. Stem dwarf or bulbiform; leaflets with hairs on the margin 1. *farinifera*
 1b. Stem not dwarf or bulbiform; leaflets without hairs on the margin :
 2a. Stem robust, solitary, ripe fruits oblong, yellow-purple 3. *sylvestris*
 2b. Stem not robust, clustered, ripe fruits ovoid, reddish-purple 2. *paludosa*

1. *Phoenix farinifera* Roxb. Cor. Pl. i. 55, t. 74 and Fl. India (ed. Carey) 3: 785. 1832; Beccari & Hook. f. in Hook. f., Fl. Brit. India 6: 426. 1893.

Stem acaulescent or very shortly stemmed; stoloniferous; aerial portion of the stem thickly covered with leaf base. Leaves 1 m or more long, erect to slightly inclined; petiole short, with a few solitary or paired spines; leaflets mostly opposite, ensiform, much pointed, smooth, green in colour. Inflorescence, 20-30 cm long at anthesis; rachillae slender, simple, irregularly disposed on the axis. Male flowers 1 cm long, white, calyx slightly 3-toothed, petals oblong, rigid; stamens 6, filaments inserted to the fleshy globular receptacle; anthers oblong. Ripe fruits 1-1.5 cm long, deep red, ovoid; pericarp pulpy, sweet; seed ovoid, smooth, brown in colour, greenish within, longitudinally grooved.

Ecology : Frequent on sandy backshore and elevated sandy scrubs in between the mangrove swamps.

Fl. & Fr. : January; April-May.

Distrib. : Coromandel coast and Pichavaram in Tamil Nadu.

2. *Phoenix paludosa* Roxb., Fl. India, ed. Carey 3: 789. 1832; Beccari & Hook. f. in Hook. f., Fl. Brit. India 6: 427. 1893.

Bushy gregarious, soboliferous 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, flexuous at first, entirely enveloping the inflorescence. Fruits 10-12 mm

long, ellipsoid, smooth, 1-seeded drupes. Seeds with longitudinal grooves along ventral side, bony.

Ecology : 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 a type of elevated muddy swamps; very often it forms pure community along the muddy coast starting from the intertidal zones up to 10-20 km away, as found in Orissa and Sundarbans.

It is also found along the elevated banks of tributaries and rivers where it appears as a first mangrove community along the course of the river from the upstream towards the sea; the root-system characteristically anchor with the soil firmly, so that the soil level rises year after year. Under this condition other genera of mangroves like *Ceriops*, *Heritiera*, *Excoecaria*, which require to be submerged 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.

Distrib. : Orissa (Mahanadi Delta), West Bengal (Sundarbans) and Andamans.

3. *Phoenix sylvestris* (L.) Roxb., Fl. Ind. 3: 787. 1832; Beccari & Hook. f. in Hook. f., Fl. Brit. India 6: 425. 1893.

Tall unbranched, trees, with straight or crooked trunk. Leaves 1.5-3.0 m long, pinnate; leaflets 20-30 x 1.0-2.5 cm, linear-lanceolate, conduplicate, coriaceous, spinous, pointed, glaucous. Inflorescence a spadix. Male flowers, fragrant, cream-yellow. Female flowers distant, roundish. Drupes, ellipsoid-oblong, orange-yellow. Seeds rounded at both ends, deeply grooved on one side.

Ecology : Frequent in sandy coast. Common in cultivated lands and margins of wetlands.

Fl. & Fr. : February-August.

Distrib : Throughout the coastal districts.

PANDANACEAE

Pandanus L. f.

KEY TO THE SPECIES

- 1a. Carpels connate in groups :
 2a. Marginal spines of the leaves pointed forward, ovary 5-12 celled 6. *tectorious*
 2b. Marginal spine ascending, ovary 1 celled 7. *thwaitesii*
 2c. Fruit globose, style not lobed :
 3a. Leaves 3-4 m long; margin of the leaf spines slender;
 fruits 12-25 cm in diam. 4. *leram*
 3b. Leaves 5-8 m long, margin of the leaf spines rigid;
 fruits 30-45 cm in diam. 1. *andamanensis*
 2d. Fruits club shaped, style bilobed 2. *canaranus*
 1b. Carpels not connate in groups :
 4a. Leaves 180 x 10 cm, leaf marginal spines upcurved; fruit ovoid 5. *odoratissimus*
 4b. Leaves 205 x 12 cm, leaf marginal spines incurved; fruit subglobose 3. *foetidus*

1. *Pandanus andamanensis* Kurz in Journ. Asiat. Soc. Beng. 38, 2: 148. 1869; Hook. f. in Hook. f., Fl. Brit. India 6: 485. 1893.

Elegant tree 10-15 x 0.5-1 m, simple smooth with numerous short sharp prickles, supported at the base with stilt roots. Leaves 5-6 m x 7-12 cm, sword shaped, with slender marginal spines. Fruit large globose, scarlet, drupes with a flat or depressed crown and an oblique lamelliform depressed style pungent when dry.

Ecology : Common along the rocky and sandy littoral regions and in low moist, sandy places that get easily flooded by sea webs.

Fl. & Fr. : November-March.

Distrib. : Andaman and Nicobar Islands.

2. *Pandanus canaranus* Warb. in Engl., Pflanzent. Pandanaceae 9: 75, f. 21 E, 1900; Fischer in Gamble, Fl. Pres. Madras 3: 1015. 1967. Repr.

A tufted shrub with stilt roots at the base. Leaves 1.5-1.8 m long, margin densely spiny. Lower male spathes flagelliferous; anthers 0.2-0.3 cm long; ovary one celled; drupes club shaped, 6 cm long, connate below the pyramidal apex. Styles bilobed.

Ecology : Frequent along rocky intertidal belt as well as coastal sands.

Fl. & Fr. : April-September.

Distrib. : Tamil Nadu and Karnataka coast.

3. *Pandanus foetidus* Roxb. Fl. India 3: 744. 1832; Hook. f. in Hook. f., Fl. Brit. India 6: 483. 1893.

A densely branched shrub 1.5-3 m tall. Leaves 1-2.5 m long, narrowly oblong, glossy; margin distantly covered with incurved spinules. Spathes pale yellow; anthers 1.2-1.5 cm long, slender. Fruits sub-globose or oblong, very variable in size, crown of drupes smooth.

Ecology : Common along the river banks and inland sand bars near the coast.

Fl. & Fr. : May-September.

Distrib. : It is commonly distributed towards the sandy riverbeds in Assam. Frequently found along inland sands of Goa and Maharashtra region.

4. *Pandanus leram* Jones ex Fontaine in asiat. Res. 3: 163. 1792; Hook. f. in Hook. f., Fl. Brit. India 6: 486. 1893.

A palm like tree 6-12 m tall, branched, supported by stilt roots at the base. Stems smooth with sharp prickles. Leaves 3-4 m long, sword shaped; marginal spines 3-4 mm, slender, apex ending into a tail like point. Ripe carpels broader, red when ripe, over topped by 6-12 stigmas. Fruits ellipsoid or globose, 30-40 cm across, fleshy and consumed as bread fruit by all tribals.

Ecology : Common along the sandy beach forests and littoral hilly areas of the coastland.

Fl. & Fr. : March-September.

Distrib. : Endemic to Andaman and Nicobar island.

5. *Pandanus odoratissimus* Roxb. Cor. Pl. i. 65, t. 94-96 and Fl. India (ed. Carey) 3: 738. 1832. *P. fascicularis* Lamk.: Hook. f. in Hook. f., Fl. Brit. India 6: 485. 1893.

Small trees, about 4 m high with stilt roots. Leaves 180 x 10 cm, glossy green, drooping margins spines, acuminate at apex, cordate at base. Male spadixes many enclosed in long, white, fragrant, caudate, acuminate spathes; stamens many in connate filaments. Female spathes solitary, terminal. Fruits ovoid, 25 cm in diam., orange yellow, rounded with subulate persistent style at apex.

Ecology : Frequent along the riverbank and sandy seashore.

Fl. & Fr. : April-November.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Kerala, Andaman and Nicobar Islands.

6. *Pandanus tectorius* Soland ex Park., J. Voy. H. M. S. Endeavour, 46, 1773. *P. fascicularis* Lamk.: Hook. f. in Hook. f., Fl. Brit. India 6: 485. 1893.

Trees 3-6 m tall, laxly branched, erect or inclined, with many prop-roots, often with stout aerial roots from branches. Leaves 1-2.5 m long, caudate, ensiform, coriaceous, pointed, spinous marginated, acuminate. Male spadix yellowish, fragrant, with many cylindric spikes enclosed by caudate-acuminate spinulous spathes. Female spadix solitary, 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.

Ecology : Commonly found along estuarine river banks and sandy seashore.

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

Distrib. : West Bengal, Orissa, Andhra coast and Andaman islands; wild along the seashore over high watermark, often found along the interior sandbars in between the creeks and channels. Locally cultivated.

7. *Pandanus thwaitesii* Mart. in Bull. Soc. Ital. 369. 1904; Fischer in Gamble, Fl. Pres. Madras 3: 1095. 1967, Repr.

Arboreous with tufted stem. Leaves chartaceous, up to 2.5-2.8 cm long, 2.5-4.44 cm wide, margins and keel (sometimes 2-keeled) ascendingly spinulose, glaucescent below, conspicuously tessellated by the raised longitudinal veins and transverse veinules; male spathes boat shaped, lower flagelliferous, margins spinulose throughout or only in the half; syncarp connate, slightly narrowed to the base, 4.06 cm long, 0.63 cm wide, free; apex pentagonal-pyramidal, terminated by the entire subspinescent subulate style. Ovary 1 celled; anther filamentous. Drupes cylindric.

Ecology : Frequent along sandy and rocky coasts. Sometimes towards inland sand.

Fl. & Fr. : March-August.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

TYPHACEAE

Typha L.

Typha domingensis Person C.D.K. Cook in Aquatic Wet. Plants 365, 1996. *T. angustata* Bory & Chaub., Exp. Sc. Mores 1: 338. 1832; Hook. f., Fl. Brit. India 6: 489. 1893.

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.

Ecology : Specially in fresh water swamps, frequently found in slightly brackish water at low-lying areas and in paddy fields.

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

Distrib. : Throughout the coastal districts and Andaman Islands.

A R A C E A E

Cryptocoryne Fisch. ex Wydl.

KEY TO THE SPECIES

1a. Tube of spathe narrow, longer than the limb :

2a. Leaves with lower half sheathing; spathe limb ciliate 1. *ciliata*

2b. Leaves narrowed into short petiole; Spathe limb spiral 3. *retrospiralis*

1b. Tube of spathe shorter than limb 2. *cognata*

1. *Cryptocoryne ciliata* (Roxb.) Schott., Melet. 1: 16. 1832; Hook. f. in Hook. f., Fl. Brit. India 6: 492. 1893.

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. 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.

Ecology : Common in intertidal regions of creeks and channels under brackish water; usually in association with species of *Excoecaria*, *Rhizophora* and *Ceriops*; occasionally found under seasonal fresh water conditions.

Fl. & Fr. : Very rarely found during July-August.

Distrib. : West Bengal, Orissa.

2. *Cryptocoryne cognata* Scott., Bonpland. 1857; Hook. f. in Hook. f., Fl. Brit. India 6: 492. 1893.

Aquatic herb with creeping rootstock. Leaves

14-25 x 2.5-3.5 cm oblong-lanceolate or linear-oblong, margins undulate, narrowed and acute at both ends. Flowers unisexual on very slender spadix.

Ecology : Frequent on moist sand and gravel near the coast.

Fl. & Fr. : August-September.

Distrib. : Only in Ratnagiri coast and Maharashtra coast.

3. *Cryptocoryne retrospiralis* Fisch. ex Wydl., Linnaea 5: 428. 1830; Hook. f. in Hook. f., Fl. Brit. India 6: 493. 1893.

Submerged aquatic herbs, with fleshy fibrous roots and creeping root-stock. Leaves radical 30-100 x 1.2-1.5 cm, narrowly linear to lanceolate, apex acute to acuminate. Flowers in spadix; male and female separated by a bare region. Fruits a fleshy berry. Seeds many, oblong.

Ecology : Rare along banks of river in sandy soil.

Fl. & Fr. : June-September.

Distrib. : Kerala, Goa, Maharashtra and Karnataka coast. Endemic to India.

L E M N A C E A E

Lemna L.

Lemna perpusilla J. Torrey, Fl. N. Y. 2: 245. 1843; *L. paucicostata* Hegelm.: Hook. f., Fl. Brit. India 6: 556. 1893.

Free floating aquatic herbs. Fronds 1.2-4.5 x 1-2.5 mm, ovate-obovate or oblong, entire, rounded at apex, obtuse at base. Flowers unisexual, minute, rarely seen. Fruits ellipsoid. Seed with longitudinal ribs.

Ecology : Frequent in fresh water or in slightly brackish water lakes and lagoons near the coast.

Fl. & Fr. : January-April.

Distrib. : Throughout the coastal districts.

A L I S M A T A C E A E

KEY TO THE GENERA

1a. Leaf blades suborbicular 1. *Caldesia*

1b. Leaf blades sagittate or triangular :

- 2a. Leaf blades stellately hairy, flowers mostly unisexual, nutlets with 2-gas-filled chambers 2. *Limnophyton*
 2b. Leaf blades glabrous; flowers bisexual, nutlets not with gas-filled chambers, winged 3. *Sagittaria*

1. *Caldesia* Parl.

Caldesia oligococca (Muell.) Buchenan. in Bot. Jahrb. 2: 479. 1882. *Alisma oligococcum* F. Muell. & *Alisma glandulosum* Thwaites.: Hook. in Hook. f., Fl. Brit. India 6: 560. 1893.

Annual or perennial herb with 60-70 cm long petioles. Leaf blades 5-15 x 4-8 cm, ovate cordate, membranous, submerged or floating, deeply cordate with narrow sinus at base. Flowers 2-6 mm long, yellowish

white arranged in compound panicle on 40-110 cm long scape, 4-ribbed, 2-6 mm long with hard endocarp.

Ecology : Frequent along the margins of fresh water lakes, rivers and swamps near the coast.

Fl. & Fr. : February-March.

Distrib. : Throughout the plains of coastal districts.

2. *Limnophyton* Miq.

Limnophyton obtusifolium (L.) Miq., Fl. Ind. Bat. 3: 242. 1855; Hook. in Hook. f., Fl. Brit. India 6: 560. 1893.

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; Flowers 8-10 mm across, white, many-flowered whorls, arranged on long-branched panicles; upper whorls mostly males and 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.

Ecology : Frequent in low ditches inside the scrubs and lee side of the seashore, under fresh water condition. Very common in pools.

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

Distrib. : Throughout the peninsular regions, along the coastal freshwater lakes, ponds and swamps.

3. *Sagittaria* L.

KEY TO THE SPECIES

- 1a. Sepals in fruit reflexed; petals white without a purple blotch 2. *sagittifolia*
 1b. Sepals in fruit not reflexed; petals white with a purple blotch 1. *guayanensis*

1. *Sagittaria guayanensis* H.B.K., Nov. Gen. Sp. 1. 250. 1816; Hook. in Hook. f., Fl. Brit. India 6: 561. 1893.

Laticiferous aquatic perennial herbs. Leaves floating, 1.5-6.5 cm long, ovate, membranous, lobed, rounded at apex, deeply cordate at base. Flowers 1.4-1.7 cm long, white, with a purple blotch in racemes. Achenes numerous, 3-4 mm, elliptic with blunt spiny crest. Seeds 1.5 mm brown.

Ecology : Rare on fresh water ditches and marshes.

Fl. & Fr. : January-December.

Distrib. : Orissa, Andhra Pradesh and Tamil Nadu coast.

2. *Sagittaria sagittifolia* L., Sp. Pl. 2: 993. 1753; Hook. in Hook. f., Fl. Brit. India 6: 561. 1893.

Laticiferous aquatic perennial herbs. Leaves floating, 4-9.5 cm long sagittate lobed, thin acute at apex, cordate at base. Flowers 1.5-2 cm long, white, in terminal racemes. Achenes 3-5 x 1.5-3 mm, obovate, winged, entire or subrenate. Seeds 1.5 mm, light brown.

Ecology : Common on the margins of pools and polluted water bodies along the back shore.

Fl. & Fr. : January-December.

Distrib. : West Bengal, Orissa, Tamil Nadu and Kerala coast.

A P O N O G E T O N A C E A E

Aponogeton L. f.

KEY TO THE SPECIES

- 1a. Floating leaves occasionally absent; follicles 2-seeded; seeds with single coat 1. *crispus*
 1b. Floating leaves present; follicles 8-seeded; seed double coated 2. *natans*

1. *Aponogeton crispus* Thunb., Nov. Gen. 1: 73. 1781; Hook. in Hook. f., Fl. Brit. India 6: 564. 1893.

Aquatic herbs with round tubers. Leaves 10-20 x 1.5-2 cm, submerged, acute or obtuse at apex, narrowed into petioles; spikes 6-8 cm long. Follicles 3, oblong, beaked with 2-3-seeds. Seeds with a single coat.

Ecology : Frequent in shallow river-beds and ditches under fresh and brackish water condition.

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

Distrib. : Orissa, Tamil Nadu and Kerala coast. Endemic to South India.

2. *Aponogeton natans* (L.) Engl. & Krause, Engl.

Pflanzenr. 24: 22. 1906. *A. monostachyon* L. f.; Hook. in Hook. f., Fl. Brit. India 6: 564. 1893.

Aquatic herbs with stoloniferous rootstock and many fibrous roots. Leaves floating, 6-12 x 1-2 cm, linear-oblong or linear-lanceolate, entire, acute or obtuse at apex, cuneate at base. Flowers white, pale-blue or pinkish, densely set in solitary spikes; spikes enclosed in a sheath while young. Follicles 3, subglobose, 3-8-seeded. Seeds with a double coat.

Ecology : Frequent in low-lying ditches inside the scrubs and coastal thickets; common under fresh water condition.

Fl. & Fr. : September-December.

Distrib. : Throughout the coastal rice fields and marshes.

P O T A M O G E T O N A C E A E

KEY TO THE GENERA

- 1a. Flowers bisexual; stigma discoid or decurrent 2. *Potamogeton*
 1b. Flowers unisexual; stigma subulate or capillary :
 2a. Leaves terete, fleshy, grooved, lip 3 toothed 1. *Halodule*
 2b. Leaves linear nearly straight, lip rounded or truncate and 3 toothed 3. *Syringodium*

1. *Halodule* Endl.

Halodule uninervis (Forssk.) Asch.: in Boiss., Fl. Orient. 5: 24. 1882; Hartog, Seagrasses World 147. 1970; Ramamurthy *et al.* Seagrasses of Coromandel coast, India 48. 1992; *Cymodocea australis* Trim. Hook. in Hook. f., Fl. Brit. India 6: 570. 1893.

Submerged aquatic herb; rhizomes creeping, branched white to pale brown; shoots 30 cm long, erect, branched or unbranched, bearing 2-4 leaves at each branch. Leaf sheaths linear 1.4-4.8 cm x 3-8 mm, transparent, entire, folded along the margins, with reddish-brown streaks; lamina linear 6-24 cm x 0.7-5 mm, entire, narrowed at base and widened or furcate at apex. Flowers

unisexual, male flowers, white, two, dorsally connected at the top of the stalk; female flowers enclosed in leaf sheaths. Fruits subglobose to ovoid, 2 mm across with persistent style.

Ecology : This seagrass is found to occur in open seas, sheltered localities of bays, gulfs, backwater estuaries and margins of mangrove creeks where the substratum is mostly fine sand to coarse sand, black mud, rock and coral rubble.

Fl. & Fr. : June-July.

Distrib. : Coromandel coast.

2. *Potamogeton* L.

KEY TO THE SPECIES

- 1a. Leaf filiform; peduncles flexible; flowers in whorls and in discontinuous spikes 3. *pectinatus*
 1b. Leaf flat; peduncles rigid; flowers not in whorls and in continuous spike :
 2a. Submerged herb; submerged leaves sessile, always clasping the stem; leaves lanceolate, not heterophyllous 1. *crispus*
 2b. Floating herb; submerged leaves petiolate, not clasping the stem; leaves heterophyllous 2. *nodosus*

1. *Potamogeton crispus* L., Sp. Pl. 126. 1753; Hook. f. in Hook. f., Fl. Brit. India 6: 566. 1893.

Submerged herb; stem stoloniferous yellowish-white, rarely branched. Leaves 3.0-5.0 x 0.5-0.9 cm, linear-lanceolate, translucent, wavy, apex acute, base rounded. Flowers in terminal spike. Drupelets 5.0-6.0 mm long, globose- curved and beaked.

Ecology : Common in flowing water, sometimes in still eutrophicated water and produce gregarious growth.

Fl. & Fr. : July- August.

Distrib : Throughout the coastal districts.

2. *Potamogeton nodosus* Poit. in Lamk. Encycl. Suppl. 4: 535. 1816. *P. indicus* Roxb. non Roth. Hook. f. in Hook. f., Fl. Brit. India 6: 565. 1893.

Floating herb; branches, slender, terete. Leaves 5-13 cm, oblong-elliptic, minutely serrate, heterophyllous. Flowers 4 mm across, in dense spike. Drupelets 2.4 x 4 mm, globose, red, keeled and shortly beaked.

Ecology : Common in lakes and shallow lagoons, specially in deep fresh water condition.

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

Distrib. : Andhra Pradesh, Tamil Nadu, Gulf of Mannar and Gujarat.

3. *Potamogeton pectinatus* L., Sp. Pl. 127. 1753. Hook. f. in Hook. f., Fl. Brit. India 6: 567. 1893.

Submerged herb; stoloniferous terete; repeatedly branched. Leaves 4.0-20.0 x 2.0-3.5 cm, filiform, entire, apex pointed. Flowers in interrupted spike. Drupelets 2.0-5.0 mm long, ovoid, dentate-curved and beaked. Seeds smooth.

Ecology : Grows vigorously in coastal lagoons, fresh, brackish and salt water.

Fl. & Fr. : March-April.

Distrib : Throughout the coastal provinces

3. *Syringodium* Kutz.

3. *Syringodium isoetifolium* (Asch.) Dandy in J. Bot. 77; 166. 1939; Hartog, Seagrasses World 177. 1970; Ramamurthy et al. Seagrasses of Coromandel Coast, India 55. 1992; *Cymodocea isoetifolia* Asch.: Hook. f. in Hook. f., Fl. Brit. India 6: 570. 1893.

Submerged aquatic herb, rhizomes creeping, herbaceous, branched fleshy, slender, white to pale yellow. Shoots up to 60 cm long, erect, branched or unbranched, bearing 2-3 leaves at each branch. Leaf sheaths tubular 1.1-6.3 cm x 4-7 mm narrowed at base, greenish brown;

lamina terete, 40 cm long, fleshy, brittle, acute at apex. Flowers unisexual; male flowers 1.4 cm long, brownish; female flowers in terminal cymes, 5-9 mm long. Fruits obliquely ellipsoid, angular, 4-6 x 1-2 mm.

Ecology : It is common in submerged coral rocks on sea water.

Fl. & Fr. : Throughout the year.

Distrib. : Palk Bay, Gulf of Mannar, Chennai and Andamans coasts.

RUPPIACEAE

Ruppia L.

Ruppia maritima L., Sp. Pl. 127. 1753; *R. rostellata* Koch.: Hook. f., Fl. Brit. India 6: 568. 1893.

Submerged, slender aquatic herb. Leaves 2.5-7.5 cm long, elongate, filiform, membranous, entire, blunt at apex, sheathed at base. Flowers 2-3 mm long, reddish, arranged in cymes within the leaf sheath. Achenes

3-5 mm, ovoid, beaked. Seeds uncinatae.

Ecology : Common on shallow water bed in sandy hollows in brackish and saline condition.

Fl. & Fr.: March-September.

Distrib.: Chilka Lake, Orissa.

NAJADACEAE

Najas L.

KEY TO THE SPECIES

- 1a. Internode with spiny teeth; intravaginal scale fleshy; leaf margins with less than 15 teeth 2. *marina*
 1b. Internode without spiny teeth; intravaginal scales thin; leaf margins with more than 50 teeth 1. *graminea*

1. *Najas graminea* Del., Descr. Egypte, Hist. nat. 282. t. 50. f. 1813; Hook. f., Fl. Brit. India 6: 569. 1893.

Submerged aquatic herbs. Leaves 1-2 x 0.2-0.5 cm, acicular, flat, translucent, margin with orange spiny teeth, glabrous, acute at apex, sheathing at base. Flowers 3.3-4 mm long, hyaline, 1-3 in axillary cymes. Fruits 2 x 1 mm, subterete to subtrigonal or ellipsoid.

Ecology : Frequent in fresh and brackish water, coastal lagoons and inland hills.

Fl. & Fr. : January-April.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Saurashtra coast.

2. *Najas marina* L., Sp. Pl. 1015. 1753; *N. major* All.: Hook. f., Fl. Brit. India 6: 569. 1893.

Submerged aquatic herb. Leaves 0.6-1.5 x 0.1-0.2 cm, linear flat, thick denticulate, acute at apex, oblique and sheathing at base. Flowers 2 mm long, whitish, solitary axillary. Fruits 3 x 1.5 mm, ovoid-subglobose.

Ecology : Common on coastal slacks and inland pools and lakes.

Fl. & Fr. : January-April.

Distrib. : West Bengal (Sagar Island), Orissa, Tamil Nadu, Karnataka and Kerala coast.

ERIOCAULACEAE

Eriocaulon L.

Eriocaulon sieboldianum Sieb. & Zucc. ex Steud., Stn. Pl. Cyp. 2: 272. 1885; Hook. f., Fl. Brit. India 6: 577. 1893

Stemless, tufted herbs. Leaves 7-30 x 1-2 mm, narrowly linear, subulate with acuminate tip. 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.

Ecology : Frequent in moist sandy places along the lee side of the seashore sand dunes. Common in paddy fields.

Fl. & Fr. : October-December.

Distrib. : Throughout the Indian coast.

CYPERACEAE

KEY TO THE GENERA

- 1a. Spikelets remaining attached to the rachis at maturity; glumes are of large numbers :
- 2a. Glumes arranged in two rows on the rachilla; spikelets flattened :
- 3a. Nuts usually 3-sided and flat side facing the rachilla, stigma 3 3. *Cyperus*
- 3b. Nuts flattened with one angle facing the rachilla; stigma 2 9. *Pycreus*
- 2b. Glumes arranged spirally on the rachilla; spikelets rounded :
- 4a. Style constricted and swollen at the base :
- 5a. Perianth bristly, filiform, persisting in fruit 4. *Eleocharis*
- 5b. Perianth not bristly, not filiform, persisting :
- 6a. Style constricted and swollen at base; bracts not culm like :
- 7a. Styles smooth, base falling off with a scar on the fruit 2. *Bulbostylis*
- 7b. Styles hairy, base persistent on the nut 5. *Fimbristylis*
- 6b. Style not constricted and not swollen at base; culm like bracts present 10. *Schoenoplectus*
- 4b. Style not constricted, not swollen at base :
- 8a. Inflorescence terminal with 20-40 spikelets; glumes with extended awn 1. *Bolboschoenus*
- 8b. Inflorescence pseudolateral with 1-3 spikes; glumes absent 7. *Lipocarpus*
- 1b. Spikelets falling entire from the rachis at maturity; glumes are of smaller numbers :
- 9a. Inflorescence open or head like; stigmas 3; spikelets with many glumes 8. *Mariscus*
- 9b. Inflorescence of clustered spikelets; stigmas 3; spikelets with 2 or 3 glumes 6. *Kyllinga*

1. *Bolboschoenus* Palla.

Bolboschoenus maritimus (L.) Palla in Bot. Jahrb. 10: 228. 1889. *Schoenoplectus maritimus* (L.) K. Lye in Blythia 29: 145. 1971. *Scirpus maritimus* L., Sp. Pl. 51. 1753; Clarke in Hook. f., Fl. Brit. India 6: 658. 1893.

Stolon thin, stem 80 cm long. Leaves flat, 40 cm long, linear, ligulate, acuminate at apex. Inflorescences antherate, loose, spikelets ovoid to cylindrical, 10-20 x 4.5 mm terete, acute. Glume oblong, hispidulous. Nut

obovate, compressed-trigonal, smooth.

Ecology : Common on the margins of brackish and salt water lagoons, back mangroves and margins of salt marshes.

Fl. & Fr. : November onwards.

Distrib. : Orissa, Chilka, Andhra Pradesh, Tamil Nadu, Gujarat and Kerala coast.

2. *Bulbostylis* Kunth.

Bulbostylis barbata (Rottb.) Clarke in Hook. f., Fl. Brit. India 6: 651. 1893.

Annual 4-25 cm high, stem 0.3-0.7 mm thick. Leaves 0.3 mm broad, margins involute, sheaths white hairy at the mouth, acuminate. Inflorescence hemispherical, capitula 4-18 mm across, bracts 3 foliaceous, spikelets linear, polygonal, many flowered, glume

1.5-2.2 mm long, laxly imbricating, acute. Nut 0.5-0.8 x 0.4-0.7 mm, smooth, pale brown.

Ecology : Common on back shore sand and lee side of the sand dunes.

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

Distrib. : Throughout the coastal districts.

3. *Cyperus* L.

KEY TO THE SPECIES

- 1a. Spikelets arranged in distance on elongated rachis :
- 2a. Culms without bladed leaves; plants large perennials :
- 3a. Culms transversely septate, terete, just below the inflorescence 3. *articulatus*
- 3b. Culms with concave side, 3 winged, just below the inflorescence 10. *malaccensis*
- 2b. Culms with bladed leaves; plants annual or perennials :
- 4a. Plants annual with no rhizome, corns or stolons :
- 5a. Glumes 3 or 5 nerved with flattened keel; spikelets not squarrose 9. *iria*
- 5b. Glumes 1-2 nerved with recurved awns; spikelets squarrose 14. *squarrosus*
- 4b. Plants perennial with woody rhizome, corns or stolons :
- 6a. Style with 2 branches; nuts flattened 1. *alopecuroides*
- 6b. Style with 3 branches; nuts rounded or 3-sided :
- 7a. Glumes mostly 4 mm or more long; stolons ending in tubers 13. *rotundus*
- 7b. Glumes less than 4 mm; stolons without tubers :
- 8a. Rachis hairy; glumes with hyaline margins 12. *procerus*
- 8b. Rachis glabrous; glumes not with hyaline margins :
- 9a. Culms not with convex side, not 3 angled; blades of leaves not half as long as culms :
- 10a. Spikelets rusty brown; glumes not more than 2.5 mm, densely arranged with raised nerves to the margin 7. *esculentus*
- 10b. Spikelets reddish; glumes less than 2 mm long, remotely arranged with upper half of margin, hyaline 6. *distans*
- 9b. Culms with convex side, 3 angled; blades of leaves more than half as long as the culm 11. *pangorei*
- 1b. Spikelets arranged digitately or stellately in clusters :
- 11a. Plants annual with minute root system; inflorescence not in whitish head :
- 12a. Spikelets reddish brown, arranged in loose clusters 8. *haspan*
- 12b. Spikelets not reddish brown, arranged in tight clusters :
- 13a. Glumes 0.5-0.8 mm, orbicular; plants not silvery green 5. *difformis*
- 13b. Glumes 3-4 mm, elliptic; plants silvery green 4. *compressus*
- 11b. Plants perennial with long creeping stolon; inflorescence in whitish head 2. *arenarius*

1. *Cyperus alopecuroides* Rottb., Descr. et. Icon. 38. t. 8, f. 2. 1773; *Juncellus alopecuroides* (Rottb.) Clarke in Hook. f., Fl. Brit. India 6: 595. 1893.

A robust perennial, glabrous, herb, stem trigonous above and subcylindric below. Leaves many almost equal to stem, coriaceous, acuminate. Umbel large, compressed, bracts leaflike. Spikelet straw coloured to light brown, compressed, rachilla stout. Glume not keeled, ovate-oblong. Nut ellipsoid.

Ecology : Frequent on river banks and moist sandy back shore.

Fl. & Fr. : July-October.

Distrib. : West Bengal, Orissa, Gujarat, Maharashtra, Andaman and Kerala coast.

2. *Cyperus arenarius* Retz. Obs. fasc. 4: 9. 1786, Clarke in Hook. f., Fl. Brit. India 6: 602. 1893.

A little sage with creeping root stock often deep down in the sand with vertical branches, clothed with brown sheath. Leaves 1.5-3 cm broad, terete and fleshy, coriaceous, often recurved with inflated and striate sheaths at base. Inflorescences terminal, globose head, spikelets ovoid or elliptic, pale brown, glume elliptic concave, not much compressed. Nut 0.1 cm long, obovoid, unequally trigonous, concavo-convex, black.

Ecology : Pioneer sand binder on sandy beaches.

Fl. & Fr. : February-June.

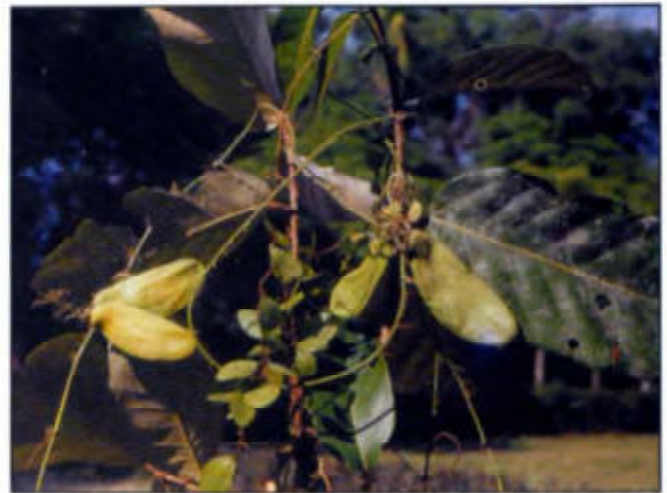
Distrib. : Throughout the coastal districts.



Cycas rumphii



Cymbidium aloefolium



Dischidia major



Salix trasperma



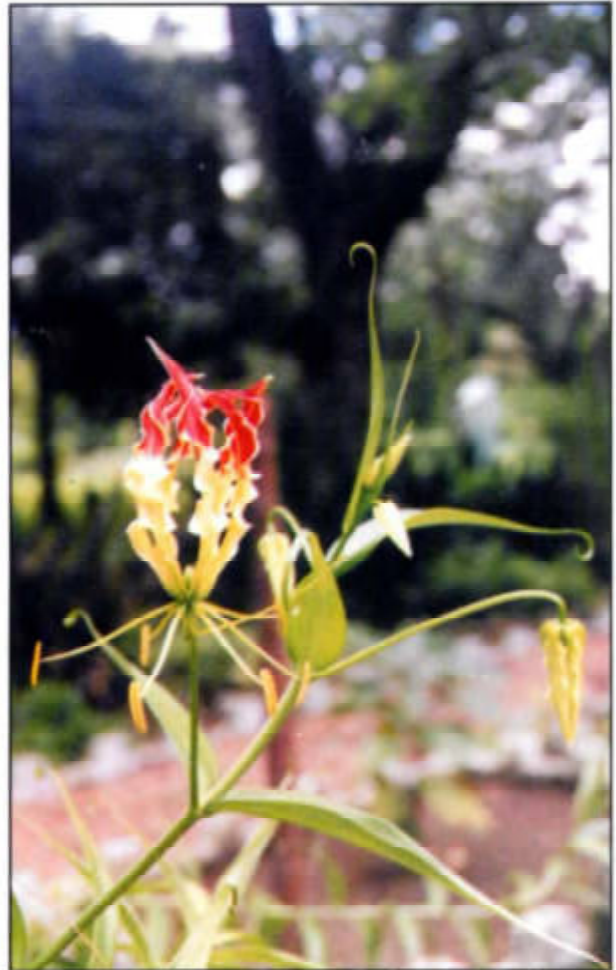
Eria bractescens



Asparagus racemosus



Nypa fruticans



Gloriosa superba



Ensete ventricosa

3. *Cyperus articulatus* L., Sp. Pl. 44. 1753; Hook. f., Fl. Brit. India 6: 611. 1893.

Robust, rhizomatous, leaflets perennial. Stem 2 m, spongy, terete, transversely septate. Leaves reduced to 1-2 papery, brownish or purplish sheathes, spike linear, spikelets in cluster, linear, pale brown, acute. Nut 1.3-1.5 x 0.5-0.6 mm oblong, blackish, apiculate.

Ecology : Frequent on the lee side of sand dunes and rocky crevices along the coast.

Fl. & Fr. : October-March.

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka and Kerala coast. It is well known for essential oils from the rootstocks.

4. *Cyperus compressus* L., Sp. Pl. 46. 1753; Clarke in Hook. f., Fl. Brit. India 6: 605. 1893.

A glabrous annual, stems tufted erect, 15-35 cm long, slender, trigonous with rounded smooth angles. Leaves 1.5-3 cm broad, finely acuminate. Flowers yellow, arranged in simple umbel, spikelets much compressed, rachilla stout, angular, glume oblong-lanceolate. Nut 0.2 cm long, broadly obovoid, triquetrous, black.

Ecology : Common along the margin of lakes, ditches and wet sandy back shore.

Fl. & Fr. : September-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh.

5. *Cyperus difformis* L., Cent. Pl. 2. 6. 1756; Clarke in Hook. f., Fl. Brit. India 6: 599. 1893.

Erect tufted herb, with numerous filiform, fibrous roots. Stem 7-50 cm tall, tufted, triquetrous. Leaves 9-30 x 0.3-0.5 cm, usually shorter than the culms, linear, flaccid, glabrous, acute. Spikelets 2-3.5 x 1-1.5 mm, pale brown, oblong, compressed, bracts 3-20 x 0.3-0.4 cm, linear-acute, unequal, glabrous. Nuts 0.7 x 0.5 mm, white, broadly obovoid, trigonous, smooth.

Ecology : Common weed in moist sandy places and on the margins of canals near the coast.

Fl. & Fr. : September-January.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Kerala coast.

6. *Cyperus distans* L. f., Suppl. 103. 1781; Clarke in Hook. f., Fl. Brit. India 6: 607. 1893.

Perennial with shortly creeping rhizome. Stem 10-40 cm long, triquetrous. Leaves equal to stem, 5 mm broad, denticulate. Umbel decomposed, 12-20 cm diam., bract 4-8, large, leaflike. Spikelet 5-22 x 0.6-0.9 mm, 6-20 flowered. Glume at distant, 1.5-1.9 mm long, reddish brown, elliptic oblong. Nut 1.1 x 1.4 mm long elliptic oblong, trigonous, dark-grey.

Ecology : Occasional on the margins of ponds, ditches and rivers near the coast.

Fl. & Fr. : Summer and rainy season.

Distrib. : West Bengal, Orissa, Tamil Nadu, Karnataka and Kerala coast.

7. *Cyperus esculentus* L., Sp. Pl. 45. 1753; Clarke in Hook. f., Fl. Brit. India 6: 616. 1893.

An erect glabrous herb, up to 5.4 cm tall, with slender subterranean stolons, ending in ovoid to cylindrical tubers. Stem base pale brown, triquetrous, smooth, striated. Leaves linear, gradually tapering towards the upper part. Umbel compound, spike and spikelet many. Nut obovoid, ellipsoid with 3 sharp angles.

Ecology : Occasional on the road sides and marshy areas near the coast.

Fl. & Fr. : Rainy season.

Distrib. : West Bengal, Orissa, Andhra Pradesh and Kerala coast.

8. *Cyperus haspan* L., Sp. Pl. 45. 1753; Clarke in Hook. f., Fl. Brit. Ind. 6: 600. 1893.

A perennial tufted herb; solitary or tufted stems with slender creeping rhizome. Leaves narrow, bractate, reduced to bladeless sheath. Flowers compound or decomposed, loose or dense, bracts 2-3 foliaceous spreading. Spikelets linear-lanceolate, glume ovate-oblong, keeled, membranous. Nuts broadly obovoid, trigonous, yellowish.

Ecology : Frequent on moist sandy places, margins of inundated fields and lagoons.

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

Distrib. : Mostly throughout the coastal provinces.

9. *Cyperus iria* L., Sp. Pl. 45. 1753; Clarke in Hook. f., Fl., Brit. India 6: 606. 1893.

Annual or perennial with yellowish red roots. Stem, tufted, slender 20-45 cm long, triquetrous, striate. Leaves nearly as long as stem, 1.5-5 mm broad, acuminate, flaccid. Flowers yellow or pale brown arranged in decompound umbel, spikes 5-15, irregularly fascicled with few flowered spikelets, bracts 3-5, foliaceous. Nuts 1-1.5 mm long obovoid, triquetrous, brown or black.

Ecology : Frequent along road sides, streams, on moist sandy loam or clayey soil, a common weed of paddy fields.

Fl. & Fr. : May-December.

Distrib. : West Bengal, Orissa, Tamil Nadu and Kerala coast.

10. *Cyperus malaccensis* Lam. Illus. 3: 146. 1791; Clarke in Hook. f., Fl. Brit. India 6: 608. 1893.

Perennial erect herb up to 50 cm tall, glabrous, rhizome long, thick, creeping clothed with brown scales; stem 0.4-1.1 m high, triquetrous, compressed. Leaves few, 15 cm long, erect, sheaths enclosing the stem. Umbel 2-10 cm diam., dense, spikes with 4-10 spikelets. Glumes 2.5 x 0.09 mm, straw coloured, oblong or elliptic-oblong. Nut 1.4-1.6 mm long narrowly elliptic-oblong, obtusely trigonous, shortly apiculate, blackish brown.

Ecology : Occasional in moist sandy places, margins of ditches, lakes and waterbodies near the coast.

Fl. & Fr. : All round the year.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra, Karnataka and Kerala coast.

11. *Cyperus pangorei* Rottb. Descr. et Icon 31, t. 7, f. 3. 1773. *Cyperus tagetum* Roxb.: Clarke in Hook. f., Fl. Brit. India 6: 613. 1893.

A robust perennial sedge with solid green shining stems. Rhizome long creeping, woody, strongly aromatic. Stolons 10-20 cm long. Leave usually reduced to bladeless sheaths, 18-20 x 0.4-0.7 cm. Anthela compound, lax, 18-34 cm across, bracts 3-5 foliaceous, spikelets clustered, 4-9 together, 14-34 flowered. Nuts 1.5 mm long, narrowly obovoid, trigonous, brownish black.

Ecology : Common along the river banks, canals and ditches on sandy beds. Commonly cultivated for making mats.

Fl. & Fr. : August onwards.

Distrib. : Mostly on Eastern coastal districts West Bengal, Orissa and Tamil Nadu.

12. *Cyperus procerus* Rottb. Descr. et Icon. t. 5, f. 3. 1773; Clarke in Hook. f., Fl. Brit. India 6: 610. 1893.

Perennial, stems 0.6-1 m tall, stoloniferous, stolons elongated, clothed with long acuminate scales, bulbiferous. Leaves long, often exceeding the stem, 0.7-1.2 cm broad, thickly coriaceous or spongy. Umbel compressed, stout 10-15 flowered, straw coloured, boat shaped. Nuts 1.5 mm long broadly obovoid, trigonous apiculate, tapering towards the base, yellow.

Ecology : Frequent along the moist back shore sand and margin of rice fields near the coast.

Fl. & Fr. : June-August.

Distrib. : Throughout the coastal districts.

13. *Cyperus rotundus* L., Sp. Pl. 45. 1753; Clarke in Hook. f., Fl. Brit. India 6: 614. 1893.

Perennials, with long slender stolon and ellipsoid aromatic tubers. Stem solitary or 2-3 together, compressed, trigonous. Leaves several, usually shorter than the stem, 2-4 mm broad. Anthera simple or compound, lax, bracts 2-4, foliaceous, spikelets 3-10 together, 12-40 flowered. Nut 1.5-1.7 mm long, obovoid-ellipsoid, trigonous, glossy black.

Ecology : Common along road sides, moist sandy shore and shaded places.

Fl. & Fr. : May-September.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Gujarat and Kerala coast.

14. *Cyperus squarrosus* L., Cent. Pl. 2. 6. 1756; *Mariscus squarrosus* Clarke in Hook. f., Fl. Brit. India 6: 623. 1893.

A small, glabrous, annual sedge of 7-15 cm tall, stem tufted, trigonous. Leaves erect, 1-1.5 mm broad, shorter than stem, acuminate, flat, flaccid. Flower arranged on small dense heads of spikelets with brown glumes furnished with awnlets as long as blades. Nut oblong or narrowly oblong-obovoid, triquetrous, brown minutely mucronate.

Ecology : Frequent along the margin of waterbodies, sandy slacks and coastal lagoons.

Fl. & Fr. : September-November.

Distrib. : West Bengal, Orissa, Tamil Nadu, Pondicherry and Kerala coast. It also occurs in Lakshadweep and Andaman Islands.

4. *Eleocharis* R. Br.

Eleocharis geniculata (L.) R. & S. Syst. Veg 2 : 150. 1817; *E. capitata* R. Br., Prodr. 223. 1810.

Annual with fibrous roots. Stem densely tufted, numerous, 6-22 cm long, slender, trigonous. Leaves absent, sheath short, acute. Spikelets globose ovoid, rounded at the apex, pale. Lowest glume bractiform, ovate-oblong, obtuse. Fertile glume orbicular-ovate, obtuse, imbricate, easily detached, concave, bristles longer

than nut. Pale rose-brown when ripe. Nut globose obovoid, brown, smooth, shining, apiculate with broad style base.

Ecology : Common in moist sandy places and muddy areas on back mangroves.

Fl. & Fr. : October-January.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Kerala coast.

5. *Fimbristylis* Vahl

KEY TO THE SPECIES

- 1a. Nuts oblong cylindrical with club shaped out growths on the side 4. *dipsacea*
- 1b. Nuts ellipsoidal to suborbicular without club shaped out growths on the side :
 - 2a. Stigma 2, style flat, usually hairy; glumes spiral nerves in 2 rows :
 - 3a. Ligule absent :
 - 4a. Spikelets 5-15 mm, sterile glumes mucronate and all other glumes not mucronate; culms setaceous 9. *polytrichoides*
 - 4b. Spikelets less than 5 mm; glumes are of one type; culms not setaceous :
 - 5a. Annual, not rhizomatous, style base papillose; nuts flattened, reticulate 1. *aestivalis*
 - 5b. Perennial, rhizomatous, style base glabrous; nuts obovoid, 3 sided, smooth 2. *cymosa*
 - 3b. Ligule present as a fringe of hairs or membranous :
 - 6a. Nut smooth throughout; glumes pubescent 6. *ferruginea*
 - 6b. Nut with 10-12 longitudinal rows appearing as pits; glumes glabrous 3. *dichotoma*
 - 2b. Stigmas 3, styles 3 angled, glabrous, glumes spiral, nerves in two rows :
 - 7a. Inflorescence compound, spikelets rusty brown; culms 5 angled 7. *miliacea*
 - 7b. Inflorescence of a single terminal spikelet; spikelets glaucous; culms not angled :
 - 8a. Stem rigid; margin of glumes scarious; nut obovoid, reticulate 5. *falcata*
 - 8b. Stem densely tufted; margin of glumes not scarious; nut pyriform, tuberculate 8. *ovata*

1. *Fimbristylis aestivalis* (Retz.) Vahl, Enum. 2: 288. 1806; Clarke in Hook. f., Fl. Brit. India 6: 637. 1893.

A small tufted herb up to 14.5 cm long, with slender erect, angular stem. Leaves up to 1 mm broad, filiform, pubescent, acute. Spikelet up to 8 mm long, compound or decomposed umbel. Glumes few. Nut subglobose, smooth.

Ecology : Common on the banks of ponds, ditches and moist sandy places of sea shore.

Fl. & Fr. : March-July.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat and Kerala coast.

2. *Fimbristylis cymosa* R. Br. Prodr. 228. 1810; *F. spathacea* Roth.: Clarke in Hook. f., Fl. Brit. India 6: 640. 1893.

Tufted, very rigid perennial with woody rhizome. Stem 7-20 cm tall, densely leafy below. Leaves many, 1.5 cm broad, densely crowded on the rootstock, spreading, recurved or incurved, narrowly linear, obtuse or acute at apex. Umbel simple or compound, ellipsoid to ovoid, spikelets ellipsoid or ovoid, glumes lax. Nuts 0.08 cm long, obovoid, dull black, smooth.

Ecology : Common on sandy back shore, margins of water course and eroded places.

Fl. & Fr. : May-August.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Lakshadweep and Andaman Islands.

3. *Fimbristylis dichotoma* (L.) Vahl, Enum. 2: 287. 1806. *F. diphylla* (Retz.) Vahl: Clarke in Hook. f., Fl. Brit. India 6: 636. 1893.

A small tufted perennial up to 30 cm long, with flatten stem. Leave 10.2-30 x 0.3-0.4 cm coriaceous, flat, striate, scaberulous margin, obtuse or acute at apex. Umbel small, compound. Spikelet up to 7 mm long, ovoid, deep brown. Nut obovoid, brown, 0.93-0.98 mm long.

Ecology : Common on sandy backshore, margins of lakes and marshy areas.

Fl. & Fr. : March-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Gujarat and Kerala coast.

4. *Fimbristylis dipsacea* (Rottb.) Clarke in Hook. f., Fl. Brit. India 6: 635. 1893. *Scirpus dipsaceus* Rottb. Descr. et Icon. 56, t. 12, f. 1. 1773.

A small sedge, culms tufted, slender, filiform. Leaves often as long as stem, capillary. Spikelet numerous, single or dense in umbels with 2-3 filiform bracts, often overtopping umbel. Glumes hyaline. Nut linear, cylindrical, brownish.

Ecology : Common on sandy backshore, road side and in eroded soil.

Fl. & Fr. : May-August.

Distrib. : West Bengal, Orissa, Gujarat, Maharashtra coast.

5. *Fimbristylis falcata* (Vahl) Kunth, Enum. 2: 239. 1837; *F. junciformis* (Nees) Kunth.: Clarke in Hook. f., Fl. Brit. India 6: 647. 1893.

A densely leafy herb. Stem about 0.2-0.4 m long, arising from a stout thick rootstock, angular and compressed. Leaves 5-12.5 cm long, obtuse, margins in curved, spikelets clustered, in compound or decomposed umbels. Glume usually with an aristate bract.

Ecology : Frequent on sandy moist places and margins of coastal slacks.

Fl. & Fr. : May-September.

Distrib. : Orissa, Gujarat, Maharashtra, Karnataka and Kerala coast.

6. *Fimbristylis ferruginea* (L.) Vahl, Enum. 2: 291. 1806; Clarke in Hook. f., Fl. Brit. India 6: 638. 1893.

A glabrous annual with fibrous root. Stem 15.2-60 cm tall, compressed, subtrigonus. Leaves short, 11.8 cm x 1.4 mm, sheath membranous, brownish. Umbel simple with 5-10 spikelets 6-12.5 mm long, ovoid, ellipsoid, reddish-brown. Glume ovate, keeled upwards, brown. Nut white or pale yellow, orbicular, obovoid.

Ecology : Common along the margins of creeks, canals and muddy tidal flats on back mangroves.

Fl. & Fr. : May-October.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Gujarat, Andaman and Lakshadweep Islands.

7. *Fimbristylis miliacea* (L.) Vahl, Enum. 2: 287. 1806; Clarke in Hook. f., Fl. Brit. India 6: 644. 1893.

Glabrous annual; root filiform. Stem 30-75 cm tall, densely tufted, erect slender 4-angled. Leaves more or less equal to stems, up to 2.3 mm broad, flat, tapering towards the tip. Spikelets 2.4 mm long, 6-16 flowered, brown, subglobose or ovoid. Nut 0.4-0.5 mm long, obovoid, trigonous, brownish yellow.

Ecology : Common on the bank of pond and ditches, frequently along the moist sandy places near the coast.

Fl. & Fr. : March-July.

Distrib. : West Bengal, Orissa, Tamil Nadu and Kerala coast.

8. *Fimbristylis ovata* (Burm. f.) Kern. in Blumea 15: 126. 1967; *F. monostachyus* Hassk.: Clarke in Hook. f., Fl. Brit. India 6: 649. 1893.

A dense tufted perennial of 25 cm tall with fibrous root. Stem compressed and striated, hispidulous. Leaves several at the base of stem, 2.5-15 cm long, filiform, margin scabrid. Spikelet solitary, terminal ovoid, subtended at the base by 1-3 boat shaped awned bracts. Nut 1.4-1.7 mm long, obovoid, 3-sided, angle ridges extending down at the base, straw coloured.

Ecology : Common in wet places along the banks of streams, ponds, ditches as well as embankment of paddy fields near the coast.

Fl. & Fr. : July-September.

Distrib. : West Bengal (Sagar Island), Orissa, Andhra Pradesh and Kerala coast.

9. *Fimbristylis polytrichoides* (Retz.) Vahl, Enum. Pl. 2: 248. 1806; Clarke in Hook. f., Fl. Brit. India 6: 632. 1893.

Glabrous densely tufted annual; root fibrous. Stem 6.8-25.2 cm long, erect or suberect, trigonous, striate. Leaves half as long as stem. Spikelets solitary, up to 0.5 mm long, brown, many flowered, elliptic-oblong to linear oblong, acute or obtuse at apex. Glumes 1.8-2.4 mm long, oblong, pale brown, lowest glume with leaf-like appendage resembling bracts. Nut 0.7-0.9 mm long, obpyriform, brown.

Ecology : Common in wet places along the banks of streams, ponds, ditches and margins of paddy fields near the coast.

Fl. & Fr. : July-November.

Distrib.: Both East and West coastal districts.

6. *Kyllinga* Rottb.

KEY TO THE SPECIES

- 1a. Rhizome 15-16 cm long; head subglobose; upper glumes ovate; keel setulose; nut elongated 1. *brevifolia*
 1b. Rhizome 5-6 cm long; head ovoid; upper glume elongated; keel crested; nut suborbicular 2. *nemoralis*

1. *Kyllinga brevifolia* Rottb., Clarke in Hook. f., Fl. Brit. India 6: 588. 1893. *Cyperus brevifolius* (Rottb.) Hassk. Cat. Hort. Bogor. 24. 1844.

A perennial, rhizomatous herb. Rhizome creeping, covered by reddish brown scales. Stem triquetrous, smooth, 4-30 cm. Leaves 5-3.5 x 2-3 mm, scabrid on margins. Flowers arranged on capitate head, bracts 3 or 4, foliaceous, spike usually solitary or with 2-3 additional lateral spikes; spikelets numerous, congested, elliptic lanceolate, 1-flowered. Nut 1-1.5 x 0.7 mm obovoid or oblong-obovoid, yellowish-brown.

Ecology : Common along roads, grass fields, wastelands on dry to moist sandy alluvium to gravely substratum, forming dense patches.

Fl. & Fr. : March-November.

Distrib. : Throughout the coastal districts.

2. *Kyllinga nemoralis* (J. R. & G. Foster) Dandy ex Hutchinson & Dalziel, Fl. W. Africa ed. 1. 2: 487. 1936; *K. monocephala* Rottb.: Clarke in Hook. f., Fl. Brit. India 6: 588. 1893.

Rhizome short, aromatic, stem 7-36 cm tall, usually solitary, erect, compressed triangular. Leaves usually as long as the stem, 2-4 mm broad, acuminate at apex. Head up to 7 mm long, spiciform, globose to broadly-oblong, more or less white, bracts 3-4, leaf-like, spikelets many up to 2 mm long, 1 or rarely 2 flowered. Glumes outer one hyaline, lanceolate, broadly ovate obtuse, 3rd and 4th glumes acuminate. Nut 0.8-1.2 mm long, blackish brown, obovoid-oblong, minutely punctate, apiculate.

Ecology : Common in moist places near the coast.

Fl. & Fr. : All most all round the year.

Distrib. : Throughout the coastal provinces.

7. *Lipocarpa* R. Br.

Lipocarpa squarosa (L.) Goetghebeur. *Riklicella squarosa* (L.) J. Raynal in *Adansonia* Ser. 2. 13: 154. 1973; *Scirpus squarrosus* L.: Hook. f., *Fl. Brit. India* 6: 663. 1893.

A slender glabrous tufted annual, root fibrous. Stem 5-25 cm tall, filiform, terete. Leaves 24-40 x 0.2 cm, shorter than stem, filiform, smooth, involute margin, acuminate at apex. Flowers with 1-3 foliaceous bracts, arranged on capitate inflorescence, pseudolateral

spikelets 1-4, ovoid in terminal cluster. Nut obovoid, ellipsoid, trigonous, yellow.

Ecology : Common in ponds, ditches and paddy fields, mostly in fresh water conditions near the coast.

Fl. & Fr. : July-December.

Distrib. : West Bengal, Andhra Pradesh, Tamil Nadu, Maharashtra, Gujarat and Kerala coast.

8. *Mariscus* Vahl

Mariscus javanicus (Houttuyn) Merr. & Metcalfe. *Lingnan Sci. Journ.* 21: 4. 1945; *M. albescens* Gaud.: Clarke in Hook. f., *Fl. Brit. India.* 6: 623. 1893.

Perennial, stoloniferous herb, rootstock tuberous. Stem up to 0.8 m tall, stout, trigonous. Leaves as long as the stem, 1 cm broad, coriaceous, margin scaberulous. Umbel compound, 12 mm diam., bracts 4-6 leaf-like.

Spikelets 6-10 mm long, brownish, 3-9 flowered. Nut 1.2-1.4 mm long, obovoid, trigonous, black.

Ecology : Frequent along the margins of ponds, ditches, canals and coastal slacks.

Fl. & Fr. : July- November.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Lakshadweep and Kerala coast.

9. *Pycnus* Beauv.

KEY TO THE SPECIES

- 1a. Glumes emarginate at apex; nuts biconvex, laterally compressed, surface with tubercles 2. *pumilus*
 1b. Glumes hyaline at apex; nuts narrowly oblong, surface puncticulate 1. *polystachyos*

1. *Pycnus polystachyos* (Rottb.) P. Beauv. *Fl. d' Owone* 2: 48. t. 86. f. 2. 1807; Clarke in Hook. f., *Fl. Brit. India* 6: 592. 1893.

Annual or perennial tufted. Stems 22-50 cm tall, erect, compressed trigonous. Leaves half the length of the stem, 3 mm broad. Umbel few to many; bracts 3-6, leaf-like; spikelets many flowered, brownish green. Glume 1.7-1.9 mm long. Nut 0.7-1 mm long, black, ellipsoidly obovate, oblong, laterally compressed.

Ecology : Common along the sides of the bunds of paddy fields and margin of ponds and ditches near the coast.

Fl. & Fr. : June-September.

Distrib. : West Bengal, Orissa, Tamil Nadu, Kerala, Islands of Agathi, Minicoy, Kadnal, Kalpani

2. *Pycnus pumilus* (L.) Nees, *Linnaea* 9: 283. 1834. *P. nitens* (Retzius) Nees: Hook. f., *Fl. Brit. India* 6: 591. 1893.

Tufted ephemeral, stems 2-25 cm. Leaves 2-3 per stem. Inflorescence in capitate head or shortly anthelate. Spikes congested, spikelets linear 7-30 x 1.5-2.5 mm. Glumes obovate 1.2 mm long obtuse, apiculate membranous. Nuts 0.6 x 0.4 mm ovoid, smooth.

Ecology : Occasional on moist sandy alluvium along the back shore and tidal flats.

Fl. & Fr. : September-November.

Distrib. : All along the coastal districts of East and West coast and Andaman Islands.

10. *Schoenoplectus* (Reichb.) Palla.

Schoenoplectus articulatus (L.) Palla in Bot. Jahrb. 10: 229. 1889; *Scirpus articulatus* L.: Clarke in Hook. f., Fl. Brit. India 6: 656. 1893.

Annual stems densely tufted, cylindrical, striate, spongy or transversely septate. Leaves reduced to 1-2 bladeless sheaths. Inflorescences capitate, spikelets few to many in the stem at different heights, arranged in a

lateral cluster, sessile, brown. Glume persistent. Nut 1.4 mm long, black, triquetrous, apiculate.

Ecology : Common in ditches, margins of ponds and paddy fields and moist sandy back shore.

Fl. & Fr. : July-December.

Distrib. : Throughout the coastal districts.

P O A C E A E

KEY TO THE GROUPS

- 1a. Spikelets two flowered, falling entire at maturity, usually with the upper floret hermaphrodite and the lower male or barren and if the later often reduced to the lemma, frequently dorsally compressed *Panicoideae*
- 1b. Spikelets 1-many flowered, breaking up at maturity above the glume, or if falling entire, then not 2 flowered, with the lower floret male or barren and the upper hermaphrodite, usually more or less centrally compressed *Pooideae*

KEY TO THE GENERA OF GROUP PANICOIDEAE

- 1a. Male or female spikelets in separate inflorescence or different parts of same inflorescence, lemma hyaline or membranous and thinner than glume 17. *Coix*
- 1b. Spikelets all hermaphrodite or with male or barren and hermaphrodite spikelets mixed in the same inflorescence and so arranged that a male or barren spikelets is near a hermaphrodite spikelets or if unisexual then the lemma of the fertile floret indurated :
 - 2a. Spikelets often paired, with one sessile and the other pedicelled, those of each pair similar or more often dissimilar, rarely solitary and all alike; glumes as long as the spikelets and enclosing the florets, more or less rigid and firmer than the lemmas which are both hyaline or membranous, upper lemma usually awned :
 - 3a. Spikelets solitary, usually sessile 24. *Dimeria*
 - 3b. Spikelets paired or rarely 3, both sessile and pedicelled :
 - 4a. Inflorescence a true or false panicle :
 - 5a. Panicles of racemes interrupted by spathe 5. *Apluda*
 - 5b. Panicles of racemes not interrupted by spathe :
 - 6a. Panicles densely silky villous :
 - 7a. Panicles contracted, spiciform up to 20 cm long, both spikelet in a pair, pedicelled 32. *Imperata*
 - 7b. Panicles effuse, up to 50 cm long or more, one of the spikelet in a pair, sessile, the other pedicelled 49. *Saccharum*
 - 6b. Panicles not silky villose:
 - 8a. Lower glume muricate or spinulose, spikelets awnless, branches of panicles whorled 60. *Vetiveria*
 - 8b. Lower glume smooth not muricate or spinulose, spikelets awned or awnless; branches of panicles not in whorls 15. *Chrysopogon*

- 4b. Inflorescence a solitary, digitate or subdigitate raceme :
- 9a. Racemes solitary :
- 10a. Joints and pedicels fused, raceme cylindrical, upper lemma sessile, spikelets awnless :
- 11a. Spikelet paired, one sessile other pedicelled, joints and pedicels fused, lower florets male; palea not well developed 47. *Rotboellia*
- 11b. Spikelets solitary, sessile, pedicels rudimentary, pedicels fused to the internodes, lower floret usually male with well developed palea 39. *Ophiuros*
- 10b. Joints and pedicels not fused, racemes not strictly cylindrical, upper lemma of the sessile spikelets awned :
- 12a. Racemes terete, callus pungent; pedicelled spikelets twisted around the sessile spikelets; awns hairy up to 10 cm long 29. *Heteropogon*
- 12b. Racemes not terete, callus not pungent, spikelets not as above, awns more or less glabrous, up to 5 cm long 22. *Dichanthium*
- 9b. Racemes 2 or many :
- 13a. Upper lemma of the sessile spikelets awned from the back, often just above the base, lowest glume often muricate or spinulose, pedicelled spikelets reduced or not 7. *Arthraxon*
- 13b. Upper lemma of the sessile spikelets awned from the middle, lower glumes not as above, pedicelled spikelets usually well developed, rarely reduced by then the joints toothed :
- 14a. Spikelets disarticulating in groups, upper glumes of sessile spikelets deeply notched, racemes always 2 11. *Bhidea*
- 14b. Spikelets not disarticulating in groups, upper glume not deeply notched, racemes 2 to many 34. *Ischaemum*
- 2b. Spikelets often paired, with one sessile and the other pedicelled, those of each pair similar or more often dissimilar, rarely solitary and all alike; glume as long as the spikelets and enclosing the florets, more or less rigid and firmer than the lemmas which are both hyaline or membranous, upper lemma usually awned :
- 15a. Inflorescence spicate or racemose, rachis broad, flat and disarticulating, spikelets in 1-6 clustered 56. *Trachys*
- 15b. Inflorescence in panicles, heads of racemes, rachis not as above, spikelets not in groups :
- 16a. Spikelets unisexual or hermaphrodite :
- 17a. Spikelets dioecious, the female solitary in spherical head and the male seated on a sharp pointed rachis 52. *Spinifex*
- 17b. Spikelets monoecious, female not in spherical head, the male 4-6 in the upper rachis and female or hermaphrodite in the lower 55. *Thuarea*
- 16b. Spikelets all similar in shape and sex :
- 18a. Spikelets awned or mucronate from the tips of upper glume, upper glume markedly gibbous, 5 nerved 48. *Rhynchelytrum*

- 18b. Spikelets not awned, not mucronate upper glume not gibbous, 5-7 nerved :
- 19a. Spikelets falling singly, not subtended by bristles or if so, then the bristles persisting after the spikelets have fallen :
- 20a. Spikelets arranged in more or less open panicles or with the panicles contracted and the spike-like :
- 21a. Spikelets not subtended by bristle-like branches :
- 22a. Spikelet arranged in open or contracted panicles :
- 23a. Spikelets not or only slightly gibbous; upper glume as long as the spikelet..... 40. *Panicum*
- 23b. Spikelets distinctly gibbous and upper glume smaller than spikelets 19. *Cyrtococcum*
- 22b. Spikelets usually arranged in cylindrical spike like panicles :
- 24a. Upper lemma and palea indurated and closed at apex; spikelets more or less gibbous 48. *Sacciolepis*
- 24b. Upper lemma and palea membranous, gaping at apex, spikelets lanceolate 30. *Hymenachne*
- 21b. Spikelets subtended or replaced by one to many bristles like branches 51. *Setaria*
- 20b. Spikelets arranged in one sided spikes or spike-like racemes; spikes or racemes digitate or scattered, rarely solitary :
- 25a. Lemma of the upper floret more or less crustaceous or coriaceous, usually with narrow inrolled margins :
- 26a. Lower glume and the lowest internodes of the rachilla not forming a swollen callus at the base of spikelet :
- 27a. Glumes and lemmas with laterally compressed and thickened apices..... 1. *Acroceras*
- 27b. Glumes and lemmas not laterally compressed and not thickened apices :
- 28a. Lower glume turned away from the rachis of the racemes or spike, the back of the upper lemma facing it :
- 29a. Lower glume developed although sometimes small :
- 30a. Spikelets not sunken in hollows of a thickened corky rachis :
- 31a. Glumes acuminate or awned, rarely only acute; upper lemma not mucronate 25. *Echinochloa*
- 31b. Glumes awnless, if acuminate then the upper lemma mucronate :
- 32a. Upper lemma acute not acuminate 41. *Paspalidium*
- 32b. Upper lemma obtuse, mucronate or very short awned 58. *Urochloa*
- 30b. Spikelets sunken in hollows of a thickened rachis 54. *Stenotaphrum*
- 29b. Lower glume usually absent 42. *Paspalum*
- 28b. Lower glume turned towards the rachis, the back of the upper lemma turned way from it :
- 33a. Lower glume present 12. *Brachiaria*
- 33b. Lower glume absent 10. *Axonopus*

- 26b. Lower glume and lowest internode of the rachilla forming a swollen callus at the base of spikelet :
- 26b₁. Lower glume absent or reduced to a ring, upper glume ovate, 5 nerved 27. *Eriochloa*
- 26b₂. Lower glume present, lanceolate, upper glume lanceolate, 2 nerved 28. *Hemathria*
- 25b. Lemma of the upper floret thinly cartilaginous, usually with flat hyaline margins :
- 34a. Spikelets awnless 23. *Digitaria*
- 34b. Spikelets awned 4. *Alloteropsis*
- 19b. Spikelets with an involucre of bristles or subtended by a solitary bristle and falling with or without the bristles at maturity, solitary or in cluster :
- 35a. Involucre of free, naked or plumose bristles 43. *Pennisetum*
- 35b. Involucre of spines of rigid bristles united at the base into a hard cup 13. *Cenchrus*

KEY TO THE GENERA OF GROUP POOIDEAE

1a. Stamens 6 :

- 2a. Leaf blades ovate-oblong or ovate-lanceolate with inflated sheaths, lemma awned, floating grasses 30. *Hygrorhiza*
- 2b. Leaf blades linear, sheaths not inflated, lemmas awned or not, not floating :
- 3a. Fertile lemma supported by two empty scales; tip of pedicel with two obscure lips 46. *Porteresia*
- 3b. Fertile lemma solitary; tip of pedicel without lips 5. *Leersia*

1b. Stamens 1-3 :

- 4a. Spikelets with one floret :
- 5a. Spikelets awned :
- 6a. Awns trifid 6. *Aristida*
- 6b. Awns simple :
- 7a. Glumes with long capillary awns, several times longer than the glumes 44. *Perotis*
- 7b. Glume not with long capillary awns as above 3. *Agrostis*
- 5b. Spikelets not awned :
- 8a. Inflorescence a solitary raceme or spike; glumes often stiff, cartilaginous :
- 9a. Glumes with recurved spines or one armed and one smooth; spikelets in pair, crowded in short pedicel, lower glume armed, upper glume smooth 57. *Tragus*
- 9b. Glumes of the spikelets, smooth compressed, shining, spikelets arranged in rigid, erect spikes not as above 61. *Zoysia*
- 8b. Inflorescence not solitary and glumes not as above :
- 10a. Inflorescence of several digitate or subdigitate racemes or spikes :
- 11a. Inflorescence terminal, spicate, not of digitate or racemose spikes, lemmas not obovate 37. *Melanocenchris*

- 11b. Inflorescence digitate, spikes racemose, very rarely solitary but if so lemmas obovate :
- 12a. Spikelets with awn; florets dissimilar, lower one or more fertile, with a few sterile florets above 14. *Chloris*
- 12b. Spikelets without awns, florets similar, fertile 18. *Cynodon*
- 10b. Inflorescence a panicle, rarely spiciform but then the glume delicate, hyaline, but never cartilaginous :
- 13a. Paleas 2 keeled :
- 14a. Spikelets in open contracted or spike like panicle:
- 15a. Lemma rounded on the back, 3-5 nerved; grain hollowed out on the adaxial surface, rugose on the other 16. *Coelachyrum*
- 15b. Lemmas more or less acutely keeled, 3 nerved, grain not rugose or hollowed out on the adaxial surface 26. *Eragrostis*
- 14b. Spikelets sessile or very short pedicelled, loosely or densely imbricate, in digitate or racemosely arranged spikes or spike like racemes :
- 16a. Spikelets short, straight, crowded, spikelets closely packed, upper glume not awned 21. *Desmostachya*
- 16b. Spikelets long, digitate, spikelets not closely packed, upper glume awned 20. *Dactyloctenium*
- 13b. Paleas not 2 keeled :
- 17a. Inflorescence a panicle; fruit without a beak :
- 17a₁. Spikelets compressed, glumes coriaceous, dorsally rounded 38. *Myriostachya*
- 17a₂. Spikelets not compressed, spiciform, glumes membranous, not dorsally rounded 53. *Sporobolus*
- 17b. Inflorescence elongate, spikelike; fruit with a conspicuous beak 59. *Urochondra*
- 4b. Spikelets with 2-many florets :
- 18a. Lemmas and rachilla with long silky hairs :
- 19a. Lemmas hairy or glabrous rachilla long villous 45. *Phragmites*
- 19b. Lemmas all over the back, rachilla glabrous 9. *Arundo*
- 18b. Lemmas and rachilla usually glabrous :
- 20a. Leafblades convolute, inflorescence capitate, lemmas 7-9 nerved, without awns 2. *Aeluropus*
- 20b. Leafblades flat, inflorescence not capitate, lemmas usually 1-5 nerved, rarely 7 nerved, but then with awns :
- 21a. Second lemma not awned, glumes almost equal in size 33. *Isachne*
- 21b. Second lemma usually awned or atleast with a bristle; glumes unequal in size :
- 22a. Panicles contracted, spiciform, ovate densely spiculate, lemma of the upper floret deeply notched 35. *Jansenella*
- 22b. Panicles lax, not spiciform, loosely spiculate, lemma of the upper floret glabrous minutely two lobed at apex 8. *Arundinella*

1. *Acroceras* Stapf.

Acroceras munroanum (Balansa) Henr.: Bor. 275. 1960;
Panicum latifolium L.: Hook. f., Fl. Brit. India 7: 39. 1896.

Annual or perennials, culms creeping or geniculate, 30-75 cm long, often prostrate and rooting at nodes, nodes glabrous. Leaves 2-8 x 0.4-0.8 cm, lanceolate, glabrous on both surface, margins scabrid, base rounded, acute at apex. Ligule fimbriate, membranous. Inflorescence: a panicle of 4-6 sub-erect, interruptedly spiciform racemes, 3-10 cm long. Spikelets

arranged in one sided spikes, spikelets elliptic, lower glumes ovate-lanceolate, chartaceous, upper glume elliptic, broadly ovate. Upper floret bisexual. Grains 2-1.25 mm, ovate blunt at both ends.

Ecology : Rare in coast. Forms an important sand binder along coastal areas.

Fl. & Fr. : March-November.

Distrib. : West Bengal and Kerala coast.

2. *Aeluropus* Trin.

Aeluropus lagopoides (L.) Trin ex Thw.: Bor. 380. 1960.
A. villosus Trin. ex C.A.: Hook. f., Fl. Brit. India 7: 334. 1897.

A rigid perennial herb of 5-40 cm high, rhizomatous, creeping, decumbent, long stolons, nodes glabrous. Leaves 0.2-5 x 0.1-0.3 cm lanceolate, glaucous, ciliate, rounded or shallowly cordate at base, acuminate at apex, ligule a shortly hairy ridge. Inflorescence capitate, globose or densely crowded, spikelets elliptic, 6-8 flowered, lower floret male or barren. Lemmas oblong,

mucronate, chartaceous, villous. Paleas oblong, hyaline, 3 lobed. Grains oblong or obovoid, free within lemmas and palea.

Ecology : Rare along the coastal belt and frequent in salt marshes, often in damp soil, sometimes on sandy soils, in wastelands and shallow fields.

Fl. & Fr. : January-July.

Distrib. : Coasts of Andhra Pradesh, Saurashtra, Pondicherry and West Bengal.

3. *Agrostis* L.

Agrostis pilosula Trin. in Mem. Acad. Sci. Petersb. Ser. 6, 6: 372. 1841; Bor. 388. 1960. *Calamagrostis pilosula* Hook. f., Fl. Brit. India 7: 263. 1897.

Annual or perennials, culms 10-40 cm high, erect, tufted, rooting at the lower nodes, nodes glabrous. Leaves 3-12 x 0.1-4 cm, linear, scabrid, rounded at the base, acute at apex, ligule ovate, membranous. Panicles broadly ovate, lax,

green or purplish, spikelet elliptic-lanceolate, one flowered. Lemma elliptic, notched, awned, palea oblong, hyaline.

Ecology : Frequent among open grasslands of higher elevation near the coast.

Fl. & Fr. : August-January.

Distrib. : Coast of Saurashtra, Tamil Nadu and Kerala.

4. *Alloteropsis* C. Persl.

Alloteropsis cimicina (L.) Stapf.: Bor. 276. 1960;
Axonopus cimicinus (L.) P. Beauv.: Hook. f., Fl. Brit. India 7: 64. 1896.

Erect tufted or decumbent annual culms 15-120 cm with nodes tubercled hairy. Leaves 2.5-7.2 cm, ovate-lanceolate, hirsute, base deeply cordate, acute at apex, margin ciliated, sheath coarse with dense hair, ligule truncate, fimbriate. Flowers arranged in 3-8 sub-verticillate spikes, shortly pedicelled, dorsally

compressed, pale, 1st glume acuminate, 2nd glume mucronate or shortly awned. Caryopsis 1-1.5 x 1 mm, ovoid, compressed.

Ecology : Very common along the road side waste places, margin of streams, rivulets and also as a weed in cultivated lands.

Fl. & Fr. : During rainy season.

Distrib. : Throughout the coastal provinces.

5. *Apluda* L.

Apluda mutica L.: Bor, 93, t. 7, 1960; *A. varia* Hack. subsp. *mutica* Hack.: Hook. f., Fl. Brit. India 7: 150, 1896.

Annual or perennials, creeping or erect, culms 30-200 cm long, nodes glabrous. Leaves 2-3.5 x 0.2-1.5 cm, elliptic lanceolate, margin scaberulous, narrowed base, acuminate apex, ligule membranous. Inflorescences in pedunculate raceme. Spikelets sessile, 3-8 mm long, laterally compressed, awned, lower glume lanceolate, upper glume boat shaped, upper floret

bisexual, lower floret male, pedicelled spikelet oblong-lanceolate. Floret more or less similar to those of sessile spikelet. Upper lemma unawned.

Ecology : A very common grass all over India in plains, hills along margin of streams. Often found in hedges and bushes near the coast.

Fl. & Fr. : August-December.

Distrib. : Throughout the coastal districts.

6. *Aristida* L.

KEY TO THE SPECIES

- 1a. Panicle contracted :
 2a. Awn not articulated on the floral glume :
 3a. Involucral glume not awned 1. *adscensionis*
 3b. Involucral glume awned 4. *setacea*
 2b. Awns with twisted column on the glume 2. *funiculata*
 1b. Panicle effuse 3. *hystrix*

1. *Aristida adscensionis* L.: Bor, 407, t. 43, 1960; Hook. f., Fl. Brit. India 7: 224, 1897.

Annuals or perennials, tufted, culms very slender, 30-100 cm high, erect or geniculate, nodes glabrous. Leaves 1-15 x 0.1-3 cm filiform, linear-acuminate narrow or rounded at base, acute at apex often convolute. Ligule membranous, fimbriate. Inflorescence panicle, 3-20 cm long, spikelets linear-lanceolate, pale green or purplish. Lower glume oblong-lanceolate, chartaceous, upper glume oblong-lanceolate, lemma linear-oblong, laterally compressed, convolute, 3 awned. Palea oblong, hyaline. Grain linear, as long as glume.

Ecology : Abundant on road sides, waste lands, dry fields hill slopes and rocky places along the coast.

Fl. & Fr. : March-August.

Distrib. : Coast of Andhra Pradesh, Kerala, Tamil Nadu, Maharashtra, Gujarat, Orissa and West Bengal.

2. *Aristida funiculata* Trin & Rupr.: Bor, 410, 1960; Hook. f., Fl. Brit. India 7: 226, 1897.

Slender, annual grass, stem slender many, tufted, geniculately ascending, 30-60 cm high. Leaves 5-15 x 0.1-0.2 cm, narrowly linear, flat, pubescent, acuminate. Inflorescence narrow, lax panicle, branches filiform, short, erect spikelets one flowered, greenish. Involucral glume linear-lanceolate, acute, terminating as in awn. Florate

hermaphrodite, floral glume short and prolonged towards the apex as a narrow, firmly convolute sharp, forming a twisted column and ends in 3 slender awns. Grain cylindrical.

Ecology : Common in sandy soil of the cultivated fields.

Fl. & Fr. : August-October.

Distrib. : Coast of Saurashtra and Maharashtra.

3. *Aristida hystrix* L. f.: Bor, 410, 1960; Hook. f., Fl. Brit. India 7: 225, 1897.

Perennials, culms 20-80 cm high, tufted erect, nodes glabrous. Leaves 3-20 x 0.1-0.3 cm, lanceolate or linear lanceolate, flat or convolute, glaucous, acuminate. Ligule rows of hairs or very narrow fimbriate, membranous. Panicle ovate, very lax, 5-20 cm long. Spikelets 10-20 mm long, lanceolate or elliptic-lanceolate, yellowish, callus, 1-3 mm long, pungent. Lower glume oblong-lanceolate, 5-10 x 1-1.5 mm, chartaceous, keeled, aristate, upper glume oblong-lanceolate, shortly aristate, chartaceous. Lemma linear, convolute, 3 awned, palea narrowly oblong, small hyaline. Grains 6-8 x 0.5-1 mm, linear or linear-oblong.

Ecology : Rare, along the coastal area, on dry, rocky soil and other drier habitats.

Fl. & Fr. : June-December.

Distrib. : Coast of Kerala and Maharashtra.

4. *Aristida setacea* Retz.: Bor, 412.1960; Hook. f., Fl. Brit. India 7: 225. 1897.

Perennial, culms robust, tufted 30-150 cm high, leaves 3-30 x 0.1-0.5 cm enrolled, filiform, glaucous, scaberulous, cordate at base, acuminate apex. Ligule a rim of stiff hairs. Inflorescence a contracted panicle, branches ascending, scabrid. Spikelets 1-flowered, lower and upper glume awned prominently. Lemma 1.1 cm long, convolute around palea, awns 3, palea oblong, hyaline.

Caryopsis 1.5 cm long, cylindrical, brown.

Ecology : Very common along the road side, hill slopes, waste places, banks of backwater, in grasslands and dry rocky places near the coast.

Fl. & Fr. : December-February.

Distrib. : Coast of Maharashtra, Gujarat, Kerala, Tamil Nadu, Karnataka, West Bengal and Orissa.

7. *Arthraxon* P. Beauv.

Arthraxon villosus C.E.C. Fischer: Bor, 103. 1960. Hook. f., Fl. Brit. India 7: 143. 1896.

Annuals. Culms 5-40 cm long, creeping; nodes bearded. Leaves 0.5-3 x 0.2-0.8 cm, ovate, densely villous, margins ciliate, rounded at base, acute at apex. Ligule ovate, membranous, fimbriate. Racemes 2-3 in numbers,

1-4 cm long, sessile spikelet lanceolate, densely villous, lower floret empty, upper floret bisexual. Pedicelled spikelet lanceolate usually empty.

Ecology : Rare along moist, shady places near the coast.

Fl. & Fr. : October-December.

Distrib. : Kerala, Maharashtra.

8. *Arundinella* Reddi.

KEY TO THE SPECIES

- 1a. Spikelets 1-2 mm long; culms slender, up to 60 cm long; panicles very effuse, up to 30 cm long 2. *pumila*
 1b. Spikelets 2-4 mm long; culms densely hairy, up to 15 cm long; panicles loosely spiculate 1. *ciliata*

1. *Arundinella ciliata* (Roxb.) Nees ex Miq.: Bor, 421.1960. *A. agrostoides* auct. non. Trin.: Hook. f., Fl. Brit. India 7: 71. 1896.

Annual, erect densely tubercled-based, hairy, slender, herb, culms 5-50 cm high. Leaves 2-15 x 0.2-1.2 cm, elliptic-lanceolate, glabrous, rounded base. Ligule fimbriate, membranous or row of hairs. Panicles 2-15 cm long, spikelet lanceolate, 4-8 mm long brown or purplish. Lower glume lanceolate, chartaceous, upper glume oblong-lanceolate, chartaceous. Lower floret male, upper floret bisexual.

Ecology : Common along road sides of hilly places, moist, rocky places and hill slopes near the coast.

Fl. & Fr. : July-December.

Distrib. : Endemic to South Indian coast.

2. *Arundinella pumila* (Hoshst) Steud.: Bor, 423. 1960; *A. tenella* Nees ex Steud.: Hook. f., Fl. Brit. India 7: 71. 1896.

Erect, annual, tufted herb, with glabrous nodes, culms slender 10-60 cm high. Leaves 1-20 x 0.2-1.5 cm, lanceolate, glabrous, sheath compressed, rounded base, acuminate apex. Ligule truncate, membranous. Panicle pyramidal, 3-25 cm long, effuse. Spikelets elliptic, 1-2 mm long, lower glume ovate-acute, upper glume ovate-lanceolate, acuminate. Upper floret male or neuter. Caryopsis cilipsoid.

Ecology : Very common along margins of forests in humus, fringes of forests and sandy places in the coast.

Fl. & Fr. : August-November.

Distrib. : Coast of Western Ghats and Maharashtra.

9. *Arundo* L.

Arundo donax L.: Bor, 413. *t.* 44. 1960; Hook. f., Fl. Brit. India 7: 302. 1897.

Perennials, culms reed-like, 40-200 cm or more high, erect, tufted, with creeping woody rhizomes, nodes glabrous. Leaves 8-40 x 0.5-3 cm lanceolate or linear-lanceolate, sheath glabrous, shallowly cordate at base, acuminate at apex. Ligule membranous, fimbriate. Panicle 20-50 cm long compact. Pedicels scaberrulous, spikelets

elliptic-lanceolate, 2-3 flowered. Lower glume lanceolate, acuminate, upper glume lanceolate, acuminate, chartaceous, palea elliptic, shortly notched.

Ecology : Banks of streams, back waters and canals, usually wet habitats. A very good sand binder.

Fl. & Fr. : August-December.

Distrib. : Throughout the coastal plain.

10. *Axonopus* Hook. f.

Axonopus compressus (Sw.) P. Beauv.: Bor, 278. 1960. Hook. f., Fl. Brit. India 7: 63. 1896.

Perennials, culms 10-60 cm long, creeping or stoloniferous, rooting at the nodes, erect when flowering, sometime rosette like and forming mat. Leaves 2-2.5 x 0.3-1.5 cm, oblong, linear-lanceolate, margin ciliate, sheath keeled, base rounded or shallowly cordate, acute at apex. Ligule membranous, fimbriate. Racemes 2-6, binate, digitate. Spikelets oblong-lanceolate, sessile or

shortly pedicelled, green. Lower glume absent, upper glume ovate, chartaceous.

Ecology : Very common along the banks of backwaters, rivers, lakes and canals usually in wet situation. Grows gregariously and form mats and serve as a very good sand binder and as pasture grass.

Fl. & Fr. : Throughout the year.

Distrib. : Coast of Tamil Nadu, Kerala. Introduced.

11. *Bhidea* Stapf. ex Bor

Bhidea burnsiana Bor, 103. *t.* 2. 1960.

Annuals, culms 10-30 cm high, erect, upper nodes villous, lower ones glabrous. Leaves 2-12 x 0.1-0.3 cm, lanceolate, margin serrulate, sheath keeled, ligule membranous, fimbriate at apex. Racemes 1 or 2, 1-4 cm long, shortly exerted from spathes. Spikelets greenish yellow, in group of 2, one sessile, other pedicelled. Sessile

spikelets awned, densely villous. Pedicelled spikelets chartaceous, broadly winged on one side.

Ecology : Rare, monotypic along dry rocky grassland near the coast.

Fl. & Fr. : August-December.

Distrib. : Maharashtra and Kerala coast.

12. *Brachiaria* (Trin.) Griseb.

- 1a. Culms robust, tall, erect, 5-10 mm in diameter, racemes 10-20 3. *mutica*
- 1b. Culms not robust, creeping or decumbent, 3 mm in diam., racemes usually 2-8 in number :
 - 2a. Rachis flat, spikelets secund, solitary, oblong-obovate :
 - 3a. Racemes 2 or rarely 3 peduncled, softly hairy below the racemes; leaves up to 5 cm long, spikelets 2-3 mm long 1. *distachya*
 - 3b. Racemes 3-8, peduncle, puberulous or glabrous, leaves up to 20 cm long, spikelets 3.5-4 mm long 2. *milliformis*
 - 2b. Rachis triquetrous, spikelets not secund, often paired, broadly elliptic :
 - 4a. Lower involucre glume ovate acute, half as long as the upper floral glume 4. *ramosa*
 - 4b. Lower involucre glume orbicular, one third as long as the upper floral glume ... 5. *setigera*

1. *Brachiaria distachya* (L.) Stapf.: Bor, 281. 1960; *Panicum distachyon* L.: Hook. f., Fl. Brit. India 7: 37. 1896.

Annual or perennial, culms 20-45 cm long, leafy, creeping or decumbent rooting at nodes, nodes glabrous or sparsely bearded. Leaves 1-4 x 0.3-6 cm, lanceolate, glabrous, Sheaths softly hairy, ciliate along one margin, cordate base, ligule a tuft of hairs. Inflorescence 2 or 3 spreading racemes, rachis flattened, glabrous. Spikelets elliptic-obovate, glabrous. Lower glume 1/4 of the spikelet, upper lemma transversely rugose, pale brown. Lower lemma empty, similar to upper glume, palea oblong, ovate-oblong. Caryopsis oval, flattened, light yellow.

Ecology : Common along banks of back water seashores and wastelands, near the coastal areas.

Fl. & Fr. : August-December.

Distrib. : Coast of West Bengal, Orissa and Kerala.

2. *Brachiaria milliformis* (J. Presl & C. Prest) A. Chasc.: Bor, 283-284. 1960; *Panicum distachyon sensu* Hook. in Hook. f., Fl. Brit. India 7: 37. 1896.

Annuals or perennial, culms 30-100 cm long, creeping or willowy rooting at the lower nodes, nodes glabrous. Leaves 2-20 x 0.3-1.2 cm linear-lanceolate, sheath glabrous, ciliate along margins, rounded at base. Ligule fimbriate or row of hairs. Inflorescence-raceme 3-8 in number, rachis flat. Spikelets elliptic, lower glume ovate, upper glume ovate, acute. Lower florets empty, upper floret bisexual.

Ecology : Common along paddy fields, banks of river and back waters of coastal plains.

Fl. & Fr. : April-September.

Distrib. : Coast of South India.

3. *Brachiaria mutica* (Forssk.) Stapf.: Bor, 284. 1960; *Panicum muticum* Forssk.: Hook. f., Fl. Brit. Ind. 7: 34. 1896.

Tall perennials, culms 50-150 cm high, tufted erect; nodes densely bearded. Leaves 10-30 x 0.5-2 cm linear-lanceolate, sheaths covered with dense hair, rounded or shallowly cordate base, acuminate at apex. Ligules membranous, fimbriate. Racemes pseudo-paniculate, 10-20 in numbers, each 2-8 cm long. Rachis

flat, ribbon like, laterally covered with solitary or paired, stalked spikelets. Spikelets elliptic crowded, arranged in 2 rows. Lower glume ovate, scaly, upper glume chartaceous. Lower floret male, upper floret bisexual.

Ecology : Very common along the banks of streams, canals, backwaters and rivers, semi-aquatic habitats.

Fl. & Fr. : November-March.

Distrib. : Coasts of West Bengal, Kerala and Tamil Nadu.

4. *Brachiaria ramosa* (L.) Stapf.: Bor, 284. 1960; *Panicum ramosum* L.: Hook. f., Fl. Brit. India 7: 36. 1896.

Annuals or perennials, culms 15-100 cm long, creeping or decumbent, nodes glabrous. Leaves 2-15 x 0.2-2 cm, lanceolate or linear-lanceolate, glabrous or softly villous. Sheaths slightly keeled, cordate base, acuminate apex. Ligule as row of hairs. Panicles 2-16 cm long, lax, raceme 3-16, rachis angular. Spikelets broadly elliptic or ovate-elliptic. Upper glume broadly ovate, lower floret barren, upper floret hermaphrodite, transversely rugose, apiculate, palea-hyaline, lemma elliptic. Caryopsis 0.5 mm long, ovoid, apiculate, brown.

Ecology : Common along margin of embankments, banks of channels and other shady damp places near the coast.

Fl. & Fr. : July-October.

Distrib. : Coast of Kerala and Tamil Nadu.

5. *Brachiaria setigera* (Retz.) C.E. Hubb.: Bor, 286. 1960; *Panicum setigerum* var. *tomentosa* Hook. in Hook. f., Fl. Brit. India 7: 37. 1896.

A slender, prostrate, annual with 30-90 cm long stem and long internodes, rooting at nodes. Leaves 7.5-12.5 x 1.2-1.7 cm, flat, margins crispedly wrinkled below, ciliate, acuminate at apex. Ligule a few hairs. Spikes 3-6, sub-erect or spready, spikelets solitary acuminate, 0.2-0.3 cm long, 2 seriate, glume 4, floral glume equal to upper glume, palea membranous.

Ecology : Frequent on sandy beaches, river banks and moist sandy places.

Fl. & Fr. : September-December.

Distrib. : West Bengal and Saurashtra coast.



Phoenix farinaria



Phoenix paludosa



Pandanus leram



Pandanus tectorius



Pandanus thwaitesii



Ruppia maritima



Envis



Porteresia coarctata



Spinefex littoreus



Myriostachya wightiana



Achrostichum aureum

13. *Cenchrus* L.

KEY TO THE SPECIES

- 1a. Bristles of the involucre retorsely scabrid 1. *catharticus*
 1b. Bristles of the involucre antorsely scabrid 2. *ciliaris*

1. *Cenchrus catharticus* Delile, Cat. Hort. Mon. Sp. 1838: 4. 1839; *C. biflorus* Roxb.: Bor, 287. 1960; Hook. f., Fl. Brit. India 7: 89. 1896.

An erect or ascending annual grass, 30-60 cm high. Leaves 6-20 x 0.4-0.9 cm, linear-lanceolate, glabrous or hairy, ligule a ciliate rim. Inflorescence solitary, cylindrical, raceme 5-8 cm long, two flowered, enclosed in the uppermost leaf sheath. Spikelets mostly 2 in each involucre. Caryopsis 0.2 x 0.5 cm, orbicular oblong, compressed, smooth, pale brown.

Ecology : Common in sandy seashore and inward sandy places.

Fl. & Fr. : August-December.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Saurashtra coast.

2. *Cenchrus ciliaris* L.: Bor, 287. 1960; *Pennisetum cenchroides* Rich.: Hook. f., Fl. Brit. India 7: 88. 1896.

Perennial, stem tufted, up to 50 cm long, erect, much branched from base, stout, leafy. Leaves 4.5-24 x 0.3-0.4 cm, linear, glabrous or hairy, tapering to a fine point. Panicle 5 cm, cylindrical, dense, pale or purplish. Spikelets 4.5 mm, glume ovate.

Ecology : Common on sand stones and coastal laterites.

Fl. & Fr. : December-January.

Distrib. : Throughout the East and West coast.

14. *Chloris* Sw.

Chloris barbata Sw.: Bor, 465. 1960; Hook. f., Fl. Brit. India 7: 292. 1897.

Annual or perennial with strong root-fibres, stem tufted, ascending upwards, up to 10-80 cm, nodes glabrous. Leaves 2-20 x 0.1-0.6 cm long, narrowly linear-lanceolate, rounded at base, acuminate at apex, ligule truncate, membranous. Spike 5-20, digitately arranged in

truncate fascicle. Spikelet 2 seriate, subsessile, 2-3 flowered, green or purple; rachilla bearing 2 small, turgid, obovate, awned, barren glumes. Grains trigonous.

Ecology : Very common along the road sides and distributed as a weed in cultivated fields and wetlands.

Fl. & Fr. : March-December.

Distrib. : Throughout the Indian coastal districts.

15. *Chrysopogon* Trin

KEY TO THE SPECIES

- 1a. Pedicels half the length of the sessile spikelets or longer; sessile spikelets
 3-4.5 mm long 1. *aciculatus*
 1b. Pedicels shorter than half the length of the sessile spikelets; sessile spikelets
 4-6 mm long 2. *fulvus*

1. *Chrysopogon aciculatus* (Retz.) Trin : Bor, 115. 1960; *Andropogon aciculatus* Retz.: Hook. f., Fl. Brit. India 7: 188. 1896.

Perennials, culms 20-80 cm long, creeping and decumbent; nodes glabrous. Leaves 1-10 x 0.3-0.6 cm, ovate-lanceolate, sheaths slightly keeled, margins serrulate, acute apex. Ligule annular, thin, membranous. Panicles pyramidal, 5-10 cm long, open or contracted. Sessile spikelets lanceolate, chartaceous, pungent, lower

glume lanceolate, upper glume boat-shaped, chartaceous, lower floret empty, upper floret bisexual; pedicelled spikelets lanceolate, unawned.

Ecology : Very common along the banks of back waters, rivers, streams and canals, usually forming dense carpet and help to prevent tidal erosion.

Fl. & Fr. : March-December.

Distrib. : Kerala and Tamil Nadu coast.

2. *Chrysopogon fulvus* (Sprong) Choiv.: Bor, 116. 1960; *Andropogon monticola* Roem & Schult.: Hook. f., Fl. Brit. India 7: 192. 1896.

Erect or geniculately ascending perennial; 50-150 cm high, rootstock creeping, leaves 40 x 1 cm rigid, scabrid on margins, acuminate at apex. Ligule minute membranous rim. Panicles up to 15 cm long, yellowish, purple. Spikelets sessile and

pedicellate, glumes with white or rufous hairs, awned. Grains linear.

Ecology : Commonly found in sandy and rocky habitat near the coast.

Fl. & Fr. : August-November.

Distrib. : Coasts of West Bengal and Tamil Nadu. Mainly found in East coast.

16. *Coelachyrum* Hochst. & Nees

Coelachyrum lagopoides (Burm.f.) Senar.: Bor, 488. 1960; *Eleusine brevifolia* (Willd.) R. Br. ex Hook. f. in Hook. f., Fl. Brit. India 7: 294. 1897.

Culms creeping, 5-10 cm, 1 mm wide, glabrous at nodes. Leaves 1-2.5 x 0.2-0.3 cm, oblong-lanceolate, plicate, scaberulous along margins. Ligule membranous, ciliate. Spikes dense, aggregated, globose. Spikelets

several flowered. Caryopsis triquetrous, 1.5 mm, margins sharply angled, tapering at tip.

Ecology : Common on back shore, cultivated areas and crevices of rocky coast line.

Fl. & Fr. : June-August.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

17. *Coix* L.

Coix lacrima-jobi L.: Bor, 264. 1960; Hook. f., Fl. Brit. India 7: 100. 1896.

Annual, culms 25-100 cm high, densely tufted, nodes glabrous. Leaves 10-40 x 1-3.5 cm, lanceolate or linear-lanceolate, smooth on both surface, spinulosely serrate margins, acuminate apex, cordate at base. Ligules ovate, membranous. Inflorescence much branched, leafy panicles, with cluster of racemes subtended by leaflike sheaths. Male spikelets 2-3, elliptic or lanceolate, female spikelet globose or ovoid, bony, shining white, grey or bluish, bead like structure formed from leaf sheath. Fruit

0.6-0.9 cm long, ovoid-globose, bluish grey, smooth, polished.

Ecology : Very common along marshy places, water courses, bank of streams, river, back waters, ponds, paddy fields and other wetlands.

Fl. & Fr. : July-March.

Distrib. : Throughout hotter and damper part of Indian coast.

18. *Cynodon* Rich.

Cynodon dactylon (L.) Pers.: Bor, 469. 1960; Hook. f., Fl. Brit. India 7: 288. 1897.

Perennial, creeping grass, stoloniferous, rooting at nodes. Leaves narrow, linear, glabrous, glaucous, sheath compressed, glabrous, ligule fimbriate, membranous. Inflorescence made of 2-6 spikes, erect, spreading, rachis slender. Spikelets sessile, compressed, 1 flowered. Lower glume membranous, narrowly oblong. Keel acute, upper glume similar to the lower glume.

Lemma membranous, keels and margins hispid with white hairs. Caryopsis very small.

Ecology : Common along the banks of back waters, streams and canals, road sides, margins of paddy fields and often in wastelands.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coastal districts.

19. *Cyrtococcum* Stapf.

Cyrtococcum trigonum (Retz.) A. Camus: Bor, 292. 1960; *Panicum trigonum* Retz.: Hook. f., Fl. Brit. India 7: 56. 1896.

Annuals, culms 5-50 cm long, creeping or trailing, rooting at nodes. Leaves 1-4 x 0.1-0.6 cm, lanceolate, sheaths softly villous, ciliate along the margins, cuneate or narrowed at base, acute at apex. Ligule ovate, membranous. Panicles 1-5 cm long, contracted. Spikelets obovate or oblong, 1-2 mm long softly hairy. Lower glume

ovate, acute, upper glume ovate softly hairy. Lower floret empty, upper floret bisexual.

Ecology : Occasional in damp, sandy places along the coast, forming dense mats. It is a good sand binder.

Fl. & Fr. : August-November.

Distrib. : Coast of Kerala, Karnataka, Maharashtra and Tamil Nadu.

20. *Dactyloctenium* Willd.

Dactyloctenium aegypticum (L.) Willd.: Bor, 489. 1960. *Eleusine aegyptia* (L.) Desf.: Hook. f., Fl. Brit. India 7: 285. 1897.

An annual, culms 15-60 cm high, rooting at nodes. Leaves 1.25 x 0.1-0.6 cm, oblong-lanceolate, lanceolate or linear, flat, glabrous or hispid, margin ciliate, rounded or shallowly cordate at base, acuminate apex. Inflorescence 2-6 spikes, spikelets ovate or oblong, 3-4 flowered. Lower glume boat shaped, keeled, upper glume

ovate-obovate, chartaceous. Lemma 2.8 mm long, palea 2 winged, ciliated keels. Caryopsis 1.3 x 0.6 mm, obovoid-globose, rugose.

Ecology : Common in sandy coast, grassland, gardens and by the sides of the road.

Fl. & Fr. : June-October.

Distrib. : Throughout the coastal districts of India.

21. *Desmostachya* Stapf.

Desmostachya bipinnata (L.) Stapf., Fl. Cap 7: 632. 1900; *Eragrostis cynosuroides* (Retz) P. Beauv.: Hook. f., Fl. Brit. India 7: 324. 1897.

Stout, perennial. Culms 30-100 cm tall, rhizome thick, creeping, deep rooted. Leaves 4-8 mm broad, linear, leathery, convolute, acute, sheaths leathery, glabrous, hairy at throat. Ligule a ring of hairs. Inflorescence large panicle of many spikes. Spikelets 2 seriate, pectinate, 3-17

flowered, purple brown. Lower glume keeled, mucronate, upper glume obtuse. Caryopsis obliquely ovoid, compressed.

Ecology : Common in moist places of the seashore.

Fl. & Fr. : August-October; March-April.

Distrib. : Throughout the coastal districts.

22. *Dichanthium* Willd.

Dichanthium annulatum (Forssk.) Stapf.: Bor, 133. 1960; *Andropogon annulatus* Forsk.: Hook. f., Fl. Brit. India 7: 196. 1896.

Perennials, culms 50-150 cm high, erect or geniculate, node densely villous. Leaves 5-20 x 0.2-0.6 cm, linear-lanceolate, membranous, margin scabrid, acute apex, ligule ovate. Racemes 3-10, sessile spikelets ovate, awned, lower floral glume chartaceous,

lower floret empty, upper floret bisexual. Pedicelled spikelets oblong, unawned, florets often empty. Grain elliptic.

Ecology : Abundant along roadsides, wastelands and also in open grasslands, often in moist situation near the coast.

Fl. & Fr. : June-December.

Distrib. : Throughout coastal districts of India.

23. *Digitaria* Heist ex Fabricus

KEY TO THE SPECIES

- 1a. Rachis winged, racemes branched :
- 2a. Spikelets 1-2 mm long; hairs on the spikelets verrucose; lower glume absent 4. *longiflora*
- 2b. Spikelets 2-4 mm long; hairs on the spikelets not verrucose; lower glume usually present :
- 3a. Spikelets with glassy bristles; racemes 2 1. *bicornis*
- 3b. Spikelets without glassy bristles; racemes 2-15 in number :
- 4a. Lower glume absent or reduced to a rim, upper glume usually less than half the length of the spikelet 5. *setigera*
- 4b. Lower glume a triangular scale, upper glume always more than half the length of spikelet 2. *ciliaris*
- 1b. Rachis triquetrous; racemes not branched 3. *griffithii*

1. *Digitaria bicornis* (Lam.) Roem & Schult.: Bor, 299. 1960; *Paspalum heterantherum sensu* Hook. f., Fl. Brit. Ind. 7: 16. 1896.

Annual, culms 10-60 cm high, nodes glabrous. Leaves 1-15 x 0.2-0.6 cm, lanceolate, sheaths glabrous, shallowly cordate base, acute apex. Ligule truncate, erose, membranous. Racemes usually 2, each 3-12 cm long, rachis winged. Spikelets paired, heteromorphous, sessile spikelets glabrous, pedicelled spikelets elliptic, pubescent. Lower glume variable, triangular scaled, upper glume lanceolate, silky pubescent, chartaceous. Lower floret empty, upper floret bisexual.

Ecology : Frequent in waste places, damp and shady places of seashores and riverbanks.

Fl. & Fr. : March-September.

Distrib. : Coast of Kerala.

2. *Digitaria ciliaris* (Retz.) Koel.: *D. adscendens* (Kunth) Henrard.; Bor, 298, 1960; *Paspalum sanguinale* (L.) Lam. var. *rotteli* Hook.f., Fl. Brit. India 7: 16. 1896.

Culms 20-120 cm long tufted erect, annuals, sparsely bearded at nodes. Leaves 3-8.5 x 0.3-0.7 cm oblong-linear or lanceolate, oppressed, pubescent, undulate on one margin, narrowed at base, ligule ovate membranous. Racemes 7-13 cm, digitate or 1-3 whorls

on a common axis, rachis serrate. Spikelets 3.2 x 0.8 mm, oblong binate, pubescent. Lower glume triangular, upper glume linear-lanceolate.

Ecology : Very common in wasteland, along seashore river banks, moist shady places, road sides and woods in cultivated lands.

Fl. & Fr. : August-December.

Distrib. : Throughout the coastal districts.

3. *Digitaria griffithii* (Hook. f.) Henr.: Bor, 304. 1960; *Paspalum sanguinale* (L.) Lam. var. *griffithii* Hook. f., Fl. Brit. India 7: 13. 1896.

An annual erect grass, 30-90 cm tall, slender, smooth, glabrous, often rooting at lower nodes. Leaves 6-15 x 0.4-0.7 cm linear-lanceolate, softly hairy on the both surfaces, rounded at the base, acute at apex, ligule membranous. Racemes 3-15 or more, digitate or subdigitate. Spikelets binate, lower glume triangular, upper glume lanceolate, chartaceous. Upper floret hermaphrodite, lower florets empty. Caryopsis narrowly lanceolate, brownish.

Ecology : Frequent along the banks of river, waste places and road sides near the coast.

Fl. & Fr. : August-November.

Distrib. : Kerala coast.



Suaeda maritima (L.) Dum.



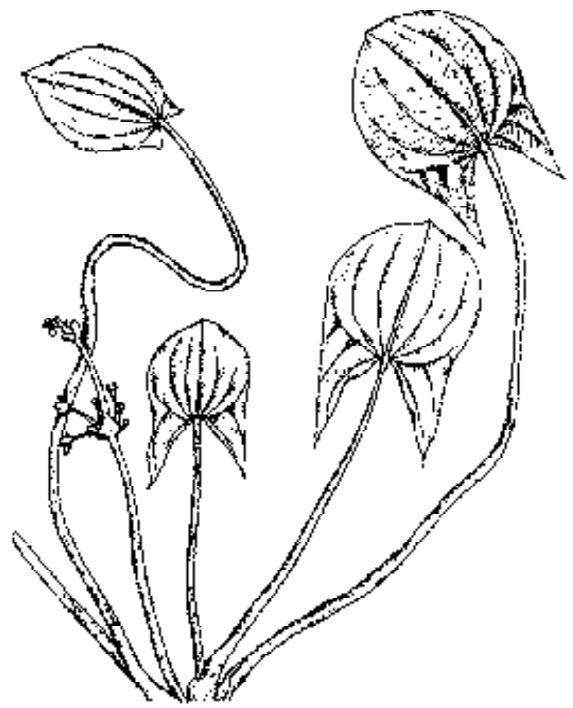
Euphorbia serpens Kunth



Micrococca mercurialis (L.) Benth.



Murdania spirata (L.) Brueck.



Limnophyton obtusifolium (L.) Miq.



Flagellaria indica L.

4. *Digitaria longiflora* (Retz.) Pers.: Bor. 302. 1960; *Paspalum longiflorum* Retz.: Hook. f., Fl. Brit. India 7: 17. 1896.

Glabrous annual with ascending branches, culms 10-15 cm long, slender, rooting at nodes. Leaves 1-10 x 0.2-1 cm, oblong-lanceolate, acute, membranous, sheath keeled, rounded at base, acute apex, ligule ovate membranous. Raceme 2-3, digitately arranged in an inflorescence, rachis flat. Spikelet pale-green, puberulous, lower glume absent, upper glume ovate-elliptic. Lower floret empty, lemma puberulous along the nerves. Palea and lodicules very minute, upper floret bisexual, Caryopsis ellipsoid oblong, compressed, pale coloured.

Ecology : Frequent in open grasslands, along road side and waste places of the seashore.

Fl. & Fr. : April-September.

Distrib. : Coast of Orissa, West Bengal, Andhra Pradesh, Tamil Nadu, Kerala and Maharashtra.

5. *Digitaria setigera* Roth ex Roem. & Schult.: Bor. 305. 1960. *Paspalum sanguinale* (L.) Lam. var. *extensum* Hook. f., Fl. Brit. India 7: 15. 1896.

Annual, culms 20-120 cm long, creeping and geniculate, rarely erect, nodes glabrous. Leaves elliptic to lanceolate or linear, sheath keeled, rounded or shallowly cordate base, acuminate apex, ligules membranous. Racemes 3-15, digitate or subdigitate 3-20 cm long. Spikelets elliptic, lanceolate, lower glume absent or minute, upper glume smaller. Lower floret empty, upper floret bisexual. Caryopsis oblong.

Ecology : Common along the bank of rivers, waste places and roadsides.

Fl. & Fr. : August-December.

Distrib. : Coast of Saurashtra and Kerala.

24. *Dimeria* R. Br.

Dimeria lawsonii (Hook. f.) Fischer: Bor. 142. 1960; *D. pusilla* Thw. var. *lawsonii* Hook. in Hook. f., Fl. Brit. India 7: 103. 1896.

Annuals, culms tufted, 8-40 cm high, slender, erect or geniculate, nodes glabrous. Leaves 1-10 x 0.1-0.3 cm, lanceolate, sheath keeled with few bulbous based hairs. Ligule ovate, membranous. Racemes solitary, 1-6 cm long, rachis flat, densely ciliate along margins. Spikelets oblong-lanceolate, sessile compressed laterally,

glumes keeled, upper glume elliptic-lanceolate, awned, lower glume linear-lanceolate, shortly awned. Lower floret empty, upper floret bisexual.

Ecology : Rare endemic grass. Occasional along the banks of back waters, streams and rivers, usually in coastal areas.

Fl. & Fr. : October-March.

Distrib. : Coast of Tamil Nadu and Kerala.

25. *Echinochloa* P. Beauv.

Echinochloa colona (L.) Link.: Bor. 308. t. 34. 1960; *Panicum colonum* L.: Hook. f., Fl. Brit. India 7: 32. 1896.

Annual, culms 10-100 cm high, erect, tufted; nodes glabrous. Leaves 2-30 x 0.2-0.8 cm, lanceolate-linear, sheaths keeled, acuminate apex, cordate at base, ligule absent. Panicles linear-oblong, 2-15 cm long, racemes 4-12, spikelets hispidulous, lower glume ovate

and upper glume boat shaped, equally acute, not awned. Lower floret barren, upper floret bisexual.

Ecology : Very common in the paddy fields, wastelands, fallow fields and marshes along the margins of paddy fields near the coast.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coastal provinces.

26. *Eragrostis* Wolf.

KEY TO THE SPECIES

- 1a. Spikelets not breaking at maturity 10. *tef*
 1b. Spikelets breaking at maturity :
 2a. Spikelets breaking up from the above downwards :
 3a. Panicle spiciform or compact and dense :
 4a. Annuals, lemma ciliate on the keels 2. *ciliaris*
 4b. Perennials, lemma not ciliate on the keels :
 5a. Lemmas 1.25 mm long, rounded at the apex; panicles very
 dense, cylindric 8. *riparia*
 5b. Lemmas 1.75 mm long, acute at the apex in profile, panicle
 more or less dense, not cylindric 3. *coarctata*
 3b. Panicles effuse 11. *tenella*
 2b. Spikelets breaking up from below upwards :
 6a. Lemmas up to 1.5 mm long :
 7a. Lowest branches not whorled 7. *poaeoides*
 7b. Lowest branches of panicle fascicled or subwhorled :
 8a. Spikelets linear-oblong or lanceolate. 0.5-1.25 mm wide; lemmas
 often with a purplish spot at the tips, culms glandular 6. *pilosa*
 8b. Spikelets ovate-oblong, 1.5-2.5 mm wide,
 lemmas without purple spots, culms not glandular :
 9a. Spikelets 10-60 or more flowered, pale green or purplish,
 pedicels often 5 mm or more long 13. *tremula*
 9b. Spikelets 3-20 flowered leaden-grey, pedicels up to 3 mm long :
 10a. Panicles contracted, spiciform, up to 10 cm long, paleas persistent 5. *nutans*
 10b. Panicles lax, not spiciform, up to 15 cm long, paleas deciduous 4. *gangetica*
 6b. Lemmas over 1.5 mm long :
 11a. Spikelets leaden-grey or black :
 12a. Pedicels of the spikelets with glandular bands, spikelets with apparently
 serrate margins due to the gaping lemmas; panicles up to 6 cm wide 12. *tenuifolia*
 12b. Pedicels without glandular bands, spikelets not as
 above; panicles often lax 1. *atrovirens*
 11b. Spikelets purplish or olive-green :
 13a. Spikelets broadly ovate, ovate-oblong or oblong-obtuse, 1.5-4 mm wide 14. *unioloides*
 13b. Spikelets oblong-lanceolate or lanceolate, acute, 1-2 mm wide :
 14a. Panicles up to 25 cm long, loosely spiculate, spikelets subsecund 9. *subsecunda*
 14b. Panicles up to 15 cm long, densely spiculate, spikelets often crowded 15. *zeylanica*

1. *Eragrostis atrovirens* (Desf.) Trin ex Steud.: Bor, 503.
 1960. *E. papposa* Steud.: Hook. f., Fl. Brit. India 7: 322.
 1897.

Perennials, culms 15-100 cm high, densely tufted,
 nodes glabrous. Leaves 2-30 x 0.1-0.5 cm, lanceolate,
 sheaths slightly keeled, rounded or cordate at base. Ligule
 truncate, narrow, membranous. Panicles 5-30 cm long,
 lax, ovate. Spikelets ovate, 5-40 flowered, upper glume

ovate-lanceolate, lemmas broadly ovate, acute, paleas
 elliptic-lanceolate. Grains 0.5 x 0.75 mm, ellipsoid.

Ecology : Very common along the banks of back waters,
 river, streams and canals, in wetland and puddles in the
 coastal plains.

Fl. & Fr. : August-December.

Distrib. : Coast of Tamil Nadu and Kerala.

2. *Eragrostis ciliaris* (L.) R. Br.: Bor, 506. 1960; *E. ciliaris* var. *ciliaris* Stapf. in Hook. f., Fl. Brit. India 7: 314. 1897.

Tufted, erect or procumbent annuals, 10-35 cm high. Leaves 2-10 x 0.15-0.5 cm, linear-lanceolate, flat, acute at apex, ligule ciliate. Panicles 1.5-7 cm, spiciform, lobed or dense cylindrical, woolly. Spikelets 5-12 flowered, densely clustered, green with pinkish tinge, lemmas ciliate on the keels. Caryopsis 3.5-0.6 mm broad, ellipsoid.

Ecology : Common in moist sandy soils, irrigation channels, dam sites, dried up river beds in the coastal plains.

Fl. & Fr. : August-November.

Distrib. : Throughout the West coast and rarely in the East coast.

3. *Eragrostis coarctata* Stapf.: Bor, 507. 1960; Hook. f., Fl. Brit. India 7: 313. 1897.

Tufted perennial herb, 20-40 cm high. Leaves 5 cm long, linear-lanceolate, ligule short. Panicles 10 cm long, sub spiciform. Spikelets sub-compressed, 5-10 flowered. Lemma obtuse, ciliate. Palea ciliate, grains ovoid oblong, brown, polished.

Ecology : Rare, found in open water logged areas, coastal slacks and moist coastal sands.

Fl. & Fr. : July-March.

Distrib. : Coast of Tamil Nadu and Maharashtra.

4. *Eragrostis gangetica* (Roxb.) Steud.: Bor, 508. 1960; *E. stenophylla* Hoechst ex Miq.: Stapf. in Hook. f., Fl. Brit. India 7: 318. 1897.

Annual herb up to 80 cm high, culms tufted, erect, nodes glabrous. Leaves 25 x 0.5 cm, linear, flat or in rolled, glaucous, rounded at base, acute or acuminate at apex, ligule a rim of short hairs. Inflorescence narrow panicle, lax, grey. Spikelets 1.25 cm long, linear, 5-20 flowered glumes subequal, lemma boat shaped, palea scabrid. Caryopsis 0.5 mm long, subglobose, dark brown.

Ecology : Common on sandy loam soils in wastelands, river bed and wetlands near the coast.

Fl. & Fr. : August-November.

Distrib. : Throughout the coastal provinces.

5. *Eragrostis nutans* (Retz.) Nees ex Steud.: Bor, 511. 1960; *E. stenophylla* auct. non Hoechst ex Miq.: Hook. f., Fl. Brit. India 7: 318. 1897.

Perennials, culms tufted 10-50 cm high, nodes glabrous. Leaves 1-8 x 0.1-0.3 cm, acicular, sheaths with tuft of hairs at mouth, narrow or rounded at base. Ligules row of hairs. Panicles spiciform, 2-10 cm long contracted, grey. Spikelets oblong, 6-15 flowered. Lower and upper glume ovate, chartaceous.

Ecology : Occasional along the margins of paddy fields and coastal scrub jungles.

Fl. & Fr. : April-June.

Distrib. : Coast of West Bengal, Kerala, Tamil Nadu and Andaman island.

6. *Eragrostis pilosa* (L.) P. Beauv.: Bor, 512. 1960; Hook. f., Fl. Brit. India 7: 323. 1897.

Annual, culms 30-60 cm, slender, erect ascending form decumbent base. Leaves 4-10 x 0.2-0.4 cm, plicate or infolded, glabrous, tapering at apex, ligule ciliate. Inflorescence panicle 10-25 x 1-2.5 cm, oblong-elliptic, 5-30 cm long, dark grey or black, spikelets 3.5-5.5 x 0.5-1 mm slate grey, 3-10 flowered, opposite floret not overlapping. Caryopsis 0.6 mm ellipsoid, brown, compressed.

Ecology : Usually grow in moist open ground and waste places, ditches, margins of ponds, water logged areas near the coast.

Fl. & Fr. : September-December.

Distrib. : Coasts of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Maharashtra.

7. *Eragrostis poaeoides* P. Beauv.: Bor, 512. 1960; *E. minor* Host.: Stapf. in Hook. f., Fl. Brit. India 7: 321. 1897.

Annuals, culms loosely tufted, 10-60 cm high, erect or geniculately ascending, nodes glabrous. Leaves 5-12 x 0.2-0.5 cm, linear, flat or convolute, glabrous or pillose on upper surface. Sheaths compressed. Ligules a rim of hairs. Panicles ovate-oblong, dense. Spikelets linear or narrowly oblong, 5-15 flowered, olive green or yellowish, lower glume ovate-lanceolate, upper glume lanceolate or oblong-lanceolate, chartaceous, lemmas ovate lanceolate, paleas oblong-lanceolate, 2 keeled. Grain 0.5-0.75 mm, obovate, cuneate at base.

Ecology : Occasional in open grassland and as a weed in garden, cultivated fields and irrigated lands near the coast.

Fl. & Fr. : May-August.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra coast.

8. *Eragrostis riparia* (Willd.) Nees: Bor, 513. 1960; *E. tenella sensu* Stapf, var. *riparia* Stapf. in Hook. f., Fl. Brit. India 7: 315. 1897.

Perennials, culms densely tufted, 10-15 cm high, nodes glabrous. Leaves 1-10 x 0.1-0.3 cm, lanceolate, sheath keeled, rounded at base, acuminate at apex. Ligules row of hairs. Panicles contracted, 0.5-8 cm long. Spikelets 3-8 flowered, lower and upper glume chartaceous, ovate-lanceolate.

Ecology : Fairly common in dry, sandy localities along the coast especially near back water and in wastelands and road sides.

Fl. & Fr. : December-June.

Distrib. : Coast of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Lakshadweep.

9. *Eragrostis subsecunda* (Lam.) Four., Mex. Pl. 2: 118, 1886. *E. secunda* Nees ex Steud.: Hook. f., Fl. Brit. India 7: 326. 1897.

Perennials, culms woolly 20-80 cm long, nodes glabrous. Leaves 1-15 x 0.1-0.3 cm, lanceolate, sheaths keeled, rounded at base. Ligule obscure. Panicles 3-25 cm long, lax, loosely spiculate, subsecund. Spikelets oblong, 10-16 flowered, purplish green. Upper glume ovate-lanceolate 2-2.5 x 0.5-1 mm, chartaceous. Lower glume lanceolate, 1-2 x 0.5 mm, chartaceous. Lemma broadly ovate, paleas elliptic-lanceolate. Grain ovate, 0.5-1 mm long.

Ecology : Occasional along the banks of back waters, streams and canals near the coast.

Fl. & Fr. : March-September.

Distrib. : Rare in Kerala coast.

10. *Eragrostis tef* (Zucc.) Trotter: Bor, 513. 1960.

Annual, culms slender, 15-40 cm high, nodes glabrous. Leaves 3-25 x 0.2-0.4 cm linear-lanceolate, narrow or rounded at base, acuminate. Ligule tufts of hairs. Panicles 10-15 cm long, contracted. Spikelets oblong, 4-8 flowered. Lower glume lanceolate, chartaceous. Upper glume ovate-lanceolate. Lemmas ovate-oblong. Paleas hyaline, oblong, keels scabrid.

Ecology : Occasional along the road sides and banks of back waters.

Fl. & Fr. : September-December.

Distrib. : Kerala coast.

11. *Eragrostis tenella* (L.) P. Beauv.: Bor, 513, 1960; *E. tenella* (L.) P. Beauv. ex Roem & Schult. var. *plumosa* (Retz.) Stapf. in Hook. f., Fl. Brit. India 7: 315. 1897.

Annuals, culms slender, 10-60 cm long, tufted, nodes glabrous. Leaves 1-15 x 0.1-0.5 cm, linear-lanceolate, margin and sheath glabrous, rounded or shallowly cordate at base. Ligule row of hairs. Panicle ovate, 10-40 cm long, very lax, loosely spiculate, spikelets oblong, 10-40 or more flowered. Lower glume ovate-lanceolate, upper glume more or less similar to the lower. Lemmas ovate-oblong. Paleas elliptic-oblong. Grains 0.3-0.5 mm long, subglobose or orbicular, reddish brown.

Ecology : Occasional as a weed in irrigated fields and along the margins of wetlands.

Fl. & Fr. : August-December.

Distrib. : Throughout the coastal districts.

12. *Eragrostis tenuifolia* (A. Rich) Hochst. ex Steud.: Bor, 514. 1960; Stapf. in Hook. f., Fl. Brit. India 7: 322. 1897.

Annual or perennial; culms tufted 15 to 60 cm tall, nodes glabrous. Leaves 2-25 x 0.2-0.6 cm, lanceolate or linear-lanceolate, convolute, glaucous, rounded or shallowly cordate at base, acuminate at apex. Ligule row of hairs. Panicles lax 5-20 cm long, grey to black. Spikelets 4-14 flowered greyish or black. Lower glume ovate, chartaceous, lobed. Upper glume ovate to oblong, 2-3 lobed at apex.

Ecology : Frequent along road sides and waste places.

Fl. & Fr. : March-September.

Distrib. : Tamil Nadu, Kerala, Maharashtra and Goa coast.

13. *Eragrostis tremula* (Lam.) Hochst ex Steud.: Bor, 514. 1960; Stapf. in Hook. f., Fl. Brit. India 7: 320. 1897.

Annuals or perennials, culms loosely tufted, 30-80 cm high, erect or ascending; nodes glabrous. Leaves 3-20 x 0.2-0.5 cm, lanceolate flat, rounded or shallowly cordate at base, ligules with row of hairs. Panicle ovate, 10-40 cm long, very lax. Spikelets oblong, 10-40 flowered, grains 0.3-0.5 mm long, subglobose or orbicular.

Ecology : Weed in irrigated fields and along the margins of wetlands near the coast.

Fl. & Fr. : August-December.

Distrib. : Tamil Nadu, Kerala, Karnataka, Maharashtra and Andaman coast.

14. *Eragrostis unioloides* (Retz) Nees ex Steud.: Bor, 515. 1960; *E. amabilis* auct non Wight & Arn. ex Nees: Stapf. in Hook. f., Fl. Brit. India 7: 317. 1897.

Annuals or perennials, culms tufted, 5-80 cm high, erect or geniculate, nodes glabrous. Leaves 0.5-25 x 0.1-0.8 cm, lanceolate or linear lanceolate, sheath smooth, glabrous, subcordate base, acute apex, ligule membranous. Panicles lax, oblong to ovate. Spikelets 6-40 flowered, green or purplish. Lower glume oblong lanceolate, chartaceous; upper glume ovate-lanceolate, chartaceous. Lemma broadly ovate. Paleas elliptic, 2 keeled. Grains obovoid-ellipsoid, 0.75-0.5 mm, reddish brown.

Ecology : Very common along the road sides, paddy fields, bank of backwaters, streams and river, wastelands of the seashores.

Fl. & Fr. : December-February.

Distrib. : Coastal areas of Orissa, Tamil Nadu, Kerala and Maharashtra.

15. *Eragrostis zeylanica* Nees & Mey.: Bor, 515. 1960; *E. elongata* Jacq.: Stapf. in Hook. f., Fl. Brit. India 7: 319. 1897.

Annuals or perennials, culms tufted, 5-25 cm high, erect or trailing, nodes glabrous. Leaves 2-6 x 0.1-0.2 cm, ligule fimbriate, thin membranous. Panicles oblong, 3-15 cm long, spreading. Spikelets oblong-lanceolate, sharply acute, 10-60 flowered. Lower glume lanceolate, keeled. Lemmas ovate-lanceolate, palea elliptic-oblong, 2 keeled. Grains 0.5 x 0.5 mm ovate-orbicular.

Ecology : Occasional along the road sides, banks of streams and back waters of the seashore.

Fl. & Fr. : December-January.

Distrib. : Coast of West Bengal, Kerala and Andaman islands.

27. *Eriochloa* Kunth

Eriochloa procera (Retz.) C. E. Hubb.: Bor, 312. 1960. *E. polystachya* auct. non H.B.K.: Hook. in Hook. f., Fl. Brit. India 7: 20. 1896.

Annual or perennials, culms 30-80 cm high, tufted, erect, nodes glabrous. Leaves 10-30 x 0.2-0.8 cm, linear-lanceolate or linear, acuminate at apex, rounded at base, sheaths slightly keeled, ligule membranous, fimbriate. Panicles 3-20 cm long, lax, purplish, racemes simple or branched, bearing paired spikelets. Spikelets 3-4 mm long, elliptic-lanceolate, softly silky hairy, lower

glume absent, upper glume ovate-lanceolate, chartaceous, softly silky hairy. Lower floret barren, epaleate. Upper floret bisexual. Caryopsis oblong, smooth.

Ecology : Fairly semiaquatic species common along the wetlands, ditches, edges of paddy fields, banks of back water and similar damp habitats.

Fl. & Fr. : March-September.

Distrib. : Coast of Tamil Nadu and Kerala.

28. *Hemathria* R. Br.

Hemathria compressa (L. f.) R. Br., Prodr. 207. 1810; Bor, 161. 1960. *Rotboella compressa* L. f., Suppl. 114. 1781. Hook. f., Fl. Brit. India 7: 153. 1896.

Stoloniferous creeper or floater up to 8 m in length. Culms ascending from a creeping base. Leaf sheaths hairy at base; ligules membranous; ciliate; leaf blades folded, flat, 9-12 x 6-8 mm. Inflorescence spike like racemes, axillary, solitary, enclosed in leaf sheaths. Spikelets 4-6 mm long, 2-flowered, awnless. Lower

glumes lanceolate, leathery, upper glumes membranous. Caryopsis 1 mm long, oblong, laterally flattened.

Ecology : It is a pioneer grass in open mud flats, creeping, bottom rooted, hardy and spreading first under saline conditions.

Fl. & Fr. : July-September.

Distrib. : Throughout the East and West coastal wetlands and Andamans.

29. *Heteropogon* Pers.

Heteropogon contortus (L.) P. Beauv. ex Roem & Schult.: Bor. 163. t. 6. 1960; *Andropogon contortus* L.: Hook. f., Fl. Brit. India 7: 199. 1896.

Gregarious perennials, culms densely tufted, erect or geniculate, 20-100 cm high, nodes glabrous. Leaves 2-25 x 0.2-0.6 cm, lanceolate or linear, flat, hirsute, sheath glabrous, rounded at base, acute or blunt at apex. Ligule truncate, fimbriate, membranous. Raceme 2-6 cm long with lower homogamous spikelet pairs alike in sex and shape, awnless, male or neutral and upper heterogamous ones of pairs of one sessile and other pedicelled, long

awned, female. Spikelets close, sessile, pubescent. Sessile spikelets 6 mm long, upper floral glume reduced to stout awn. Lower glumes of fertile spikelets oblong, densely hairy. Caryopsis cylindric, 1-1.5 mm long, dorsally compressed.

Ecology : Common in dry rocky places, wasteland and road sides, in drier situation of the seashore.

Fl. & Fr. : October-December.

Distrib. : Coast of Kerala, Lakshadweep, Maharashtra and Tamil Nadu.

30. *Hygrophiza* Benth.

Hygrophiza aristata (Retz.) Nees ex Wight & Arn.: Bor. 597. 1960; Hook. f., Fl. Brit. India 7: 95. 1896.

Annual or perennial, glabrous floating herb, culms spongy below, 5-20 cm or more long with capillary roots at nodes. Leaves 4-8 x 0.3-1.8 cm, ovate-oblong, with inflated sheaths and spongy, subcordate base. Panicles ovate or triangular, lax, 3-8 mm long. Spikelet

long pedicellate, 1 flowered, lanceolate. Glumes absent, lemmas awned. Grains narrowly oblong.

Ecology : Common in ponds, ditches and open brackish water lakes of the seashore

Fl. & Fr. : October-February.

Distrib. : Throughout the coastal provinces. Chilka in Orissa coast.

31. *Hymenachne* P. Beauv.

Hymenachne acutigluma (Steud.) Gilliland: *H. pseudointerrupta* Muel.: Bor. 313. 1960; *Panicum myurus auct. non Lam.*: Hook. f., Fl. Brit. India 7: 39. 1896.

Perennial, culms 50-100 cm long, tough, creeping or trailing at the lower, spongy below. Leaves 10-35 x 0.5-1.5 cm, lanceolate, linear-lanceolate, softly villous or glabrous, ciliate along the margins, rounded or shallowly cordate at base, acuminate at apex. Ligule truncate, narrow membranous. Panicle spiciform, interrupted 10-35 cm

long, densely spiculate. Spikelets 4-5 mm long, oblong, secund. Glumes aristate. Lower floret barren, upper floret bisexual, caryopsis 1.5 mm long, ellipsoid-obovoid.

Ecology : Rare, found in wet-aquatic habitats, ditches, shallow streams, backwaters and swamps along the coast.

Fl. & Fr. : March-August.

Distrib. : Tamil Nadu and Kerala coast.

32. *Imperata* Cyr.

Imperata cylindrica (L.) Raeusch.: *I. cylindrica* (L.) P. Beauv. var. *major* (Nees.) Hubb. ex Hubb. et Vaughan: Bor. 170. 1960; *I. arundanacea* Cyr.: Hook. f., Fl. Brit. India 7: 106. 1896.

Perennial, culms 20-150 cm high, rhizomatous, densely tufted from scaly rhizomes, nodes densely villous. Leaves 5-60 x 0.4-1.4 cm, lanceolate or linear-lanceolate, mostly collected at base, glaucous, margin scaberulous, ligule hairy. Panicles cylindrical, 5-20 cm long, white,

silky hairy. Spikelets lanceolate, awnless, enveloped in long silky hairs from callus and glumes. Lower glumes lanceolate, upper glumes slightly bigger, lower florets empty, upper bisexual. Grains oblong, small.

Ecology : Frequent in wet situation along the banks of backwaters, river sides, abandoned fields, low level grasslands, usually on black cotton soil near the coast.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout the coastal provinces.

33. *Isachne* R. Br.

Isachne globosa (Thumb.) Kuntze: Bor, 580. 1960; *I. australis* R. Br.: Hook. f., Fl. Brit. India 7: 24. 1896.

A perennial grass, with slender stem, 20-30 cm high, erect or ascending from a creeping rootstock, leafy, smooth, branched below, nodes glabrous. Leaves 2.25-5 x 1.5-3.5 cm, linear-lanceolate, flat, scaberulous on both surfaces, base rounded. Ligule a row of hairs. Panicles compact, 1-15 cm long. Spikelets globose or

obovoid, lower glume ovate-oblong, upper glume ovate-oblong, chartaceous.

Ecology : Fairly common and grows gregariously in marshy wetlands, paddy fields and along margin of streams near the coast.

Fl. & Fr. : Throughout year.

Distrib. : Throughout the coastal provinces.

34. *Ischaemum* L.

KEY TO THE SPECIES

- 1a. Margin of the lower glume of sessile spikelet expanded below the middle :
 - 2a. Keel of the upper glume of the sessile spikelets winged above the middle 2. *muticum*
 - 3a. Lower glume of the sessile spikelet not winged 6. *thomsonianum*
 - 3b. Lower glume of the sessile spikelet with broad or narrow wings. 1. *indicum*
- 2b. Keels of the upper glume of the sessile spikelet not winged above the middle 7. *timorense*
- 1b. Margins of the lower glume of the sessile spikelet narrowly and evenly intumed from base to apex :
 - 4a. Pedicel of the pedicelled spikelet more than one third to the length of the sessile spikelet 3. *pilosum*
 - 4b. Pedicel of the pedicelled spikelet less than one-third to the length of the sessile spikelet :
 - 5a. Lower glume of sessile spikelet coriaceous with nodules on the rounded keels :
 - 6a. Lower leaves tapering at the base 5. *santapauli*
 - 6b. Lower leaves not tapering at the base, rounded or shallowly cordate :
 - 7a. Lower glume of the pedicelled spikelet with a very broad wing on the margin 8. *travancorensis*
 - 7b. Lower glumes of the pedicelled spikelet narrowly winged 9. *vembadense*
 - 5b. Lower glume of the sessile spikelets crustaceous, with side nodules joined by sharp ridges. 4. *rugosum*

1. *Ischaemum indicum* (Houtt.) Merril: Bor, 180. 1960; Hook. f., Fl. Brit. India 7: 133. 1896.

Perennial, culms 30-60 cm tall, erect or decumbent. Leaves 5-10 cm long, linear, pubescent to villous on both surfaces, sheath glabrous; ligule membranous, truncate. Inflorescence made of 2-3 spikes, sessile spikelets oblong-lanceolate. Lower glume 5.2 mm long, sub-obovate, glabrous, terminal wings ciliolate on upper surface. Upper glume boat shaped, keels scabrid,

awn 2 mm long. Lower lemma hyaline, boat shaped, glabrous, palea linear lanceolate, scabrid. Upper lemma deeply notched awned. Lower lemma with ciliated margin. Caryopsis with persistent style.

Ecology : Common along bunds and paddy fields usually in moist places near the coast.

Fl. & Fr. : August-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka and Kerala coasts.

2. *Ischaemum muticum* L.: Bor, 183. 1960; Hook. f., Fl. Brit. India 7: 132. 1896.

Perennials, culms 5-80 cm long, creeping or trailing, stoloniferous, sometimes rooting at the nodes, nodes glabrous. Leaves 0.5-10 x 0.2-1 cm lanceolate, sheaths slightly keeled, ciliate along one margin, sparsely hairy, shallowly cordate at base, acuminate at apex. Ligules truncate, thin, membranous. Racemes 2 concealed or hardly exerted from the spathe. Sessile spikelets oblong-acute, awnless, lower glume oblong, coriaceous, lower floret male, upper floret bisexual. Pedicelled spikelets elliptic, awnless.

Ecology : Common along the banks of backwater, coastal sands, estuaries and salt marshes, sometimes in shallow water of the coastal plains.

Fl. & Fr. : July-March.

Distrib. : East and West coast and Lakshadweep islands.

3. *Ischaemum pilosum* (Klisch ex Willd.) Wight: Bor, 183. 1960; Hook. f., Fl. Brit. India 7: 130. 1896.

Perennial, rhizome giving out densely scaly long stolons, stem erect 0.6-1 m long, slender, terete, glabrous, nodes glabrous. Leaves 15-30 x 0.5-0.8 cm linear, glabrous, finely acuminate, ligule membranous. Inflorescence-racemes 2-6, fascicled, yellow or brownish, pilose, rachis hairy, joints and pedicels slender, spikelets sessile and pedicellate. Sessile spikelets sparsely ciliated, pedicellate spikelets 4-5 mm long with shorter awns. Caryopsis oblong, dorsally compressed.

Ecology : Frequent on the backshore sands.

Fl. & Fr. : August-November.

Distrib. : Maharashtra and Saurashtra coast.

4. *Ischaemum rugosum* Salisb.: Bor, 184. 1960; Hook. f., Fl. Brit. India 7: 127. 1896.

Annual; stems 30-60 cm long, erect or ascending, slightly thickened beneath the inflorescence, leafy, compressed, nodes glabrous. Leaves 8.5-13 x 0.3-1 cm, linear-lanceolate, flat, glabrous, margins scabrid, acuminate apex, upper most leave often reduced to spathiform lanceolate sheath which partially enclose the racemes, ligule membranous. Racemes usually 2, erect, pale yellow, glabrous. Spikelets linear oblong, sessile and

pedicellate, closely pressed together. Sessile spikelet 4-6 mm long, lower glume coriaceous and transversely rigid below; upper lemma with 15-20 mm long awn. Lower floret male, upper floret bisexual. Pedicelled spikelets awnless.

Ecology : Wastelands and sandy river beds, margins of backwaters, ponds and shallow stagnant water near the coast.

Fl. & Fr. : January-May.

Distrib. : Throughout the coastal districts.

5. *Ischaemum santapaui* Bor in Bor, Grasses of Burm. Cey. Ind. & Pak. 185.1960.

Annual. Culms 2 m tall, decumbent at the base with numerous stilt root from lower nodes, much branched. Leaves 15 x 1 cm, linear, glabrous, scabrid, acute at apex, shallowly cordate at base; ligule lacerated membranous. Racemes binate 5-6 cm long. Spikelets sessile and pedicelled. Sessile spikelets, lower floret male, upper floret hermaphrodite; pedicelled spikelet rudimentary, pedicel 2 mm long.

Ecology : Common along the sandy seashore.

Fl. & Fr. : September- February.

Distrib. : Maharashtra coast, Mumbai.

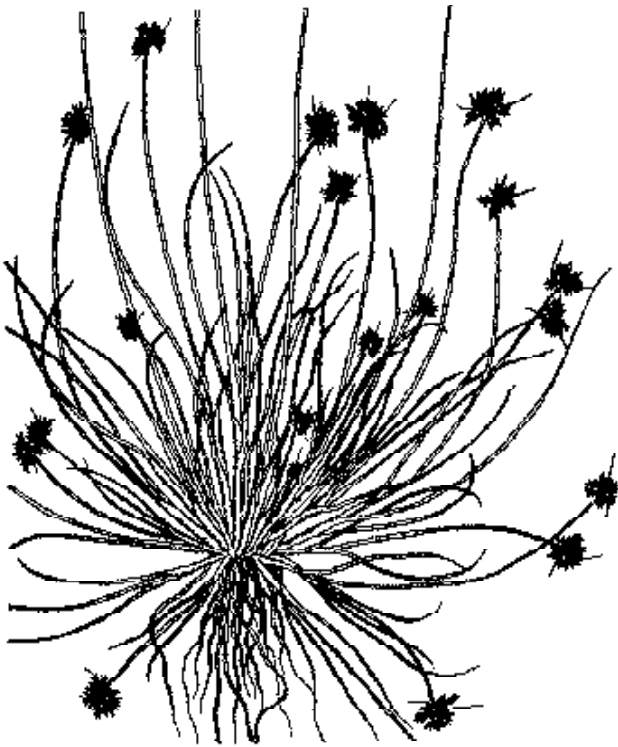
6. *Ischaemum thomsonianum* Stapf ex Fischer: Bor, Grasses of Burm. Cey. Ind. & Pak. 185.1960. *I. murinum* auct. non Frost.: Hook. f., Fl. Brit. India 7: 135. 1896.

Annuals, culms 20-100 cm long, creeping and rooting at nodes. Leaves 2-15 x 0.4-1 cm, linear-lanceolate, densely or sparsely hairy, rounded at base, acuminate at apex. Ligule thin, fimbriate, membranous. Raceme 2 or 3, 3-10 cm long slender, spikelets sessile and pedicelled. Sessile spikelets awned. Lower floret male, upper floret bisexual. Pedicelled spikelets similar to sessile spikelets.

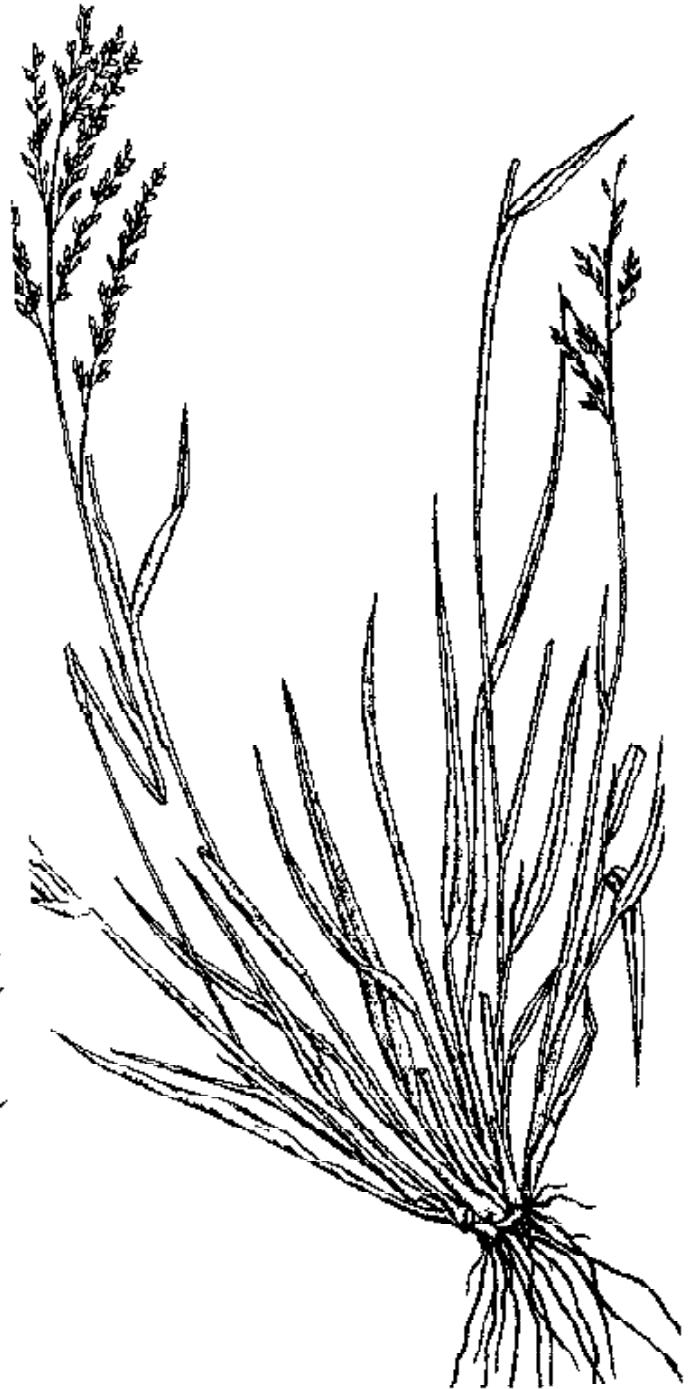
Ecology : Rare, along the margins of paddy fields, road sides and wastelands, banks of backwater and rivers near the coast.

Fl. & Fr. : September-March.

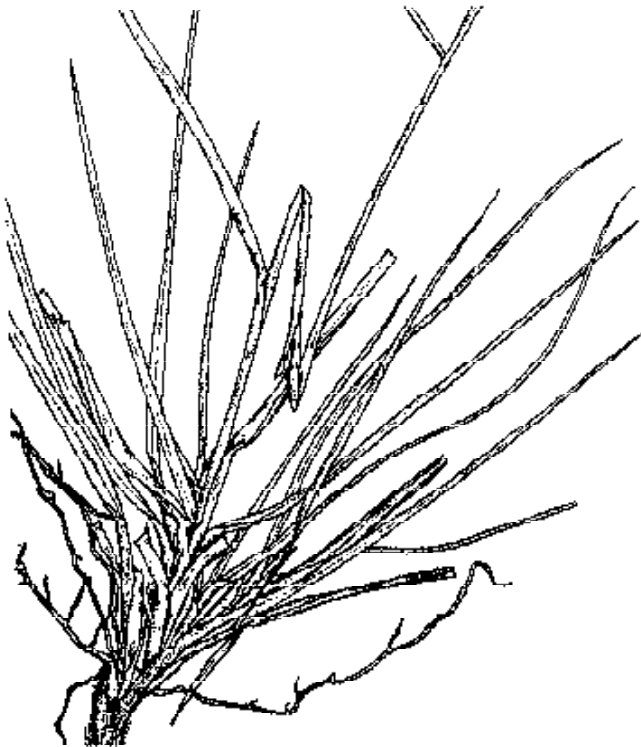
Distrib. : Coasts of Tamil Nadu, Karnataka, Kerala and Maharashtra.



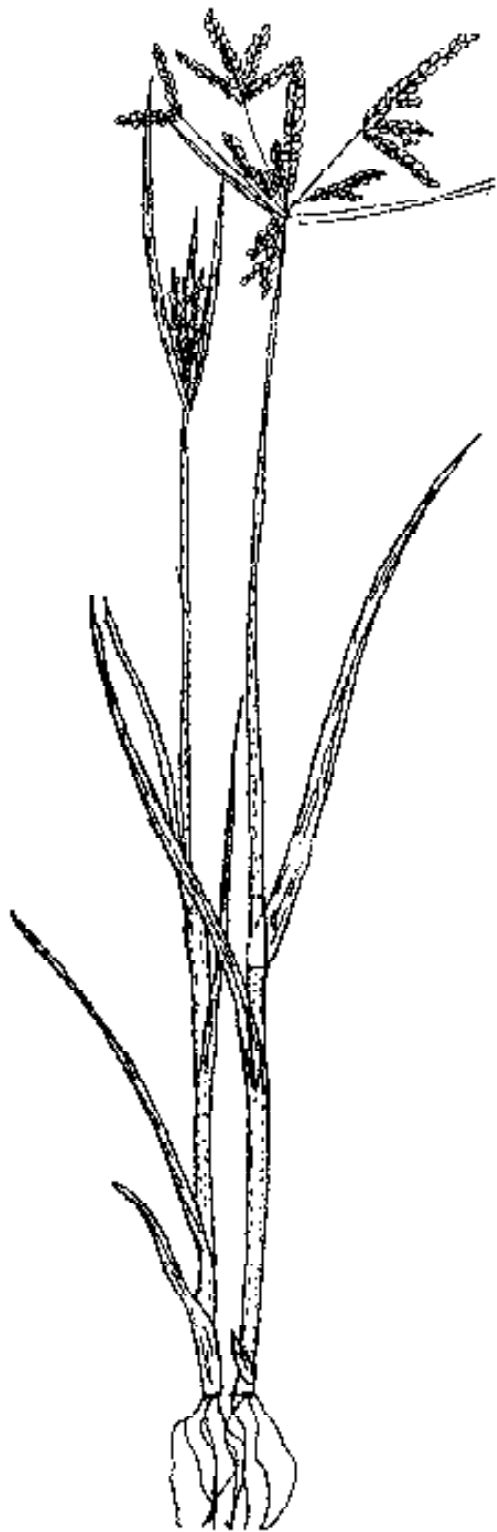
Bulbostylis barbata (Rottb.) Clarke



Eriochlou procera (Retz.) Hubb.



Desmostachya bipinnata (L.) Stapf



Cyperus iria L.



Urochondra setulosa (Trin.) Hubb.

7. *Ischaemum timorenses* Kunth: Bor, Grasses of Burm. Cey. Ind. & Pak. 185. 1960; Hook. f., Fl. Brit. India 7: 136. 1896.

Perennial, culms 10-120 cm long, creeping, stoloniferous, rooting at the node. Leaves 1-12 x 0.1-0.8 cm, lanceolate or linear-lanceolate, rounded or shallowly cordate at base and acuminate at apex. Ligule ovate membranous. Racemes solitary or paired, 1-4 cm long, hairy. Sessile spikelets ovate-lanceolate, awned, lower floret male, upper floret bisexual. Pedicelled spikelet oblong-lanceolate, 3-4 mm long, floret similar to those of the sessile spikelets.

Ecology : Fairly common along the road cuttings, canal sides and margins of back waters, usually creeping and trailing on sandy soil and damp places near the coast.

Fl. & Fr. : September-December.

Distrib. : Throughout the East and West coastal plains.

8. *Ischaemum travancorenses* Stapf ex Fisher: Bor, Grasses of Burm. Cey. Ind. & Pak. 186. 1960; *I. aristatum sensu* Hook. f. subsp. *rotleri* Hook. f., Fl. Brit. India 7: 127. 1896.

Perennials, culms 30-200 cm long, trailing or geniculate, rooting at lower nodes, nodes glabrous. Leaves

5-30 x 0.5-1.5 cm, lanceolate, acuminate rounded or cordate at base, ligule membranous. Raceme 2, adpressed together, 4-5 mm long. Sessile spikelets 6-7 mm long, awnless. Pedicelled spikelets ovate oblong, 5-6 mm long, awnless. Upper glume and florets smaller to those of pedicelled and sessile spikelets.

Ecology : Occasional along the shallow streams, banks of backwaters in muddy areas on the seashore.

Fl. & Fr. : September-March.

Distrib. : Endemic to Kerala coast.

9. *Ischaemum vembadense* Patil & D'Cruz in J. Bomb. Nat. Hist. Soc. 70: 324. 1973.

Perennials. Culms 20-150 cm long, trailing and rooting at lower nodes. Leaves 5-12 x 0.5-1 cm, lanceolate, acuminate at apex, rounded or shallowly cordate at base, ligule membranous. Raceme 2, adpressed and appears solitary, 5-8 cm long. Sessile spikelets awned, lower floret male, upper floret bisexual; pedicelled spikelet awnless, pedicle 1-2 mm long.

Ecology : Rare along the banks of rivers and back waters of the coastal provinces.

Fl. & Fr. : October-January.

Distrib. : Kerala and Maharashtra coast.

35. *Jansenella* Bor

Jansenella griffithiana (C. Muell.) Bor, 426. t. 45. 1960; *Arundinella avenacea* Munro ex Thw.: Hook. f., Fl. Brit. India 7: 69. 1896.

Annuals, culms 3-35 cm long, erect or creeping and geniculate, nodes glabrous. Leaves 3-10 x 0.1-1.2 cm, elliptic-lanceolate, glabrous or villous, acuminate at apex, cordate at base, ligule thin membranous. Panicles capitate or ovate, densely compact. Spikelets elliptic-

lanceolate, lower floret male, upper floret bisexual, glumes more or less long awned.

Ecology : Very common along the hill places, in moist rocky places and swampy fields near the coast.

Fl. & Fr. : October-December.

Distrib. : Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Maharashtra coast.

36. *Leersia* Solane. ex Sw.

Leersia hexandra Sw.: Bor, Grasses of Burm. Cey. Ind. & Pak. 599. 1960; Hook. f., Fl. Brit. India 7: 94. 1896.

Perennials, culms 50-150 cm long, erect or trailing, elegant, nodes bearded. Leaves 5-15 x 0.2-1 cm, lanceolate to linear-lanceolate, rounded or shallowly cordate at base, acuminate at apex, ligules ovate, membranous. Panicles lax, 3-10 cm long with flexuous branches. Spikelets oblong or ovate-oblong, compressed,

cream yellow. Glumes rounded to a rim. Lemma oblong, coriaceous, laterally compressed.

Ecology : Very common along the stream, back waters, canals and in fallow fields, wetlands and marshes.

Fl. & Fr. : August-June.

Distrib. : Throughout the East and West coastal provinces.

37. *Melanocenchris* Nees

KEY TO THE SPECIES

- 1a. Cluster of spikelets including the awns 8 mm long 2. *jacquemontii*
 1b. Cluster of spikelets including the awns 10 mm or more long 1. *abyssinica*

1. *Melanocenchris abyssinica* (R. Br.) Hochst.: Bor, Grasses of Burm. Cey. Ind. & Pak. 473. 1960; *Gracilea royleana* Hook. f. var. *plumosa* Hook. f., Fl. Brit. India 7: 284. 1897.

A tufted, slender annual 10-20 cm high, pubescent, erect stem. Leaves 2.5-5 x 0.1-0.15 cm, linear-lanceolate, filiform, glabrous, distantly ciliate, acute at apex. Ligule a hairy ridge. Inflorescence 2.5-8 cm long, rachis trigonous, spikelets in fascicles on rachis, 10-11 mm long. Glumes 4, outer and inner involucrel glume rigidly coriaceous, outer floral glume ovate-lanceolate, inner floral glume stalked, 3 toothed at apex.

Ecology : Frequent on dry sandy coastal slacks and sand dunes.

Fl. & Fr. : August-September.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Saurashtra coast.

2. *Melanocenchris jacquemontii* Jaub & Spach: Bor, Grasses of Burm. Cey. Ind. & Pak. 473. 1960; *Gracilea royleana* Hook. f., Fl. Brit. India 7: 284. 1897.

Annual, culms densely tufted. Leaves acutely pointed, glabrous, ciliate on margins, sheath glabrous, ligule a fringe of hair. Inflorescence spicate, filiform, spikelets in cluster of 3, green or purple. Involucrel glumes 4, outer glumes hairy below, awn retrose barbed; inner glumes wider than outer. Palea as long as the glume, 2-toothed; rachilla projected beyond palea. Caryopsis 1.5-2 mm long, grey brown.

Ecology : Frequent in the crevices of rocks along the coast.

Fl. & Fr. : September-November.

Distrib. : West Bengal, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat coast.

38. *Myriostachya* Hook. f.

Myriostachya wightiana (Nees ex Steud.) Hook. f., Fl. Brit. India 7: 327. 1897.

Perennial grass. Stem stout, densely tufted, 1.5-2.5 m tall. Leaves 0.5-1 cm broad, linear, smooth, compressed, acuminate at apex. Spikelets 5-8 mm long, compressed, in long panicles; glumes coriaceous, dorsally rounded. Caryopsis obliquely ovoid.

Ecology: Common in sandy elevated intertidal regions in the mangrove swamps as a pioneer. Frequent on the back of creeks and canals of the tidal forests.

Fl. & Fr. : March - April.

Distrib. : West Bengal, Sundarbans; Orissa, Bhitarkanika; Andhra Pradesh, Machalipattanam; Tamil Nadu, Pitchavaram; Rarely in Andamans, Bakultala.

39. *Ophiuros* Gaertn. f.

Ophiuros exaltatus (L.) O. Kuntze.: Bor, 199. 1960. *O. corymbosus* Gaertn. f.: Hook. f., Fl. Brit. India 7: 160. 1896.

Erect, rhizomatous, perennial, 50-100 cm high. Leaves 20-40 x 0.5-2.5 cm, linear-lanceolate, margins tubercled, sheath terete, smooth rounded at base, acuminate at apex, ligule very short. Spike up to 12 cm long, terminal, slender, corymbosely fascioled on filiform

peduncles. Spikelets 2.25 mm long, glabrous. Glumes equal. Lemma hyaline. Caryopsis slightly compressed.

Ecology : Commonly found in moist sandy situation near the coast.

Fl. & Fr. : November-February.

Distrib. : Throughout the west coast and Tamil Nadu coast.

40. *Panicum* L.

KEY TO THE SPECIES

- 1a. Leaves ovate to acuminate, amplexicaul, spikelets somewhat gibbose 2. *brevifolium*
- 1b. Leaves linear to narrowly lanceolate, spikelets symmetrical :
 - 2a. Spikelet 4-5 mm long, sharply acute, ovate to elliptic :
 - 3a. Leaf sheath hairy; spikelet persistent; lower glume three
quarter the length of the spikelet 3. *millaceum*
 - 3b. Leaf sheath glabrous; spikelet deciduous; lower glume as long
as spikelet 8. *turgidum*
 - 2b. Spikelet up to 3.5 mm long rarely up to 4 mm long, narrowly lanceolate :
 - 4a. Lower glume cuspidate or cuspidate acuminate; spikelet 1.5- 3 mm
long widely gaping 7. *trypheron*
 - 4b. Lower glume not cuspidate acuminate; spikelet 2.5-4 mm, not
gaping:
 - 5a. Spikelet narrowly lanceolate to oblong-lanceolate, acute
lower glume one sixth to one fourth the length of the spikelet :
 - 6a. Spikelet above 3 mm long; leaf broad, flat, culms
spongy floating 4. *palludosum*
 - 6b. Spikelet 2.5-3 mm long; leaf blades narrow often
involute, glaucous, culms tough 6. *repens*
 - 5b. Spikelet oblong, ovate, oblong-elliptic, acute or obtuse;
glume one fourth to half the length of spikelet :
 - 7a. Annual; panicle effuse; Spikelet giant and deformed;
leaves linear 5. *psilopodium*
 - 7b. Perennial; panicle not effuse; spikelet crowded very
rarely spaced; leaves linear to lanceolate 1. *antidotale*

1. *Panicum antidotale* Retz.: Bor, 322. 1960; Hook. f., Fl. Brit. India 7: 52. 1896.

Perennial, culms 50-150 cm high, erect or creeping with stout rootstock, nodes thickened, glabrous. Leaves 10-40 x 0.2-1.5 mm, linear-lanceolate, narrow or rounded at base, tapering or acuminate at apex, ligules ring of tufted hairs. Panicles pyramidal, ovate, 10-30 cm long, densely spiculate, alternately branched. Pedicel angular, spikelets ovate-lanceolate, 2-3 mm long, greenish-white. Lower glume broadly ovate, membranous. Upper glume broadly ovate, membranous, hyaline margins. Lower floret barren, upper floret bisexual.

Ecology : Frequent along the sandy seashore, dry river beds and other drier habitat of the coastal plains.

Fl. & Fr. : May-December.

Distrib. : Maharashtra, Goa, Karnataka, Gujarat and Kerala coast.

2. *Panicum brevifolium* L.: Bor, 324. 1960; *P. ovalifolium* Poit.: Hook. f., Fl. Brit. India 7: 44. 1896.

Annuals, culms 10-80 cm long, slender, creeping, nodes glabrous. Leaves ovate, 1-8 x 0.5-3 cm, glabrous, sheath ciliate along one margin, cordate with a few cilia at base, acuminate at apex. Ligules membranous, ciliate, panicle ovate 2-16 cm long, spikelets ovate, 1.5-2 mm long, acute hairy. Lower glume ovate oblong, margin hyaline, upper glume boat shaped. Lower floret male, upper floret bisexual. Grains 1 x 0.75 mm, ovate orbicular.

Ecology : Common in moist, shady places, along the margins of coastal forests and banks of back waters.

Fl. & Fr.: March-December.

Distrib.: Almost throughout the coastal provinces.

3. *Panicum miliaceum* L.: Bor, 327. 1960; Hook. f., Fl. Brit. India 7: 45. 1896.

Tufted, tall annuals, 50-150 cm high. Leaves 20 x 1 cm, linear-lanceolate, often covered with hairs. Ligule a narrow ciliate rim. Panicles up to 20 cm long lax. Spikelets 4.5 cm long, ovate, green. Lower glume cuspidate, upper one cuspidate-acuminate, upper lemma 2.5 mm long, crustaceous.

Ecology : Often found as a weed in irrigated fields along the coast.

Fl. & Fr. : August-October.

Distrib. : Orissa and Tamil Nadu coast.

4. *Panicum paludosum* Roxb.: Bor, 329. 1960; *P. proliferum auct. non Lam.*: Hook. f., Fl. Brit. India 7: 50. 1896.

Aquatic perennials, culms 30-100 cm long, spongy below, erect or geniculate and rooting at lower nodes, nodes glabrous. Leaves 2-20 x 0.3-1 cm, linear-lanceolate, flat, glabrous, margin scaberulous, rounded or sub cordate base, acute at apex. Ligule a ring of white hairs. Panicle 6-25 x 4-16 cm long, ovate-oblong, widely spreading branched. Spikelets elliptic-lanceolate, greenish, acute. Upper glume chartaceous, acute, lower floret barren, upper floret bisexual. Grains 1.5 x 0.5 mm, rounded at apex.

Ecology : Common aquatic grass, submerged or floated in shallow and still water like ponds along banks of streams and backwaters.

Fl. & Fr. : March-December.

Distrib. : Throughout the coastal regions.

5. *Panicum psilopodium* Trin var. *coloratum* Hook. f., Fl. Brit. India 7: 47. 1896; Bor, 330. 1960.

Annual, culms 30-50 cm tall, erect, glabrous. Leaves lanceolate, acuminate, sheath compressed glabrous, ligule membranous, lacerate. Inflorescence a lax panicle. Spikelets 2.5-3 mm long, elliptic acute, purplish-red flower, 1-1.2 mm long, ovate, apiculate, upper glume 1.5-2 mm long, membranous, lower florets barren, lemma 2.5 mm long, upper florets bisexual, lemma 1.2-1.7 mm long, obtuse or apiculate. Caryopsis 1.5 mm long, dark brown, ellipsoid.

Ecology : Frequent, in wetlands and as a weed in cultivated field near the coast.

Fl. & Fr. : July-November.

Distrib. : West Bengal, Orissa and Kerala coast.

6. *Panicum repens* L.: Bor, 330. 1960; Hook. f., Fl. Brit. India 7: 49. 1896.

Perennials; culms 30-100 cm long, erect or trailing, rhizomatous or stoloniferous, stout, rooting at the lower nodes and ascending, nodes glabrous. Leaves 3-20 x 0.3-0.8 cm, linear-lanceolate, rigid, convolute, sheath ciliate along the margins, rounded or shallowly cordate at base, acuminate at apex. Ligule membranous, thin, annular with dense tuft of hairs behind. Panicles 7-20 cm long, oblong lanceolate, rachis angular, spikelets ovate to lanceolate. Lower glume broadly ovate, upper glume ovate-lanceolate. Lower floret male, upper floret bisexual.

Ecology : Common along the bunds of paddy fields, banks of back waters, streams and river, occasionally in wetlands and marshes, common in Orissa coast, possessing a wide range of adaptability.

Fl. & Fr. : January-December.

Distrib. : Throughout the coastal regions, specially along the Orissa coasts.

7. *Panicum trypheron* Schult.: Bor, 331. 1960; Hook. f., Fl. Brit. India 7: 47. 1896.

Annuals; culms 10-75 cm high, erect or geniculate, slender, leafy at the base, nodes glabrous. Leaves 4-30 x 0.2-0.8 cm, mostly basal, narrow, margin minutely serrate and ciliated, rounded or cordate base, ligule dense tuft of hairs. Panicle oblong or elliptic, 5-45 cm long. Spikelets sparse, distant, greenish or pink. Lower floret barren, upper floret bisexual. Grains ovate.

Ecology : Common in open grassland, along fringes of forests and road side in hilly areas near the coast.

Fl. & Fr. : July-January.

Distrib. : Orissa and probably throughout the East coast.

8. *Panicum turgidum* Forssk.: Bor, 331. 1960; Hook. f., Fl. Brit. India 7: 44. 1896.

Perennial; tufted grass with hard, solid, polished stem, about 0.25-0.3 cm in diam. and fascicle of branches from base. Leaves 2.5-7.5 cm long, linear-lanceolate, flat, coriaceous, acuminate at apex. Those of upper nodes reduced to open chartaceous, sheaths with setiform blade. Panicle terminal, 3.7-10 cm long. Spikelets solitary or 2 nate, white, glume 4, sub-coriaceous.

Ecology : Common and characteristic mat forming species along the sand dunes of coastal areas.

Fl. & Fr. : November-January.

Distrib. : Gujarat and West Bengal.

41. *Paspalidium* Stapf.

KEY TO THE SPECIES

- 1a. Leaves blunt; spikes much shorter than the internodes; spikelets gibbosely globose 1. *flavidum*
- 1b. Leaves not blunt, acuminate or acute, spikes equal to or longer than the internode; spikes not gibbose :
- 2a. Upper glume nearly as long as the spikelets, lower glume 1-1.5 mm long, lower floret male paleate 2. *geminatum*
- 2b. Upper glume about half the length of the spikelets, lower floret barren, apaleate 3. *punctatum*

1. *Paspalidium flavidum* (Retz.) A. Camus: Bor, 333. 1960; *Panicum flavidum* Retz.: Hook. f., Fl. Brit. India 7: 28. 1896.

Annual, culms 20-70 cm, sub-compressed nodes glabrous. Leaves 5-35 x 0.3-0.8 cm, linear-lanceolate, glabrous, rounded or shallowly cordate at base; sheath glabrous. Ligule hairy, very short. Inflorescence 5-30 cm long spiciform, spikes 3-10, alternate. Spikelets 2.5-3.0 mm, biseriate. Glumes membranous ovate. Lower florets empty, lemma chartaceous, rounded. Upper floret hermaphrodite. Caryopsis broadly elliptic.

Ecology : Along the banks of backwaters streams and rivers, and other wet, damp localities of coastal plains.

Fl. & Fr. : July-December.

Distrib. : Throughout the coastal plains.

2. *Paspalidium geminatum* (Forssk.) Stapf.: Bor, 333. 1960; *P. paspaloides* Pers.: Hook. f., Fl. Brit. India 7: 30. 1896.

Perennials, culms 30-150 cm long, creeping or floating, stoloniferous or spongy rhizomatous, rooting at lower nodes. Leaves 5-30 x 0.3-1.5 cm, lanceolate or linear-lanceolate, rounded or shallowly cordate base, tapering or setaceously acuminate at apex. Ligules tuft of hairs. Panicles 5-30 cm long, spikes several, congested, rachis narrowly winged. Spikelets ovate, acute, greenish yellow. Lower glume ovate-lanceolate, rounded or truncate, membranous,

upper glume ovate, chartaceous. Lower floret male, upper floret bisexual.

Ecology : Frequent along the water logged areas, margins of paddy fields, marshes, shallow water ditches, wetlands and other such damp places of coastal areas.

Fl. & Fr. : June-March.

Distrib. : Common in Orissa coast, Chilka lake and West coastal provinces.

3. *Paspalidium punctatum* (Burm.) A. Camus: Bor, 333. 1960; *Panicum punctatum* Burm.: Hook. f., Fl. Brit. India 7: 29. 1896.

Perennial. Culms 30-150 cm, base spongy, floating and rooting at nodes. Leaves 3-30 x 0.3-1 cm, lanceolate, margin scabrid; sheath glabrous, lower inflated, narrow or rounded at base, acute at apex, ligule a ring of hairs. Inflorescence of several false spikes, distant and appressed to rachis. Spikelets ovate or broadly elliptic, glabrous. Lower glume membranous, truncate. Lower florets barren, upper floret hermaphrodite. Lemma undurated, acuminate, cuspidate. Caryopsis orbiculate, compressed.

Ecology : Common in wetlands and swamps near the coast.

Fl. & Fr. : August-December.

Distrib. : Throughout Indian coast.

42. *Paspalum* L.

KEY TO THE SPECIES

- 1a. Spikelets fringed with fine white hairs from the margins of the upper glume 2. *conjugatum*
- 1b. Spikelets glabrous or pubescent, not with fine hairs on the margin :
- 2a. Spikelet broadly elliptic to ovate-elliptic, 2.5-4.5 mm long 1. *distichum*
- 2b. Spikelet ovate elliptic or orbicular, 1.8-2.2 mm long 3. *orbiculare*

1. *Paspalum conjugatum* Berg.: Bor, 336. 1960; Hook. f., Fl. Brit. Ind. 7: 11. 1896.

Perennials; culms 30-100 cm long, creeping or stoloniferous, compressed, rooting at the nodes. Leaves 4-25 x 0.3-1.5 cm, lanceolate or linear-lanceolate, sheath compressed, keeled, ciliate along one margin, rounded or narrowed and ciliate at base, acuminate at apex. Ligule membranous, narrow. Racemes 2, conjugate, 4-15 cm long. Spikelets broadly elliptic or ovate, greenish yellow. Lower glume absent, upper glume ovate or orbicular, membranous, long ciliate along the margins. Lower floret barren, upper floret bisexual.

Ecology : Very common along the banks of back waters, rivers and canals in the coastal plains.

Fl. & Fr. : September-December.

Distrib. : Throughout the coastal provinces.

2. *Paspalum distichum* L.: Bor, 338. 1960; Hook. f., Fl. Brit. Ind. 7: 12. 1896.

Annuals or perennials; culms 10-90 cm, long, creeping or rooting at nodes, floating, stoloniferous, nodes glabrous. Leaves 1-20 x 0.1-0.8 cm, lanceolate or linear-lanceolate, rounded or shallowly cordate at base, acuminate at apex. Ligule ovate, membranous. Racemes 2, 1-8 cm long. Spikelets ovate-elliptic, 2.5-4 mm long, softly hairy. Lower glume absent, upper glume broadly

ovate-acute, chartaceous. Lower floret barren, upper floret bisexual.

Ecology : Very common along the embankments of back waters, streams and canals, frequent in fallow fields and salt marshes near the beach or on tidal flats.

Fl. & Fr. : May-December.

Distrib. : West Bengal, Tamil Nadu, West coast and Andaman Islands.

3. *Paspalum orbiculare* Forst.: Bor, 340. 1960; *P. scrobiculatum* L. Mant.: Hook. f., Fl. Brit. India 7: 10. 1896.

Annuals or perennials, culms 10-100 cm high, densely tufted and erect or creeping and rooting at the lower nodes, nodes glabrous. Leaves 2-40 x 0.2-1.2 cm, lanceolate, linear, rounded or cordate base, apex acute. Ligule membranous, narrow. Racemes 2, usually 1-10 cm long, spikelets 2-3 mm long, 2 ranked, ovate, lower glume absent, upper glume membranous. Lower florets barren, upper floret bisexual.

Ecology : Very common along the wetlands, puddles and other water logged areas of the seashore.

Fl. & Fr. : September-December.

Distrib. : Throughout the coastal regions.

43. *Pennisetum* Rich.

KEY TO THE SPECIES

- 1a. Lemma more or less alike, lower not 3 lobed; upper floret not deciduous; rachis ribbed, ribs not winged :
 2a. Involucral bristles scabrid; anthers not bearded at apex; leaves folded 2. *hohenackeri*
 2b. Involucral bristles ciliate; anthers bearded at apex; leaves flat :
 3a. Spikelet sessile, not gaping; longest involucral bristles 15 mm 4. *purpureum*
 3b. Spikelet prominently pediceled; gaping and exposing grain; longest involucral bristles 5-7 mm 1. *americanum*
- 1b. Lemma heteromorphic, lower often 3 lobed; upper floret readily disarticulating; rachis with decurrent wings on the ribs below the pedicel 3. *pedicellatum*

1. *Pennisetum americanum* (L.) K. Schum., Eng. Pflanzenr. Ocs. Afr. B. 51, c. 1. 4, f. A & B. 1895; *P. typhoides* (Burm.) Stapf. & C.E. Hubb.: Bor, 350. 1960; *P. typhoideum* L. C. Rich.: Hook. f., Fl. Brit. India 7: 82. 1896.

Herbs, 20-30 cm high, robust annuals. Leaves 15-20 x 0.3-0.5 cm, linear-lanceolate. Panicle 5-7 cm long with villose or woolly rachis, each involucre with 2 - many spikelets. Spikelet 0.3 cm long, oblong. Lemmas pubescent on the margins.

Ecology : Frequent in lee side of the coastal dunes.

Fl. & Fr. : November-December.

Distrib. : Throughout the coastal districts.

2. *Pennisetum hohenackeri* Steud., Syn. Groom: Bor, 344. 1960; *P. alopecuroides* Nees ex Steud.: Hook. f., Fl. Brit. India 7: 84. 1896.

Perennials; culms 30-150 cm high, erect, densely tufted; nodes glabrous. Leaves 10-60 x 0.2-0.8 cm, narrowly linear, convolute, glaucous, glabrous or sparsely pilose, sheaths keeled, distichous, rounded at base, acuminate at apex, ligule row of hairs. Panicles 5-20 cm long, involucre enclosing on sessile spikelet. Spikelet elliptic-lanceolate. Lower glume obovate, upper glume ovate-lanceolate. Lower floret male or barren, upper floret bisexual.

Ecology : Occasional along the banks of stream, backwater and other water courses, margins of paddy fields and on river beds near the coast.

Fl. & Fr. : February-August.

Distrib. : Kerala and Maharashtra coast.

3. *Pennisetum pedicellatum* Trin: Bor, 346. 1960; Hook. f., Fl. Brit. India 7: 86. 1896.

Annuals; culms 30-150 cm high, tufted, erect, nodes glabrous. Leaves 5-25 x 0.3-1 cm, linear-lanceolate, glabrous, acuminate rounded at base. Ligule membranous, fimbriate. Panicles spiciform, 5-15 cm long, white or purplish. Spikelets solitary and pedicelled, bristles usually very woolly, lower glume at least half of the length of lower lemma.

Ecology : Occasional along hill slopes, road sides, water courses and in coastal scrub jungles.

Fl. & Fr. : September-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh (Godavari dist.), Tamil Nadu and Maharashtra coast.

4. *Pennisetum purpureum* Schum.: Bor, 348. 1960. *P. purpureum* H.B.K.: Hook. f., Fl. Brit. India 7: 87. 1896.

Perennial; culms 50-250 cm high, erect tufted, nodes sparsely bearded. Leaves 20-80 x 0.5-2.5 cm, linear or linear-lanceolate, dull green, rounded at base, acuminate at apex; ligule membranous, thin fimbriate. Panicles spiciform compact 15-25 cm long, yellow or purplish black. Rachis densely pubescent, involucre sessile, enclosing 1-4, sessile or pediceled spikelets. Spikelet 5-6 mm long lanceolate. Lower glume ovate to acute, upper glume ovate to lanceolate. Lower floret male or barren, upper floret bisexual.

Ecology : Occasionally found along the banks of river and backwaters in the coastal plains.

Fl. & Fr. : September-November.

Distrib. : Throughout the coastal districts.

44. *Perotis* P. Beauv.

Perotis indica (L.) O. Kuntze: *Bor*, 611, t. 72, 1960; *P. latifolia* Ait.: Hook. f., *Fl. Brit. India* 7: 98, 1898.

Annual; culms erect, 40-50 cm tall leave ovate, cordate at base, margin scabrid; sheath terete, glabrous. Flowers arranged in terminal spike. Lower glume 1.9 mm long, lanceolate, 1 nerved, awn, 1 cm long, upper glume similar to lower, with 7.5 mm long awn. Lemma 0.6 mm

long, lanceolate, 1 nerved, palea nerveless. Anthers 3, 14 mm long. Caryopsis 1.4 mm long terete, brown.

Ecology : Fairly common along the road sides, in wastelands and seashore sands.

Fl. & Fr. : Throughout the year.

Distrib. : Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Maharashtra and Gujarat coast.

45. *Phragmitis* Adans.

Phragmitis karka (Retz.) Trin ex Steud.: *Bor*, 416, 1960; Hook. f., *Fl. Brit. India* 7: 304, 1897.

Perennial; culms, erect, reed like, stout, densely tufted 50-300 cm high, covered with leaf sheath up to the inflorescence. Leaves 10-60 x 0.5-2 cm, linear-lanceolate, margins scabrous, cordate at base, attenuate at apex. Ligules narrow rim of hairs, panicle loose, 30-45 cm long, erect, composed of numerous filiform, scabrous branches, purplish brown. Spikelets numerous, flowers 7.5-12.5 cm each. Glumes oblong, lanceolate. Lower floret with male

flower, upper floret with hermaphrodite flower. Grain oblong, terete.

Ecology : Very common along banks of backwaters, beside streams and rivers. Sometimes in swamps and marshes, often associated with *Saccharum spontaneum* and *Pandanus* sp.

Fl. & Fr. : Throughout the rainy season.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Gujarat coast.

46. *Porteresia* Tateoka

Porteresia coarctata Tateoka, *Bull. Nat. Sci. Mus. Tokyo* 8: 406, 1965; *Oryza coarctata* Buch.-Ham. ex Roxb.: *Bor*, 604, 1960; Hook. f., *Fl. Brit. India* 7: 93, 1896.

Stem tall up to 30-180 cm, branched, smooth, hard, polished; rhizome stout, creeping. Leaves 15-30 x 1-1.5 cm, unequal sided, coriaceous, polished, spinulose-serrate, undulately reticulate, cordate-acuminate at apex. Inflorescence panicle 10-15 cm, spikelets laxly arranged.

Palea keeled, keel dilated above into a rounded wing, lodicules large membranous. Grain narrowly oblong, compressed, closely covered by glume and palea.

Ecology : Pioneer along the intertidal banks, on lands recently reclaimed by silt in the mangrove forests.

Fl. & Fr. : July-October.

Distrib. : Throughout the East and West coastal regions.

47. *Rottboelia* L. f

Rottboelia cochinchinensis (Lour.) W. D. Clayton, *Kew Bull.* 35(4): 817-818, 1981; *R. exaltata* L. f.: *Bor*, 206, t. 13, 1960; Hook. f., *Fl. Brit. India* 7: 156, 1896.

Annuals; culms 30-150 cm high, supported below by stilt roots; nodes glabrous. Leaves 3-60 x 0.3-2 cm linear-lanceolate, basal sheaths covered with stilt bristles, narrowed or rounded at base, acuminate at apex. Ligules ovate, membranous. Spikes terete, 3-15 cm long, terminating in a tail of reduced spikelets. Sessile spikelets 3-4 mm long glabrous, lower glume broadly ovate,

coriaceous, pale yellow, upper glume boat-shaped, keeled coriaceous, narrowly winged at apex. Lower floret male, upper floret bisexual. Pedicelled spikelets ovate-lanceolate, lower glume elliptic-oblong, acute, dark green.

Ecology : The grass survives in semi-aquatic habitat, usually in moist or water logged fields.

Fl. & Fr. : August-March.

Distrib. : West Bengal, Orissa, Tamil Nadu, Kerala and Andaman islands.

48. *Rhynchelytrum* Nees corr. Endl.

Rhynchelytrum repens (Willd.) C.E. Hubb.: Bor, 335. 1960; *Trichalaena wightii* Nees & Arn. ex Steud.: Hook. f., Fl. Brit. India 7: 65. 1896.

Annual or perennials; culms 20-100 cm high, erect or willowy, tufted, nodes softly villous. Leaves 2-20 x 0.1-0.8 cm, lanceolate-linear, glabrous, ligule a row of hairs. Panicles rhomboid, 4-20 cm long, silvery-

whitish or reddish-brown. Spikelets ovate or oblong, emarginate, chartaceous. Upper glume gibbose, boat-shaped. Upper floret bisexual.

Ecology : Frequent in dry coastal regions and on rocks.

Fl. & Fr. : March-August.

Distrib. : Gujarat, Maharashtra, Tamil Nadu and Kerala.

49. *Saccharum* L.

Saccharum spontaneum L.: Bor, 214. 1960; Hook. f., Fl. Brit. India 7: 118. 1896.

Strong perennial with extensive rhizomes. Culms erect, glabrous, nodes hairy. Leaves filiform, margins scabrid, sheaths auriculate, glabrous, throat hairy; ligule hairy. Inflorescence a lax panicle, silvery white. Spikelets lanceolate, sessile and pedicelled, similar, 1-flowered, bisexual, sessile spikelet. Lower glume sharply acute,

margin ciliate, 2 nerved, upper glume 1 keeled, lower lemma oblong, ciliate, epaleate, upper lemma bisexual, linear elliptic. Caryopsis narrowly lanceolate.

Ecology : Common along the river banks, wetlands and swamps near the coast. Acts as soil binder due to its thick rhizomatous rootstock.

Fl. & Fr. : September-November.

Distrib. : Throughout coastal districts.

50. *Sacciolepis* Nash.

KEY TO THE SPECIES

- 1a. Culms spongy and floating; Spikelet 3-5 mm; panicle interrupted 2. *interrupta*
 1b. Culms never spongy and floating; Spikelet 1-3 mm long; panicles not interrupted :
 2a. Panicles up to 10 cm long; spikelets elliptic or lanceolate, acute, 2-3 mm long; leaves up to 20 cm long 1. *indica*
 2b. Panicles up to 35 cm long; spikelet subglobose, obtuse, 1-2 mm long; leaves up to 40 cm long 3. *mysuroides*

1. *Sacciolepis indica* (L.) A. Chase.: Bor, 357. 1960; *Panicum indicum* L.: Hook. f., Fl. Brit. India 7: 41. 1896.

Annual; culms 20-60 cm, slender, spreading, nodes glabrous. Leaves 0.5-20 x 0.1-0.5 cm, flat to involute, glabrous; sheath slightly keeled; ligule membranous, cordate at base. Inflorescence a spike-like panicle, 1-4 cm long. Spikelet ovate-acute, slightly gibbose, lower floret male or barren, upper floret bisexual. Lower glume ovate, upper glume ovate-oblongs; lower lemma empty, upper lemma narrowly ovate, acute, pale yellow, shining. Caryopsis elliptic.

Ecology : Very common in wasteland marshes, moist sandy soil along the banks of back waters.

Fl. & Fr. : August-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Gujarat coast.

2. *Sacciolepis interrupta* (Willd) Stapf.: Bor, 358. 1960; *Panicum interruptum* Willd.: Hook. f., Fl. Brit. India 7: 40. 1896.

Perennial; Culms 20-50 cm, creeping or floating with swollen spongy rhizome, nodes glabrous. Leaves 4-35 x 0.3-1.4 cm, flat lanceolate, glabrous, rounded at base; sheath swollen, glabrous, purple; ligule membranous, truncate. Inflorescence a terminal spike like panicle; peduncles with 5-6 flowers usually one fertile. Fertile spikelet 4 mm. Lower glume mucous, upper glume elliptic-oblong. Lower lemma empty, upper lemma chartaceous. Caryopsis elliptic, usually dorsally compressed.

Ecology : Commonly found in swampy places near the coast.

Fl. & Fr. : September-December.

Distrib. : Throughout the Indian coast.

3. *Sacciolepis myosuroides* (R. Br.) A. Camus: Bor, 358. 1960; *Panicum myosuroides* R. Br.: Hook. f., Fl. Brit. India 7: 42. 1896.

Annual; culms 50-120 cm high, erect or decumbent; nodes glabrous. Leaves 15-40 x 0.2-0.6 cm, linear to lanceolate, glabrous or pillose, rounded or narrowed at base, acuminate at apex, sheath compressed,

ligule truncate; spikelets 2-5, in cluster, ovoid, purplish. Upper glume 1.5 mm. Caryopsis 1 mm, ellipsoid, turgid.

Ecology : Rare, along the ditches and water logged fields.

Fl. & Fr. : August-December.

Distrib. : Karnataka coast.

51. *Setaria* Beauv.

KEY TO THE SPECIES

- 1a. Bristles retrorsely barbed 3. *verticillata*
 1b. Bristles antrorsely barbed :
 2a. Spikelet 3 mm long; upper lemma coarsely rugose, boat-shaped, keeled, broadly and dorsally strongly curved in profile 1. *glauca*
 2b. Spikelets 2.5 mm long; upper lemma usually finely rugose, narrow and dorsally gently curved, not keeled 2. *pumila*

1. *Setaria glauca* (L.) P. Beauv., Ess. Arost. 51: 169. 178. 1812; Hook. f., Fl. Brit. India 7: 78. 1896.

Annual. Culms 30-60 cm, erect to geniculate. Leaves linear, glabrous, margins rough; sheaths keeled, glabrous; ligule hairy. Inflorescence a dense panicle, spike-like, cylindric, yellow at maturity, axis densely pubescent; bristles 5-20 in a cluster, scabrous, very unequal, 6-10 mm long. Spikelets broadly elliptic. Lower florets male or barren, upper florets boat-shaped, convex on back side, transversely rugose. Caryopsis rounded elliptic.

Ecology : Common on beach sand, sand dunes and roadside of the seashore.

Fl. & Fr. : August-October.

Distrib. : Throughout Indian coast.

2. *Setaria pumila* (Poir.) Roem. & Schult., Syst. Veg. 2: 891. 1817; *S. palida-fusca* (Schum.) Stapf. & C.F. Hubb.: Bor, 363. 1960; *S. glauca sensu* Hook. f., Fl. Brit. India 7: 78. 1896.

Annual. Culms 5-120 cm, geniculate, glabrous, nodes glabrescent. Leaves 2-30 x 0.1-1 cm, lanceolate, flaccid, flat, glabrous, rounded or shallowly cordate at base. Sheaths keeled, ligule ovate, membranous. Inflorescence spikes or spiciform panicles, pale yellow,

compact. Spikelets 3 or solitary, ovate or sub globose. Lower glume ovate, upper glume obicular, Upper florets bisexual, lower florets male or barren. Caryopsis 1.5 mm, ellipsoid.

Ecology : Very common in wetlands, margins of paddy fields and forests, in open grasslands, along the banks of streams, backwaters and canals of the seashores.

Fl. & Fr. : May-December.

Distrib. : Throughout out the Indian coast.

3. *Setaria verticillata* (L.) P. Beauv.: Bor. 365. 1960; Hook. f., Fl. Brit. India 7: 80. 1896.

Annual. Culms 30-100 cm, erect or ascending. Leaves 10-30 cm long, soft, base rounded sparsely pillose; sheath glabrous, throat pilose; ligule hairy. Inflorescence spiciform, interrupted panicle; rachis slender, angular, scabrid. Spikelets 2.0-2.5 mm, broadly ovate. Lower glume 0.8-1.0 mm long, 3 nerved. Upper glume 2.0-2.2 mm long, acute, 3-7 nerved. Lower lemma empty, epaleate. Upper lemma broadly oblong. Caryopsis truly rugose.

Ecology : In shady places along the roadside, river banks and hill slopes near the coasts.

Fl. & Fr. : August-October.

Distrib. : Throughout the coastal districts.

52. *Spinifex* L.

Spinifex littoreus (Burm. f.) Merr.: Bor, 366. 1960; *S. squarrosus* L.: Hook. f., Fl. Brit. India 7: 63. 1896.

Perennial. Culms 20-60 cm high, stoloniferous, trailing and rooting at nodes, decumbent, glaucous, nodes glabrous. Leaves 3-20 x 0.1-0.6 cm, acicular, convolute, rigid glaucous, margins ciliate towards mouth, spiny at apex. Ligule row of hairs. Male inflorescence capitate consists of several spikes, 5-15 cm long, spikelets 8-12 x 1-2 mm lanceolate, 1-3 flowered. Lower glume and upper

glume subcoriaceous. Female inflorescence capitate, 10-25 cm wide, globose.

Ecology : Common and restricted along the seashore, beaches and sand dunes, often associate with *Ipomoea pes-caprae* and *Launaea sarmentosa*. Specially acts as sand binder.

Fl. & Fr. : September-March.

Distrib. : Throughout coastal districts.

53. *Sporobolus* R. Br.

KEY TO THE SPECIES

- 1a. Lower glumes as long as spikelet or at least three quarter its length 8. *virginicus*
- 1b. Lower glume much shorter than the lemma, rarely two third as long :
 - 2a. Upper glume distinctly shorter than the lemma, less than three quarter :
 - 3a. Panicle effuse, at least at maturity 2. *dlander*
 - 3b. Panicle contracted :
 - 4a. Panicle cylindric; spikelet crowded 6. *spicatus*
 - 4b. Panicle subspiciform, often interrupted 3. *indicus*
 - 2b. Upper glume nearly as long or longer than the lemma :
 - 5a. Panicles contracted, lower branches not truly whorled :
 - 6a. Spikelet 1.5-1.75 mm long, lower glume lanceolate; leaf margin smooth 7. *tremulus*
 - 6b. Spikelet 2 mm long lower glume rounded at tip; leaf margin spinulose 4. *maderaspatanus*
 - 5b. Panicle effuse spreading lower branches truly whorled :
 - 7a. Annual; spikelet minute just over 1 mm long 1. *coromandelianus*
 - 7b. Perennial; spikelet 2.1-2.4 mm long. 5. *marginatus*

1. *Sporobolus coromandelianus* (Retz.) Kunth : Bor, 627. 1960; Hook. f., Fl. Brit. India 7: 252. 1897.

Culms 10-15 cm, 1.5 mm wide, smooth. Leaves 1-5 x 0.1-0.3 cm oblong, flat, ligule 0.5 mm. Panicles ovate, 3-5 cm long, spikelets 1.5 mm. Lower glume 0.2 mm, upper glume oblong. Caryopsis 0.7-1 mm, ovoid-oblong.

Ecology : Frequent in black cotton soil near the coast.

Fl. & Fr. : August-September.

Distrib. : Orissa, Andhra Pradesh and Tamil Nadu coast.

2. *Sporobolus dlander* (Retz.) P. Beauv.: Bor, 629. 1960; Hook. f., Fl. Brit. India 7: 247. 1896.

Culms 20-60 cm, 1.5 mm wide. Leaves 7-20 cm, oblong. Ligule 0.2 mm. Panicles 12-25 cm, pyramidal or narrowly lanceolate, loose. Spikelets densely clustered, ellipsoid. Lower glume obovate, upper glume ovate. Lemma elliptic, narrowly lanceolate as long as spikelet. Caryopsis 0.7 mm oblong.

Ecology : Common along the moist sandy areas, river banks and boundary of the lakes.

Fl. & Fr. : May-July.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat coast.

3. *Sporobolus indicus* (L.) R. Br. var. *fertilis* (Steud.) Jovet & Guedes in taxon 22 : 163. 1973; *S. indicus sensu* Hook. f., Fl. Brit. India 7: 247. 1896; Bor, 630. t. 76. 1960.

Perennials; culms tufted erect, 60-120 cm high, nodes glabrous. Leaves 10-40 x 0.2-0.8 cm linear-lanceolate, rounded or shallowly cordate at base. Ligules truncate, membranous or row of hairs. Panicles contracted, spiciform, 15-35 cm long. Spikelets obovoid, 1.5-2.5 mm long greyish. Lower glume, oblong, chartaceous, obtuse. Upper glume ovate, 0.5-1 mm long chartaceous, palea elliptic. Grains 0.5-1 mm long, oblong.

Ecology : Occasional as a weed in wetlands and along the margins of back water and ponds near the coast.

Fl. & Fr.: June-December.

Distrib. : Kerala, Maharashtra and Tamil Nadu coast.

4. *Sporobolus maderaspatanus* Bor, 632. 1960; *S. orientalis* Kunth: Hook. f., Fl. Brit. India 7: 251. 1897.

Stoloniferous, perennial grass. Leaves 5-10 x 0.25-0.35 cm, linear-lanceolate, margin spinulose, acute at apex. Panicles narrowly oblong, suberect, contracted, spikelets 2 mm long, lower glume 0.5 mm long, rounded at tip. Caryopsis 0.75 x 0.35 mm, lanceolate.

Ecology : Commonly found in moist, clayey soils.

Fl. & Fr. : August - December.

Distrib. : Throughout the peninsular coast.

5. *Sporobolus marginatus* Hoehst ex A. Rich: Bor, 632. 1960; *S. arabicus* Boiss.: Hook. f., Fl. Brit. India 7: 252. 1897.

Perennial; culms 20-60 cm, base wood, stoloniferous. Roots very thick, covered with soft felt of root hairs. Leaves flat or convolute, margin serrulate, ciliate, sheath glabrous, ligule hairy. Inflorescence a panicle, branches capillary. Spikelets 2.5 mm, pedicels stout. Caryopsis sub-globose, slightly convex.

Ecology : Common in dry coastal regions and sand dunes.

Fl. & Fr. : July-December.

Distrib. : Gujarat, Maharashtra, Karnataka, Kerala, Andhra Pradesh and Tamil Nadu coast.

6. *Sporobolus spicatus* (Vahl) Kunth: Bor, 632. 1960; Hook. f., Fl. Brit. India 7: 250. 1896.

Culms geniculate, 10-50 cm long and 1 mm wide. Leaves 2.5-7.5 cm, blades oblong, flat or in rolled scattered pilose within. Ligule 0.3 mm, panicles spiciform, narrow, contracted. Spikelet oblong 1.8-2 mm. Lower glume sub-quadrate to 0.4 mm, upper glume ovate, 0.8-1 mm, lemma as long as spikelets. Caryopsis 0.7 mm, ovoid subglobose.

Ecology : Frequent along the crevices of the rocky coastline and river banks.

Fl. & Fr. : August-September.

Distrib. : Tamil Nadu, Karnataka, Maharashtra and Gujarat coast.

7. *Sporobolus tremulus* (Willd.) Kunth: Bor, 633. 1960; Hook. f., Fl. Brit. India 7: 250. 1896.

Culms 50-150 cm then erect or prostrate from knotted stoloniferous stock 15-45 cm. Leaves short subulate or filiform, rigid. Ligule a few hairs. Inflorescence panicle 2.5-10 cm pedicel short. Spikelets crowded, subpersistent, very pale. Palea like glume. Caryopsis oblong.

Ecology : Common towards the back shore regions.

Fl. & Fr. : November-January.

Distrib. : Throughout the east coastal regions and Gujarat coast.

8. *Sporobolus virginicus* (L.) Kunth : Bor, 634. 1960; Hook. f., Fl. Brit. India 7: 249. 1896.

Perennial; culms stoloniferous, creeping and spreading by long, slender, rhizomes. 10-50 cm long, nodes glabrous. Leaves 1-15 x 0.2-0.6 cm, lanceolate, rounded or cordate at base. Ligule row of hairs. Panicles 3-10 mm long, contracted, spikelets lanceolate, 1.5-2.5 mm long, lower glume lanceolate, upper glume ovate-lanceolate.

Ecology : Occasional along the seashores, banks of back waters, often in wet saline soils.

Fl. & Fr. : July-September.

Distrib. : Throughout the coastal districts and Andaman islands.

54. *Stenotaphrum* Trin

Stenotaphrum dimidiatum (L.) Brongn.: Bor, 366, 1960; *S. glabrum* Trin: Hook. f., Fl. Brit. India 7: 90, 1896.

Perennial; culms 10-60 cm long, creeping, stoloniferous, rooting at nodes, nodes glabrous. Leaves 3-15 x 0.3-1 cm, linear-oblong, sheath compressed, strongly keeled, rounded at base and sub-obtuse or rounded at apex, ligule with fringe of hairs. Raceme solitary, spiciform, 3-10 cm long, rachis flat, wavy.

Spikelets 3-6 together, elliptic. Lower glume orbicular, toothed, chartaceous, ciliate at apex, upper glume boat-shaped, upper floret bisexual, lower floret barren.

Ecology : Frequently found near seashores and banks of back waters and streams.

Fl. & Fr. : June-March.

Distrib. : Throughout the coastal states.

55. *Thuarea* Pers.

Thuarea involuta (Forst.) R. Br. ex Roem. et Schult.: Bor, 368, 1960; *T. sarmentosa* Pers.: Hook. f., Fl. Brit. India 7: 91, 1896.

A small much branched prostrate leafy littoral grass. Leaves 2.5-4.5 cm, linear-oblong, glabrous or silky, acute apex, ligule hairy. Spikes 1-2.25 cm, spikelets uniseriate, 0.6 cm long, glume obtuse, ciliate. Fruit 0.8 cm long and broad, trigonously obconic or turbinate,

obscurely ribbed, with deep depression on one side of the crown.

Ecology : Common on sandy beaches and sand dunes in the littoral zones.

Fl. & Fr. : December-March.

Distrib. : Andaman islands, Lakshadweep and rarely in Gujarat coast.

56. *Trachys* Pers.

Trachys muricata (L.) Pers. ex Trin: Bor, 369. t. 42, 1960; *T. mucronata* Pers.: Hook. f., Fl. Brit. India 7: 96, 1896.

Annual; culms 10-60 cm long, creeping and rooting at nodes, decumbent. Leaves elliptic-lanceolate, acuminate, hispid, undulate on one margin, sheath tubercled based hairy, ligule ovate, membranous. Racemes 1-3, each 1-6 cm long. Spikelets clustered on flat rachis. Lower glume lanceolate. Lower florets barren,

opalcate, upper florets bisexual, 1st lemma broadly elliptic, 2nd elliptic-lanceolate, palea elliptic-lanceolate, hyaline. Ovary oblong.

Ecology : Grows gregariously along the coastal belts, sometimes forming mats to check tidal erosion.

Fl. & Fr. : October-December.

Distrib. : Throughout coastal regions specially Coromandal coast.

57. *Tragus* Panz.

Tragus roxburghii Panigrahi, Kew. Bull. 29: 495, 1974; *T. biflorus sensu* Schult.: Bor, 682, 1960; *T. racemosus sensu* Hook. f., Fl. Brit. India 7: 97, 1896.

Geniculate ascending or prostrate annuals, often rooting at lower nodes. Leaves 0.5-5.0 x 0.25-0.5 cm, linear-lanceolate, margin undulate with bristles, acuminate at apex, ligule, a ciliate rim. Inflorescence up to 6.5 cm long, cylindrical, loose, spike-like panicle; rachis

pubescent. Spikelets in pair, lower glume minute, hyaline, upper one coriaceous with rows of stout, hooked spines. Caryopsis 1.5 mm long, oblong-elliptic, compressed.

Ecology : Fairly common throughout dry coastal plains on sandy waste places.

Fl. & Fr. : August-November.

Distrib. : Throughout the coastal plains.

58. *Urochloa* Beauv.

Urochloa panicoides P. Beauv.: Bor, 372. 1960; *Panicum javanicum* Poir.: Hook. f., Fl. Brit. India 7: 35. 1896.

Annuals; culms tufted 20-60 cm high, erect or creeping and decumbent, rooting at the lower nodes. Leaves 1-8 x 0.3-1 cm, ovate-lanceolate or linear-lanceolate, sheath keeled, hairy, margin tuberculate, ciliate towards base, undulate or one sided, rounded or cordate at base, ligule rows of hairs. Racemes 3-5, each 1-4 cm long, rachis flat, narrowly winged, bearing solitary or paired spikelet, pedicels with white glossy hairs. Spikelets

biseriate, elliptic. Lower glume ovate, upper glume broadly ovate, densely pubescent. Lower floret male, upper floret bisexual.

Ecology : Occasional along the margins of paddy fields and along wet sandy shores.

Fl. & Fr. : July-December.

Distrib. : West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Gujarat coast.

59. *Urochondra* C.E. Hubbard

Urochondra setulosa (Trin.) C.E. Hubbard.: Bor, 634. 1960; *Heleochoa dura* (Boiss) Boiss: Hook. f., Fl. Brit. India 7: 236. 1896.

Annual or perennial herb, clothed all over with minute velvety pubescent hairs, stem stout, ascending up to 25 cm. Leaves narrow, 7.5-15 cm long, involute, terete, coriaceous, glabrous, pungent, ligule a narrow line of hair. Inflorescence open panicle of small spikelets.

Spikelets one flowered; glume membranous, shining, greyish; palea hyaline. Caryopsis with a conspicuous beak.

Ecology : Coastal beaches and along the bank of salt water creeks and salt marshes.

Fl. & Fr. : December-February.

Distrib. : Endemic to Gujarat coast.

60. *Vetiveria* Bory.

Vetiveria zizanioides (L.) Nash: Bor, 258. 1960; *Andropogon squarrosus auct. non L.* f.: Hook. f., Fl. Brit. India 7: 186. 1896.

Strong perennial; culms 100-200 cm high, tufted erect with rhizomatous rootstock. Leaves 25-80 x 0.5-1 cm, linear to lanceolate, base narrowed and tapering down to sheath. Ligule annular, membranous, elliptic, 10-30 cm long, densely spiculate. Inflorescence-panicle in pairs, sessile spikelet lanceolate, acute. Lower glume muriculate on back, upper glume concave, spinulosely

muricate on the keel. Lower lemma empty, ciliate, upper lemma 3 mm long. Pedicelled spikelets dorsally compressed, lemma awnless. Caryopsis broader at base, linear towards apex.

Ecology : Along the banks of streams, backwaters and rivulets. Commonly used for checking soil erosion in waste lands.

Fl. & Fr. : August-November.

Distrib. : Throughout the coastal districts.

61. *Zoysia* Willd.

Zoysia matrella (L.) Merr.: Bor, 604. 1960; *Z. pungens* Willd.: Hook. in Hook. f., Fl. Brit. India 7: 99. 1896.

Perennial, culms tufted, erect, 5-30 cm high, rhizomatous, stoloniferous, forming mats, nodes glabrous. Leaves 1-2.5 mm x 0.1-0.3 cm linear, rigid, convolute, base pilose. Ligule membranous, fimbriate. Raceme spiciform, solitary, 1-5 cm long, purplish. Spikelets

2.5-3 mm, ovoid, laterally compressed, 1 flowered. Glume 1, coriaceous. Caryopsis 1.5 mm, oblong-ovoid.

Ecology : Common on the beaches and margins of stream, forming mats along the seashores.

Fl. & Fr. : March-September.

Distrib. : Throughout the coastal districts.

PTERIDACEAE

KEY TO THE GENERA

- 1a. Climbing ferns; pinnae serrate-dentate 2. *Stenochlaena*
 1b. Erect ferns; pinnae entire 1. *Acrostichum*

1. *Acrostichum* L.

KEY TO THE SPECIES

- 1a. Apex of pinnae rounded or lobed, always mucronate tip at apex 1. *aureum*
 1b. Apex of pinnae not rounded or lobed, always acuminate with sharp spinous tip at apex 2. *speciosum*

1. *Acrostichum aureum* L., Sp. Pl. 2: 1096. 1753; Bedd. Handbook Ferns British India 440. t. 268. 1892; Clarke in Ferns of Northern India 582. 1879.

Erect ferns, 1.5-2.5 m tall. Stipes many, woody, glabrous; each 50-200 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 at base, rounded or lobed with mucronate tip at apex; upper pinnae ruddy-brown. Sori densely covered along the undersurface of upper pinnae. Indusium absent.

Ecology : Common in mangrove swamps towards the back mangrove areas where the areas are under the occasional tidal flood and soils become acidic. It also occurs in deep black clay along the banks of creeks and canals.

Sori formation : May-December.

Distrib. : Throughout the Indian Mangrove swamps and Andaman and Nicobar islands except in Godavari-Krishna deltas and Gujarat coast.

2. *Acrostichum speciosum* Willd., Sp. Pl. 5: 117. 1810; Dixit & Sinha, Petridophytes of Andaman and Nicobar Islands 61. 2001.

Erect ferns, 1-1.5 m tall. Stipe 30-130 cm long; rhizome dark brown, scales larger than *Acrostichum aureum*. Fronds unipinnate; pinnae 6-12, alternate, each 6-10 x 1-1.5 cm, linear-oblong, cuneate at base, narrowly pointed at apex. Fertile pinnae smaller than sterile one. Sporangia with trichomous; paraphysis with many lobed apical cells.

Ecology : Frequent on backward mangrove swamps. Sometimes found on the rocky crevices along the intertidal regions.

Sori formation : June-November.

Distrib. : It is restricted only in Andamans and Nicobar islands, Roth island in south Andaman and Galathea Bay, Campbell Bay in Nicobar island.

2. *Stenochlaena* J. Sm.

Stenochlaena palustre Bedd. Ferns British India Suppl. 26. 1876; Clarke in Ferns of Northern India 577. 1879.

Climbing ferns, 6-10 m tall. Stipes woody, glossy; fronds simple pinnate, dimorphic. Sterile pinnae 20-25 x 3-6 cm, oblong-lanceolate, shining, serrate or dentate, acute at apex, cuneate at base; fertile pinnae

15-23 cm, linear-oblong, narrowly contracted into rolled margins.

Ecology : Common on back mangroves, on sandy uplands and inland rocky crevices.

Distrib. : Orissa coast, Chilka, Andaman islands.

Addition to the Coastal Flora in India

RANUNCULACEAE

Clematis L.

Clematis smilacifolia Wallich subsp. *andamanica* Kapoor in Kew Bull. 19:331. f. 1. 1965; Rau in Fl. India 1:1. 1993.

Woody climbers. Leaves usually simple, sometimes 1-3 foliolate, broadly ovate or elliptic-ovate, broadly cordate or rounded at base, entire or serrulate, subacute or mucronata at apex, 6-18 x 1.8-4 cm, subcoriaceous, glabrous. Flowers 3-5 cm across, in

axillary or terminal 3-many flowered, trichotomously branched panicles. Achenes hairy with 7 cm long feathery tails.

Ecology: Frequent along the coastal semi-evergreen hill slopes.

Fl. & Fr.: September-March.

Distrib.: Little Andaman. Endemic.

DILLENACEAE

Dillenia L.

Dillenia andamanica Parkinson in Indian For. 61: 425, t. 293. 1935; Majumdar in Fl. India 1: 152. 1993.

Trees up to 25 m high, deciduous. Leaves 25-45 x 10-15 cm, narrowly obovate to oblanceolate, acute at base, obtuse at apex, entire or dentate along margins. Flowers solitary or in pairs on long shoots. Fruits 2.5 cm

across, subglobose, orange in colour.

Ecology: Rare in tropical rainforest and coastal hills.

Fl. & Fr.: March-July.

Distrib.: Baratang in S. Andaman; Campbell bay in Great Nicobar island. Endemic to A. & N. islands.

Tetracera L.

Tetracera sarmentosa (L.) Vahl subsp. *andamanica* (Hoogl.) Hoogl. in Blumea 9: 588. 1959; Majumdar in Fl. India 1: 159. 1993. *Dillenia sarmentosa* L. var. *glabra* Hook. f. & Thomson in Fl. Brit. India 1: 31. 1872.

Climbers; young branches strigose with tufts of hairs. Leaves elliptic, obovate or oblong, rounded or

cuneate at base, acute or obtuse at apex, shallowly serrate in upper portion, 5-12 x 2-6 cm. Flowers 7-10 cm across. Seeds ovoid; aril fimbriate.

Ecology: Rare in tropical rainforest on littoral zone.

Fl. & Fr.: May-October; June-February.

Distrib.: Wrightnyo in South Andaman.

MAGNOLIACEAE

Magnolia L.

Magnolia andamanica (King) Raju & Nayar in Indian J. Bot. 3: 171. 1980.

Trees up to 10 m high; branches grey, glabrous. Leaves oblong-lanceolate, narrowed at base, acuminate at apex, 17-36 x 6-13 cm, glossy above. Flowers solitary,

fragrant, 6 cm across. Fruits globose. Seeds 1 cm across.

Ecology: Endemic to Andaman group of islands.

Fl. & Fr.: March-May.

Distrib.: Havelock island in South Andaman.

ANNONACEAE

Anaxagorea A. St-Hil.

Anaxagorea luzonensis A. Gray, Bot. Wilkes. U.S. Explor. Exped. 27. 1854; D. Mitra in Fl. India 1: 296. 1993.

Shrubs up to 2 m high. Leaves elliptic rarely oblong, cuneate, acuminate, 12-19 x 4-8 cm, glossy green above. Flowers solitary or in pairs, leaf-opposed. Ripe carpels follicular, up to 4 cm long. Seeds 1-2, shining black.

Ecology : Frequent in the tropical evergreen forests along the coastal slopes.

Fl. : July-August; **Fr.** : September-November.

Distrib. : Rutland island in South Andaman.

Artabotrys R. Br.

Artabotrys nicobarianus D. Das in Bull. Bot. Surv. India 11:194. 1969; D. Mitra in Fl. India 1: 252. 1993.

Climbing shrubs; stem blackish brown. Leaves elliptic, base cuneate, acuminate or caudate, 10-13.5 x 4-5.5 cm, glabrous. Flowers many in fascicles on recurved hooked peduncles. Ripe carpels not known.

Ecology : Rare on tropical forests on hilly areas near the coast.

Fl. & Fr. : March-April.

Distrib. : Sippighat near Port Blair in South Andaman. Endemic to the islands.

Cyathostemma Griff.

1. *Cyathostemma micranthum* (DC.) Sinclair in Gard. Bull. Sing. 14: 225. 1955; D. Mitra in Fl. India 1: 279. 1993.

Large woody climber; young branches sometimes twining around. Leaves oblong-lanceolate; slightly cuneate at base, acuminate, 5-8 x 2-4 cm, glabrous. Flower leaf-opposed or terminal, 2-5 in cymes, greenish-yellow. Ripe carpels many, sub-globose, 5-7 mm in diam.; stalks slender 2.5 cm long. Seeds in 2 rows, smooth, brown.

Ecology : Frequent in inland forests at sea level.

Fl. & Fr. : June-July.

Distrib. : Chiriatapu and Poona Nallah in South Andaman. Endemic.

2. *Cyathostemma viridiflorum* Griffith, Notul. 4:70. 1854 and in Icon. 4: t. 650. 1854; Hook. f., Fl. Brit. India 1: 57. 1872; D. Mitra in Fl. India 1: 280. 1993.

Climbers or scandent shrubs up to 5 m high. Leaves oblong-lanceolate or oblong-elliptic, slightly subcordate at base, acute, 10-20 x 5-8 cm. Flowers bisexual. Ripe carpels obtuse, irregularly bulged, thick walled; stalks stout, 2 cm long; seeds 5-6.

Ecology : Rare on coastal scrubs on littoral zone.

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

Distrib. : Chiriatapu in S. Andaman and Keralapuram in N. Andaman.

Goniothalamus Hook. f. & Thoms.

Goniothalamus malayanus Hook. f. & Thomson, Fl. Ind. 107. 1855 & in Fl. Brit. India 1: 75. 1875; D. Mitra in Fl. India 1: 236. 1993.

Trees up to 10 m high. Leaves elliptic-oblong, acute at base, acuminate at apex, 8-16 x 3-7 cm, margins wavy, glabrous. Flowers yellowish green, solitary, axillar or from the axils of fallen leaves, fragrant. Ripe carpels

oblong often with one constriction, apiculate and stipitate, 2.5-3.5 cm long, stalk 4-5 mm long. Seeds 2-5, shining dark brown, ovoid.

Ecology : Rarely found in coastal evergreen forests.

Fl. & Fr. : March-June.

Distrib. : Navy Dera in S. Nicobar.

Mezzettia Becc.

Mezzettia parviflora Beccari in Nuovo Giorn. Bot. Ital. 3: 188.1871; D. Mitra in Fl. India 1: 267. 1993.

Trees up to 20 m high. Leaves oblong-lanceolate, narrowed at base, acuminate, 7.5-12 x 2.1-3.4 cm, glabrous, petioles up to 1 cm long. Flowers fasciculate

axillary. Ripe carpels sessile, subglobose. Seeds oblong.

Ecology : Frequent in tropical rainforests of littoral regions.

Fl.: January-February.; **Fr.**: July-August.

Distrib. : Shoal Bay in S. Andaman.

Milusa Leschen. ex DC.

Milusa jainii Goel and Sharma in Nord. J. Bot. 10(6): 629.1990.

Trees up to 4 m high. Leaves elliptic to ovate-lanceolate, base rounded or acute, 3.5-18.0 x 1.2-7.5 cm, thinly coriaceous, unequally bilobed.; Inflorescence 1-3 flowered, axillary or extra-axillary; pedicels 1-2 cm long,

stout. Ripe carpels globose, 2-seeded, gridled with a horizontal groove. Seeds 9 mm across, sub-globose.

Ecology: Frequent in tropical rainforest of coastal region.

Fl. & Fr. : September-october.

Distrib.: Rutland islands of S. Andaman.

Orophea Blume

Orophea katschallica Kurz in J. Bot. 4: 323. 1875, Emend. Thoth. in Indian For. 92(8): 530, t.1. 1966; D. Mitra in Fl. India 1: 225. 1993.

Shrubs or small trees up to 4 m high; older branches glabrescent. Leaves oblong-lanceolate or elliptic, subcuneate at base, acuminate at apex, 12-18 x 4-7 cm, glabrous above. Flowers solitary or up to 4 together, creamy white. Fruits consisting of 3 carpels, cylindric or liner

oblong, constricted between seeds, wrinkled longitudinally when dried, pointed at apex, up to 10 cm long. Seeds 6-8.

Ecology : Frequently occurs in evergreen forests in coastal belt.

Fl.: June-September; **Fr.**: December-January.

Distrib. : Harminder Bay in L. Andaman, Katchal island in N. Nicobar, Laful forest in S. Nicobar. Endemic.

Polyalthia Blume

Polyalthia simiarum Benth. Hook. f. & Thomson in Fl. Brit. India 1: 63. 1872; D. Mitra in Fl. India 1: 276. 1993

Trees up to 25 m high. Leaves ovate-oblong to oblong-lanceolate, obliquely cordate at base, acuminate at apex, 12.5-30 x 5-12 cm, glabrous. Flowers in fascicles from the leaf axils or the leaf scars. Ripe carpels numerous, ovoid

to ellipsoid, apiculate, 2.5-3.5 cm long, orange red or bluish black; stalks up to 4 cm long. Seed one, transversely ribbed.

Ecology : Frequent in coastal hill slopes on littoral zone.

Fl.: April-June; **Fr.**: July-November.

Distrib. : Katchal island in N. Nicobar.

MENISPERMACEAE

Cissampelos Miq.

Cissampelos pareira L. var. **hirsuta** (Buch.-Ham. ex DC.) Forman in Kew Bull. 22: 356.1968; Gangopadhyay in Fl. India 1: 317. 1993.

Lianas. Leaves ovate to orbicular, apiculate, peltate-cordate at base, 5.5 x 4 cm, hairy beneath; petioles 10 cm long. Female inflorescences longer than the male,

with many conspicuous bracts. Flowers greenish white. Drupes ovoid subglobose, red colour, pilose.

Ecology : Evergreen forests near the coast.

Fl. & Fr.: June-September.

Distrib. : Andaman & Nicobar Islands. Rare.

Cyclea Arn. ex Wight

Cyclea peltata (Lam.) Hook. f. & Thomson, Fl. Ind. 201. 1855 & in Fl. Brit. India 1: 104. 1872, p.p.; Gangopadhyay in Fl. India 1: 321. 1993.

Twining shrubs with grooved branches. Leaves triangular ovate, deltaoid, elongate-ovate or ovate-oblong, truncate, obtuse or subcordate at base, obtuse, acute, acuminate or apiculate at apex, 5-12 x 4-8 cm, pilose. Flowers green,

pedicellate. Female inflorescence panicles, pilose, flowers sessile; staminodes 6. Drupes obovoid, 3-4 x 3-4 mm, pilose.

Ecology : Rare in tropical swamp forests on coastal wetlands.

Fl. & Fr.: April-May.

Distrib. : Dugong creek in L. Andaman.

Pycnarrhena Miers ex Hook. f. & Thoms.

Pycnarrhena longifolia (Decne ex Miq.) Becc. Malesia 1: 160. 1877; *Cocculus longifolius* Decne ex Miq., Ann. Mus. Bot. Lugd. Bot. 4: 84. 1868; Hazra *et al.* in Fl. And. & Nic. 1: 101. 1999.

A suberect or climbing shrub. Leaves elliptic to narrowly elliptic to lanceolate elliptic, base obtuse to rounded, apex acuminate, 8-12 x 3-6 cm. Inflorescence

ramiflorous, fasciculate, peduncles 1-flowered. Male and female yellow. Drupes globose; endocarp crustaceous.

Ecology : Frequent in littoral forests along with mangroves.

Fl. & Fr.: December-February.

Distrib. : Dugong creek in L. Andaman and Karmatang in Middle Andaman.

ACTINIDACEAE (SOURAUIACEAE)

Saurauia Willd.

Saurauia bracteosa DC. in Mem. Soc. Phys. Hist. Nat. Geneve 1: 422. 1822; Paul in Fl. India 3: 199. 1993.

Trees, 8 m high. Leaves elliptic oblong, rounded at base, acuminate at apex, 35 x 15 cm, dentate serrate, scaly above, densely tomentose and scaly beneath. Flowers in corymbs; bracts foliaceous, scaly. Petals

notched at apex. Berries 1 x 0.6 cm, densely white, tomentose. Seeds pyramidal, reticulate.

Ecology : Rare in littoral forests.

Fl. & Fr.: February-April.

Distrib. : Campbell Bay, Andaman

ICACINACEAE

Codiocarpus Howard

Codiocarpus andamanica (Kurz) Howard in Brittonia 5: 1943; Mast. in Hook. f., Fl. Brit. India 1: 588. 1875.

Trees, 3-30 m high; branchlets yellow-puberulous, terete, with striation in younger portions. Leaves coriaceous, dark green and glossy above, pale beneath, oblong to elliptic-lanceolate, elliptic to elliptic-oblong or obovate to obovate-oblong, up to 24 x 10.5 cm acuminate at apex rounded, truncate or cuneate at base.

Inflorescences cymose, axillary or on leafless branches up to 3 cm long, white. Seed 14 x 4 mm, with 6-7 veins, anastomosing on dorsal side and a single longitudinal median furrow on ventral side.

Ecology : Common in tropical rain-forests, on coastal hills.

Fl. & Fr. : December-May or almost throughout the year.

Distrib. : Andaman Islands.

Iodes Blume

Iodes cirrhosa Turcz. in Bull. Soc. Nat. Moscow 27 (2): 281. 1854; *I. ovalis* sensu Mast. in Hook. f., Fl. Brit. India 1: 596. 1875 non Bl. 1828.

Climbers, ochraceous-pubescent; branchlets terete. Leaves thinly coriaceous, glabrescent above, densely pilose beneath, broadly ovate to elliptic or oblong-elliptic to lanceolate, up to 15 x 8 cm, mucronate or acute at apex, rounded, subcordate or rarely cuneate at base. Male inflorescences in much branched and many flowered, rather lax cymes, up to 35 cm long. Female

inflorescences few-flowered, up to 6 cm long. Drupes oblong-ellipsoid or ovoid, up to 2 x 1.5 cm, laterally compressed and crested. Seed oblong, 1 x 3 mm, pubescent towards distal end.

Ecology: Rare in the littoral forests or edges of evergreen forest on rocky loam soil.

Fl. & Fr.: April-October.

Distrib.: South Nicobar.

CAPPARACEAE

Capparis L.

1. *Capparis cantoniensis* Lour. Fl. Cochinch. 331. 1790; Raghavan in Fl. India 2: 260. 1993. *C. pumila* Champ.: Hook. f. & Thomson in Fl. Brit. India 1: 177. 1872.

Climbing or scandent shrubs. Leaves elliptic, oblong-lanceolate, cuneate or attenuate at base, bluntly acuminate at apex, 6-9 x 1.5-3.2 cm, glabrous. Flowers white fragrant, pedicellate in few flowered corymbs or umbels arranged in large terminal panicles. Petals white. Fruit ellipsoid or globose with pointed tip, faintly ribbed, 0.5-1.8 x 0.4-0.8 cm, reddish.

Ecology: Frequent in coastal semi-evergreen forests and coastal scrubs.

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

Distrib.: S. Andaman and Tamil Nadu coast.

2. *Capparis floribunda* Wight, Illus.: 1: 33, t. 14. 1840; Hook. f. & Thomson in Fl. Brit. India 1: 177. 1872.

Scandent, woody shrubs. Leaves oblong or elliptic tapering at base, rounded to obtuse at apex, 4 x 3.5-5 cm, entire, lateral nerves 7-10 pairs. Flowers white,

fragrant, at the tops of axillary panicles. Fruit globose, shortly beaked at apex, orange-red with thin stipe.

Ecology: Occasional in littoral forests and coastal scrubs.

Fl. & Fr.: January-April; May-June.

Distrib.: Lamia Bay and Ramnagar in N. Andaman and Hut Bay in L. Andaman.

3. *Capparis tenera* Dalz. in Hook. J. Bot. Kew Gard. Misc. 2: 14. 1850; Hook. f. & Thomson in Fl. Brit. India 1: 179. 1872; Raghavan in Fl. India 2: 297. 1993.

Scandent shrubs with stipular recurved thorns. Leaves distichous, ovate-elliptic or ovate-oblong, subcordate at base, caudate-acuminate at apex, 5-10 x 2-5 cm, herbaceous to subcoriaceous. Flowers white, fragrant, 2-4 in a row above the axils. Fruits subglobular, deep orange or red when ripe; seeds 3-4.

Ecology: Rare in coastal evergreen forests and coastal scrubs.

Fl. & Fr.: February-June.

Distrib.: Portlob island and Chouldari in S. Andaman.

VIOLACEAE

Rinorea Aubl.

Rinorea bengalensis (Wallich) O. Ktze, Rev. Gen Pl. 1: 42. 1892; Banerjee and Pramanik in Fl. India 2: 348. 1993.

Shrubs or small trees up to 4 m high. Leaves elliptic-lanceolate or ovate, acute at base, acuminate at apex, crenate or serrate along margins, 6-18 x 2-9 cm, glabrous. Flowers small, white, on slender pedicels in axillary fascicles, globular. Capsules globose, 3-valved,

longitudinally dehiscent; seeds 3-4, globose, glabrous.

Ecology: Frequent in littoral hills and moist evergreen forests near the coast.

Fl. & Fr.: January-November.

Distrib.: Myomyo in S. Andaman, Hut Bay in L. Andaman.

Rinorea longiracemosa (Kurz) Craib. Fl. Siam. Enum. 1:90. 1925; Banerjee & Pramanik in Fl. India 2: 350. 1993.
Alsodeia racemosa Hook. f. & Thomson in Fl. Brit. India 1: 187. 1872.

Shrubs or small trees up to 3 m high. Leaves oblong-lanceolate to elliptic-obovate, cuneate at base, acuminate at apex, serrate, 5.16 x 2.5-5 cm, glabrous.

Racemes axillary, 5-10 cm long, flowers yellowish-white. Capsules subglobose, 3-sided with blunt angles, up to 1.5 cm long. Seeds 6.

Ecology: Rare in coastal inland forests.

Fl. & Fr.: February-May.

Distrib.: Katchal island in N. Nicobar.

FLACOURTIACEAE

Flacourtia Comm. ex L'Herit.

Flacourtia jangomas (Lour.)Racusch, Nomencl. Bot. ed. 3: 290. 1797; Mitra in Fl. India 2: 403. 1993; Hook. f. & Thomson in Fl. Brit. India 1: 193. 1872.

Small trees up to 6 m high, dioecious; trunks and branches with simple and branched thorns when young. Leaves ovate to ovate-lanceolate, cuneate to rounded at base, acuminate at apex, crenate along

margins, 5-11 x 3-5 cm, glabrous above. Flowers greenish white mostly in glabrous racemes. Berries 2 cm across, purple when ripe.

Ecology: Rare in dry sandy areas on backshores.

Fl. & Fr.: March-October.

Distrib.: Katchal island in N. Nicobar.

Scolopia Schreb.

Scolopia acuminata D. Clos. in Ann. Sci. Nat. 4, 8: 250. 1857. *Scolopia crenata* (Wight. & Arn.) Clos.: Hook. f. & Thomson. in Fl. Brit. India 1: 191. 1872.

Evergreen tree up to 8 m high; trunk usually armed with spines when young, branches of older trees unarmed. Leaves alternate, variable, ovate, ovate-lanceolate, elliptic to elliptic lanceolate, cuneate or obtuse at base, subacute to bluntly sub-acuminate at apex, minutely crenate to subentire along margins, 5-15 x 2.5-7.5 cm, glossy above, glabrous, minutely glandular at the

junction of petiole and lamina. Flowers in axillary or terminal racemes. Berry globose to subglobose, apiculate, 2-3 to many seeded, 1.5-1.7 cm across.

Ecology: Frequent in coastal forests; common in lowland evergreen forests.

Fl. & Fr.: March-April; July-October.

Distrib.: West coast; Middle and S. Andaman. Seeds used to extract essential oil.

CARYOPHYLLACEAE

Arenaria L.

Arenaria neelgherrensis Wight & Arn., Prodr. 43. 1834; Hook. f., Fl. Brit. India 1: 239. 1872.

Erect herbs; stem much branched. Leaves obovate, subsessile, 6-15 x 3-6 mm, glabrous, gland dotted, obtuse at base. Flowers 3-4 mm across, solitary, axillary or in terminal cymes. Capsule ovoid,

as long as sepals; seed compressed, transversely striated.

Ecology: Rare in rocky coastal slopes.

Fl. & Fr.: April-August.

Distrib.: Western Ghats, Tamil Nadu and Karnataka coast.

XANTHOPHYLLACEAE

Xanthophyllum Roxb.

Xanthophyllum andamanicum King in J. Asiat. Soc. Bengal 59(2): 135. 1891; Banerjee & Balakrishnan in Fl. India 2: 495.1993.

Evergreen trees, up to 25 m high. Leaves elliptic-ovate to lanceolate, cuneate at base, subacute at apex, 8-13 x 3-5 cm, glaucous beneath. Inflorescence paniculate,

white with pinkish tinge. Fruits globose.

Ecology: Rare in tropical evergreen forests on littoral hill slopes.

Fl. & Fr.: February-May.

Distrib.: Wrightmyo in S. Andaman.

CLUSIACEAE

Garcinia L.

1. *Garcinia nervosa* Miq., Ann. Mus. Bot. Ludg.-Bat. 1: 208.1864; Singh in Fl. India 3:121.1993. *G. andersoni* Hook. f., Fl. Brit. India 2: 270. 1874.

Trees, up to 6 m high; branchlets 4-angled, almost winged when dry. Leaves oblong-lanceolate, narrowed to rounded at base, shortly acuminate apex, 20-56 x 5-15 cm, margins recurved, glossy above, pale yellowish below. Male flower, ciliate pubescent outside. Berries pomiform, crowned by persistent stigma.

Ecology: Frequent in semi-evergreen forests on littoral hill slopes.

Fl. & Fr.: May-July.

Distrib.: Car Nicobar and Kathchal islands in Nicobar.

2. *Garcinia speciosa* Wallich, Pl. Asiat. Rar. 3: 37, t. 258.1832; T. Anderson in Fl. Brit. India 2:260.1874; Singh in Fl. India 3: 125.1993.

Trees, up to 16 m high; young branches slightly tetragonous, grooved; bark peeling in flakes. Leaves elliptic-oblong narrowed at both ends, 15-35 x 5-10 cm, leathery. Male flowers, bright yellow, fragrant; female flowers, solitary, fragrant. Berries up to 5 cm in diam., bright red when ripe with persistent sepals.

Ecology: Rare in coastal forests on the islands of littoral rocks.

Fl. & Fr.: January-July.

Distrib.: Rutland Island in S. Andaman and Car Nicobar.

Mesua L. emend Kosterm.

Mesua ferrea L., Sp. Pl. 515.1753; T. Anderson in Hook. f., Fl. Brit. India 1: 277.1874; Singh in Fl. India 3: 136. 1993.

Evergreen trees, up to 25 m high with trunk often buttressed at base; bark thin, greyish-brown. Leaves opposite decussate, linear-lanceolate, acute at base, acuminate at apex, dark green, glossy above, rigidly coriaceous, under surface covered with a whitish powder.

Flowers large, white sweet scented, axillary and terminal. Fruits 2.5-3.5 cm, globose with a prominent conical point. Seeds pyriform.

Ecology: Frequent in tropical rain-forests near the coast.

Fl. & Fr.: January-May; June onwards.

Distrib.: Wrightmyo (Kalatone forest) in S. Andaman and Kalpong in N. Andaman.

Pociloneuron Bedd.

Pociloneuron indicum Bedd., J. Linn. Soc. VIII. 267, 1: 278. 1872. Hook. f., Fl. Brit. India 1: 278. 1874.

Large tree often buttressed, 25-30 m tall; bark greyish brown. Leaves 10-20 x 1.5-2 cm, elliptic-oblong, coriaceous, acuminate at apex, obtuse at base. Flowers

1.5-2 cm across, yellowish white, fragrant, arranged in 10-15 cm long panicles. Fruit ellipsoid, 1-seeded

Ecology: Frequent or rare in Ghat forests near the coast.

Fl. & Fr.: June-August.

Distrib.: West peninsular coast.

Calophyllum L.

1. *Calophyllum calaba* L. var. *bracteatum* (Wight) P. Stevens, in J. Arn. Arb. 61: 261. f. 13. 1980. Hook. f., Fl. Brit. India 1: 272. 1874.

Trees, up to 30 m high; bark yellowish, with strong horizontal fissures; exudate yellow, watery. Leaves 3-11 x 1.5-4.5 cm, elliptic to oblong lanceolate, acute to rounded at base, obtuse to shortly acuminate at apex. Flowers white or light yellow, bisexual, scented in racemes. Fruits globose or pisiform with spherical stone.

Ecology: Frequent along the littoral forests on sandy and rocky areas.

Fl. & Fr.: October-May.

Distrib.: Andaman group of islands.

2. *Calophyllum soulattri* Burm. f., Fl. Ind. 2: 121. 1768; Singh in Fl. India 3: 96. 1993. *C. wallichianum* auct. non Planch. & Triana : Anderson in Hook. f., Fl. Brit. India 1: 273. 1874.

Trees, up to 40 m high; bark grey or brown with boat-shaped fissures; exudate usually white. Leaves ovate to ovate-oblong or elliptic-oblong, cuneate at base, acute to acuminate at apex. Racemes 7-21 flowered, axillary or terminal. Flowers white, scented, sepals white, unequal, petals absent. Drupes glabrous, mucronate with persistent style base; pericarp thick; stone 0.7-1.1 x 0.65-1 cm, subspherical, basal plug sometimes present.

Ecology: Rare in beach forests.

Fl. & Fr.: March-October.

Distrib.: Nicobar island.

DIPTEROCARPACEAE

Hopea Roxb.

1. *Hopea odorata* Roxb. Hort. Beng. 42; Dyers in Hook. f., Fl. Brit. India 1: 308. 1874.

A large tree, 20-35 m tall with large cylindrical trunk. Leaves 10-15 cm long, ovate-lanceolate, glabrous, acute at apex, rounded at base. Flower 6 mm long, yellowish, fragrant, arranged in grey tomentose axillary panicles. Fruit a nut, ovoid with linear wings.

Ecology: Close to streams rivers and ravines in coastal tropical evergreen forest.

Fl. & Fr.: March-April

Distrib.: Andaman, Kerala, Karnataka and Tamil Nadu.

2. *Hopea parviflora* Bedd., Fl. Sylvat. t. 7. 1869; Dyers in Hook. f., Fl. Brit. India 1: 308. 1874.

Large trees, 15-20 m. Leaves ovate to oblong entire. Flowers in unilateral, tomentose panicles. Sepals obtuse, imbricate, tomentose. Petals glabrous. Fruits enclosed in the accrescent sepals. Straw coloured winged.

Ecology: Common in moist evergreen forests on coastal ghats.

Fl. & Fr.: February-April.

Distrib.: Kerala, Karnataka.

Vateria L.

Vateria indica L., Sp. Pl. 515. 1753; Dyers in Hook. f., Fl. Brit. India 1: 313. 1874.

Evergreen resinuous and oil yielding trees, 20-30 m tall. Leaves 9-22 x 5-11 cm, oblong or elliptic oblong, apex obtuse or minutely acuminate, base rounded. Flowers less, in drooping panicles. Fruits fleshy,

large, ovoid, rough.

Ecology: Frequent in coastal Ghat forests.

Fl. & Fr.: July-September.

Distrib.: Western Ghats, South Kanara, Karnataka and Kalikot.

TILIACEAE

Grewia L.

Grewia calophylla Kurz : Masters in Hook. f., Fl. Brit. India 1: 392. 1874.

Trees, 6-10 m high. Leaves ovate-lanceolate, ovate-elliptic or oblong elliptic, 12-18 x 3-8 cm, apex acuminate, rounded or subacute at base, entire, coriaceous, glabrous. Flowers in terminal panicles, petals pink, linear

oblong; androgynophore 1.2 mm long. Drupes rhovoid, tapering at base, glabrous, orange-yellow.

Ecology: Frequent in semi-evergreen coastal forests.

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

Distrib.: Andaman and Nicobar Islands.

BALANITACEAE

Balanites Del.

Balanites aegyptica (L.) Del. Fl. Aegypt. III. 263. t. 28. f. 1. 1813. *B. roxburgii* Planch.: Bennett in Hook. f., Fl. Brit. India 1: 522. 1875.

Armed tree 8 m high. Leaves 2-foliolate; leaflet elliptic-oblancoolate, glabrescent 3 x 1 cm, thin-coriaceous, apex obtuse, apiculate; base subacute. Cymes

axillary, 2.5 cm. Flowers 1 cm across. Fruits drupe ovoid-oblong, 4.5 x 3 cm, woody. Seeds solitary.

Ecology: Drier parts of the coast.

Fl. & Fr.: March-April; April onwards.

Distrib.: Gujarat coast.

RUTACEAE

Paramignya Wight

Paramignya andamanica (L.) Tanaka: *P. armata* (Thw.) Bedd. ex Oliv., J. Linn. Soc. Bot. 5 Suppl. 2:43. 1861; Hook. f., Fl. Brit. India 1: 511. 1875.

Much branched scandent shrub, with many axillary spines. Leaves 3.7-7.6 x 1.6-3.5 cm, aromatic, ovate-lanceolate or oblong-lanceolate, entire, acute or obtuse at apex, base rounded. Inflorescence axillary,

flowers 3-7 together, greenish white. Fruit globose-ovoid, 8-18 mm in diameter, yellow, 1-4 seeded.

Ecology: Frequent in tropical evergreen forests of the coastal islands.

Fl.: November-March; **Fr.:** March-May.

Distrib.: Dhanikhari in S Andaman, Lamia Bay to Kalipur in N. Andaman, Kimus in N. Nicobar. Endemic.

Triphasia Lour.

Triphasia trifolia (Burm. f.) Wilson in Torrey 9: 33. 1909. Hook. f., Fl. Brit. India 1: 506. 1875.

Shrubs with spines, generally in pairs, sometimes solitary. Leaves alternate, sessile, 3-foliolate; leaflets elliptic to ovate, terminal one larger, apex retuse, margin crenate. Flowers solitary or in 3-flowered cymes, axillary, sweet

scented. Berry small, ovoid, 1-3 seeded, edible; seeds oblong.

Ecology: Rare in coastal forests. Cultivated for fruit syrup.

Fl. & Fr.: January-June.

Distrib.: North and central Nicobar and south India.

Glycosmis Corr.

Glycosmis mauritiana (Lamk.) Tanaka Bot. Not. 159.1928. *G. pentaphylla* (Retz.) Corr: Hook. f., Fl. Brit. India 1: 499. 1875.

Shrubs, up to 3 m high. Leaves usually with 3-5 leaflets, rarely with 1-2 or 6-7 leaflets; leaflets thin, coriaceous, pale beneath, 4-10 x 1.5-4 cm, elliptic to somewhat ovate or obovate, acuminate to subcordate.

1a. Leaves oblong or elliptic lanceolate or oblanceolate. Panicles up to 5 cm long :

2a. Leaves pinately 3-1 foliolate 1. var. *andamanensis*

2b. Leaves pinnately 5-3 foliolate 3. var. *insularis*

1b. Leaves ovate or obovate. Panicles more than 5 cm long :

3a. Leaves pinnately 3-1 foliolate 4. var. *latifolia*

3b. Leaves pinnately 3-4 foliolate 2. var. *fuscescens*

1. var. *andamanensis* (Narayanaswami) Mitra & Subramanyam, J. Arnold Arbor. 50: 156. 1969.

Small trees. Leaves pinately 3-1 foliolate; leaflets elliptic-lanceolate, 9-20 x 4.2-8.0 cm. Inflorescences axillary short panicle, 3-4 cm long.

Ecology : Rare in tropical evergreen forests in littoral zone.

Fl. & Fr. : September-February; April-October.

Distrib. : Endemic to Andaman and Nicobar Islands.

2. var. *fuscescens* (Kurz) Mitra & Subramanyam, J. Arnold Arbor. 50: 156. 1969.

Small trees. Leaves pinnately 3-4 foliolate; leaflets ovate or obovate. Inflorescences axillary panicle, 6-7 cm long.

Ecology : Rare in coastal scrubs.

Fl. & Fr. : January-March.

Distrib. : Andaman and Nicobar islands.

Inflorescences axillary, bi-pinnate; bractcoles minute, deltoid, puberulent. Flowers in cymes, 4-5 merous, sepals ovate-deltoid, concavo-convex, ciliolate, obscurely few glandular; petals elliptic or subovate, sparsely glandular, 4-6 x 1.8-2 mm; stamens with few hairs near apex of anther. Fruit subglobose, 10 mm in diameter, 1-seeded.

3. var. *insularis* (Kurz) Tanaka. Journ. Indian Bot. Soc. 16: 229. 1937. *G. arborea* var. *insularis* Kurz, Journ. Bot. 14:38. 1876, pro parte. *G. pentaphylla* var. *insularis* (Kurz) Narayanaswami, Rec. Bot. Surv. India 14.1:20. 1941.

Trees. Leaves pinately 5-3 foliolate; leaflets oblong or elliptic lanceolate or oblanceolate, 9-20 x 4.5-7 cm. Inflorescences axillary panicle, up to 5 cm long.

Ecology : Frequent on coastal hill slopes.

Fl. : October-January; **Fr.** : January-May.

Distrib. : South Nicobar.

4. var. *latifolia* (Kurz) Balakr. in Bull. Bot. Surv. Ind. 22:173. 1980.

Shrubs or small trees. Leaves pinnately 3-1 foliolate; leaflets 14-21 x 7.5-10.2 cm. Inflorescences axillary panicle, 5-9 cm long.

Ecology : Frequent in littoral forests.

Fl. & Fr. : December-April.

Distrib. : Endemic to Nicobar Islands.

BURSERACEAE

Commiphora L.

Commiphora wightii (Arn.) Bhandari in Bull. Bot. Surv. India 6: 327. 1964; *Balsamodendron wightii* Arn.: Hook. f., Fl. Brit. India 1: 529. 1872.

Bushy shrub; leaflet 1-3, rhomboid-ovate, 1.2-2.4 x 0.9-1.7 cm, acute, entire towards the base and serrate near the apex, lateral leaflets when present much shorter.

Flowers solitary or in fascicled cymes at the end of branches. Drupes ovoid, shortly beaked, deep red in colour.

Ecology : Rare in rocky coastal slopes and islands.

Fl. & Fr. : January-May.

Distrib. : Orissa, Chilka lake.

SIMAROUBACEAE

Harrisonia R. Br.

1. *Harrisonia brownii* A. H. L. Juss. in Mem. Mus. Hist. Nat. Paris 12: 540. t. 28, no. 47. 1825; *H. bennettii* in Hook. f., Fl. Brit. Ind. 1: 519. 1875.

Scandent shrubs, about 3 m high; branches prickly. Leaves ternate; apical leaflets largest and gradually narrowing into the petiole, ovate rhomboid, acuminate; lateral leaflets usually oblique, cuneate towards the rachis. Flowers few, white. Drupes glabrous. 0.5 cm across, green, entire.

Ecology : Frequent in littoral forests and coastal scrubs.

Fl. & Fr. : June-October; July-November.

Distrib. : S. And.; Baratang, Chiriatapu; M. And.; Bakultala.

2. *Harrisonia perforata* (Blanco) Merr. in Philip. J. Sc. Bot. 7: 236. 1912; Bennett in Hook. f., Fl. Brit. India 1: 519. 1875.

Scandent shrubs, 5 m high. Leaves 8-16 cm long, leaflets ovate, glabrous, crenate. Flowers with pubescent pedicels; calyx lobes persistent. Drupes slightly lobed.

Ecology : Frequent in the bay islands in littoral parts.

Fl. & Fr. : December-May; February-August.

Distrib. : South Andaman; Havelock, Rangat Bay; North Andaman; Aerial Bay.

MELIACEAE

Aglaia Lour.

Aglaia lawii (Wight) Saldanha ex Ramamoorthy in Saldanha & Nicolson, Flora of Hassan District 392, Pl. 76. 1976; *A. andamanica* Hiern, in Hook. f., Fl. Brit. India 1: 555. 1875.

Trees up to 30 m high with white latex. Leaves imparipinnate, ovate or obovate in outline, leaflets 2-7, laterals or subopposite, 4-30 x 1.5-11.5 cm, asymmetrical, elliptical, ovate or obovate, acuminate or acuminate-caudate at apex with the obtuse acumen 5-15 mm long, usually broadly cuneate but occasionally

rounded, attenuate or cordate at the asymmetrical base. Flowers 1.5-4.5 x 1.5-5 mm, obovoid or subglobose, corolla a short tube connate with the base of the staminal tube.

Ecology : Common in coastal evergreen forests in hilly areas.

Fl. & Fr. : October-January; January-March.

Distrib. : Baratang, Bakultala, Ramnagar, Harmander Bay in Andaman.

Walsura Roxb.

Walsura candollei King in J. Asiat. Soc. Beng. 64: 85. 1895. *W. ternata* Roxb.: Hook. f., Fl. Brit. India 1: 563. 1875.

Trees. Leaves imparipinnate, 10-17 cm long; leaflets-5, 5-10 cm long, lanceolate, apex acute, rounded at the base, pale beneath. Flowers in corymbose panicles, yellow; Berry 2 cm long, ovoid-globose, densely and minutely rusty puberulous.

Ecology : Frequent in inland semi-evergreen forests near the coast.

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

Distrib. : Baratang (Bamboo nallah side) in S. Andaman. Endemic to Andaman islands.

OLACACEAE

Ximenia L.

Ximenia americana L., Sp. Pl. 1193. 1753; Mast. in Hook. f., Fl. Brit. India 1: 574.1875.

A root parasite or small trees, 4-5 m high; branchlets straight, stiff, angled and armed with straight spines, blackish-brown to grey, ribbed, lenticellate. Leaves coriaceous, pinkish-brown to black when dry, ovate to broadly elliptic or obovate, up to 6 x 3.5 cm, emarginate or obtuse with a short mucro at apex, cuneate

or rounded at base, entire; lateral nerves 4-8 pairs. Flowers yellowish-white or white, 1.2 cm across. Drupes globose, 2 cm across, ripens yellow, edible, used as substitute of ghee.

Ecology : Occasional in littoral forests.

Fl. & Fr. : February- November.

Distrib. : North & South Andaman. North Nicobar.

Olax L.

Olax imbricata Roxb., Fl. Ind. 1: 164. 1820; Hook. f., in Fl. Brit. India 1: 575. 1875.

Scandent shrubs. Leaves ovate oblong or oblong lanceolate, acute or acuminate at apex, rounded at base, 15 x 5.8 cm; lateral nerves 4-7 pairs. Flowers greenish white, fragrant, 1.2 cm long. Drupes globose,

1 cm across, orange.

Ecology : Rare in coastal scrub forests.

Fl. & Fr. : December-October.

Distrib. : Andaman & Nicobar Islands.

OPILIACEAE

Champeria Griff.

Champeria manillana (Bl.) Merr. in Philipp. J. Sci. Bot. 7:233.1912. *C. griffithiana* Planch. in Hook. f., Fl. Brit. India 5: 236.1886.

Trees or shrubs, 2-10 m high; branchlets terete, yellowish-brown when young, greyish to pale brown at maturity, smooth, flexuous. Leaves subcoriaceous, granulate, elliptic to elliptic-oblong, ovate-oblong or lanceolate, up to 21 x 8.7 cm, acuminate or acute at apex,

cuneate, attenuate, rounded or rarely oblique at base. Panicles up to 10 cm long. Drupes up to 1.7 x 1 cm, ripens orange-red. Seed 1, oblong, 10 x 5 mm, white or yellow, grooved at base.

Ecology : Common in the inland and littoral forests.

Fl. & Fr. : February-April.

Distrib. : Andaman islands and North Nicobar.

CELASTRACEAE

Glyptopetalum Thw.

Glyptopetalum calocarpus (Kurz) Prains in J. Asiat. Soc. Bengal 60 (2): 209. 1891; *Euonymus calocarpus* Kurz: Hook. f., Fl. Brit. India 1: 609.1875.

Shrubs or small trees, 1-2 m high. Leaves coriaceous, elliptic to oblong or oblong-lanceolate, up to 16 x 8 cm, shortly and bluntly acuminate to subacuminate at apex, cuneate at base, entire and slightly incurved. Flowers greenish-white, 3 mm long. Capsules 1.5 cm

across, 1-4 loculed, dark brown. Seed 1 in each cell, globose, red.

Ecology : Scarce in the littoral forests or hilly areas at low altitudes.

Fl. & Fr. : July-December.

Distrib. : North & South Andaman, North Nicobar. Endemic to Andaman and Nicobar Islands.

***Leoseneriella* A. C. Sm.**

***Leoseneriella cumingii* (Laws.) Ding Hou.** in Blumea 12: 32. 1963. *Hippocratea cumingii* Laws. in Hook. f., Fl. Brit. India 1: 624. 1875.

Scandent shrubs; branchlets terete, dark brown to black. Leaves coriaceous, up to 11.5 x 6.5 cm attenuate or rarely rounded at base; lateral nerves 5-8 pairs. Inflorescences in axillary and terminal, 2-4 times

dichotomously branched cymes, up to 12 cm long, puberulous. Flower buds yellowish, 3.5 mm long, densely puberulous.

Ecology : Scarce in the littoral forests especially on rocks at sea level.

Fl. & Fr. : February-April.

Distrib. : North Nicobar.

***Reissantia* Hall.**

***Reissantia grahmi* (Wight) Ding Hou** in Blumea 12: 33. 1963. *Hippocratea grahmi* Wight: Laws. in Hook. f., Fl. Brit. India 1: 624. 1875.

Lianas or rarely trees 15 m high; branchlets terete, blackish, greyish or pinkish-brown, smooth or sometimes fissured. Leaves subcoriaceous or coriaceous, greyish green or blackish-brown above and coppery brown beneath when dry, broadly elliptic to elliptic, oblong to oblong-elliptic, ovate-oblong to oblong-elliptic, ovate-oblong to ovate-elliptic or rarely oblanceolate, 5-16 x 2-9 cm, shortly acuminate, obtuse or acute at apex,

cuneate, rounded or rarely oblique at base, entire and slightly incurved. Flowers pale greenish-white or yellowish-green, 2 mm across. Ripe carpels oblong or obovoid-oblong, 5.5-10.5 x 2.5-4 cm, obtuse or truncate at apex, narrowed towards base, brown when dry, pericarp woody, striate. Seed ellipsoid or ovoid-oblong, 2 x 1 cm, wings pale to pinkish brown when dry.

Ecology : Rare in littoral forests and inland semi-evergreen forests.

Fl. & Fr. : January-September; September-February.

Distrib. : South Andaman.

***Salacia* L.**

***Salacia nicobarica* (Kurz) Raju** in J. Biol. Sci. 8:58. 1965. *S. flavescens* Kurz in J. Asiat. Soc. Beng. 1872. Pt. 2: 300; Hook. f., Fl. Brit. India 1: 625. 1875.

Lianas; branchlets terete, blackish, sparsely or minutely lenticellate. Leaves coriaceous, elliptic to elliptic-oblong or elliptic-lanceolate, up to 18.5 x 8.1 cm, shortly and bluntly acuminate at apex, cuneate or rounded

at base; lateral nerves 4-10 pairs. Inflorescences up to 4 x 5 cm. Flowers greenish or yellowish, 4 mm long. Fruits globose, 1.2 cm in diam., black, stalked.

Ecology : Rare in the coastal forests.

Fl. & Fr. : May-December.

Distrib. : Endemic to North Nicobar.

RHAMNACEAE

***Smythea* Seem. ex Gray**

***Smythea lanceata* (Tul.) Summerh.** in Kew Bull. 1928: 389. 1928; Bhandari & Bhansali in Nayar *et al.*, Fasc. Fl. India 20: 77. 1990.

Scandent shrubs; branchlets pale brown to pinkish-brown. Leaves greyish when dry, elliptic to elliptic-oblong or elliptic-lanceolate, ovate to ovate-oblong, up to 13 x 5 cm, acuminate at apex, oblique, rounded or cuneate at base, entire to distantly denticulate;

lateral nerves 3-6 pairs. Flowers greenish-white, 1.5 x 3 mm. Capsules greyish when dry, ovoid lanceolate, up to 8 x 3 cm, compressed. Seed broadly orbicular-obovoid, compressed.

Ecology : Rare in the littoral forests.

Fl. & Fr. : February-July.

Distrib. : South & Little Andaman; South Nicobar.

VITACEAE

Cissus L.

1. *Cissus pentagona* Roxb. Fl. Ind. 1: 408. 1820; Laws. in Hook. f., Fl. Brit. India 1: 646. 1875.

Climbers; branches pale yellowish, brownish to brownish-green, thick, succulent glossy. Leaves ovate or ovate-oblong, up to 10 x 6 cm, acuminate at apex, truncate or slightly sinuate to rounded at base, subentire to remotely bristly toothed; lateral nerves 4-5 pairs. Paniced cymes up to 6 cm long. Flowers yellowish or pinkish-brown, 2 mm long. Berries globose or obovoid, up to 6 x 5 mm, glossy black when mature.

Ecology : Common in littoral forests and inland hill slopes.

Fl. & Fr. : October-February.

Distrib. : North & South Andaman.

2. *Cissus repanda* Vahl, Symb. 3: 18. 1794; Laws. in Hook. f., Fl. Brit. India 1: 648. 1875.

Large climbers; stem compressed, deeply and longitudinally cracked, blackish. Leaves ovate, broadly cordate, usually somewhat angular or lobed, up to 15 x 15 cm, shortly and bluntly acuminate at apex. Cymes up to 6.2 cm long. Flowers reddish, 2 mm across. Berries drooping, obovoid, 9 x 6 mm, purplish-black.

Ecology : Frequent in coastal and inland forests.

Fl. & Fr. : April-October.

Distrib. : South Andaman, Nicobar Islands.

Tetrastigma Planch

Tetrastigma andamanicum (King) Suesseng. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20 d: 319. 1953. *Vitis andamanicum* King in J. Asiat. Soc. Bengal 65: 393. 1896; Hajra *et al.* in Fl. Andaman & Nicobar 1: 304. 1999.

Lianas; mature branches woody, young branches striate, terete, black or dark. Leaves mostly 3-foliolate or pedately 4-5 foliolate; leaflets thinly coriaceous, oblong to elliptic or ovate, up to 19 x 10 cm, shortly cuspidate or acuminate at apex, cuneate or rarely oblique at base, broadly serrate. Cymes axillary, 3.5 x 4.6 cm, many flowered, much

branched, spreading, puberulous, flowers 2 mm long. Berries globular-ovoid, 2 x 2 cm, green with a scanty pulp. Seed 1, ovoid, 10 x 7 mm, subcompressed, grooved on one face and 3-ridged on the other.

Ecology : Common in semi-evergreen inland forests near the coast.

Fl. : January-May; **Fr.** : July-May.

Distrib. : Middle, South & Little Andaman; North & South Nicobar. Endemic.

SAPINDACEAE

Arytera Blume

Arytera littoralis Bl. in Rumphia 3: 170. 1849; *Cupania adenophylla* Planch. ex Hiern in Hook. f., Fl. Brit. India 1: 677. 1865.

Trees, 2-10 m high; branchlets lenticellate with prominent scars of fallen leaves, reddish in young parts when fresh, greenish-brown, pinkish-brown to blackish upon drying. Leaves 4-6 foliolate; leaflets subopposite, coriaceous, glabrous above, glabrous to hairy especially on major nerves, elliptic, elliptic-oblong to oblong-lanceolate or ovate, up to 19.5 x 5.2 cm, acuminate at

apex, cuneate and slightly attenuate at base. Inflorescences axillary to pseudoterminal, up to 6 cm long, pubescent, flowers yellowish, 2.5 cm across. Capsules with 1 or 2 well developed lobes, 2.2 x 0.8 cm, stalked. Seeds ellipsoid to orbicular.

Ecology : Frequent in the littoral forests on rocky areas.

Fl. & Fr. : February-November.

Distrib. : North, Middle and South Andaman; North Nicobar.

***Dimocarpus* Lour.**

Dimocarpus tongan Lour., Fl. Cochinch. 233. 1790; *Nephelium tongana* Camb.: Hiern in Hook. f., Fl. Brit. India 1: 688. 1875.

Trees, 4-16 m high; branchlets terete, dark brown to greyish-brown, warty, lenticellate. Leaves up to 19 cm long; leaflets 2-8 pairs, coriaceous, dark brownish above and glaucous beneath, lanceolate to oblong-lanceolate, oblong-elliptic, elliptic or oblanceolate, up to 17.5 x 8

cm, acute or acuminate at apex, cuneate or often oblique at base, entire. Inflorescences of axillary or terminal panicle cymes, up to 20 cm long. Flowers white, 4 mm long. Fruits subglobose or ellipsoid, 1.2 cm across, granulate to nearly smooth, brownish.

Ecology : Scattered in the coastal and tropical forests.

Fl. & Fr. : February-May.

Distrib. : North & Middle Andaman; North Nicobar.

***Ganophyllum* Blume**

Ganophyllum falcatum Bl., Mus. Bot. 1: 230. 1850; Parkinson, For. Fl. Andaman islands 116. 1923; Baker & Bakh. f., Fl. Java 2: 142. 1965; Hazra *et al.* in Fl. Andaman & Nicobar 1: 317. 1999.

Trees, 8-21 m high; bark rough, reddish-brown, branchlets greyish-white to greyish-brown, lenticellate. Leaves up to 60 cm long; leaflets 7-21, coriaceous, lanceolate to oblong-lanceolate or ovate, up to 10 x 3.7 cm, acuminate at apex, oblique at base. Inflorescence

axillary or pseudo-terminal, 20 cm long, tomentose to pubescent. Flowers yellow, 2 mm long. Fruits ellipsoid to ovoid, 1.5 x 1 cm, slightly pointed, glossy green to yellowish-orange.

Ecology : Frequent in the littoral forests.

Fl. & Fr. : December-March.

Distrib. : North, Middle & South Andaman; North Nicobar.

***Lepisanthes* Blume**

Lepisanthes andamanica King in J. Asiat. Soc. Bengal 65 (2): 428. 1896.

Trees, 6-10 m high, bark pale, purplish-brown to greyish, branchlets terete. Leaves paripinnate, rarely 1-foliolate, up to 30 cm long; leaflets usually 4, chartaceous, bluntly acute or acuminate at apex, upper pair elliptic or sometimes lanceolate to oblanceolate, up to 9.5 cm, slightly oblique-cuneate at base, lower pair ovate, obovate or elliptic, up to 10 x 5.3 cm, rounded at base.

Inflorescences of compound, densely fulvous to greyish-puberulous panicles. Flower white, 6 mm across. Drupes globose, 2 x 1.5 cm, 3-lobed, smooth, densely appressed short-hairy, yellow when ripe.

Ecology : Rare in the inland and littoral forests.

Fl. & Fr. : February-September.

Distrib. : South Andaman; North Nicobar. Endemic.

***Mischocarpus* Blume**

Mischocarpus pentapetalus (Roxb.) Radlk., Sapind. Holl. Ind. 43. 1879; van der Ham in Blumea 23: 271. 1977; *Cupina pentaphylla* Hiern in Hook. f., Fl. Brit. India 1: 678. 1875; Hazra *et al.* in Fl. Andaman & Nicobar 1: 322. 1999.

Shrubs or trees, 3-5 m high; branchlets pinkish-brown. Leaves up to 11 cm long; leaflets 2-4 pairs, coriaceous, lanceolate to elliptic-oblong or rarely ovate, up to 13 x 4.8 cm, obtusely acuminate at apex, cuneate or almost oblique at base, entire; lateral nerves 9-14 pairs.

Inflorescences of axillary or subterminal cymes, up to 15 cm long. Flowers yellowish-green, 4 mm long. Fruits globose, subglobose or ellipsoid, 1.2 cm long with a persistent calyx, stipe 5 mm long. Seed 1, globose, 5 mm across.

Ecology : Rare in the mangrove forests and along streams.

Fl. & Fr. : June-October.

Distrib. : South Andaman. Mount Harriet hill ranges.

Pometia J.R. & G. Forst.

Pometia pinnata J.R. & G. Forst., Cher. Gen. 110, t. 55. 1776. *P. tomentosa* Kurz ex Hook. f. in Hook. f., Fl. Brit. India 1: 691. 1875.

Trees, 8-10 m high; bark purple-brownish or blackish-grey; branchlets brown-puberulous when young. Leaves up to 90 cm long; leaflets basal pair like auricles, suborbicular to elliptic, up to 4 cm long, upper ones suborbicular, elliptic to elliptic-oblong or lanceolate, rarely ovate, up to 33.5 x 11 cm, acuminate at apex, subcordate,

rounded, cuncate or oblique at base, broadly dentate. Inflorescences up to 60 cm long. Flowers pale red or yellow, 2 mm across. Fruits oblong, up to 3.5 x 3 cm, ripens brownish-black. Seed 1, oblong with an oblique and truncate apex, 2.5 x 1 cm.

Ecology : Common along the streams and canals in the moist evergreen forests.

Fl. & Fr. : December-May.

Distrib. : North, South & Little Andaman; South Nicobar.

ANACARDIACEAE

Gluta L.

Gluta tavoyana Wall. ex Hook. f., Fl. Brit. India 2: 22. 1876.

Trees up to 30 m high. Leaves obovate-oblong, elliptic-oblong or lanceolate, up to 16 x 5.5 cm, obtuse, acute or rarely acuminate at apex, cuncate at base. Panicles up to 15.5 cm long, puberulous. Drupes globose, 3.5 cm across, brown, scurfy, stalked.

Ecology : Frequent in lowland and littoral forests up to 300 m altitude.

Fl. & Fr. : February-October.

Distrib. : South and middle Andaman.

CONNARACEAE

Connarus L.

Connarus planchonianus Schellenb. in Kew Bull. 1927: 375. 1927; *C. grandis* Jack.: Hook. f., Fl. Brit. India 2: 53. 1876.

Large lianas, shrubs or small trees, 2-5 m high; branchlets brown, minutely tomentose when young, soon glabrous. Leaves 1-2 jugate, usually 5-foliolate; leaflets oblong to lanceolate or elliptic, up to 16 cm long, obtusely acuminate at apex, cuncate or rounded at base, entire.

Flowers white, 2 mm long. Follicles slightly compressed, ellipsoid to obovoid, green, turning yellowish-orange and ultimately brownish when dry.

Ecology : Infrequent in the littoral forests and also along roadsides, rocky hill slopes of the inland forests.

Fl. & Fr. : August-October.

Distrib. : Andaman islands and South Nicobar.

FABACEAE

Aganope Miq.

Aganope heptaphylla (L.) Polhill in Kew Bull. 25: 268. 1971. Baker in Hook. f., Fl. Brit. India 2: 246. 1876.

Scandent shrubs or lianas up to 15 m long; branchlets pinkish or pinkish-brown, striate, lenticellate. Leaves up to 34 cm long; leaflets ovate to elliptic or suborbicular, up to 15 x 12 cm, obtuse or acute or shortly acuminate, rarely emarginate at apex, rounded to cuneate at base; lateral nerves 5-7 pairs. Panicles up to 35 cm

long. Flowers greenish or white, 1.3 cm long. Pods oblong, up to 3 cm broad.

Ecology : Common in the inland forests, also seen rarely in littoral forests.

Fl. & Fr. : Almost throughout the year.

Distrib. : Middle and Little Andaman; North and South Nicobar.

Astragalus L.

Astragalus fatmensis Hochst. ex Bunge, Mem. Acad. Sci. St.-Pet. Ser. 7, 2:16. 1868; *A. proluxus* non Sieb. ex Bunge: Baker in Hook. f., Fl. Brit. India 2:121.1876.

Annual weeds, stem slender, densely hairy. Leaves 1.5-7.5 cm, leaflets 11-17, oblong, obtuse. Flowers in dense heads, yellow. Pods short, straight,

linear-oblong, 6-8 seeded.

Ecology : Common on seashore sands, sand dunes and inland sand bars.

Fl. & Fr. : July-September.

Distrib. : Gujarat coast.

Dalbergia L. f.

Dalbergia confertiflora Benth. in Miq., Pl. Jungh. 1: 255. 1852; Baker in Hook. f., Fl. Brit. India 2: 133. 1876.

Climbers, extensive, woody; branches blackish-brown, lenticelled. Leaves up to 18 cm long; leaflets elliptic-oblong or obovate, obtuse to retuse at apex, rounded to cuneate at base; lateral nerves 6-9 pairs, indistinct. Panicles axillary and terminal, up to 32.5 cm

long. Flowers yellow or white, 7 mm long. Pods oblong, up to 14 x 2.5 cm, acute at apex, rounded at base shortly stalked, 1-3 seeded. Seeds reniform, 7 x 4 mm, compressed.

Ecology : Rare in the littoral forests.

Fl. & Fr. : December-April.

Distrib. : Middle and South Andaman.

Dendrolobium (Wight & Arn.) Benth.

Dendrolobium umbellatum (L.) Benth. in Miq., Pl. Jungh. 216, 218. 1852. *D. umbellatum* (L.) DC., Prodr. 2: 325. 1825; Baker in Hook. f., Fl. Brit. India 2: 161. 1876 p.p.; Sanjappa in Legumes of India 165. 1992.

Shrubs or small trees, 3-15 m high; branchlets whitish-green to dark brown, lenticellate, glabrescent. Leaves up to 17.5 cm long; leaflets pale brown to dark brown above and pale whitish beneath, obtuse to acute at apex, rounded to cuneate at base. Flowers 1.2 cm long.

Pods narrowly oblong, up to 3.5 x 0.6 cm, pale brownish, straight or curved, 1-5 seeded. Seeds ellipsoid, up to 3.1 x 4.2 cm.

Ecology : Frequent along the coral islands on beach forest.

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

Distr. : Talmugri and Boat islands in S. Andaman; Jackson Creek in Little Andaman and Nicobar Islands.

Derris Lour.

Derris elegans Benth. in Miq., Pl. Jungh. 1: 242. 1878; Baker in Hook. f., Fl. Brit. India 2: 242. 1876.

Lianas; branchlets blackish to pinkish-brown, lenticellate, young parts covered with brown pubescence. Leaves up to 20.5 cm long; leaflets elliptic to elliptic-lanceolate or obovate, up to 16 x 6 cm, acuminate or obtuse at apex, cuneate to rounded at base; lateral nerves 6-8 pairs. Racemes up to 6.2 cm long. Flowers white,

1 cm long. Pods obliquely rounded to oblong, up to 5 x 2.5 cm, reticulately veined, 1-2 seeded.

Ecology : Rare in the inland forests.

Fl. & Fr. : December-April.

Distrib. : Middle and South Andaman; North and South Nicobar.

Erythrina L.

Erythrina fusca Lour., Fl. Cochinch. 427.1790; Baker in Hook. f., Fl. Brit. India 2: 189.1976.

Trees, 12-15 m high; branchlets pale yellowish or whitish. Leaves 30 cm long; leaflets chartaceous, up to 17 x 15 cm, terminal deltoid, bluntly acute at apex, truncate to broadly cuneate at base, entire, lateral obliquely ovate; lateral nerves 4-7 pairs. Racemes robust, greyish tomentose. Flowers pale purple with keel and wing bases greenish-

yellow. Pods up to 25 x 2.2 cm, stalked, puberulous, ripens black, 6-8 seeded. Seeds oblong.

Ecology : Frequent in the littoral forests, river banks and estuarine areas of fresh water course.

Fl. & Fr. : February-May.

Distrib. : West Bengal, Chilka in Orissa and Andaman coast.

Pterocarpus Jacq.

Pterocarpus dalbergioides Roxb. (Hort. Beng. 53. 1814 *nom. nud*) ex DC., Prod. 2: 418. 1825. *P. indicus auct. non* Willd.: Hook. f., Fl. Brit. India 2: 238. 1876.

Tall tree, with ascending glabrous branches. Leaves 15-25 cm long; leaflets 5-10 cm long, glabrous, rounded or deltoid at the base. Flowers yellowish, in copiously panicle racemes. Pods orbicular 5 cm broad,

1 seeded, with broad rigid wing.

Ecology : Common in tropical rain-forests on hilly areas in the inland forest near the coast.

Fl. & Fr. : August-October.

Distrib. : Endemic, Andaman island.

Vigna Savy.

Vigna marina (Burm. f.) Merr. in Inter. Rumph. Herb. Amb. 285.1917; Baker in Hook. f., Fl. Brit. India 2: 205. 1876.

Climbing herbs; stems pale yellowish, striate, glabrescent. Leaves 30 cm long; leaflets ovate, elliptic or orbicular, up to 12 x 9 cm, obtuse at apex, cuneate or rounded at base, entire; lateral nerves 4-5 pairs. Racemes up to 30 cm long. Flowers pale yellow, 1.2 cm long. Pods linear, 6 mm broad, subcompressed, with a lateral

beak at apex, ripens black, glabrous or thinly hairy; seeds 6 x 5 mm, greyish, greyish-brown or reddish.

Ecology : Common in the littoral forests and sometimes near the mangrove swamps.

Fl. & Fr. : June-March.

Distrib. : South and Little Andaman; North and South Nicobar.

MIMOSACEAE

Entada Adans.

Entada rheedii Spr., Syst. Vcg. 2: 325. 1825. *E. scandens auct. non* Benth. : Hook. f., Fl. Brit. India 2: 287. 1878 p.p. Sanjappa in Legumes of India 66. 1992 (as ssp. *rheedii*)

Lianas; branchlets lenticellate or not, ribbed, pinkish-brown or greyish-brown. Leaflets 2-8 pairs, subcoriaceous to coriaceous, elliptic, up to 9 x 3.5 cm retuse or rounded to rarely acuminate at apex, broadly cuneate at base. Spikes axillary up to 25 cm long. Flowers pale yellow or yellowish-white, 4.5 mm across. Pods

oblong, up to 120 x 10 cm, thickened along edges, depressed and constricted between seeds. Seeds up to 5 cm across, chocolate red.

Ecology : Common along the littoral forests close to mangroves.

Fl. & Fr. : June-October.

Distrib. : Karwar in Karnataka and Andaman Islands.

COMBRETACEAE

Terminalia L.

1. *Terminalia bialata* Kurz in For. Fl. Brit. Burma 1: 456. 1877; Clarke in Hook. f., Fl. Brit. India 2: 449. 1878.

Tall trees up to 30-40 m high, with large, thin, curved and often branched buttresses; bark light brown, smooth and finely fissured. Leaves crowded at the end of the branchlets. Perfectly glabrous, chartaceous, obovate or oblanceolate, 10-15 x 2.5-10 cm, shortly acuminate, tapering at base; petiole slender, 5-8 cm long. Flowers small greenish-yellow, supported by minute deciduous bract, forming simple puberulous axillary spikes. Fruit butterfly-shaped, about 5 cm long and 10 cm across, ellipsoid, with 2-broad, stiff, veined wings.

Ecology : Frequent in tropical rain-forests and on rocky littoral forests along the coast.

Fl. & Fr. : June-April.

Distrib. : Andaman Islands.

2. *Terminalia citrina* (Gaertn.) Roxb. ex Flem. in As. Res. 11: 183, 1810; Clarke in Hook. f., Fl. Brit. India 2: 446. 1878.

A tall tree, 20-30 m high, buttressed at base, all parts glabrous, the very young shoots rufous-villous. Leaves papyraceous or chartaceous, opposite or subopposite, elliptic-lanceolate, 10-16.5 x 4.5-7 cm, usually shortly acuminate at apex and rounded or broadly cuneate at base. Flowers small, dull yellow, sessile, all hermaphrodite, in terminal panicles. Drupe oblong-lanceolate, 20-30 x 8-20 mm, 5 cornered, dull orange yellow.

Ecology : Common in beach forest.

Fl. & Fr. : August-February.

Distrib. : Nicobar Islands.

MYRTACEAE

Eugenia L.

Eugenia caryophyllaea Wight, Ill. ii. 15. 1840; Duthie in Hook. f., Fl. Brit. India 3: 264. 1879.

Large shrub. Leaves 7.5-10 x 3-4 cm, obovate spatulate, base attenuated. Flower 2-3 mm in terminal corymbose cymes. Fruit globose 5-6 mm diam.

Ecology : Frequent along river bank and moist sandy backshore.

Fl. & Fr. : September-December.

Distrib. : Tamil Nadu, Kerala, Karnataka.

Syzygium Gaertner.

Syzygium samurangense (Bl.) Merr. & Perry in J. Arn. Arb. 19:115-216.1938. *Eugenia javanica* Lamk.: Hook. f., Fl. Brit. India 2: 474. 1878.

Trees, 40 m high. Leaves thinly coriaceous, ovate to oblong-lanceolate, blunt or acuminate at apex, rounded or subcordate at base, 15 x 8 cm; petioles short. Flowers white, 4 cm in diam., in two or three, short axillary or

terminal corymbose racemes. Fruits apple or pear shaped, 5 cm diam., depressed, turbinate, white and glossy.

Ecology : Common and characteristic element in littoral forests.

Fl. & Fr. : February-July.

Distrib. : Andaman & Nicobar Islands.

MELASTOMATACEAE

Medinilla Gaudich.

Medinilla malabarica Bodd., Ic. Pl. Ind. Or. 157. 1840; Clarke in Hook. f., Fl. Brit. India 2: 548. 1878.

Erect or scandent shrub. Leaves 5-7.5 cm long, elliptic narrowed at both ends. Flowers large, white. Fruits are berry crowned by limb of the calyx. Seeds many ovoid.

Ecology : Rare in dense evergreen forest.

Fl. & Fr. : April.

Distrib. : Kerala, Maharashtra.

Memecylon L.

1. *Memecylon angustifolium* Wight, Ill. 1:215. 1840 & Ic. t. 276. 1840; Clarke in Hook. f., Fl. Brit. India 2: 562. 1879. Gamble in Fl. Pres. Madras 1: 355. 1957. (Rep. ed.).

Shrub 4-5 m, tall. Leaves 3-7.5 x 0.5-1.5 cm, linear-oblong, tapering at both ends. Flower bright blue in axillary slender umbels. Berry size of a pea, black purple.

Ecology : Rare in coastal scrub forests on sandy areas, near the streams.

Fl. & Fr. : July-November.

Distrib. : Andaman, Tamil Nadu, Kerala.

2. *Memecylon andamanicum* King in Journ. As. Soc. Beng. 69: 85. 1899.

Shrubs, 5 m high. Leaves oblong-lanceolate, bluntly acuminate at apex, cuncate at base, 9 x 3.5 cm; petioles 6 mm, venation obscure. Inflorescences umbellate in the axils of the leaf or from the scars of fallen ones,

flowers blue. Fruits small, depressed, globose, on slender stalk, 5 mm diam.

Ecology : Frequent in littoral forests and also in inland forests.

Fl. & Fr. : April-September.

Distrib. : Endemic to Andaman and Nicobar Islands.

3. *Memecylon umbellatum* Burm. f., Fl. India 87. 1768; Manilal & Sivarajan Fl. Calicut 110. 1982.

Small tree about 5 m tall; branches angular, not pendulous. Leaves ovate-oblong, 2.5-4.5 cm long, coriaceous, entire, acute at apex. Flowers blue, in compact umble, sessile. Berries globose, 5 mm across.

Ecology : Frequent on sandy backshore and hill slopes scrubs.

Fl. & Fr. : March-July.

Distrib. : West coast.

LYTHRACEAE

Nesaea Commersom ex H.B.K.

Nesaea lanceolata (Wight & Arn.) Koehne, Bot. Jahrb. Syst. 3: 325. 1882. *Ammannia lanceolata* Heyne ex Wight & Arn.: Hook. f., Fl. Brit. India 2: 570. 1879.

Annual or perennial herbs or undershrubs; stems tetragonous; leaf oblong-lanceolate, 13.5 x 0.4-1 cm, chartaceous, entire, obtuse at apex, cordate or subamplexicaul at base. Flowers reddish-brown, 2-3

flowered in solitary or dichasial cymes, tetramerous; capsule 2 mm across, globose. Seed 30-40, compressed.

Ecology : Rare in coastal scrubs on moist sandy places.

Fl. & Fr. : December-February; January onward.

Distrib. : Tamil Nadu, Karnataka and Kerala coast.

ONAGRACEAE

Ludwigia L.

Ludwigia octovalis (Jacq.) Raven in Kew Bull. 15: 476. 1962.

Branched herbs, 3 m high. Leaves lanceolate or linear-lanceolate, 14 x 4 cm; petioles 1 cm long. Flowers yellow, solitary, axillary. Capsules thin walled, with 8 darker ribs, 4.5 x 0.8 cm. Seeds brown.

Ecology : Common near streams.

Fl. & Fr. : August-January.

Distrib. : East and West coast, Andaman & Nicobar Is.

Ludwigia prostrata Roxb., Fl. Ind. 1: 441. 1820.

Prostrate or decumbent herbs. Leaves elliptic, cuneate at base, acute at apex, 13 x 2.7 cm, petioles 2.5 cm long. Flowers yellow, sessile, 4-fid. Capsules glabrous thin walled, slightly 4 angled, pale brown, 22 x 1 mm. Seeds pale brown.

Ecology : Common in inland forests, shaded places.

Fl. & Fr. : July-September.

Distrib. : East and West coast, Andaman & Nicobar Is.

TURNERACEAE

Turnera L.

Turnera ulmifolia L., Sp. Pl. 271. 1753; Benni Fl. Howrah 249. 1979; Haines Bot. Bih. Orissa Part. 1: 383, 1925.

Herbs or shrubs with densely hairy branches. Leaves 3-4 inch long, elliptic lanceolate, coarsely hairy, serrate, acute at apex, obtuse at base. flowers 1.5-2 inch long, yellow, in terminal racemes within the two leafy

bracts. Capsules subglobose, hairy or tubercled; seeds brown rugose.

Ecology : Frequent on dry coastal rocks and old brick walls.

Fl. & Fr. : August-September.

Distrib. : West Bengal, Orissa, Tamil Nadu and Karnataka coast.

PASSIFLORACEAE

Adenia Forssk.

- Adenia penangiana* (Wall. ex G. Don.) de Wilde var. *penangiana* de Wilde, in *Blumea* 15:266.1967. *Modecca nicoborica* Kurz ex Trin.: Hook. f., *Fl. Brit. India* 2: 603. 1879.
- Climbers, 6 m high. Leaves broadly ovate-elliptic to oblong, apex distinctly acuminate, rounded or subpeltate at base, 12 x 5.5 cm. Capsules 6 x 3 cm (excluding the 2.5 mm long gynophore), glabrous, oblong, acute, 3-valved. Seeds flattened, nearly smooth or shallowly pitted.
- Ecology :** Common in littoral forests.
- Fl. & Fr. :** May-August.
- Distrib. :** Little Andamans Nicobar islands.

CUCURBITACEAE

Schefflera Forster & Forster f.

- Schefflera elliptica* (Bl.) Harms. in Engler & Prantl., *Pflanzenf.* 3(8): 39.1894.
- cm. Flowers greenish white or yellow in umbels. Fruits ovoid bluntly redged, yellow when ripe, 5-angled.
- Large straggling shrubs. Leaves palmately compound, 5-7 foliate; common petioles 15 cm long; leaflets oblong or ovate-elliptic, coriaceous, glabrous on both sides, acuminate at apex, subacute at base, 15 x 8.5
- Ecology :** Common in inland and littoral forests.
- Fl. & Fr. :** March-August.
- Distrib. :** Nicobar islands.

ALANGIACEAE

Alangium Lamk.

- Alangium salvifolium* Wangerin ssp. *salvifolium* Turill & Milne-Rehd *Fl. Trop. East Africa Alangiaceae* 3: 1958.
- A. lamarckii* Th.: Hook. f., *Fl. Brit. India* 2: 741. 1879.
- Tree. Leaves oblong-lanceolate, 5-14 x 2-2.5 cm, apex attenuate or subacute, entire, base oblique, glabrous above and peberulous below. Flowers in axillary cymes. Berry globose, crowned by calyx lobes, seeds solitary.
- Ecology :** Frequently found in rocky coastal areas; common in dry inland forests.
- Fl. & Fr. :** February-April.
- Distrib.:** Orissa, Tamil Nadu, Karnataka and Maharashtra coast.

RUBIACEAE

Canthium Lam.

- Canthium glabrum* Blume, *Bijd.* 967; Hook. f. in Hook. f., *Fl. Brit. India* 3:133. 1880.
- 2-2.5 cm long.
- A small tree; branches stout, upper compressed. Leaves 10-15 cm x 2-3.5 cm, ovate subacute. Cymes with short spreading branches, flowers small 2 mm. Fruit
- Ecology :** Frequent in coastal forests.
- Fl. & Fr. :** September-December.
- Distrib. :** West coast and Andaman.

***Ixora* L.**

1. *Ixora brunnescens* Kurz, J. As. Soc. Beng. 41: 317. 1872; Hook. f., Fl. Brit. India 3: 143. 1880.

Shrubs or small trees, 12 m high. Leaves obovate or oblong rounded at base, acuminate, obtuse or retuse at apex; lateral nerves 9-16 pairs. Inflorescence terminal panicles, forming a trichotomous cymes. Flowers white, 50-80 per head. Fruits 0.6 x 0.6 cm, globose; whitish green, ripe fruits having red or black strips.

Ecology : Frequent in coastal forests on seashore.

Fl. & Fr. : January-December.

Distrib. : Endemic to Bay islands of Andaman & Nicobar.

2. *Ixora grandifolia* Zoll & Mor., Syst. Verz. 65.1846; Hook. f., Fl. Brit. India 3: 143. 1880.

Shrubs or small trees. Leaves elliptic, ovate, obovate or lanceolate, mucronate or rounded at apex, 24 x 11.5 cm. Corymbs 10-20 cm wide, nearly sessile. Flowers white or rose colour; pedicel pubescent. Fruits 1 x 1.2 cm. green, mature black.

Ecology : Common in hill forests on littoral zones.

Fl. & Fr. : September-January.

Distrib. : Almost all islands of Andamans and Nicobars.

var. *rosella* (Kurz) Hook. f., Fl. Brit. India 3: 143.1880.

Leaves glabrous, acuminate at apex, 24 x 10.5 cm. Flowers rose colour. Calyx 0.2-0.5 cm long, pubescent. Corolla 2-3 cm long, lobes oblong. Anthers 0.4-0.5 cm long.

Ecology : Rare in beach forests.

Fl. & Fr. : March-April.

Distrib. : South creek-Baratang; Campbell Bay-Nicobar.

3. *Ixora tenuifolia* Bremekamp in Ind. For. 85(7): 374.1959.

Small trees; branches glabrous. Leaf base contracted, 15.5-37 x 6-11 cm, glabrous; lateral nerves 15 pairs; petioles 2 cm long. Inflorescence lax, corymbose, glabrous. Flowers 60 per head. Calyx glabrous, lobes ovate. Corolla tube glabrous, obtuse, bearded at the throat with white hairs.

Ecology : Rare in littoral and beach forests.

Fl. & Fr. : February-May.

Distrib. : Endemic to Bay Island.

***Ophiorrhiza* L.**

Ophiorrhiza mungos L., Sp. Pl. 150. 1753; Hook. f., Fl. Brit. India 3: 77. 1880.

Erect glabrous herbs, 40 cm high. Leaves elliptic or elliptic-lanceolate, long acuminate at apex, tapering at base, narrowed into the petiole, 1.5 x 4.5 cm; Cymes 7 cm across, glabrous or pubescent; bracts absent, flower

white. Capsules 1 cm across, compressed, protruded beyond the calyx.

Ecology : Rare in coastal forests.

Fl. & Fr. : July-March.

Distrib. : Nicobar islands.

ASTERACEAE

***Flaveria* Juss.**

Flaveria australasia Hook., Benth. Fl. Aust III 546; Gamble Fl. Madras 2: 401. 1956 (Rep. ed.).

Glabrous herb. Leaves opposite, entire or dentate. Heads very small, yellow in colours, hetero or homogamous, receptacle very small. Achenes oblong,

compressed, with 8-10 prominent ribs.

Ecology : Introduced from Australia often in muddy places near the coast.

Fl. & Fr. : June-September.

Distrib. : West coast.

Spilanthes Jacq.

Spilanthes paniculata Wall. ex DC., Prodr. 5:625. 1836. *S. acmella* (L.) Murr.: Chowdhery, in Fl. India. 12:410. 1995.

Erect, ascending, hairy annuals. Leaves opposite, petiolate, ovate-elliptic to elliptic, narrowed at base, acute or obtuse at apex. Heads 6-8 mm in diam., in axillary

and terminal panicles. Achenes dorsally compressed, ciliate along the margins; pappus of 2-3 stiff awns.

Ecology : Medicinal herbs. Wet places of all coastal islands.

Fl. & Fr. : May-December.

Distrib. : Andaman and Nicobar island.

Struchium P. Browne

Struchium sparganophorum (L.) Kuntze, Rev. Gen. Pl. 1: 366. 1891; Uniyal in Fl. India 13:347. 1995.

Herbs, 1 m high; rooting from basal nodes. Leaves simple, alternate, elliptic, narrow at both the ends, dentate, 15 x 5 cm, subglabrous. Inflorescences axillary, globose. Heads discoid, 5 mm across. Corolla purple,

salver-shaped. Achenes, glabrous, 3-4 ribbed; pappus coroniform, cartilaginous.

Ecology : Rare in littoral forests. Leaf paste massaged in body by Nicobories in fever.

Fl. & Fr. : May-September.

Distrib. : Indira point, Nicobar island.

Vernonia Schreber.

Vernonia patula (Dryand.) Merr. in Philip. J. Sci. 3: 439. 1908; Uniyal in Fl. India. 13: 379. 1995.

Herbs, 70 cm high; stems terete, ribbed, pubescent; young branches greyish villous. Heads at the top of dichotomous, branches, terminal or in the upper

axils. Corolla glandular. Achenes 5-angled, glabrous, glandular, 1.5 mm long; pappus white, uniserate.

Ecology : Common in coastal areas.

Fl. & Fr. : Throughout the year.

Distrib. : Andaman and Nicobar Islands

PLUMBAGINACEAE

Limonium Miller

Limonium stocksii (Boiss.) Kuntze, Rev. Gen. 2: 396. 1891; *Statice stocksii* Boiss.: Clarke in Hook. f., Fl. Brit. India 3: 480. 1882.

Herbs or small shrubs 15-25 cm high; branches woody, leafy. Leaves 2-3 cm spatulate-oblong, glabrous fleshy. Scapes branched, many flowered. Flower rose

pink. Fruits utricle, oblong, fusiform. Seeds albuminous.

Ecology : Common along the rocky coast and rocky embankments near the salt pans.

Fl. & Fr. : November-January.

Distrib. : Gujarat coast.

MYRSINACEAE

Maesa Forssk.

Maesa andamanica Kurz, For. Fl. Brit. Burma, 2: 575. 1877; Hook. f., Fl. Brit. India 3: 508. 1882.

Straggling shrubs with fine warted branchlets. Leaves ovate-acuminate rounded at the base, 10 x 5 cm, entire or denticulate; petioles slender, 1.25 cm long. Flowers small cream coloured or white on slender pedicels

in short axillary racemes. Fruits yellowish when ripe, 0.5 cm across.

Ecology : Common along the stream.

Fl. & Fr. : January-May.

Distrib. : Andaman and Nicobar islands. Endemic.

SAPOTACEAE

Palaquium Blanco.

1. *Palaquium ellipticum* (Dalz.) Baillon., Traite Bot. Med. Phan. 1500. 1884; *Dichopsis elliptica* Benth.: Clarke in Hook. f., Fl. Brit. India 3: 541. 1882.

Lofty trees; young branchlets ferruginously tomentose. Leaves elliptic-obovate, acuminate at apex, cuneate at base, coriaceous. Flowers usually 2-3 together. Fruit ellipsoid.

Ecology : Occasional in evergreen forest of Western Ghats.

Fl. & Fr. : June-September.

Distrib. : Maharashtra, Karnataka.

2. *Palaquium semarum* H.J. Lam. in Bull. Jard. Bot.

Buitenz. Ser. 3 (7): 43. 1925.

Trees, 20 m high; wood pinkish red; young branchless, tomentose. Leaves spatulate, oblong-obovate, rounded and obtusely caudate-acuminate at apex, narrowly cuneate or decurrent at base, 8-12 x 3-6 cm, glabrous and glossy green above, pale green beneath, drying papery reddish-brown. Flowers in 2-7 flowered on axils of leaf scars below the terminal, crowded, white or pale yellow.

Ecology : Rare in littoral forests.

Fl. & Fr. : July-September.

Distrib. : Great Nicobar Island

OLEACEAE

Myxopyrum Blume.

Myxopyrum smilacifolium Bl. Mus. Bot. Ludg. Bat. 1: 320. 1849; Clarke in Hook. f., Fl. Brit. India 3: 618. 1882.

Scandent shrubs. Leaves oblong to ovate or cordate, cuneate at base, acuminate at apex, 17 x 8 cm, entire or rarely toothed. Cymes axillary, rarely terminal, 10-20 cm long, hairy. Flowers in clusters. Corolla 4 mm long. Berries 6 mm in diam, 1-seeded, sub-globose,

obovoid, red in colour.

Ecology : Frequent in littoral low land forests; Leaves are very medicinal.

Fl. & Fr. : April-June.

Distrib. : Nicobar island.

APOCYNACEAE

Alstonia R. Br.

Alstonia kurzii Hook. f., Fl. Brit. India. 3: 643. 1882.

Small trees, 3-5 m high. Leaves whorled, obovate-oblong, acute to alternate at base, obtuse or retuse at apex, 20 x 8 cm, entire; lateral nerves 25-30 pairs. Inflorescence terminal cymes, 9 cm. Flowers white, fragrant. Fruit a follicle, paired, linear, 20-30 x 0.2-0.3

cm. Seeds compressed, comose.

Ecology : Frequent in littoral forests.

Fl. & Fr. : January-December.

Distrib. : North, South and Middle Andaman and Nicobar island. Endemic.

Ichnocarpus R. Br.

Ichnocarpus volubilis (Lour.) Merr. in Philipp. J. Sci 21: 506. 1922. *I. ovatifolius* DC.: Hook. f., Fl. Brit. India 3: 670. 1882.

Scandent; branchlets puberulous. Leaves opposite, ovate to elliptic, rounded to obtuse at base, acute to shortly caudate at apex. 14 x 7 cm, lateral nerves 8-10 pairs. Inflorescence terminal and axillary panicles of

corymbiform cymes. Flowers white to yellowish-white, rusty pubescent outside. Follicles paired.

Ecology : Rare in coastal forests.

Fl. & Fr. : June-September.

Distrib. : Nicobar islands.

Nelsosperma Rafin

Nelsosperma oppositifolium (Lam.) Fosb. & Sac. in Micronesia 8 (1-2): 48. 1972. *Ochrosia oppositifolium* (Lamk.) K. Schum: Hook. f., Fl. Brit. India 3:639.1882.

Small trees with milky latex. Leaves opposite, cuneate obovate to elliptic-obovate, cuneate-attenuate at base, obtuse to apiculate at apex, 28 x 12 cm; Inflorescences terminal and axillary branched corymbose

cymes. Flowers white. Fruits drupaceous, paired, ovoid to semi-terete, bright yellow when ripe, 8 x 6 cm.

Ecology : Common in seashore sand and beach forests.

Fl. & Fr. : January-December.

Distrib. : Little Andaman and Nicobar island.

Tabernaemontana L.

Tabernaemontana crista Roxb., Fl. Ind. 2: 25.1832; Hook. f., Fl. Brit. India 3: 648. 1882.

Shrubs or small trees, 7 m high. Leaves opposite, broadly to narrowly oblong-elliptic to obovate, acute or attenuate at base, acuminate at apex, 30 x 11 cm. Inflorescence terminal or axillary, 2-3 crotomously branched cymes, 15 cm long. Flowers white, 2.5 cm in

diam. Follicle in pairs, shortly beaked and curved at apex, 3.5 x 1 cm.

Ecology : Common in beach forests and inland forests.

Fl. & Fr. : January-December.

Distrib. : Throughout Andaman islands.

ASCLEPIADACEAE

Cosmostigma Wight

Cosmostigma racemosum (Roxb.) Wight, Contrib. Bot. India 42. 1834; Hook. f., Fl. Brit. India 4: 41. 1883.

A climbing shrubs. Leaves cordiform, 6-13 x 4-14 cm, palmately nerved, apex abruptly acuminate, base cordate. Corymb axillary, 5 cm. Flowers 1 cm across, spirally arranged, greenish-yellow spotted purple. Follicles stout, 15 x 5 cm, apex blunt, epicarp thick, fleshy. Seed

ovoid, 2 x 1.2 cm, flattened, margined. Coma brownish, silky.

Ecology : Common along forest border and beach forests.

Fl. & Fr. : April-July.

Distrib. : Along the West coastal districts.

Dischidia R. Br.

1. *Dischidia benghalensis* Coleb. in Trans. Linn. Soc. 12. 357, t. 15. 1834; Hook. f., Fl. Brit. India 4: 50. 1883.

Epiphytic, slender, creeping shrubs. Leaves succulent, oblong, narrowed at base, obtuse or rounded at tips, glaucous, 5 x 0.7 cm. Umbels very short, peduncled, few flowered; flowers yellowish white; calyx red. Follicles slender, acuminate, 3.75 cm long.

Ecology : Frequent on inland, tidal and littoral forests.

Fl. & Fr. : April-November.

Distrib. : Andaman & Nicobar islands.

2. *Dischidia numularia* R. Br., Prodr.: Hook. f., Fl. Brit. India 4: 49. 1883.

Epiphytic, climber with succulent leaves. Leaves orbicular, blunt, 1.5-3 x 1-2.5 cm. Inflorescens hanging from the axil; flowers white, condensed. Follicles slender, acute 2.5 cm long.

Ecology : Common on mangrove forests.

Fl. & Fr. : July-August.

Distrib. : Andaman and Nicobar islands.

Heterostemma Wight & Arn.

Heterostemma tanjorensis Wight & Arn. in Wight, Contrb. Bot. India 42. 1834; Hook. f., Fl. Brit. India 4: 47. 1883.

Twiner with watery layer. Leaves oblong 5-10 x 2-5 cm, subsucculent, obtusely acute, base truncate petiole twisted, yellow gland present at the junction of leaf and

petiole; Flowers in axillary umbellate cymes. Follicle paired cylindrical, coma unequal, longer than seed.

Ecology : Frequent in Western Ghats and coastal hill slopes.

Fl. & Fr. : December-February; January onward.

Distrib. : Tamil Nadu and Karnataka coast.

LOGANIACEAE

Fagraea Thumb.

Fagraea racemosa Jack. ex Wall. in Roxb. Fl. Ind. 2: 35. 1824; Hook. f., Fl. Brit. India 4: 84. 1883.

Trees, 15 m high. Leaves thick, coriaceous, elliptic, shortly abruptly blunt, acuminate at apex, base shortly narrowed, 3.5 x 10 cm; lateral nerves 5-7 pairs. Achenes terminal, condensed. Flowers reddish white;

corolla flesh colour. Berries ovoid, 1.25 cm long surrounded by sepals at the base.

Ecology : Common in the coastal forests.

Fl. & Fr. : July-February.

Distrib. : Andaman and Nicobar island.

CONVOLVULACEAE

Convolvulus L.

1. *Convolvulus arvensis* L., Sp. Pl. 153. 1753; Clarke in Hook. f., Fl. Brit. India 4: 219. 1883.

Climbing herbs; leaves 1.5-4.5 x 0.4-3 cm, linear-oblong, pubescent, acute at apex, hastate at base. Flowers 10-12 mm long, bracteate, lilac with dark purple throat in axillary cymes. Capsules globose, 4 seeded.

Ecology : Frequent along coastal thickets, forest fringes and road sides.

Fl. & Fr. : Decemebr-February.

Distrib. : Inland and coastal sands of East and West coast.

2. *Convolvulus auricomus* (A. Rich.) Bhandari, Bull. Bot. Surv. India 6:327. 1965; *C. glomeratus* Choisy ex. DC.: Clarke in Hook. f., Fl. Brit. India 4:219. 1883.

Prostrate, white hairy herbs. Leaves 1.5-3.5 x 4-0.8 cm, apex acute or mucronate, base rounded or subcordate. Flowers in dense, axillary silky white heads. Fruits capsule, globose. Seeds puberulous.

Ecology : Rare in wastelands, particularly in desertic zones.

Fl. & Fr. : September-November.

Distrib. : Gujarat coast.

3. *Convolvulus prostratus* Forssk. Fl. Aegypt. Arab. 203. 1775; *C. pluricaulis* Choisy: Clarke in Hook. f., Fl. Brit. India 4: 218. 1883.

Prostrate herbs. Leaves linear-oblong, 1-3 x 0.5-0.6 cm, sessile, villose, subcordate at apex, obtuse at base. Flowers 12-14 mm long, purple in axillary heads. Capsules subglobose, 4 seeded; seeds densely white pubescent.

Ecology : Frequent on sandy and rocky coastal bushes.

Fl. & Fr. : December-March.

Distrib.: All along the East and West coast.

Ipomoea L.

Ipomoea gracilis R. Br., Prodr. 484. 1810.

Prostrate herbs. Leaves ovate, broadly ovate to oblong or orbicular to reniform, acute or obtuse at apex, cordate at the base, 10 x 7.5 cm, glabrous on both sides. Inflorescences 1 or several flowered. Capsules globose. Seeds 4, black.

Ecology : Common in beach forests.

Fl. & Fr. : September-December.

Distrib. : Along the sandy beaches of Andaman and Nicobar island.

SOLANACEAE

Solanum L.

Solanum arvensis Mattei in Bull. Ort. Bot. Palermo 7: 188. 1908.

Shrub up to 1.2 m high. Stem terete rigid, hairy. Leaves in pairs, 15-32 x 10-20 mm, ovate or elliptic, acute or obtuse, base rounded or cuneate and decurrent. Flower 16 x 24 mm in diam. White, in pedunculate,

scorpioid cymes. Fruits berry, globose, fruiting calyx accrescent.

Ecology : Rare on sandy and rocky littoral zones.

Fl. & Fr. : February-April.

Distrib. : Saurashtra coast, Diu.

SCROPHULARIACEAE

Peplidium Del.

Peplidium maritimum (L. f.) Wetst. in Pfamilien 4(3b): 78. 1895. *P. humifusum* Del.: Hook. f., Fl. Brit. India 4: 287. 1884.

Prostrate herbs. Leaves orbicular or ovate, 1.5 x 1 cm, succulent, apex obtuse, entire, base decurrent. Flowers solitary, axillary. Capsule globose, dehiscent

irregularly; seed tetragonous to truncate.

Ecology : Frequent on coastal salt marshes, often associated with *Suaeda nudiflora*.

Fl. & Fr. : March-April.

Distrib.: Goa, Karnataka and Maharashtra coast.

ACANTHACEAE

Lepidagathis Willd.

Lepidagathis trinervis Nees, Monogr. 21; Clarke in Hook. f., Fl. Brit. India 4: 517. 1885.

Herb or undershrub. Leaves 2.5 x 0.4 cm, linear or linear-lanceolate, entire. Flowers in spike 2.0 cm long, white. Fruits a capsule 2 seeded, elongate. Seeds

compressed ovate-oblong or orbicular.

Ecology : Common in coastal sand hills and sand dunes.

Fl. & Fr. : June-July.

Distrib. : Gujarat, Maharashtra coast.

Acanthus L.

1. *Acanthus ebracteatus* Vahl, Symb. Bot. 2, 75. t. 40, 1791; Clarke in Hook. f., Fl. Brit. India 4: 481. 1884.

Erect or scandent shrubs up to 1.5 m tall; stem stout, glabrous with stilt roots at base. Leaves 4-10 x 2.5-6.5 cm, ovate-oblong or elliptic, coriaceous, entire, narrowed at base, acute at apex. Flowers subsessile, 3-4 cm long in terminal or pseudo-axillary strobilate spike; bracts usually absent; calyx 4 segmented, lobes glabrous, green; corolla 5 segmented, 2.5-3 cm, hairy outside; stamens 2 lipped, connate hairy outside; stamens with thick filaments, anthers bearded. Capsule ovoid, up to 3 cm long, compressed, shining.

Ecology : Rare along the banks of littoral creeks in the mangrove forests and sometimes form isolated pure population on the mud floods.

Fl. & Fr. : July-September.

Distrib. : It is so far collected from the Dhanikhari mangrove nala of south Andaman. It is also reported from Kerala mangrove areas but never reported from other mangrove areas in India.

2. *Acanthus volubilis* Wall., Pl. Asia, Rat. 2: 56. t. 172, 1831; Clarke in Hook. f., Fl. Brit. India 4: 481. 1884.

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

Ecology : Rare in tidal swamps, growing in sheltered mangrove areas, climbing on tree like *Avicennia officinalis*.

Fl. & Fr. : April-August.

Distrib. : In India the species is collected only from the Sajinakhali forest block of the Sundarbans. It is reported to occur from Andaman islands but never collected.

VERBENACEAE

Vitex L.

1. *Vitex altissima* L. f., Suppl. Pl. 294. 1781; Clarke in Hook. f., Fl. Brit. India 4:584. 1885.

Tree up to 15 m. Leaves 3-foliolate; central leaflet obovate-lanceolate, lateral ones oblanceolate, 7-18 x 2.5-6 cm, thick-chartaceous, apex and base acute. Flowers blue in racemose panicles, terminal or from upper axils. Fruits globose drupe, 0.5 cm across.

Ecology : Common in semievergreen forests along the coast.

Fl. & Fr. : June-September, December

Distrib. : Tamil Nadu, Kerala, Karnataka coast.

2. *Vitex diversifolia* Kurz, Andam. Rep. App. A45 and B14. 1870; Clarke in Hook. f., Fl. Brit. India 4:585. 1885.

Trees or shrubs. Leaves simple and 3-foliolate, glabrate, leaflets sessile oblong, apex and base cuneate. Panicles 5-7.5 cm, flowers 1 cm across. Drupe globose or obovoid.

Ecology : Frequent in semievergreen coastal forests.

Fl. & Fr. : September-March.

Distrib. : Andaman islands. Endemic.

Clerodendrum L.

1. *Clerodendrum multiflorum* (Burm. f.) O. Ktze., Rev. Gen. Pl. 3: 526. 1891; *C. phlomoidis* L. f., Suppl. 202. 1787; Hook. f. in Hook. f., Fl. Brit. India 4: 590. 1885.

Large bushes, up to 3 m tall; leaves 4-6 x 3-4 cm, ovate or subrhomboid, obtuse or acute, glabrous above, puberulous beneath. Flowers creamy-white, axillary dichotomous cymes. Drupes up to 0.6 cm long, broadly obovoid, depressed, glabrous or sparsely hairy.

Ecology : Frequent in semievergreen forests along the ghats.

Fl. & Fr. : August-April.

Distrib. : West coast.

2. *Clerodendrum paniculatum* L., Mant. Pl. 90. 1767; Clarke in Hook. f., Fl. Brit. India 4: 593. 1885.

Shrubs, 2 m high. Leaves membranous, ovate or orbicular, more or less deeply lobed, lobes acute 3-7, cordate sparsely hairy or nearly glabrous above, densely glandular beneath, 30 x 20 cm. Panicles pyramidal, 30 cm long; branches red and flowers numerous. Corolla bright red. Drupes obovate, black.

Ecology : Rare along streams in inland forests and coastal ghats.

Fl. & Fr. : November-March.

Distrib. : Lakshman beach, Campbell Bay, Nicobar island.

CHENOPODIACEAE

Salsola L.

1. *Salsola baryosma* (Roem. & Schult.) Dandy in Andrews, Fl. Pl. Angl. Egypt. Sudan 1: 111. 1950; *S. foetida* Del.: Hook. f., Fl. Brit. India 5: 18. 1886.

Stout herbs up to 120 cm high. Leaves minute, fleshy, subglobose; flowers 1-2.5 mm across, greenish-white, clustered in terminal spike; fruiting perianth as long as bracteoles; bracteoles rounded, membranous; stigma 2, recurved. Fruits ovoid, seeds horizontally arranged.

Ecology : Frequent on the salt marshes along the river banks and hypersaline mud flats.

Fl. & Fr. : November-December.

Distrib. : Gujarat coast.

2. *Salsola kali* L., Sp. Pl. 1:222. 1753; Hook. f., Fl. Brit. India 5: 17. 1886.

Herbs up to 60 cm tall, erect or decumbent, succulent, scabrid, pubescent or glabrous. Leaves 8-25 x 2-3 mm, linear-subulate, decurrent, semiterete, spinescent broad and slightly clasping at base. Flower axillary or in condensed spikes; fruit utricles, hemispherical, truncate above. Seeds adherent to utricle, horizontal.

Ecology : Common on saline mudflats.

Fl. & Fr. : June-August.

Distrib. : Gujarat coast.

MYRISTICACEAE

Knema L.

Knema andamanica (Warb.) de Wilde in Blumea 25(2): 370. 1979. ssp. *andamanica*

Trees, 16 m high; young twigs densely grey-brown or yellowish-brown, scurfy tomentulose. Leaves oblong to lanceolate, attenuate at base, acute or subacute at apex, 8-30 x 2-8.5 cm; lateral nerves 12-24 pairs; petioles 2 cm long. Inflorescences sessile or 5 mm peduncled, simple or forked, 3-15 flowered in male, 2-6

flowered in female. Flowers 0.3 mm long, yellowish-brown. Fruits 1 or 2, ellipsoid, rounded or faintly pointed at tip, base rounded, 20 x 16 mm, rusty or rufous tomentose; stalked 4 mm long.

Ecology : Rare in dense mixed forests along the coast.

Fl. & Fr. : November-June.

Distrib. : Endemic to Andaman & Nicobar Islands.

EUPHORBIACEAE

Actephila Blume.

Actephila excelsa (Dalz.) Muell. & Arg., *Linnaea* 32: 78. 1863.

Trees, 8 m high. Leaves oblong-elliptic to broadly obovate, arranged at irregular intervals, acute to obtuse at base, entire, bluntly acuminate to subulate at apex, 45 x 22 cm; petioles 2-8 cm long. Inflorescences ramiflorous or axillary, fasciculate. Sepals 5. Petals 5. Male flowers: pedicels 5 mm long; disk flat, 5-lobed; stamens 5, inserted on the disk, connate; anthers orbicular; pistillode trifold.

Female flowers: pedicels 5 cm long; disk flat; ovary subglobose, styles 3. Capsules depressed, 3 cm in diam., 3-lobed, verrucose or smooth, brown or green when dry; pedicels 1-5 cm long.

Ecology : Rare in coastal forests.

Fl. & Fr. : January-December.

Distrib. : Andaman & Nicobar group of islands.

Aporosa Blume

Aporosa villosa (Lindl.) Baill., *et. Gen. Euphorb.* 645. 1858.

Small trees, 10 m high. Leaves broadly ovate to oblong-elliptic, truncate or cordate or rounded at base, entire or serrate, bluntly acuminate at apex, 25 x 11 cm. Male inflorescences axillary, 2-5 together, 5 cm long; flowers minute; female inflorescences fasciculate or shortly peduncled, 1 cm long. Capsules ellipsoid, 18 x 13

mm diam., brownish-villous to glabrous, 2-3 loculed, sessile or subsessile, brown or dark reddish-brown.

Ecology : Common in inland forests, frequent in coastal hill slopes. Tree yields red dye.

Fl. & Fr. : January-December.

Distrib. : Restricted only in Nicobar islands.

Claoxylon Juss.

Claoxylon indicum (Reinw. ex Bl.) Hassk., *Cat. Pl. Hort. Bogor. Alter.* 235. 1844; Hook. f., *Fl. Brit. India* 5: 410. 1887.

Trees, 12 m high. Leaves narrowly to broadly elliptic, cuneate or obtuse at base, obscurely sinuate-serrate, acuminate at apex, 37 x 15 cm. Male inflorescences racemose, 25 cm long. Female inflorescences 12 cm long, 7-15 flowered, umbellate.

Flowers purplish-puberulous towards apex. Capsules flattened, sub-pyriform.

Ecology : Frequent in coastal forests.

Fl. & Fr. : January-December.

Distrib. : Andaman and Nicobar islands.

Dimorphocalyx Thwaites

Dimorphocalyx lawianus Hook. f. in Hook. f., *Fl. Brit. India* 5: 404. 1886.

Glabrous trees. Leaves 10-20 cm long, elliptic ovate. Flowers in axillary or terminal few flowered racemes. Capsule 3-2 valved, crustaceous cocci. Seeds

ovoid, albumen fleshy.

Ecology : Rare in dense coastal forest.

Fl. & Fr. : May-October.

Distrib. : Konkan coast.

***Glochidion* J.R. & G. Forst.**

Glochidion calocarpum Kurz in Trimen. J. Bot. 13: 330. 1875; Hook. f., Fl. Brit. India 5: 309. 1887.

Shrubs or trees, 12 m high. Leaves elliptic-oblong to suborbicular or oblong to ovate-oblong, asymmetric and rounded, obtuse to acute at base, entire, acuminate to sub-acuminate at apex, 25 x 11 cm; lateral nerves 6-10 pairs; petioles 5-8 mm long. Inflorescences axillary,

sessile. Flowers dioecious. Capsules depressed, prominently 5-6, lobed, 16 mm diam.; fruiting pedicels 12 mm long.

Ecology : Rare in coastal forests and Bay islands.

Fl. & Fr. : January-December.

Distrib. : Endemic to Andaman and Nicobar island.

***Macaranga* Thou.**

Macaranga peltata (Roxb.) Muell. & Arg. in Linnaea 34: 1010. 1866.

Trees, 15 m high. Leaves peltate, ovate-orbicular, rounded at base, cordate or cuspidate or acute at apex, 35 x 35 cm. Inflorescences paniculate; the males 30 x 12 cm; the females narrow 10 cm long. Capsules didymous

or tricoccus depressed, echinate, 152 mm diam.

Ecology : Common in beach and littoral forests.

Fl. & Fr. : January-December.

Distrib. : South and little Andaman islands.

***Mallotus* Lour.**

1. ***Mallotus oblongifolius*** (Miq.) Muell. & Arg. in Linnaea 34: 192. 1865-66.

Shrubs or small trees, 8 m high. Leaves alternate to elliptic or ovate-elliptic, rarely suborbicular, narrowly cordate at base, glandular serrate or dentate, caudate-acuminate at apex, 36 x 15 cm. Flowers dioecious. Capsule tricoccus, depressed, sparsely echinate; pedicels 5 mm long; seed orbicular.

Ecology : Common in littoral forests.

Fl. & Fr. : January-December.

Distrib.: Andaman and Nicobar islands.

Female flowers distant, in 4-6 cm long spikes. Capsule globose, 8-10 mm across, covered with soft bristles.

Ecology : Common in littoral forests.

Fl. & Fr. : January-December.

Distrib.: Andaman and Nicobar islands.

3. ***Mallotus resinousus*** (Blanco) Merr., Spp. Blanco. 222. 1918.

Trees, 8 m high. Leaves opposite, cuneate obovate to elliptic-oblong, cuneate or acute to obtuse at base, repend-dentate to entire, bluntly acuminate to cuspidate at apex, 30 x 15 cm. Inflorescences racemose. Flowers dioecious. Capsules depressed, 3(4) lobed, sparsely echinate, spines slender.

Ecology : Common in Littoral forests.

Fl. & Fr. : January-December.

Distrib. : South Andaman & Nicobar islands.

2. ***Mallotus peltatus*** (Geisl.) Muell. & Arg. in Linnaea 34: 187. 1865-66.

Shrubs or small trees, 5 m high. Leaves 8-20 x 3-12 cm, peltate, glabrous, entire. Flowers whitish yellow. Male flowers clustered in 10-20 cm long terminal spikes.

***Phyllanthus* L.**

Phyllanthus fraternus Webster, Contr. Gray Herb. 176:53. 1955 and Jr. Asiat. Soc. Bengal 38: 308. 1957. *P. niruri sensu* Hook. f. in Hook. f., Fl. Brit. India 5:298.1887.

Erect annual herb, 30-60 cm high. Leaves 4-12 x 2-15 mm, closely distichous, linear or elliptic-oblong, apex acute or obtuse, base rounded. Flowers small greenish white, axillary, mostly on lower side of branchlets

hidden by leaves. Capsules 1, 5-3 mm in diam., depressed-globose, pale brown. Seeds 1 mm, trigonous, brown, parrallel ribbed.

Ecology : Common on seashore sands, roadside and littoral forests.

Fl. & Fr. : May-October.

Distrib. : Throughout the coastal zone.

Sphyrantha Hook. f.

Sphyrantha lutescens (Kurz) Pax. & Hoffm. in Engl. & in Hoffm. in Engl. & Horns., Pflanzenfam. ed. 2, 19c: 231. 1931.

Trees, 8 m high. Leaves elliptic to oblong or suborbicular, acute at base, shortly and bluntly acuminate at apex, 27 x 15 cm. Flowers dioecious. Capsules

depressed, 12 mm diam., smooth, pale greyish.

Ecology : Common in coastal forests and bay islands.

Fl. & Fr. : March-December.

Distrib. : Endemic to Middle Andaman and Nicobar islands.

MORACEAE

Artocarpus Forster & Forster. f.

Artocarpus peduncularis Kurz in Trimen. J. Bot. 4: 331. 1885; Hook. f., Fl. Brit. India 2: 448. 1878.

Tree 12-15 m. Leaves 12.5-17.5 cm glabrous, ovate or ovate-oblong, apex obtuse, base rounded. Flowers monoecious, flower heads erect, cylindrical. Fruits oblong,

cylindric 5-6 cm in diam.; anthocarp 4-5 angled. Seeds few, 1.5 cm long.

Ecology : Rare in coastal forest.

Fl. & Fr. : February-May.

Distrib. : Nicobar islands

Ficus L.

1. *Ficus altissima* Bl., Bijdr. 444. 1826; Hook. f., Fl. Brit. India 5: 504. 1888.

Large spreading trees. Leaves elliptic to ovate-lanceolate, acute or rounded at base, obtuse at apex, 20 x 12 cm. Figs (syconia) subglobose or ellipsoid, 2-3 cm, yellow, axillary, paired; basal bracts 3, ovate, 4 cm long, scarious. Achenes ellipsoid, shiny brown.

Ecology : Rare in the littoral forests.

Fl. & Fr. : October-June.

Distrib. : South Andaman and Nicobar islands.

2. *Ficus nervosa* Heyne ex Roth, in Roem. & Schultz. Syst. 1: 513. 1817; Hook. f., Fl. Brit. India 5: 512. 1888.

Large trees; bark greyish brown, smooth. Leaves obovate-oblong, oblong-elliptic, abruptly caudate acuminate at apex, base rounded, cuneate, coriaceous or leathery 22 x 8 cm. Figs (syconia) globose, obovoid, 1.5

cm across, yellow turning reddish, 1-3 together, bracts small at the base of peduncles.

Ecology : Frequent in evergreen and littoral forests.

Fl. & Fr. : September-March.

Distrib. : Andaman and Car Nicobar islands.

3. *Ficus rumphii* Bl., Bijdr. 437. 1825; Hook. f., Fl. Brit. India 5: 512. 1888.

Medium sized trees, 10 m high; often epiphytic; bark greyish brown, smooth. Leaves broadly ovate, acuminate at apex, base rounded or truncate, sometimes narrowed cuneate, 15 x 8 cm, entire, glabrous. Figs 1.5 cm across, globose, blackish when ripe, sessile, usually in pairs. Achenses minutely tuberculate, mucilaginous.

Ecology : Common in littoral and inland forests.

Fl. & Fr. : September-January.

Distrib. : All through the islands of Andaman and Nicobar.

Poikilospermum Zipp. ex Miq.

Poikilospermum suaveolens (Blume) Merr. in Contr. Arnold., Arb. 8: 47. 1934. *Conocephalus suaveolens* Bl.: Hook. f., Fl. Brit. India 5: 545. 1888.

Woody climbers; produce potable watery sap, 0.5-1.25 cm in diam. Leaves ovate, elliptic to obovate, rounded to cordate at base, sharp acute to obtuse at apex, 18 x 10 cm, entire, glabrous, rarely pubescent.

Inflorescences 6 cm long, dichotomously branched. Female flowers pedicellate, male flower sessile. Achenes 3-5 mm long, covered by the persistent calyx.

Ecology : Rare in littoral forests on hill slopes.

Fl. & Fr. : June-December.

Distrib. : Andaman and Nicobar islands.

URTICACEAE

Boehmeria Jacq.

Boehmeria nivea (L.) Gaud., Voy. Uranac 12: 499. 1830; Hook. f., Fl. Brit. India 5: 576. 1888.

Shrubs, 1-2 m high, yield 'rami' fibre. Leaves broadly ovate or orbicular, cuneate or subcordate at base, acute or acuminate at apex, 21 x 9 cm, crenate or serrate, chartaceous, deep green above, snow white except nerves beneath, 3 nerved; stipules free, subulate. Panicles

axillary, shorter than the petiole. Flowers in clusters. Achenes oblong, compressed, hairy.

Ecology : Common in coastal forests and inland areas. Cultivated.

Fl. & Fr. : April-September.

Distrib. : Andaman and Nicobar islands.

Procris Comm. ex Juss

Procris laevigata Bl., Bijdr. 508. 1825; Hook. f., Fl. Brit. India 5: 575. 1888.

Epiphytic undershrubs, 1.5 m high. Leaves dimorphic, small and large, obliquely oblanceolate, acuminate, entire or crenate-serrate above, 10 x 6 cm, narrowed into short petiole. Flowers from the naked branches; males in small sessile clusters; female in shortly

peduncled small receptacle. Achenes ovoid, slightly compressed.

Ecology : Rare in beach forests.

Fl. & Fr. : November-March.

Distrib. : Nicobar islands.

JUNCACEAE

Juncus L.

Juncus maritima Lamk., Encycl. iii. 264. 1781; Hook. f., Fl. Brit. India 6: 393. 1892.

Glabrous herb. Leaves absent, basal sheaths narrow, obtuse; pungent or produced into a solid terete leaf. Flowers in axillary or terminal cymes, bracteate,

green. Capsule obtuse, mucronate, shining. Seeds oblong or obovoid.

Ecology : On sandy backshore

Fl. & Fr. : October-November.

Distrib. : Gujarat coast.

LILIACEAE

Chlorophytum Ker-Gawl.

Chlorophytum tuberosum (Roxb.) Baker in J. Linn. Bot. 15: 332. 1876; Hook. f., Fl. Brit. India 6: 334. 1892.

Herb, ellipsoid tubers hanging from cylindric root fibres; leaves 6-12, membranous, 15-30 x 1.2-2.5 cm, acuminate, margin undulatus, sessile; scape naked, racemes 5-10 cm long. Flowers white. Capsule ovoid,

shiny; seed irregularly orbiculate, black.

Ecology : Frequent along sandy seashore and coastal beach forests.

Fl. & Fr. : June-September.

Distrib. : Maharashtra, Goa and Gujarat coast.

Drimia Jacq. ex Willd.

Drimia indica (Roxb.) Jessop in J. S. Afr. Bot. 43: 272. 1977; *Urginea indica* (Roxb.) Kunth: Hook. f., Fl. Brit. India 6: 347. 1892.

Herbs; bulbs 6-8 x 4-6 cm, ovoid; leaves 20-30 x 0.4-0.6 cm, linear, lanceolate or lorate, ensiform, acute; scape 17-100 cm long, purple brown, raceme 1.2-6.0 cm long. Capsule ellipsoid, seed 4-10 per locule, black, wing

scarious.

Ecology : Rare on sandy seashore and coastal scrub forests.

Fl. & Fr. : February-May.

Distrib. : Maharashtra, Tamil Nadu, Karnataka and Kerala coast.

ARECACEAE

Bentinckia A. Berry ex Roxb.

Bentinckia nicobarica Becc., Ann. J. Bot. Buitenz II. 165; Beccari & Hook. f. in Hook. f., Fl. Brit. India 6: 418. 1894.

Trunk annulate, 22.5 cm in diam. Leaves 1.5 x 2.5 m; leaflets 15-60 cm, sessile, linear, coriaceous, tip obtusely 2-lobed; Petiole short and rachis glabrous. Spadix 45-60 cm, decomposed, glabrous branches and branchlets inserted in woolly grooves of rachis. Fruits globose, sub-

ovoid when dry. Seeds ovoid-oblong, ventrally flat, dorsally convex, rugosely ribbed.

Ecology : Rare in hill slopes and sandy coastal forests.

Fl. & Fr. : July-September.

Distrib. : Nicobar island.

Hyphaene Gaertner

Hyphaene dichotoma (White) Furtado in Gard. Bull. Singapore 25: 301. 1970. *H. indica* Becc.: Rao. R.S. in Jr. Bomb. Nat. Hist. Soc. 60: 761. 1963.

Trees 12-15 m tall, cylindrical or ventricose, dichotomously branched. Leaves flabellate-multifid, suborbicular. Male spadix stout, about 3 ft long. Fruits

obovate-pyriform, attenuate at base.

Ecology : Frequent on sandy seashore.

Fl. & Fr. : September-December.

Distrib. : Daman and Remeswaram, Endemic.

CYPERACEAE

Cyperus L.

1. *Cyperus conglomeratus* Rottb., Descr. et Ic. 21, t. 15, f. 7; Clarke in Hook. f. in Hook. f., Fl. Brit. India 6: 602. 1894.

Glabrous. Rhizome sometimes elongate, 0.3 x 0.4 cm in diam. Stems 10-60 cm, robust. Leaves often length of stem and upwards. Umbel simple, not rarely constructed into 1 head; rays often 3-4, about 2.5 cm long.

Ecology : Rare on sandy beaches and moist palces.

Fl. & Fr. : June-July.

Distrib. : Gujarat coast.

2. *Cyperus pedunculatus* (R. Br.) Kem., Act. Bot. Neerl. 7: 798, f. 4. 1958.

Erect, rhizomatous sedges, 80 cm high. Leaves crowded. Inflorescences head like, consisting of some digitately arranged, sessile, short spikes. Involucral bracts 4-5. Spikes ellipsoid, 15 x 10 mm. Spikelets sessile, densely crowded, ovoid, acute, slightly compressed, 1-flowered, falling off as whole, 5 x 2 mm. Glumes broadly ovate, hardly keeled, many nerved, minutely apiculate, 3 lower ones empty, 4th glume flower bearing, uppermost vestigial. Nuts triquetrous, oblong, slightly compressed, shining.

Ecology : Common on sandy soils.

Fl. & Fr. : July-November.

Distrib. : Orissa, Tamil Nadu, Karnataka and Kerala coast.

POACEAE

Cenotheca Desv.

Cenotheca lappacea (L.) Desv. in Nouv. Bull. Sci. Soc. Philom. Paris 2: 189. 1810; Hook. f., Fl. Brit. India 7: 332. 1896; Bor, 457. 1960.

Tall perennial grasses 30-90 cm, stout erect from a branched woody rootstock. Leaves 10-30 x 2.5-3 cm, broadly lanceolate. Panicle 20-30 cm long and broad.

Spikelet 1-2 fld. Grain ovoid, acute, terete, free.

Ecology : Common and cultivated as good fodder grains along the coastal plains.

Fl. & Fr. : March-September.

Distrib. : Tamil Nadu, Maharashtra and Andaman.

Chloris Sw.

Chloris virgata Swartz., Fl. Ind. Occ. 1:203. 1797; Hook. f., Fl. Brit. India 7: 291. 1896; Bor, 468. 1960.

Perennial rarely annual grasses. Stem stout, flattened 20-30 cm high, leafy decumbent and much proliferously branched. Leaves broad, flat, acute; upper

sheath inflated. Spikes 4-10, spikelets 2 awned.

Ecology : In the hotter parts of the coastal area.

Fl. & Fr. : July-August.

Distrib. : Throughout the coastal wetlands.

***Cymbopogon* Sprengel.**

Cymbopogon caesius (Nees ex Hook. & Arn.) Stapf. in Kew Bull. 341. 1906; *Andropogon schoenanthus* L. var. *caesius* (Nees ex Hook. & Arn.) Hack.: Hook. f., Fl. Brit. India 7: 205. 1896; Bor, 125. 1960.

Annual. Stem 80-160 cm, erect, whole plant glaucous. Leaves very narrow finely acuminate, base not dilated. Panicles 30-60 cm, subsimple. Spikes

unequal.

Ecology : Commonly cultivated for oil along the coastal plains.

Fl. & Fr. : September-December.

Distrib. : All along the coast.

***Digitaria* Haller.**

Digitaria sanguinalis (L.) Scop., Fl. Carn. ed 2. 1:52. 1772; *Paspalum sanguinale* (L.) Lam.: Hook. f., Fl. Brit. India 7:13. 1896; Bor. 304. 1960.

Annual or perennial. Stem 5-80 cm, erect or ascending from a creeping, branching base. Leaves 2.5-7.5 cm x 3-8 mm. Spikes 2.5-7.5. Spikelets geminate loosely or closely imbricate. Grains free

with hardened glumes.

Ecology : Common plant thriving well in dry and moist situation along the coast.

Fl. & Fr. : April-September.

Distrib. : Throughout the coastal zone.

***Halopyrum* Stapf.**

Halopyrum mucronatum (L.) Stapf. in Hook., Ic. Pl. t. 2448. 1896; Bor, 516. 1960; Hook. f., Fl. Brit. India 7: 328. 1896.

A monotypic, stout perennial glabrous grass, with huge tufts. Leaves 20-30 cm, narrow, rigid, convolute, finely acuminate. Panicle 30-40 cm. Spikelets 1-1.5 cm, white or pale yellowish. Grain ellipsoid, compressed, deeply hollowed.

Ecology : Frequent on seashore sands and inward sand bars, a good sand binder.

Fl. & Fr. : April-September.

Distrib. : Tamil Nadu, Karnataka, Maharashtra and Goa coast.

***Lepturus* R. Br.**

Lepturus repens (G. Forst.) R. Br., Prodr. Fl. Nov. Holl. 207. 1810; Hook. f., Fl. Brit. India 7: 365. 1896.

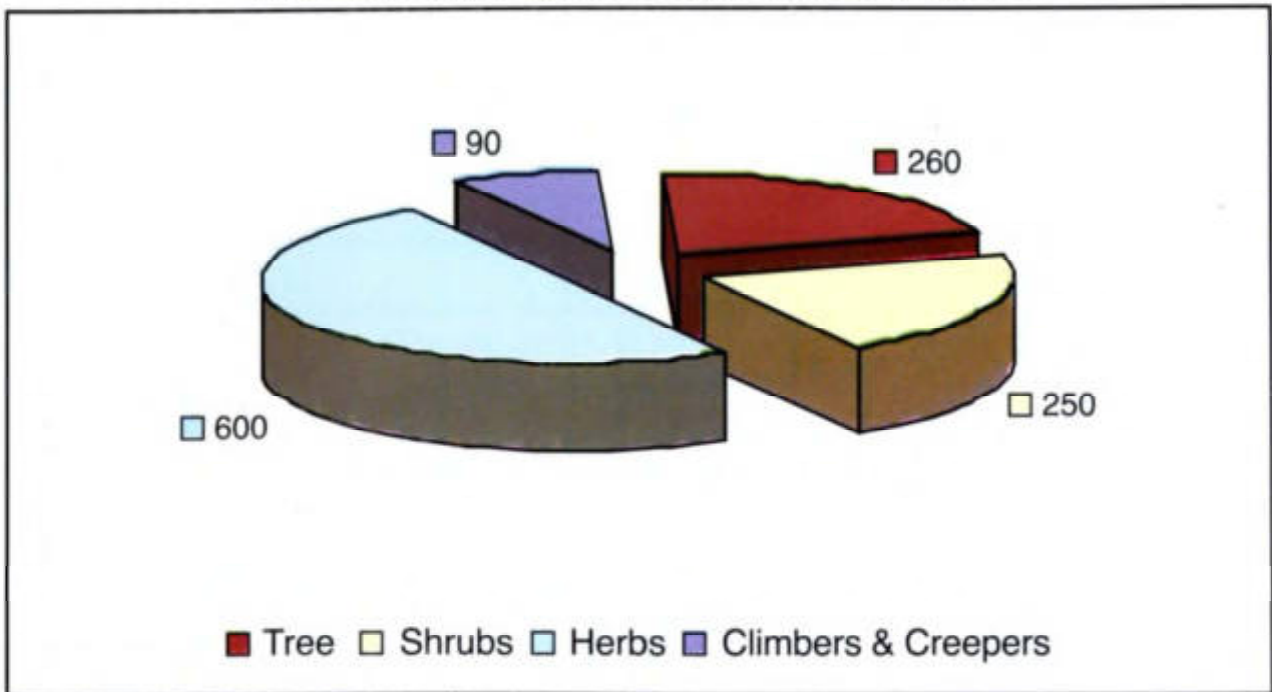
Woody, branched and widely creeping below. Leaves 7.5-15 x 0.3-0.6 cm, convolute or flat, acuminate, glaucous; spike 5-15 cm long, lodicules fleshy, glabrous, grain oblong.

Ecology : Rare in the rocky cleft with huge tufts near the coast and river banks.

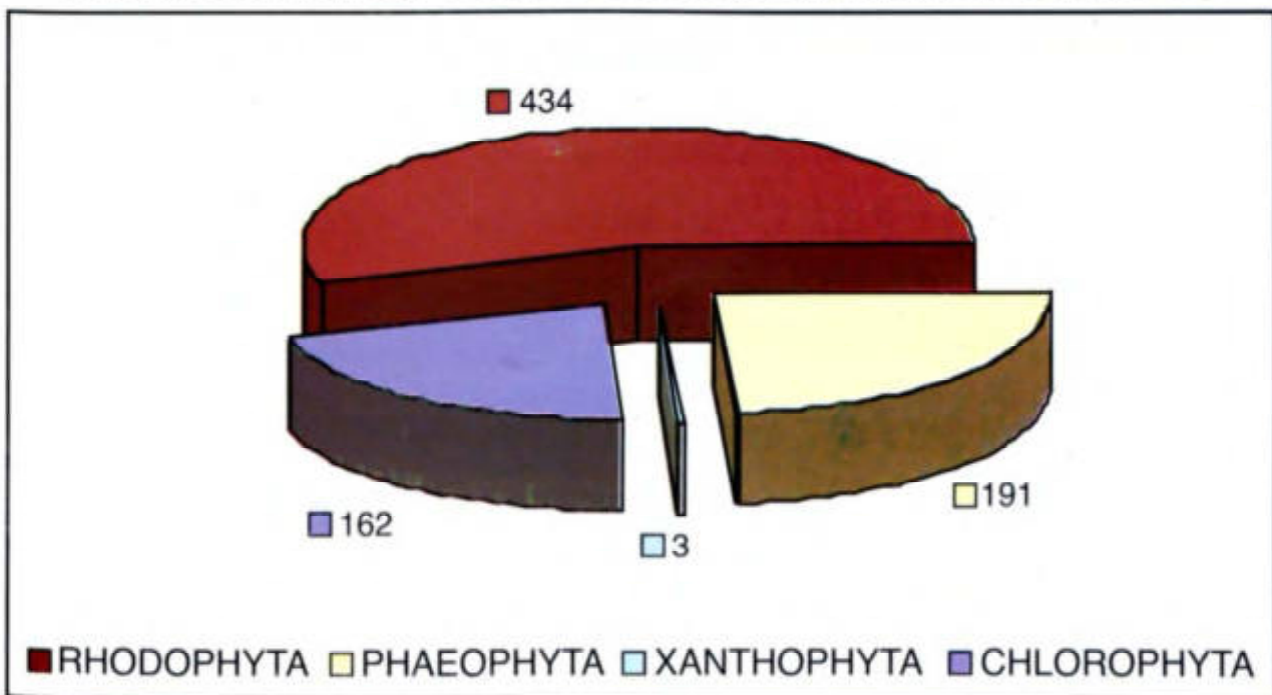
Fl. & Fr. : June-July; August-September.

Distrib.: Lakshadweep island and Gujarat.

NUMBER OF TREES, SHRUBS, HERBS, CLIMBERS AND CREEPERS OF THE COASTAL PLANT COMMUNITIES IN INDIA



TOTAL NO. OF RHODOPHYTA, PHAEOPHYTA, XANTHOPHYTA AND CHLOROPHYTA AS RECORDED FROM INDIAN MARINE SEAWEEDS



ASSESSMENT OF COASTAL PLANT COMMUNITIES IN INDIA**1. TOTAL NUMBER OF PLANT DIVERSITY AS REPORTED HERE
FROM INDIAN COASTAL REGIONS**

	GENERA	SPECIES
PHYTOPLANKTONS	168	
SEA WEEDS		550 (Out of 750)
SEAGRASSES		15
ANGIOSPERMS		1200

**2. NO. OF ANGIOSPERM FAMILIES, GENERA AND SPECIES COLLECTED
FROM THE INDIAN COASTAL REGIONS**

NO. OF FAMILIES	NO. OF GENERA	NO. OF SPECIES
155	813	1200

**3. NO. OF FAMILIES, GENERA AND SPECIES DISTRIBUTED
IN DIFFERENT COASTAL STATES IN INDIA**

COASTAL REGIONS	STATES/ PARTS	NO. OF FAMILIES	NO. OF GENERA	NO. OF SPECIES
East Coast	West Bengal	101	358	568
	Orissa	112	370	632
	Andhra Pradesh	103	357	545
	Tamil Nadu	114	433	727
West Coast	Kerala	105	376	585
	Karnataka	109	376	564
	Maharashtra	102	350	595
	Goa	87	254	340
Gujarat Coast	Gujarat	87	318	392
Andaman & Nicobar Island		81	165	241
Lakshadweep		20	34	40

4. FLORISTIC DIVERSITY :

Hooker (1906) recognized the dominant families of flowering plants in India on the basis of occurrence of total number of species in the families of Orchidaceae, Leguminosae, Poaceae, Asteraceae, Rubiaceae, Acanthaceae, Euphorbiaceae, Lamiaceae, Cyperaceae and Scrophulariaceae. In comparison to this, total number of species in the first ten families along the Indian coastal flora are as follows:

FAMILIES	GENERA	SPECIES
LEGUMINOSAE	66	131
POACEAE	64	128
EUPHORBIACEAE	31	56
ASTERACEAE	36	49
ORCHIDACEAE	19	31
CYPERACEAE	11	34
ACANTHACEAE	16	25
RUBIACEAE	17	31
LAMIACEAE	10	18
SCROPHULARIACEAE	14	22

5. SOME OF THE ENDEMIC AND RESTRICTED PLANTS ALONG THE INDIAN COAST

Due to special ecological conditions such as high saline tide water flow, high wind speed, wave action, unstable sandy, silty or clayey substrate and frequent storm and cyclone, some of the plant species are found endemic and restricted in distribution on the coastal habitats. Majority of them are specially adapted to withstand the above stress conditions.

<i>Acacia chundra</i> Willd.	<i>Astragalus fatmensis</i> Hochst. ex Bunge
<i>Acacia senegal</i> (L.) Willd.	<i>Balanites aegyptica</i> (L.) Delile
<i>Acanthus ebracteatus</i> Vahl	<i>Barringtonia asiatica</i> (L.) Kurz
<i>Acanthus volubilis</i> L.	<i>Bentinckia nicobarica</i> Becc.
<i>Acrostichum speciosum</i> Willd.	<i>Bergia suffruticosa</i> (Delile) Fenzl.
<i>Adenia penangiana</i> (Wall. ex G. Don) Wilde	<i>Blepharis indica</i> T. Anders.
<i>Aglaiia cucullata</i> (Roxb.) Pellegr.	<i>Blumeopsis flava</i> (DC.) Gagnep
<i>Aglaiia lawii</i> (Wight) Saldanha	<i>Brownlowia tersa</i> (L.) Kosterm.
<i>Alphonsea ventricosa</i> (Roxb.) Hook.f. & Thoms.	<i>Bruguiera cylindrica</i> (L.) Bl.
<i>Alstonia kurzii</i> Hook.f.	<i>Bruguiera parviflora</i> (Roxb.) Wight & Arn. ex Griff.
<i>Apama siliquosa</i> Lamk.	<i>Bruguiera sexangula</i> (Lour.) Poir.
<i>Aponogeton crispus</i> Thunb.	<i>Bulbophyllum mysorensis</i> (Rafle) J. J. Sm.
<i>Aporosa villosa</i> (Lindl.) Baill.	<i>Calophyllum soulattri</i> Burm. f.
<i>Argusia argentea</i> L. f.	<i>Convolvulus auricomus</i> (A. Rich.) Bhand.
<i>Artabotrys nicobarianus</i> D. Das	<i>Crotalaria burhia</i> Buch.-Ham. ex Benth.

- Cycas rumphii* Miq.
Dalbergia spinosa Roxb.
Dimeria lowsonii (Hook.f.) Fischer.
Dischidia numularia R. Br.
Enhalus acoroides (L.f.) Royle
Eragrostis subsicunda (Lam.) Four.
Eragrostis tef (Zucc.) Trotter.
Euphorbia atoto Forst.
Euphorbia caducifolia Haines
Fagonia indica var. *schweinfurthii* Hadidi.
Finlaysonia obovata Wall.
Glycosmis mauritiana (Lam.) Tanaka var.
andamanensis Mitra et. Subra
Glycosmis mauritiana var. *latifolia* (Kurz.) Balakr.
Glyptopetalum calocarpus (Kurz.) Prain
Harrisonia perforata (Blanco) Merr.
Helichrysum cutchicum (Clarke)R. Rao et Desh.
Heliotropium crispum Desf.
Heritiera fomes Buch.-Ham.
Heritiera kanikensis Majum. et Baner.
Hernandia peltata Meissn.
Heterostemma tanjorensis Wight & Arn.
Hewittia scandens (Mitne) Mabb.
Hopea parviflora Bedd.
Indigofera argentea Burm.f.
Intsia bijuga (Colebr.) O. Kuntze
Ipomoea gracilis R. Br.
Ipomoea obscura (L.) Kct.
Ischaemum santapaui Bor
Ixora tenuifolia Bremekamp
Ixora brunnescens Kurz
Jatropha glandulifera Roxb.
Kandelia candel (L.) Druce
Kleinia grandiflora (Wallich ex DC.) N. Rani
Knema andamanica (Warb.) Wilde
Lasianthus acuminatus Wight
Lasianthus parvifolius Wight
Lepisanthus andamanica King
Limonium stocksii (Boiss.) Kuntze
Litsea nitida (Roxb. ex Wall.) Hook.f.
Lotus garcini DC.
Lumnitzera littorea (Jack.) Voigt
Magnolia andamanica (King) Raju & Nayar
Manilkara littoralis (Kurz) Dubard
Maesa andamanica Kurz
Memecylon andamanicum King
Neisosperma oppositifolium (Lam.) Forb. & Sac.
Nypa fruticans Wurm
Oldenlandia nitida Gamb.
Oldenlandia stricta L.
Olea dioica Roxb.
Orophea katschallica Kurz
Palaquium semarum H.J. Lam.
Pandanus andamanensium Kurz
Pandanus leram Jones ex Font.
Panicum miliaceum L.
Paramignya andamanica (L.) Tanaka
Pemphis acidula Forst.
Peristrophe paniculata (Forsk.) Brummitt.
Phoenix farinaria Roxb.
Phoenix paludosa Roxb.
Pisonia aculeata L.
Pluchea arguta Beriss.
Poikilospermum suaveolens (Blume) Merr.
Polyalthia korintii (Dunl.) Thw.
Polygala arillata Buch.-Ham. ex D. Don.
Prosopis glandulosa Torrey
Pterocarpus dalbergioides Roxb. ex Dc.
Rhizophora stylosa Griff.
Ruppia maritima L.
Sacciolepis myosuroides (R. Br.) A. Camus
Salacia nicobarica (Kurz) Raju
Saurauia bracteosa DC.
Scaevola plumierii (L.) Vahl
Scheffera elliptica (Bl.) Harms.
Scyphiphora hydrophyllacea Gaertn.
Sebastiania chamaclea (L.) Muel. & Arg.
Senra incana Cav.
Sericostema pauciflorum Stocks.
Sesuvium sesuvioides (Fenzl.) Verdcourt
Solanum arvensis Mattei
Sonneratia griffithii Kurz
Sophora tomentosa L.
Sphaeromorphaea australis (Less.) Kitam
Suaeda fruticosa (L.) Forsk.
Suriana maritima L.
Syringodium isoetifolium (Asch.) Dandy
Tetrastigma andamanica (King) Success.
Thuarea involuta (Forst.) R. Br. ex Rom. & Schl.
Tylophora tenuis Bl.
Urochondra setulosa (Trin.) Hubb.
Vitex diversifolia Kurz
Walsura condollei King
Walsura trifoliata (Juss.) Harms.
Xylocarpus moluccensis (Lam.) Roem.
Zygophyllum simplex L.

LIST OF SEA WEEDS REPORTED FROM THE INDIAN COAST

RHODOPHYTA

Species	Variety	Forma
423	6	5

- | | |
|--|---|
| 1. <i>Bangiopsis dumontioides</i> | 38. <i>G. marginata</i> |
| 2. <i>B. subsimplex</i> | 39. <i>G. obtusata</i> |
| 3. <i>Chroodactylon ornatum</i> | 40. <i>G. plicata</i> |
| 4. <i>Stylonema alsidii</i> | 41. <i>G. rugosa</i> |
| 5. <i>Erythrocladia irregularis</i> | 42. <i>Scinaia bengalica</i> |
| 6. <i>E. carnea</i> | 43. <i>S. carnosa</i> |
| 7. <i>Porphyrostromium ciliare</i> | 44. <i>S. complanata</i> |
| 8. <i>Sahlingia subintegra</i> | 45. <i>S. fascicularis</i> |
| 9. <i>Bangia atropurpurea</i> | 46. <i>S. furcellata</i> |
| 10. <i>Porphyra crispata</i> | 47. <i>S. hatel</i> |
| 11. <i>P. chaudhanii</i> | 48. <i>S. moniliformis</i> |
| 12. <i>P. indica</i> | 49. <i>Tricleocarpa cylindrica</i> |
| 13. <i>P. kanyakumariensis</i> | 50. <i>T. fragilis</i> |
| 14. <i>P. laciniata</i> | 51. <i>Dermonema virens</i> |
| 15. <i>P. okhaensis</i> | 52. <i>Dotyophycus corymbosus</i> |
| 16. <i>P. suborbiculata</i> | 53. <i>Ganonema farinosum</i> |
| 17. <i>P. vietnamensis</i> | 54. <i>Helminthocladia calvadosii</i> f. <i>comoriensis</i> |
| 18. <i>Acrochaetium canariense</i> | 55. <i>H. calvadosii</i> f. <i>indica</i> |
| 19. <i>A. crassipes</i> | 56. <i>H. sreeramului</i> |
| 20. <i>A. crassipes</i> var. <i>longisetum</i> | 57. <i>Liagora albicans</i> |
| 21. <i>A. dwarkense</i> | 58. <i>L. bella</i> |
| 22. <i>A. erectum</i> | 59. <i>L. ceranoidesi</i> |
| 23. <i>A. flexuosum</i> | 60. <i>L. distenta</i> |
| 24. <i>A. gracile</i> | 61. <i>L. doridis</i> |
| 25. <i>A. iyengarai</i> | 62. <i>L. indica</i> |
| 26. <i>A. krusadii</i> | 63. <i>L. mannarensis</i> |
| 27. <i>A. liagoraefilum</i> | 64. <i>L. orientalis</i> |
| 28. <i>A. liagoroides</i> | 65. <i>L. viscida</i> |
| 29. <i>A. mlisporum</i> | 66. <i>Liagoropsis schrammii</i> |
| 30. <i>A. robustum</i> | 67. <i>Nemalion attenuatum</i> |
| 31. <i>A. sancti-thomae</i> | 68. <i>Ahnfeltia plicata</i> |
| 32. <i>A. spathoglossi</i> | 69. <i>Gelidium amansii</i> |
| 33. <i>A. subseriatum</i> | 70. <i>G. corneum</i> |
| 34. <i>A. tuticorinense</i> | 71. <i>G. crinale</i> |
| 35. <i>Palmaria palmate</i> | 72. <i>G. micropterum</i> |
| 36. <i>Actinotrichia fragilis</i> | 73. <i>G. proliferum</i> |
| 37. <i>Galaxaura lenta</i> | 74. <i>G. pusillum</i> |

75. *G. pusillum* var. *pulvinatum*
 76. *G. pulvinatum* var. *parvissimum*
 77. *Pterocladia caerulescens*
 78. *P. heteroplata*
 79. *P. kanyakumarensis*
 80. *Gelidiella acerosa*.
 81. *G. diuensis*
 82. *G. indicia*
 83. *G. lubrica*
 84. *G. myrioclada*
 85. *G. pannosa*
 86. *Gracilaria arcuata*
 87. *G. arcuata* var. *attenuata*
 88. *G. arcuata* var. *snackeyi*
 89. *G. armata*
 90. *G. blodgettii*
 91. *G. butrsa-pastoris*
 92. *G. canaliculata*
 93. *G. corticata*
 94. *G. corticata* var. *cylindrica*
 95. *G. corticata* var. *linearis*
 96. *G. corticata* var. *ramalinoides*
 97. *G. debilis*
 98. *G. disticha*
 99. *G. dura*
 100. *G. edulis*
 101. *G. eucheumatoides*
 102. *G. foliifera*
 103. *G. foliifera* f. *aeruginosa*
 104. *G. foliifera* f. *granatea*
 105. *G. gracilis*
 106. *G. incrustata*
 107. *G. indica*
 108. *G. kanyakumariensis*
 109. *G. kilakkaraensis*
 110. *G. mannarensis*
 111. *G. millardetii*
 112. *G. opuntia*
 113. *G. pudumadamensis*
 114. *G. pygmaea*
 115. *G. salicornia*
 116. *G. spinuligera*
 117. *G. textorii*
 118. *G. tuticorinensis*
 119. *G. veteroae*
 120. *G. verrucosa*
 121. *Gracilariopsis lemaneiformis*
 122. *Gelidium megaspora*
 123. *Asparagopsis armata*
 124. *A. taxiformis*
 125. *Corynomorpha prismatica*
 126. *Carpopeltis maillardii*
 127. *Cryptonemia coriacea*
 128. *C. lomation*
 129. *C. undulata*
 130. *Grateloupia comorinii*
 131. *G. filicina*
 132. *G. filicina* var. *filicina* f. *cirhosa*
 133. *G. filicina* var. *filicina* f. *horrida*
 134. *G. filicina* var. *filicina* f. *pectinata*
 135. *G. furcata*
 136. *G. indica*
 137. *G. lithophila*
 138. *G. warm*
 139. *Halymenia amoena*
 140. *H. dilatata*
 141. *H. dubia*
 142. *H. durvillei*
 143. *H. floresia*
 144. *H. formosa*
 145. *H. imbricata*
 146. *H. jelinekii*
 147. *H. microcarpa*
 148. *H. porphyraeformis*
 149. *H. tenuispina*
 150. *H. venusta*
 151. *Prionitis australis*
 152. *Peyssonnelia bicolor*
 153. *P. conchicola*
 154. *P. obscura*
 155. *P. obscura* var. *bombayensis*
 156. *P. simulans*
 157. *Portieria hornemannii*
 158. *Peyssonnelia spinulosa*
 159. *Hildenbrandia rubra*
 160. *Amphiroa anastomosans*
 161. *A. unceps*
 162. *A. brasiliana*
 163. *A. foliacea*
 164. *A. foliacea* f. *erecta*
 165. *A. fragilissima*
 166. *A. rigida*
 167. *Cheilosporum acutilobum*
 168. *C. spectabile*

169. *Corallina berteroi*
 170. *C. officinalis*
 171. *Hydrolithon craspedium*
 172. *H. farinosum*
 173. *H. iyengarii*
 174. *H. krusadiense*
 175. *H. onkodes*
 176. *H. reinboldii*
 177. *H. samoense*
 178. *H. verucosum*
 179. *Jania adhaerens*
 180. *J. capillacea*
 181. *J. fastigiata*
 182. *J. iyengarii*
 183. *J. rubens*
 184. *Lithophyllum okamurae*
 185. *L. orbiculatum*
 186. *Lithothamnion proliferum*
 187. *Mastophora rosea*
 188. *Mesophyllum erubescens*
 189. *Neogoniolithon affine*
 190. *N. brassica-florida*
 191. *N. caribaeum*
 192. *N. crassifrutum*
 193. *N. desikacharyi*
 194. *N. ganesanii*
 195. *N. krusadii*
 196. *N. misakiense*
 197. *N. pulkense*
 198. *N. pudumadamense*
 199. *N. tiruchendurens*
 200. *Phymatolithon notatum*
 201. *Pneophyllum plexifrons*
 202. *P. confervicola*
 203. *P. extensum*
 204. *P. fragile*
 205. *Pseudolithophyllum fosliei*
 206. *P. lemoni*
 207. *P. mannarens*
 208. *P. pambanense*
 209. *P. setchelli*
 210. *P. tuticorinense*
 211. *Spongites decipiens*
 212. *S. fruticosus*
 213. *Titanoderma pustulatum*
 214. *T. pustulatum* var. *confine*
 215. *T. rasile*
 216. *Sporolithon erythraeum*
 217. *S. indicum*
 218. *Catenella caespitosa*
 219. *C. impudica*
 220. *C. nipae*
 221. *Caulacanthus ustulatus*
 222. *Calliblepharis fimbriata*
 223. *C. jubata*
 224. *Furcellaria lumbricalis*
 225. *Chondracanthus acicularis*
 226. *Hypnea divaricata*
 227. *H. esperi*
 228. *H. stagelliformis*
 229. *H. hamulosa*
 230. *H. musciformis*
 231. *H. nigrescens*
 232. *H. pannosa*
 233. *H. spicifera*
 234. *H. spinella*
 235. *H. valentiae*
 236. *Predaea feldmanii* var. *indica*
 237. *Ahnfeltiopsis densa*
 238. *A. pygmaea*
 239. *Sarcodia montagneana*
 240. *Sebdenia flabellate*
 241. *Agardhiella subulata*
 242. *Eucheuma denticulatum*
 243. *Kappaphycus alvarezii*
 244. *K. striatum*
 245. *Meristotheca populosa*
 246. *Sarconema filiforme*
 247. *S. scinaoides*
 248. *Solteria robusta*
 249. *Champia compressa*
 250. *C. compressa* var. *scindica*
 251. *C. globulifera*
 252. *C. indica*
 253. *C. parvula*
 254. *C. somalensis*
 255. *C. zonata*
 256. *Gastroclonium compressum*
 257. *G. iyengarii*
 258. *Lomentaria articulata*
 259. *Botryocladia botryoides*
 260. *B. leptopoda*
 261. *B. leptopoda* f. *luxurians*
 262. *B. skottsbergii*

263. *Ceratodictyon spongiosum*
 264. *Coelarthrum muelleri*
 265. *C. opuntia*
 266. *Gelidiopsis intricata*
 267. *G. repens*
 268. *G. variabilis*
 269. *Halichrysis thivyae*
 270. *Rhodymenia dissecta*
 271. *R. sonderi*
 272. *Acrothamnion butlerae*
 273. *Aglaothamnion byssoides*
 274. *A. cordatum*
 275. *A. neglectum*
 276. *Antrichium tenue*
 277. *Antithamnion cruciatum*
 278. *Antithamnioella elegans*
 279. *A. floccosa*
 280. *A. mcnabbii*
 281. *Bornetia tenuis*
 282. *Centroceras clavulatum*
 283. *Ceramium cimbricum*
 284. *C. cruciatum*
 285. *C. deslongchampsii*
 286. *C. diaphanum* var. *elegans*
 287. *C. fastigiatum* f. *flaccidum*
 288. *C. fimbriatum*
 289. *C. flaccidum*
 290. *C. heterospinum*
 291. *C. luetzelburgii*
 292. *C. maryae*
 293. *C. procumbens*
 294. *C. rubrum*
 295. *C. subdichotomum*
 296. *C. sukrianum*
 297. *C. tenerrimum*
 298. *C. truncatum*
 299. *Crouania attenuata*
 300. *C. boergesenii*
 301. *C. iyengarii*
 302. *Desikacharyella indica*
 303. *Euptilota articulata*
 304. *E. fergusonii*
 305. *Griffithsia corallinoides*
 306. *G. crssiusscula*
 307. *G. heteromorpha*
 308. *G. rhizophora*
 309. *Gymnothamnion elegans*
 310. *Haloplegma duperreyii*
 311. *H. preistii*
 312. *Lejolisia colombiana*
 313. *Mazoyerella krishnamurthyi*
 314. *Monosporus indicus*
 315. *Plenosporium borveri*
 316. *P. carbaeum*
 317. *P. polymorphum*
 318. *Ptilothamnion cladophorae*
 319. *P. subsimplex*
 320. *Spermothamnion speluncarum*
 321. *Spyridia alternans*
 322. *S. filamentosa*
 323. *S. fusiformis*
 324. *S. hypnoides*
 325. *S. hypnoides* var. *inermis*
 326. *Tiffaniella codicola*
 327. *Wrangelia argus*
 328. *W. balakrishnanii*
 329. *W. bicuspidata*
 330. *W. penicillata*
 331. *W. sundaralingamii*
 332. *W. tanegana*
 333. *Dasya baillouviana*
 334. *D. caraibica*
 335. *D. flagelifera*
 336. *D. iengarii*
 337. *D. kamortensis*
 338. *D. ocellata*
 339. *Dictyurus purpurascens*
 340. *Heterosiphonia crispella*
 341. *H. crispella* var. *laxa*
 342. *H. mueller*
 343. *H. stiposa*
 344. *Acrosorium venulosa*
 345. *Apoglossum spathulatum*
 346. *Caloglossa beccarii*
 347. *C. bengalensis*
 348. *C. leprieurii*
 349. *C. leprieurii* var. *hookerii*
 350. *C. ogasawaraensis*
 351. *Claudea elegans*
 352. *C. multifida*
 353. *Hypoglossum heterocystideum*
 354. *Martensia fragilis*
 355. *M. indica*
 356. *Membranoptera murrayi*

357. *Myriogramme bombayensis*
 358. *M. goaensis*
 359. *M. okhaensis*
 360. *M. quilonensis*
 361. *Nitophyllum marginale*
 362. *N. punctatum*
 363. *Platysiphonia delicata*
 364. *Taenioma nanum*
 365. *T. perpusillum*
 366. *Vanvoorstia spectabilis*
 367. *Acanthophora dendroides*
 368. *A. muscoides*
 369. *A. nayadiformis*
 370. *A. spicifera*
 371. *Bostrychia radicans*
 372. *B. tenella*
 373. *Bryocladia thwaitesii*
 374. *Chondria armata*
 375. *C. capillaris*
 376. *C. cornuta*
 377. *C. dasyphylla*
 378. *C. dasyphylla* var. *stellata*
 379. *C. seticulosa*
 380. *C. transversalis*
 381. *Digenera simplex*
 382. *Enantiocladia prolifera*
 383. *Endosiphonia horrida*
 384. *Herposiphonia insidiosa*
 385. *H. prorepens*
 386. *H. secunda*
 387. *H. secunda* f. *tenella*
 388. *Laurencia botrychioides*
 389. *L. brandenii*
 390. *L. caraibica*
 391. *L. ceylanica*
 392. *L. claviformis*
 393. *L. cruciata*
 394. *L. flagellifera*
 395. *L. glandulifera*
 396. *L. glomerata*
 397. *L. gracilis*
 398. *L. indica*
 399. *L. majuscula*
 400. *L. obtusa*
 401. *L. obtusa* var. *divaricatu*
 402. *L. obtusa* var. *gracilis*
 403. *L. obtusa* var. *rigidula*
 404. *L. pannosa*
 405. *L. papitosa*
 406. *L. parvula*
 407. *L. pedicularioides*
 408. *L. platyclada*
 409. *L. rigida*
 410. *Lenormandiopsis parthasarathy*
 411. *Leaveillea jungermannioides*
 412. *Lophocladia tallemandii*
 413. *L. trichocladus*
 414. *Murrayella pericladus*
 415. *Neurymenia fraxinifolia*
 416. *Osmundea pinnatifida*
 417. *Polysiphonia atlantica*
 418. *P. brodiei*
 419. *P. coacta*
 420. *P. crassicollis*
 421. *P. dinudata*
 422. *P. ferulacea*
 423. *P. kappannae*
 424. *P. parthasarathyi*
 425. *P. Platycarpa*
 426. *P. polychroma*
 427. *P. sertularioides*
 428. *P. subtilissima*
 429. *P. tuticorinensis*
 430. *P. unguiformis*
 431. *Spirocladia barodensis*
 432. *Tolypiocladia condensata*
 433. *T. glomerulata*
 434. *Veleroa karuvaleensis*

PHAEOPHYTA

Species	Variety	Forma
159	22	10

1. *Asteronema rhodachortonoides*
2. *Ectocarpus cryptophilus*
3. *E. siliculosus*
4. *E. simpliciusculus*
5. *E. simpliciusculus* var. *vitiensis*
6. *Feldmannia columellaris*
7. *F. filifera*
8. *F. indica*
9. *F. irregularis*
10. *F. kanyakumariensis*
11. *F. padinae*
12. *Hameletta dermonematis*
13. *H. geminifrutca*
14. *Hincksia undamanensis*
15. *H. bhimlipatnamensis*
16. *H. breviarticulata*
17. *H. clavata*
18. *H. mitchelliae*
19. *H. mitchelliae* var. *nettii*
20. *H. prolifera*
21. *H. terminalis*
22. *H. thyrsoides*
23. *Giffordia turbinariae*
24. *Strebionema turmale*
25. *Bachelotia antillarum*
26. *Pitayella littoralis*
27. *Ralfsia ceylanica*
28. *R. confusa*
29. *R. expansa*
30. *R. verrucosa*
31. *Sphacelaria kovalamensis*
32. *S. novae-hollandiae*
33. *S. rigidula*
34. *S. furcigera* var. *princeps*
35. *S. tribuloides*
36. *Dictyopteris acrostichoides*
37. *D. australis*
38. *D. delicatula*
39. *D. muelleri*
40. *D. polypodioides*
41. *D. woodwardia*
42. *Dictyota alternans*
43. *D. bartayresiana*
44. *D. ceylanica*
45. *D. ciliolata*
46. *D. dichotoma*
47. *D. dichotoma* var. *intricata*
48. *D. divaricata*
49. *D. dumosa*
50. *D. fasiola*
51. *D. hauckiana*
52. *D. maxima*
53. *D. pinnatifida*
54. *Lobophora variegata*
55. *L. variegata* var. *indica*
56. *L. variegata* var. *minima*
57. *Padina australis*
58. *P. boergesanii*
59. *P. boryana*
60. *P. crassa*
61. *P. distromatica*
62. *P. dubia*
63. *P. fraseri*
64. *P. glabra*
65. *P. gymnospora*
66. *P. pavonica*
67. *P. terrastromatica*
68. *Spatoglossum asperum*
69. *S. variabile*
70. *Stoechospermum marginatum*
71. *Zonaria crenata*
72. *Levringia boergesenii*
73. *Liebmannia iaccadivarum*
74. *Myriogloea sciurus*
75. *Myriactula arabica*
76. *Ascocyclus orbicularis*
77. *Hecatonema enhali*
78. *H. sargassicola*
79. *H. terminale*
80. *Myrionema strangulans*
81. *Protectocarpus speciosus*
82. *Nemacystus decipiens*

83. *Chonospora bicanaliculata*
 84. *C. implexa*
 85. *C. minima*
 86. *Calpomenia sinuosa*
 87. *Componema gracile*
 88. *Hydroclathrus clathratus*
 89. *Pyengaria stellata*
 90. *Rosenvingea intricata*
 91. *R. nhatragensis*
 92. *R. orientalis*
 93. *R. sanctae-crusis*
 94. *Cystoseira barbata*
 95. *C. indica*
 96. *C. myrica*
 97. *C. opuntioides*
 98. *C. trinodis*
 99. *Hormophysa cuneiformis*
 100. *Sargassum acinarium*
 101. *S. angustifolium*
 102. *S. angustifolium* f. *filiforme*
 103. *S. aquifolium*
 104. *S. biserrula*
 105. *S. biserrula* var. *biserrula* f. *goodiense*
 106. *S. biserrula* var. *biserrula* f. *rudolphinum*
 107. *S. biserrula* var. *biserrula* f. *tranquebarensis*
 108. *S. brevifolium* var. *pergracile*
 109. *S. brevifolium* var. *pergracile* f. *subecostatum*
 110. *S. capillare*
 111. *S. capillare* var. *koenigii*
 112. *S. capillare* var. *pseudocapillare*
 113. *S. capillare* var. *tranquebarensis*
 114. *S. carpophyllum*
 115. *S. carpophyllum* var. *aristiferum*
 116. *S. cervicorne*
 117. *S. cinctum*
 118. *S. cinereum*
 119. *S. cinereum* var. *berberifolium*
 120. *S. cinereum* var. *thunbergii*
 121. *S. concinnum*
 122. *S. crassifolium*
 123. *S. cristaefolium*
 124. *S. cymosum*
 125. *S. cymosum* var. *esperii*
 126. *S. cystocarpum*
 127. *S. densifolium*
 128. *S. divaricatum*
 129. *S. dumosum*
 130. *S. erinaceum*
 131. *S. esperii*
 132. *S. flavicans*
 133. *S. flavicans* var. *nudum*
 134. *S. gaudichaudii*
 135. *S. glaucescens*
 136. *S. gracile*
 137. *S. grevillei*
 138. *S. hombronianum*
 139. *S. ilicifolium*
 140. *S. ilicifolium* var. *venustum*
 141. *S. incisifolium*
 142. *S. jhonstonii*
 143. *S. lanceolatum*
 144. *S. lanceolatum* var. *nicobaricum*
 145. *S. linearifolium*
 146. *S. marginatum*
 147. *S. marginatum* var. *marginatum* f. *cannanorensis*
 148. *S. microphyllum*
 149. *S. microcystum*
 150. *S. microcystum* var. *elegans*
 151. *S. natans*
 152. *S. notarissi*
 153. *S. obovatum*
 154. *S. odontocarpum*
 155. *S. odontocarpum* var. *lanceolatum*
 156. *S. oligocystum*
 157. *S. parvifolium*
 158. *S. persicum*
 159. *S. plagiophyllum*
 160. *S. polycystum*
 161. *S. prismaticum*
 162. *S. scherzerianum*
 163. *S. serratifolium*
 164. *S. spathulaefolium*
 165. *S. spinifex*
 166. *S. squarrosus*
 167. *S. subrepandum*
 168. *S. subrepandum* var. *ruppelii* f. *turneri*
 169. *S. swartzii*
 170. *S. tenerrimum*
 171. *S. tenerrimum* var. *ambiguum*
 172. *S. tenerrimum* var. *campbellianum*
 173. *S. teretifolium*
 174. *S. turbinarioides*
 175. *S. virgatum*
 176. *S. vulgare*

Diversity of Coastal Plant Communities in India

- | | |
|--|--|
| 177. <i>S. wightii</i> | 185. <i>T. ornata</i> var. <i>ornata</i> f. <i>ecoronata</i> |
| 178. <i>S. wightii</i> var. <i>sublineare</i> | 186. <i>T. ornata</i> var. <i>ornata</i> f. <i>evesiculata</i> |
| 179. <i>Turbinaria condensata</i> | 187. <i>T. ornata</i> var. <i>serrata</i> |
| 180. <i>T. conoides</i> | 188. <i>T. trialata</i> |
| 181. <i>T. conoides</i> var. <i>conoides</i> f. <i>laticuspidata</i> | 189. <i>T. trialata</i> var. <i>capensis</i> |
| 182. <i>T. decurrens</i> | 190. <i>T. triquetra</i> |
| 183. <i>T. indica</i> | 191. <i>T. turbinata</i> |
| 184. <i>T. ornata</i> | |

XANTHOPHYTA

Species	Variety	Forma
3		

1. *Vaucheria fontinalis*
2. *V. longicaulis*
3. *V. piloboloides*

CHLOROPHYTA

Species	Variety	Forma
171	21	24

- | | |
|--|---|
| 1. <i>Entocladia leptochaete</i> | 24. <i>E. prolifera</i> |
| 2. <i>E. viridis</i> | 25. <i>Ulva beytensis</i> |
| 3. <i>Ulvella lens</i> | 26. <i>U. conglobata</i> |
| 4. <i>Phaeophila dendroides</i> | 27. <i>U. covelongensis</i> |
| 5. <i>Gomontia polyrhiza</i> | 28. <i>U. fasciata</i> |
| 6. <i>Monostruma latissimum</i> | 29. <i>U. fenestrata</i> |
| 7. <i>M. oxyspermum</i> | 30. <i>U. indica</i> |
| 8. <i>Enteromorpha clathrata</i> | 31. <i>U. lactuca</i> |
| 9. <i>E. compressa</i> | 32. <i>U. lactuca</i> f. <i>laciniata</i> |
| 10. <i>E. flexuosa</i> | 33. <i>U. latissima</i> |
| 11. <i>E. flexuosa</i> sub sp. <i>flexuosa</i> | 34. <i>U. lobata</i> |
| 12. <i>E. flexuosa</i> sub sp. <i>paradoxa</i> | 35. <i>U. profunda</i> |
| 13. <i>E. flexuosa</i> sub sp. <i>pilifera</i> | 36. <i>U. quilonensis</i> |
| 14. <i>E. gujaratensis</i> | 37. <i>U. reticulata</i> |
| 15. <i>E. intestinalis</i> | 38. <i>U. rigida</i> |
| 16. <i>E. intestinalis</i> var. <i>intestinalis</i> f. <i>flagelliformis</i> | 39. <i>U. stenophylla</i> |
| 17. <i>E. intestinalis</i> var. <i>asexualis</i> f. <i>cornucopiae</i> | 40. <i>Acrosiphonia orientalis</i> |
| 18. <i>E. intestinalis</i> var. <i>crispa</i> | 41. <i>A. saxatilis</i> |
| 19. <i>E. intestinalis</i> var. <i>mesenteriformis</i> | 42. <i>Anadyomene stellata</i> |
| 20. <i>E. lingulata</i> | 43. <i>A. wrightii</i> |
| 21. <i>E. linza</i> | 44. <i>Microdictyon tenuous</i> |
| 22. <i>E. linza</i> var. <i>bicornuta</i> | 45. <i>Chaetomorpha aerea</i> |
| 23. <i>E. ovata</i> | 46. <i>C. antennina</i> |

47. *C. brachygona*
 48. *C. clavata*
 49. *C. coliformis*
 50. *C. crassa*
 51. *C. indica*
 52. *C. intestinalis*
 53. *C. linoides*
 54. *C. linum*
 55. *C. linum* f. *brachyartha*
 56. *C. litorea*
 57. *C. melagonium*
 58. *C. spiralis*
 59. *Cladophora bombayensis*
 60. *C. clavuligera*
 61. *C. coelothrix*
 62. *C. colabensis*
 63. *C. crystallinu*
 64. *C. flexuosa*
 65. *C. cracilis* f. *expansa*
 66. *C. fritschii*
 67. *C. glomerata*
 68. *C. glomerata* var. *crassior*
 69. *C. koeiei*
 70. *C. lehmanniana*
 71. *C. liebetruithii*
 72. *C. marina*
 73. *C. microcladioides*
 74. *C. nitellopsis*
 75. *C. petentiramea*
 76. *C. pellucida*
 77. *C. pinnulata*
 78. *C. prolifera*
 79. *C. radiosa*
 80. *C. rivularis*
 81. *C. saracenic*
 82. *C. savoeana*
 83. *C. sericioides*
 84. *C. sibogae*
 85. *C. socialis*
 86. *C. vagabunda*
 87. *Rhizoclonium africanum*
 88. *R. antillarum*
 89. *R. riparium*
 90. *R. riparium* var. *implexum*
 91. *R. tortuosum*
 92. *Willeella ordinata*
 93. *Boergesenia forbesii*
 94. *Boodlea composita*
 95. *B. composita* f. *robusta*
 96. *B. struveoides*
 97. *Chamaedoris auriculata*
 98. *Cladophoropsis javanica*
 99. *C. sundanensis*
 100. *Dictyosphaeria cavernosa*
 101. *D. intermedia* var. *solida*
 102. *Struvea anastomosans*
 103. *S. tuticorinensis*
 104. *Struveopsis covalamensis*
 105. *Ventricaria ventricosa*
 106. *Ernodesmis verticillata*
 107. *Valonia aegagropila*
 108. *V. utricularis*
 109. *Valoniopsis pachynema*
 110. *Bryopsis corymbosa*
 111. *B. hypnoides*
 112. *B. indica*
 113. *B. pennata*
 114. *B. pennata* var. *secunda*
 115. *B. plumose*
 116. *B. ramulosa*
 117. *Derbesia boergesenii*
 118. *D. indica*
 119. *D. tenuissima*
 120. *D. turbinata*
 121. *Trichosolen mucronatus*
 122. *T. pambanensis*
 123. *T. thikkodiensis*
 124. *Caulerpa ashmeadii*
 125. *C. cupressoides*
 126. *C. cupressoides* var. *lycopodium*
 127. *C. cupressoides* var. *lycopodium* f. *disticha*
 128. *C. fastigiata*
 129. *C. fastigiata* f. *deliculata*
 130. *C. fastigiata* f. *minor*
 131. *C. fergusonii*
 132. *C. filicoides* var. *andamanensis*
 133. *C. imbricata* f. *minor*
 134. *C. imbricata* f. *mixta*
 135. *C. lentillifera*
 136. *C. lessonii*
 137. *C. lessonii* f. *tuticorinensis*
 138. *C. mexicana*
 139. *C. mexicana* f. *indica*
 140. *C. mexicana* f. *pectinata*

141. *C. microphysa*
 142. *C. nummularia*
 143. *C. parvula*
 144. *C. peltata*
 145. *C. racemosa*
 146. *C. racemosa* var. *latevirens* f. *cylindracea*
 147. *C. racemosa* var. *latevirens* f. *laxa*
 148. *C. racemosa* var. *racemosa* f. *condensata*
 149. *C. racemosa* var. *racemosa* f. *semifalcata*
 150. *C. racemosa* var. *corynephora*
 151. *C. racemosa* var. *corynephora* f. *complanata*
 152. *C. racemosa* var. *macrophysa*
 153. *C. racemosa* var. *turbinata*
 154. *C. scalpelliformis*
 155. *C. scalpelliformis* var. *scalpelliformis* f. *dwarkensis*
 156. *C. scalpelliformis* var. *denticulata*
 157. *C. scalpelliformis* var. *intermedia*
 158. *C. sedoides*
 159. *C. selago*
 160. *C. serrulata*
 161. *C. sertularioides*
 162. *C. sertularioides* f. *brevipes*
 163. *C. sertularioides* f. *tongiseta*
 164. *C. taxifolia*
 165. *C. taxifolia* f. *tristichophylla*
 166. *C. veravalensis*
 167. *C. verticillata*
 168. *C. verticillata* f. *charoides*
 169. *Codium arbutum*
 170. *C. decorticatum*
 171. *C. dwarkense*
 172. *C. geppiorum*
 173. *C. indicum*
 174. *C. isthmocladum*
 175. *C. latum*
 176. *C. prostratum*
 177. *C. stephensiae*
 178. *C. taylorii*
 179. *C. tenue*
 180. *C. tomentosum*
 181. *Dichotomosiphon marinus*
 182. *D. salinus*
 183. *Halimeda cuneata*
 184. *H. discoidea*
 185. *H. distorta*
 186. *H. gracilis*
 187. *H. incrassata*
 188. *H. macroloba*
 189. *H. opuntia*
 190. *H. peltata*
 191. *H. tuna*
 192. *Ostreobium quekettii*
 193. *Avrainvillea amadelpa*
 194. *A. erecta*
 195. *A. mazei*
 196. *A. nigricans*
 197. *Chlorodesmis caespitosa*
 198. *C. hildebrandtii*
 199. *Penicillus manauarensis*
 200. *P. sibogae*
 201. *Rhipidosiphon javensis*
 202. *Tydemania expeditionis*
 203. *Udotea caribaea*
 204. *U. flabellum*
 205. *U. indica*
 206. *U. iyengarii*
 207. *U. orientalis*
 208. *Bornetella nitida*
 209. *Dasycladus ramosus*
 210. *Neomeris annulata*
 211. *N. dumetosa*
 212. *N. van-bosseae*
 213. *Acetabularia calyculus*
 214. *A. crenulata*
 215. *A. kilneri*
 216. *A. parvula*

THREAT TO COASTAL ECOSYSTEM

It is reported that six out of ten people live within 60 kms of coastal waters and two thirds of world's cities with populations of 2.5 million or more are near tidal estuaries. Within the next two decades it is expected to be doubled. It is estimated that two-thirds of Indian population live along the coast. There are 40 and 23 small and medium towns and cities on the West coast and East coast respectively. Marine erosion is a serious problem for conservation of soil and other properties along the shore and coastal zone in Malabar regions. Maximum impact of marine erosion is found in the Karnataka and Kerala coast where fallow land formed by off-shore bars and spits is under constant attack by south-west monsoon waves and serious erosion causing damage of cultivation, settlement, roads, bridge and other structures is a common feature.

Most of the maritime states of India within the 7,500 km long coastline face the threat of sea invasion. In Kerala, 40 km of coastal land is engulfed by sea annually. Ennore, suburb of Chennai lost over a hundred meters of land to sea in two decades. The satellite imageries reveal that in south Gujarat, the advance of sea is alarming. Dwarka was plundered not only by the invaders, marine invasion too took it's toll. Likewise, Pimpur in Tamil Nadu went under the sea and Tranquebar is about to lose its precious monuments. There are also instances of the sea having retreated leaving-houses and dunes kilometres away from the shoreline. (Meher-Homji, 1998)

THREAT TO THE DRY COASTAL LANDS

1) Various degree of encroachment for increasing oncoming industries, tourism and fisher folk's dwellings and other rehabilitation.

2) Large scale deforestation and removal of strand vegetation, tropical ever-green formation or rain forests and other biomasses available in and around the sea.

3) Massive construction of aqua-culture farming and hutments of fisher folk's and production of paddy fields.

The threat of coastal plant diversity is alarming in many parts of the world specially in India. Due to ignorance of utilization and management practices, intensive use of unplanned water bodies, polluting water

body by pesticided irrigation water and industrial and city waste-water, natural calamities, human exploitation, reclamation, resettlements, diversion of water bodies, deforestation and developmental activities are impoverishing this unique ecosystem.

THREAT TO THE WET COASTAL LANDS

Threats of Wet Coastal Mangrove Ecosystem :

The mangrove vegetation is facing some major ecological disturbances, like other inland forests. Almost every year the cyclonic storms, with wind speeds of 80-220 km/h, are reported to lash these areas and many valuable trees are damaged. Besides these natural calamities, reclamation of land due to gradual increase of settlements, rapid deforestation for firewood, tanning and house building materials, and several developmental activities, such as the construction of ports, dams, etc., cause severe destruction to the vegetation. Scientific management should be undertaken urgently to conserve this valuable natural resource.

Threats to the destruction of mangroves in India during the past, were mainly due to over-exploitation by traditional users and increased population pressure in and around the mangrove belt. People used mangrove forest directly for firewood, domestic fuel and also turned the mangrove into charcoal for domestic and small industrial fuel purpose. As a result, the clear felling of many of the mangrove forests in India were observed in different parts of the country. Other threats were seen due to large-scale timber exploitation for sale and making plywood and paper pulp. Some areas of the mangrove forests have faced complete loss of natural resources due to large demand for conversion of these forest areas to other land use patterns and constructions of railway lines.

Alongwith these past activities, the present threats have become more serious due to more increased population pressure and political division of the country. Several destructive activities for the loss of mangrove habitat have become prominent as follows: over exploitation of mangrove fisheries, poaching of wild animals including marine turtles, estuarine crocodiles,

SOME IMPORTANT DATA ON POLLUTANTS CAUSING THE THREAT TO THE COASTAL ECOSYSTEM AROUND INDIA (AS ON 1993)

Domestic sewage added to the sea by coastal population per year (60 liter per head/day)	4.9 x 10 ⁹ m ³
Industrial effluents added to the sea by coastal industries per year	0.49 x 10 ⁹ m ³
Sewage and effluents added by the rivers to the sea per year	50 x 10 ⁶ m ³
Solid waste and garbage generated by coastal population per year (0.5 kg per head/day)	36 x 10 ⁶ tonnes
Fertilisers used per year (30.5 kg/ha.yr ⁻¹)	0.5 x 10 ⁶ tonnes
Pesticides used per year	
Agriculture (336 g/ha.yr ⁻¹)	55000 tonnes
Other purposes	326000 tonnes
Synthetic detergents used per year	125000 tonnes

tiger, reptile for skin and large-scale catching of prawn shrimps. In the present status of threats, destructive form of activities generally unrelated to sustained uses of mangrove have been aggravated due to the need of more energy, lands and immediate economic benefits to the people.

Some of the threats, can be mentioned here as follows :

1) Diversion & blocking of natural canals and creeks :

For constructing of some industries mostly fertilizer factories along the coastal line. This diversion of water flow has resulted the elevation of the surrounding lands, deposition of one-way flow of salt water and formation of large salt marshes instead of development of mangrove forests.

2) Resettlement activities :

Resettlement activities within and near the areas of mangrove habitat, specially along the Sundarbans,

Mahanadi delta and Cochi of Malabar regions have caused the severe destruction of the mangrove forests.

3) Conversion of mangrove lands to agricultural field :

At present, for obtaining immediate economic benefits, many areas of mangrove forests of the Sundarbans, Orissa and Andhra Pradesh as well as along the Malabar Coast have been destroyed for the cultivation of paddy and coconut.

4) Aqua-culture activities :

Expansion of aqua-culture lands in the mangrove forest areas for tiger prawn culture has become a burning problem in many mangrove areas of the country, specially along the Godavari and Krishna Delta, Mahanadi Delta and Sundarban areas. Local people alongwith some agencies are encroaching the mangrove forest areas and are illegally expanding the aquaculture ponds. In the future due to formation of sulphuric acid solution, neither the aquaculture ponds will give the profit nor the mangrove forests will develop there.

5) Construction of new port along the coastline or construction of chemical factories near the estuaries :

Varying amount of organic materials as unwanted waste and discharge of industrial effluents into the river and estuarine areas are causing irretrievable damage to the mangrove ecosystem resulting in the loss of biodiversity.

6) Construction of dam and barrage :

The change of water salinity due to lack of fresh water flow due to construction of dams or barrages along the upper catchment is causing serious threat for the development of rich species diversity of the mangrove ecosystem, as seen in the Sundarbans due to construction of Farraka barrage.

7) Increased turbidity due to soil erosion :

The increased turbidity of coastal waters, and the consequent damage to coral reefs and seagrass beds, is the major threat to coastal waters in large parts of South-East Asia (Sengupta *et al.*, 1990). Marine habitats are also damaged by destructive development of coastal areas including land reclamation, conversion of mangrove forests and wetlands into agricultural land or aquaculture ponds, indiscriminate cutting for fuel, and dredging for channels and harbours. Whenever such habitats are eliminated, inland sediments derived from runoff are free to penetrate coastal waters, diminishing light penetration, decreasing the oxygen content of the water and smothering the benthic ecosystem.

8) Mangroves, aquaculture and coastal fisheries :

The conversion of mangrove vegetation into aquaculture in South-East Asia is also having a direct effect on coastal capture fish production. There is abundant evidence for a direct relation between the stocks of fish and shrimp, and the extent of the coastal mangrove areas. At least nine out of ten of the commercially most important fish and shellfish species use the mangrove as spawning and breeding grounds (Sengupta *et al.*, 1990). Coastal vegetation is transformed into shrimp ponds. By doing so, the basis for the coastal capture fishery for fish as well as shrimp is threatened. This fishery is frequently carried out as a traditional, small-scale fishery on a sustainable basis. The aquacultural production of shrimp that replaces the

mangroves is usually characterized by large-scale development with a high demand for capital and energy, and a production aimed at export. Furthermore, the recruitment of shrimp larvae will cease in a few years because the natural populations of shrimp can not exist without the mangroves.

9) Deterioration of coral reefs :

Coral reefs are destroyed indirectly as a result of increased turbidity of coral waters, release of sewage, pesticides, oil and industrial wastes. In addition, coral reefs are directly affected by some destructive fishing techniques, techniques involving the breaking of corals using sticks and heavy weights to scare the fish into nets deployed outside the reef. Another method of fishing that has truly devastating effects on the coral reefs is the use of poison: a pesticide such as DDT or lindane or a strong bleach is spread on the windward side of the reef. The fishermen then wait on the leeward side to pick up what will be floating by. Such use of poisons has been reported from most regions, but appears to be particularly common in South-East Asia and the Pacific Islands. If tourism is reasonably developed and coral reefs are accessible, then it usually becomes a major factor reducing the survival of reef organisms. Tourists and local entrepreneurs collect corals, shells, sea stars and other organisms, causing enormous damage to coral reefs. Corals are used extensively as raw material for cement production in India.

10) Sewage in coastal waters :

The discharge of untreated or inadequately treated sewage pollutes the coastal environment specially near all cities and towns. This has several consequences, including decreased oxygen content of the water, increased turbidity, stimulation of bacterial and algal growth and microbial pollution. Due to the oscillating tidal water, sewage is often trapped in an area extending 40-50 km from the coast, where oxygen levels decrease to zero. Consequently, fish and other fauna are almost completely absent in such area. Very few coastal cities and towns have any treatment facilities for their sewage. Beaches near population centres throughout the region are contaminated by sewage, as indicated by the number of faecal coliforms and streptococci. As a consequence, gastroenteritis and infectious hepatitis are common and outbreaks of cholera and typhoid are also relatively frequent.

11) **Conversion of mangrove land to urban development scheme :**

This has caused complete destructions of the mangrove habitat and such examples are seen as in the case of Greater Mumbai, Kolkata Salt Lake areas and Ernakulam city.

Anticipated major threats due to the destruction of mangrove habitats will be more serious due to complete destruction of mangrove ecosystem by the effect of Green House drift. Since the mangroves are situated only within the mid-tidal zone of the coastal wetland ecosystem, rise of global temperature from 2°C to 3°C, will cause the sea rise level from 25 to 50 cm and that rise of sea level will be enough to destroy completely the mangrove ecosystem of the country specially, in Bangladesh and Eastern India.

The level of threat due to destruction of mangrove forests has become more alarming along the East coast regions of Sundarbans, Mahanadi delta, Godavari-Krishna deltas and other cyclone prone areas. Serious land-need pressure and frequent conversion of land have led to reclamation of mangrove and other tidal flat areas by impoundments. Position of such reclaimed areas become gradually lower than the mean tide level causing the access of more cyclonic floods every year which damage lives and properties catastrophically.

Considering the above threats it has been possible after extensive field survey to evaluate the maximum disturbed mangrove regions in India as follows: In the Sundarbans area, Sagar Island, Gosaba and Canning blocks. In the Mahanadi delta, False Point and Hookitola blocks. In the Godavari-Krishna delta, Divi point, Nizampattanam, Antardevi, Yanam of Godavari delta and Yellichetladibba and Sorligunta of Krishna delta and in the West coast, Cochin mangrove regions.

THREAT TO THE MARINE ECOSYSTEM

A considerable amount of industrial effluents, untreated sewage, man-made chemicals, run off waters carrying fertilizers and pesticides, and other wastes are being dumped into the ocean. Ocean being about three fourth of the physical world share a great deal of burden - directly or indirectly of such natural and man-made activities. The ocean in many respect serves as a giant fly-wheel that controls the climate, regulates the amount of oxygen, carbon and other gases of the atmosphere,

receives, metabolises and dilutes wastes, transports sediments as part of the major geological cycle, supplies moisture to the hydrological cycle, acts as a major reservoir of non-renewable resources and provides a significant amount of food for terrestrial animals from its bounty. It also offers navigational, recreational, harvesting and mining facilities. It is also well established that out of the total marine zone, 90% of the biological productivity comes from only 10% of the total marine areas including estuaries, lagoons, inshore waters and many marginal seas and waters over the continental shelves and slopes. The land-based marine pollution of Bay of Bengal receive a heavy amount of industrial effluents, untreated sewage and other wastes from both the banks of the rivers. Knowledge regarding the position of heavy metals like mercury, cadmium and lead is not clear. Similar is the picture of man-made chemicals and industrial wastes of all kinds including the nutrients coming from fertilizers through run off waters into the rivers and finally merging in the coastal waters of the Bay of Bengal. It is likely that a considerable amount of industrial effluents containing heavy metals from various sources are being regularly received by coastal waters of the Bay of Bengal through the river estuaries. The waste products generated have increased enormously in recent years in their variety, toxicity and volume. Among the more toxic and wide-spread pollutants are the organochlorines. More than 11,000 different organochlorine compounds have been produced for the use in a wide variety of applications including paints, adhesives, pesticides, refrigerators and electrical transformers. Organochlorines have been released directly or indirectly into the marine environment on a massive scale. Only around 20 organochlorines can be measured reliably, and fewer than 10 of these are monitored irregularly in same parts of the world. This compounds are absorbed by plankton and enter the food chain at the lowest level. At every step up to the food chain, the concentrations increase. In fish that eat the plankton, the concentration is 170 times that of sea water, while in squid that eat the fish it rises to 240 times the level in the sea.

In the case of fish, effect of organochlorine shows high decrease in the rate of egg hatching, larval malformation, reduction of growth rates and alterations in behaviour patterns which make the fish more vulnerable to predation.

In human system too, the effects can be similar and cause severe diseases of the blood and skin, immune, nervous system and respiratory disorders, still births, and reduced birth weight. In addition they can cause mutations and cancers. Though PCB production was banned in 1972, but 50% of the total produce remains in use and still seeps into the sea. The most toxic organochlorine, 2,3,7,8-tetrachloro-dibenzo-p-dioxin, has recently been found in fish, in the North-West Pacific.

Chlorinated hydrocarbons like BHC, DDT, Aldrin, etc. in the Ganga waters have not been assessed in a systematic manner in West Bengal. Water samples were analysed to find out the pesticide residues occurring in Ganga water. Out of 36 samples, DDT was found in 11 samples.

Heavy metals such as Cadmium, Mercury, Arsenic, Copper, Manganese, Nickel and Lead are extremely toxic even at low concentrations. These enter the marine ecosystems through ore refining, chemical manufacture, waste incineration, burning of coal, oil and gas, and the dumping of untreated sewage and other wastes into rivers and coastal waters. Levels of lead have risen sharply in the northern hemisphere. Concentrations of lead in surface waters have increased by 80 times, in the Greenland ice sheet by 300 times, and in fish in contaminated coastal waters by over 1,000 times.

THREAT DUE TO LAND-BASED POLLUTANTS

Some of the important source of landbased coastal pollutions which are carried by the rivers from the inland to the sea and transported down to the deep water are as follows :

- i) Agricultural sewage and industrial wastes.
- ii) Wastes such as phosphates from detergents discharged into inland bodies of water causing eutrophication.
- iii) Thermal pollution which negatively changes the ecosystem of water bodies.
- iv) Sewage from coastal cities which affects recreation facilities and marine resources.
- v) Toxic substances, mud and floating debris discharged from coastal industry.
- vi) Shipping oil or solid waste discharges polluting beaches and marine life.

(Source: Springer Verlag-Global effect on Environmental pollution-New York, 1970.)

THREAT DUE TO METALLIC POLLUTION

Due to rapid industrialisation and urbanisation of the cities and the newly developing ports and harbours, multifarious industries of paper, textiles, chemicals, plastic, food, leather, jute, pesticides, oils, etc. are creating various degree of pollution from point sources to the coastal water. All these pollutants have now become a serious threat to the sea and marine life. Following tables show some important investigation reports of metallic pollution in the Hooghly estuarine complex of Bay of Bengal.

THREAT DUE TO SEA-BED MINING

Marine geological investigations of the western continental shelf, covering an area of about 300,000 sq. km and at a maximum water depth of 120 m, suggest that it has a promising area for offshore mining. These areas are the continental shelf between Goa and Cape Comorin for heavy minerals; the offshore region of the Saurashtra coast, and between Goa and Mangalore for phosphorite; the outer continental shelf off Bombay for calcareous sands and shelf off Kerala for quartz sand. The Indian Ocean is known to contain substantial deposits of manganese nodules, potato shaped concretions littering the deep sea-bed at depths ranging from 3,500-6,000 m. Polymetallic nodules represent an abundant source of metals such as, manganese, nickel, copper, cobalt, molybdenum, zinc, lead and cadmium. The diameter of the manganese nodules ranges from 1 to 5 cm, the maximum weight exceeds 200 gm and computed concentration of nodules varies from 1.1 to 5.8 kg/m². The nodules are dark brown to earthy black in colour, friable, compact and porous. Kr-smooth and Kr-rough types are more abundant than ellipsoidal, kidney shaped, flat, cannon ball and black berry types. The analysis indicated that Mn-ranges from 0.5%, Fe-1.2% to 37.01%, Ni-0.07 to 1.55%, Cu-0.009% to 1.36% and Co-0.014 to 0.988%. According to Cronan and Moorby (1981 and 1982), nodules from the Central Indian Ocean locally show extreme enrichment in Mn, Cu, Ni and Zn and contain Todorokite as their principal mineral phase. These nodules are similar to the ore grade nodules in the Pacific and the average values of the Mn (20.4%), Ni (0.86%), Cu (0.74%) and Zn (0.11%) are higher than any other region of the Indian Ocean. Fe and Co are relatively low in these nodules. It has been concluded by Frazer & Wilson (1979) that nodules in the Central Indian Basin



Virgin mangrove forest, along the two banks of the creeks, at False Point, Mahanadi River Mouth is reclaimed for rehabilitation



Virgin mangrove forest, at Hetamundia, Mahanadi River Mouth is encroached for paddy cultivation



Batighar creek in Orissa showing how mangrove forests are encroached for agriculture

Mangrove forest of Orissa are encroached for aquaculture





Construction activities of Mundra Port, for crude oil pipe line in the coastal regulatory zone



Coastal pollution caused severe damage to mangrove forests of Orissa



Erosion along the beach of Goa, damaging the beach vegetation



The famous littoral forests in Andaman is in danger due to coastal erosion



Algal pest damaging the trees in the Sundarbans (shown by black patches on the trunks)



Vertical fault and undercutting along the banks of river Matla, damaging the virgin mangrove forests

Mangrove forests being damaged by regular anchoring of boats to the trees in Sundarbans



Damaging of other fish seeds, while collecting prawn seeds is having a dangerous impact of the Ichthyofauna





Collection of leaves as fodder for camels and buffalos in Gujarat



Camels swimming across the creek to graze on mangroves in Gujarat

Colony of insects damaging the mangrove



Damage to an *Avicennia marina* tree, caused by microbial pests

Diversity of Coastal Plant Communities in India

Mean concentrations of dissolved trace metals of the surface water in the Bay of Bengal ($\mu\text{g/g}$ dry wt.).

Station	Zn	Cu	Mn	Fe	Pb
Diamond Harbour	109.3	13.42	21.62	127.65	7.59
	112258	22.76	35.40	191.83	13.82
	63.24	7.79	4.88	83.46	7.84
Haldia	76.82	9.34	5.78	91.75	9.92
	79.57	5.45	4.95	30.51	4.91
Sagar Island	104.85	8.30	8.43	42.69	8.40
(Southern most tip)	23.80	2.46	2.01	8.36	N.D
Henry's Island (Near 1st gate of the Fishery Project)	31.54	7.90	4.12	12.68	1.45

Trace metal concentrations ($\mu\text{g/g}$ dry wt.) in the tissues of molluscs from the Hooghly estuary in the premonsoon period (May, 1988)

Species	Zn	Cu	Mn	Fe	Pb
<i>Nerita articulata</i>	63.90	19.74	14.40	238.42	5.05
<i>Littorina undulata</i>	46.20	15.65	178.52	178.52	3.65
<i>Cymia lacera</i>	829.16	1134.20	21.34	334.05	10.81
<i>Columbella</i> sp.	81.51	23.98	15.62	331.45	6.32
<i>Crassostrea cucullata</i>	1023.36	80.54	11.93	151.27	3.10
<i>Enigmonea aenigmatica</i>	221.50	44.52	9.87	93.41	N.D*

*Not detectable

(Source : T. Sanyal - Calcutta Port Trust, Kolkata, 1995)

Trace metals concentrations ($\mu\text{g/g}$ dry wt.) in the tissues of molluscs from the Hooghly estuary in the monsoon period (September, 1988). The bivalve *Enigmonea aenigmatica* was not found in the Estuary in this season.

Species	Zn	Cu	Mn	Fe	Pb
<i>Nerita articulata</i>	81.75	21.30	15.9	303.65	6.32
<i>Littorina undulata</i>	53.84	17.89	14.23	219.46	7.54
<i>Cymia lacera</i>	1004.56	1782.14	27.49	402.83	9.74
<i>Columbella</i> sp.	87.88	31.46	17.48	283.76	4.85
<i>Crassostrea cucullata</i>	1211.55	102.63	19.33	171.34	4.45

Trace metal concentrations ($\mu\text{g/g}$ dry wt.) in the vegetative parts of mangrove plants from the Nayachar island, Sundarbans in June, 1993

Species	Parts	Zn	Cu	Mn	Fe	Co	Ni	Pb
<i>Avicennia marina</i>	Root	396.5	39.1	151.7	513.2	BDL	3.2	BDL
	Stem	341.0	28.2	133.2	501.0	BDL	2.9	BDL
	Leaf	284.3	19.5	114.8	481.4	BDL	2.5	BDL
<i>Avicennia officinalis</i>	Root	288.1	30.4	128.1	396.2	BDL	2.8	BDL
	Stem	245.2	27.6	117.6	318.4	BDL	BDL	BDL
	Leaf	213.0	21.2	100.5	300.0	BDL		
<i>Bruguiera gymnorrhiza</i>	Root	117.5	19.8	41.8	309.8	BDL	BDL	BDL
	Stem	106.3	18.5	39.6	284.6	BDL	BDL	BDL
	Leaf	93.4	13.3	28.0	279.1	BDL	BDL	BDL
<i>Sonneratia apetala</i>	Root	513.7	49.1	181.8	697.8	2.1	4.8	2.0
	Stem	480.1	42.0	172.2	681.3	1.8	3.5	1.7
	Leaf	471.4	38.6	146.5	600.7	BDL	3.2	BDL
<i>Rhizophora apiculata</i>	Root	223.6	27.1	86.2	380.0	BDL	BDL	BDL
	Stem	203.9	22.9	79.9	364.1	BDL	BDL	BDL
	Leaf	168.3	19.7	71.0	328.7	BDL	BDL	BDL
<i>Xylocarpus granatum</i>	Root	57.2	9.0	27.0	168.2	BDL	BDL	BDL
	Stem	48.0	7.5	21.4	149.8	BDL	BDL	BDL
	Leaf	39.6	6.9	17.8	141.0	BDL	BDL	BDL
<i>Xylocarpus molluscensis</i>	Root	189.3	21.7	79.3	289.9	BDL	BDL	BDL
	Stem	164.1	20.4	77.9	275.7	BDL	BDL	BDL
	Leaf	140.0	17.6	60.8	261.3	BDL	BDL	BDL
<i>Excoecaria agallocha</i>	Root	497.2	46.3	165.2	688.7	2.2	4.6	1.8
	Stem	481.5	34.8	151.0	613.6	2.0	3.8	1.6
	Leaf	464.3	30.1	137.4	597.9	1.6	1.9	BDL
<i>Heritiera fomes</i>	Root	41.9	8.3	18.1	101.2	BDL	BDL	BDL
	Stem	37.6	7.9	12.6	98.6	BDL	BDL	BDL
	Leaf	29.0	6.1	10.0	89.8	BDL	BDL	BDL
<i>Nypa fruticans</i>	Root	117.2	18.3	66.2	266.2	BDL	BDL	BDL
	Stem	104.5	17.0	51.8	204.3	BDL	BDL	BDL
	Leaf	98.8	14.3	28.4	182.5	BDL	BDL	BDL
<i>Aegiceras corniculatum</i>	Root	312.0	29.8	95.2	471.0	BDL	1.8	BDL
	Stem	303.2	26.4	81.0	415.5	BDL	BDL	BDL
	Leaf	268.7	20.5	76.7	393.2	BDL	BDL	BDL

BDL means below detectable level.

Diversity of Coastal Plant Communities in India

Monthly variations of physico-chemical variables and metal concentrations in vegetative parts of *Ipomoea pes-caprae* (in µg/g dry wt.) from western bank of Nayachar.

Month	pH	Salinity (%)	Vegetative Parts	Zn	Cu	Mn	Fe	Co	Ni	Pb
Nov.'92	8.14	2.01	Roots	182.9	65.0	82.2	352.9	BDL	7.8	BDL
			Stem	171.6	56.1	71.4	333.4	BDL	3.2	BDL
			Leaf	160.3	29.1	38.1	307.3	BDL	2.0	BDL
Dec.	8.07	2.12	Root	176.1	63.8	81.9	341.5	BDL	4.1	BDL
			Stem	152.0	51.2	70.2	315.6	BDL	2.1	BDL
			Leaf	141.3	26.2	30.7	303.8	BDL	BDL	BDL
Jan.'93	7.91	2.37	Root	168.3	60.0	79.3	326.1	BDL	3.3	BDL
			Stem	148.3	48.7	61.8	309.9	BDL	BDL	BDL
			Leaf	133.9	22.1	29.9	299.4	BDL	BDL	BDL
Feb.	7.91	4.01	Root	170.2	61.7	74.5	331.3	BDL	1.9	BDL
			Stem	149.1	42.3	58.4	284.2	BDL	BDL	BDL
			Leaf	131.6	20.4	31.6	264.6	BDL	BDL	BDL
Mar.	7.97	5.87	Root	157.5	54.4	71.6	239.8	BDL	BDL	BDL
			Stem	151.3	47.2	59.5	269.8	BDL	BDL	BDL
			Leaf	129.8	21.9	30.7	257.5	BDL	BDL	BDL
Apr.	8.01	6.72	Root	152.8	51.9	68.3	297.2	BDL	BDL	BDL
			Stem	140.0	40.4	53.4	271.7	BDL	BDL	BDL
			Leaf	121.4	20.8	34.2	238.2	BDL	BDL	BDL
May	8.00	7.18	Root	160.0	50.1	70.0	300.5	BDL	2.9	BDL
			Stem	137.6	40.0	51.1	258.0	BDL	BDL	BDL
			Leaf	117.5	19.7	29.2	230.3	BDL	BDL	BDL
Jun.	8.06	8.33	Root	156.4	49.3	72.1	306.2	BDL	3.8	BDL
			Stem	136.4	39.8	57.3	255.9	BDL	2.1	BDL
			Leaf	113.7	19.8	33.8	209.1	BDL	BDL	BDL
July	7.86	3.21	Root	201.7	81.3	101.4	389.1	BDL	10.5	BDL
			Stem	190.3	57.9	79.6	303.6	BDL	8.3	BDL
			Leaf	181.2	28.5	48.2	243.7	BDL	7.1	BDL
Aug.	7.70	1.03	Root	231.9	86.1	103.7	393.7	2.8	12.3	2.2
			Stem	204.0	60.4	84.1	317.9	1.7	6.8	BDL
			Leaf	187.6	35.2	51.2	268.5	BDL	4.7	BDL
Sept.	7.61	0.71	Root	246.3	91.4	111.5	391.9	3.1	12.9	2.0
			Stem	199.2	61.7	89.0	323.8	BDL	8.1	BDL
			Leaf	188.0	37.6	57.3	277.1	BDL	5.2	BDL
Oct.	7.70	0.01	Root	241.2	99.7	102.0	402.7	1.9	11.8	BDL
			Stem	203.6	72.8	91.2	372.1	BDL	7.2	BDL
			Leaf	190.0	39.2	55.6	314.8	BDL	6.9	BDL

BDL means below detectable level.

(Source : T. Sanyal - Calcutta Port Trust, Kolkata, 1995)

are high in nickel and copper and their average grade is similar to grades found in the Clarion-Clipperton zone of the Pacific Ocean.

The research and development work related to exploration for polymetallic nodules in the Indian Ocean was initiated by the National Institute of Oceanography, Goa, in 1977 and the Indian research vessel *Gauchos* collected the first sample from the Indian Ocean in 1980.

The Department of Ocean Development has taken an active programme to survey sea-bed nodules with the help of different research vessels.

A number of organisations are involved in research and development concerned with the extractive metallurgy of polymetallic nodules (e.g., RRL, Bhubaneswar; NML, Jamshedpur; HZL, Udaipur and HCL, Khetri and Ghatsila). The combined research efforts of these organisations have led to the installation of a "semi-pilot plant" at RRL Bhubaneswar capable of handling 200 kg of nodules/day, employing a hydrometallurgical and ammoniacal leaching-cyan-solvent extraction method. A rotary kiln capable of handling 5 kg of nodules/hour has also been commissioned to test a method of pyro-metallurgical sulphation roasting. HCL has conducted trial tests on their existing plant using nodules. HCL is also continuing research on nodules processing using both hydrometallurgical and pyrometallurgical methods.

The programme aims to include a range of environmental studies aimed at assessing the likely impacts of any proposed mining operation on the deep-sea community of the Indian Ocean. It is crucial that such studies should continue throughout the developmental stage of the project. As with all such environmental assessments, monitoring of possible deleterious effects will need to continue for many years before a viable estimate of long term impact can be produced.

Large scale offshore mining activities in the near coastal areas by deploying bucket dredging, suction dredging, grab dredging or mobile platform dredging systems for exploiting heavy mineral sands are likely to create several environmental disturbances in the coastal zone. Dredging and disposal activities directly disrupt bottom-dwelling communities, remove sediments from the bottom that may have collected toxic and other hazardous materials from upstream runoff and discharges, and transfer these sediments to other areas with the possible consequence of mobilizing and

dispersing the associated contaminants. The leakage of oil and other toxic pollutants from mining equipment may effect the environment. The fine sediments may remain in suspension for longer duration which may effect the habitat of the biota. The change in offshore bathymetry may effect sediment transport, coastal erosion and deposition and ultimately the configuration of that coast. The impact of sea-bed mining in the shallow waters may change the physiography and ecosystems as follows :

- Changes in offshore bathymetry.
- Changes in sediment transport/erosion and deposition.
- Changes in the stability of the sea-bed.
- Changes in the configuration of coast line.
- Changes in the navigational channels.
- Changes in the sediment pattern near river mouth.
- Increase in turbidity and reduction in plant photosynthesis may cause destruction of biotic breeding habitats.
- Increase of effluents from offshore mining machinery (oil spills and other toxic pollutants).
- Oil spills due to increased maritime activities associated with mining.

The exploitation of deep sea mineral resources will have direct effect on the sea floor, on the benthic biota directly in contact with the collector, and on the physical and chemical characteristics of the water column resulting from redistribution of bottom and interstitial water, bottom sediment, abraded manganese nodules and benthic biota. Mining systems will turn up bottom material into near bottom water layers. In addition, the hydraulic system will have a characteristic benthic discharge because it may separate as much unwanted material as possible just above the sea floor - This will be the formation of plume of suspended particulate matter which may ultimately settle many kilometres away from the original site of disturbance. The discharge of bottom materials from the ship will also form a plume which may effect temperature and salinity. The plume of suspended matter will reduce the light penetration which will effect the growth of phytoplankton. Oil spills due to increased maritime activities associated with mining will have adverse effect on the environment.

(Sources : J. Yates and K.R Gupta OTC 6299, 1990; Shrivastava, P.C., 1995)

THREAT DUE TO SEA-BED BACTERIAL POLLUTION

The microbiological investigations of water and sediment samples of some major river estuaries, near-shore and coastal areas extending up to 3 km along the Orissa coast reveals occurrence of different groups of enterobacteria, such as, *Vibrios*, *Shigella-Salmonella*, *Streptococcus*. Total *Coliforms*, faecal *Coliforms* and total viable counts as well as tidal influence on their distribution, viable counts and total coliforms at estuaries have been observed. The riverine and coastal waters do not show the occurrence of enteric bacteria in appreciable numbers. This variation is attributed to the effect of anthropogenic inputs such as domestic effluents and municipal sewages discharged into the estuarine environments. Near-shore waters of Puri shows very high counts of enteric bacteria up to a distance of 1 km from the discharge point. The effect of sewage as well as other wastes discharged on the receiving coastal water is localised within 1 km of the sea, from the river mouth.

THREAT DUE TO DISCHARGES FROM SHIP

Marine environment gets polluted through many sources. One of the major sources is through ships. Increasing dependence of modern civilisation on oil-based technologies in particular has intensified transportation of oil and its various by-products through ships resulting in enhanced probabilities of marine pollution.

Ports are highly susceptible to pollution. Concentration of various activities in a confined area

opens up risks of contamination of water, air and soil. Such risks are more in case of tanker-operations which feature essentially oil-transportation between the vessel and the shore. Besides, there are certain routine operations like loading of lubrication oils in bulk, delivery and sorting of stores and spear gears, washing of crude oil tanks and routine maintenance jobs. All these activities may cause pollution but by far oil-transportation through ships remains the principal contributor to marine pollution.

Oil-transportation through ships is not distributed evenly along the sea-surface but is found to be concentrated to coastal areas which incidentally happen to be regions of hectic biomass activity. The situation, though undesirable, cannot be avoided.

Disposal of pollutants into waters from ships may cause the following hazards :

- (i) Loss of benthic biota.
- (ii) Impairment of metabolic activities in aquatic organisms.
- (iii) Rise in mortality rates.
- (iv) Change in biological recolonisation rates.

The intensity of these impacts however depends on the nature of pollutants, their extent and prevailing aquatic conditions.

Bacterial response to oil-spills has since been studied. It has been found that biodegrading microbial organisms exhibit remarkable response to oil components in water and sediments.

Distribution of different of enterobacteria in the near-shore/coastal waters of Orissa

Type of Bacteria	GOPALPUR				PURI		PARADEEP					DHAMRA
	Rushikulya LT	Estuary HT	Coastal	Sediment (estuary)	Near-shore	Offshore	Mahanadi river	Mahanadi LT	Estuary HT	Paradeep port	Sediment (estuary)	Dhamra estuary
TVC	16 x 10 ⁶	59 x 10 ⁴	61 x 10 ⁶	17 x 10 ⁷	2 x 10 ⁶	6 x 10 ⁴	71 x 10 ³	4 x 10 ⁴	28 x 10 ³	62 x 10 ³	6 x 10 ⁴	43 x 10 ³
TC	54 x 10 ⁵	29 x 10 ³	ND	55 x 10 ⁶	33 x 10 ⁶	1 x 10 ⁶	1 x 10 ³	29 x 10 ³	10 x 10 ³	19 x 10 ³	3 x 10 ³	28 x 10 ³
FC	29 x 10 ³	13 x 10 ³	ND	16 x 10 ⁶	3 x 10 ³	42 x 10 ³	1 x 10 ³	15 x 10 ³	9 x 10 ³	13 x 10 ³	3 x 10 ³	13 x 10 ³
SHLO	4 x 10 ⁵	5 x 10 ³	ND	ND	33 x 10 ⁶	44 x 10 ³	ND	2 x 10 ³	ND	ND	ND	1 x 10 ³
VLO	10 x 10 ⁴	10 x 10 ³	3 x 10 ³	3 x 10 ³	1 x 10 ⁶	97 x 10 ³	1 x 10 ³	5 x 10 ³	1 x 10 ³	ND	ND	ND
SFLO	5 x 10 ³	ND	ND	ND	12 x 10 ⁶	4 x 10 ³	1 x 10 ³	3 x 10 ³	2 x 10 ³	3 x 10 ³	3 x 10 ³	ND

Population : Water = No./100 ml. Sediment = No./gm. LT = Low tide, HT = High tide, ND = Not detected,

TVC = Total viable count, TC = Total coliforms, FC = Faecal coliforms, SFLO = *Streptococcus faecalis*,

SHLO = *Shigella/Salmonella*.

(Source : M.R.Prasad *et al.*, Bhubaneswar 1995)

Usually marine ecosystem is affected by ship-discharged pollutants in three ways. Components dissolved in water are consumed by animals and absorbed by plants. Dissolved pollutants are sometimes excreted and in some cases, may bind with other chemicals. The oil pollutants in suspension or floatation affect gaseous exchange in fish and may cause casualties to living beings who consume them. In general oil pollution cause the following disturbances in the sea life :

- a) Insufficient light-penetration and impairing photosynthesis.
- b) Inadequate gaseous exchange between air and water.

Consequential effects are :

- (i) Shifting of niche of animals.
- (ii) Migration of fauna.
- (iii) Disruption of food-webs.
- (iv) Reduction in oxygen-content.

Toxicity of pollutants may cause high casualty rates in both micro-flora and micro-fauna.

It must be admitted that not much research on ecological impacts of ship discharges on different organisms at different stages has been done. It has however been established that all phytoplakton, specially algae are sensitive to oil-pollution. Carbon fixation and photosynthesis are disturbed. Similarly, zooplankton specially the larvae of invertebrates are severely affected by oil pollution. Metabolic disorders, impairment of locomotion and growth are noticed as a result of oil-induced toxicity.

Marshes and mangrove swamps in the coastal regions often become victims of pollution. Flowering is inhibited, germination impaired and functions of pneumatophores (breathing roots) disturbed. All these lead to premature casualties and consequent disturbance

of the ecosystem.

Oil pollution have serious effects on fish. Even low concentration of petroleum products in water may result in abnormalities in fish populations. Direct exposure may coat gills of fish and cause suffocation. It has been noticed that bigger varieties of fish are more immune to oil-pollution than the smaller varieties.

About 300 species of Sea birds are directly affected by floating ship-discharges. Consumption of a small quantity of oil during the breeding season is seen to have affected egg laying of seabirds.

(Source : T. Sanyal Calcutta Port Trust, Kolkata, 1995.)

THREAT DUE TO OIL-SPILL POLLUTION

Zooplankton and coral debris samples from the exclusive economic zone of the Southern Andaman Sea were analysed for petroleum hydrocarbon after the oil spill occurred from the oil tanker Maersk Navigator on 21.9.93 and the data were compared with that of samples collected from the international oil tanker route. Both zooplankton as well as coral debris samples were found to be contaminated with petroleum hydrocarbons. Higher proportion of both aliphatic and aromatic hydrocarbons were found in the samples from the spill area than that of non spill area.

THREAT DUE TO SEA LEVEL RISE UNDER GREEN HOUSE INDUCED WARMING

There is consensus amongst a sizable section of the global scientists that the global climate may warm up in the coming decades due to the increasing concentration of green house gases in the atmosphere. Due to the major impact of the green house induced warming, it is predicted that there will be, accelerating rise of sea level around the world as a result of thermal expansion of oceanic water and melting of the mountain and polar glaciers.

MANAGEMENT

Coastal areas represent a fragile ecosystem, its stability is an important pre-condition for the environmental sustainability of the marine and inland life. They contain highly diverse ecosystems, and some of the world's most biologically productive habitats. Uses of coastal space are multiple and include settlement, food production, derivation of energy, minerals and other raw materials, tourism, recreation and transport. Coastal zones in a sense act as sink of the continents, in that their degradation and pollution have both local and distant inland sources. Inadequate tenure systems, bad land use practices, use of fertiliser, pest control, poor watershed management, clearance of forests on steep lands, industrial pollution and expansion of human settlements, ports and recreational areas all contribute to the coastal and marine degradation. The coastal area destruction from the land based activities is now the major cause of immediate concern for the marine environment, that could soon be deteriorated beyond repair in the absence of effective coastal management. Hence an Integrated Coastal Management is required to evolve a framework for sustainability. Such an approach should constitute appropriate policy and legal framework for land use and siting policies which would regulate management and rate of use, promote environmentally sound technology and sustainable practices, make environmental impact assessments mandatory. It should develop coastal profiles, identifying critical areas and user conflicts, and identify appropriate management practices for handling natural disasters and crisis management. Integrated Coastal Management would involve various bodies including several government departments, local and village level institutions, scientific and research organisations, non-governmental organisations, etc. The coastal ecology is an intricate and complex process with the active interplay of various variables and any intervention in one set of variables is bound to affect the ecological process. Some of the major and important variables such as change in sea level,

erosion, coastal aquifers, storm, cyclones, degradation of mangrove and other coastal vegetations, land based pollution, chemical pollution, oil pollution, etc. are to be urgently managed to bring stable economy to the coastal inhabitants. The ecological stability and economic viability of the coastal zone is important for the entire State. In order to conserve its sustainability, an integrated approach to its development is essential. A deeper understanding of the issues in the coastal areas is difficult due to lack of adequate database.

For environmental protection of the coastal areas, the Government of India has issued directions under the Environment (Protection) Act, 1986, Coastal Regulation Zone (CRZ) and other such acts. For all coastal development programme, a coastal ecological region is defined as a 20 km belt from the shore line. Most of the regulations for the coastal zones operate within the belt of 500 m from the shore line.

Restrictions have been imposed on the setting up and expansion of industries, operations or process, etc., in the CRZ. Certain activities are prohibited in this zone. These include new industries other than those requiring water front or fore shore facilities, like ports and harbours, ship repairs and ship building. Discharge of untreated wastes and effluents from industries and human settlements are strictly prohibited. Land reclamation, building, disturbance to the natural flow of sea water, mining of sands, rocks and substrate materials, harvesting or withdrawal of ground water and dressing or altering sand dunes, hills natural features, etc., are totally prohibited.

For regulating development activities, the coastal stretches within 500 m are classified into four categories. The first category consists of areas, which are ecologically sensitive and important, such as national parks, reserve forests, wildlife habitats, mangroves, coral reefs, breeding and spawning grounds of fish and other marine life, and areas likely to be inundated due to rise in the sea level consequent upon global warming. Obviously, these areas require total protection from activities which are likely to

disturb the ecological balance. Another important category is the area from the high tide line to 200 meters landward. This is the 'no development zone' where no construction is permitted. The permitted activities are agriculture, horticulture, gardens, pastures, parks, play fields, forestry and salt manufacture from sea water. Other categories consist of areas on which activities are permitted in varying but controlled degrees. Areas requiring special protection include the coasts of Andaman and Nicobar Island and Lakshadweep.

The State Governments are required to prepare the coastal zone management plans for the coastal areas in their respective States. However, not a single comprehensive plan has yet been prepared and published. Apart from the difficulties in mapping large areas, surveying the land and studying the socio-economic status of the coastal people, there is also resistance from the local bodies and pressure groups, against curb in the present trend of influence to the coastal land and water.

There are, however, a number of non-government organizations (NGO) who are very actively working for protection of the coasts.

In the scenario of coastal environment, coastal vegetation plays an important role. Mangroves constitute the main forest ecosystem in the coastal areas. These are salt tolerant trees, herbs and shrubs growing in the inter-tidal region and are found in the tropical and subtropical countries. Mangroves have rich flora and fauna. The plants are used for fuel, construction of house, and to meet domestic needs. The aquatic fauna of the mangroves consists of fish and prawn which are economically very important. Mangroves have great significance in controlling erosion of the coastal areas.

Mangrove management plans are being formulated and implemented as parts of the coastal development plans.

Conservation of Wet Coastal Mangrove Ecosystem:

As already stated, the mangroves of India have not hitherto received appropriate attention as they deserve. Realising the importance of this fragile ecosystem, Government of India has taken a scheme

for conservation of mangrove community in 1988 for obtaining expert opinions regarding various aspect of mangrove conservation policies in consultation with UNDP/UNESCO in the field of research and conservation. According to the suggestion of the Committee, action plan programmes for conservation of mangroves and coral reefs were made. 15 mangrove areas in India were selected for proper management and conservation of biodiversity along with the financial assistances as required for those areas. The selected areas for management and conservation of mangrove ecosystem biodiversity are :

North Andaman, Nicobar Islands, Sundarbans, Bhitarkanika of Mahanadi delta, Gulf of Kutchh, Krishna estuary, Coondapur, Ratnagiri, Goa, Vembanad, Pichavaram, Koringa, Point Calimere and Lakshadweep.

Brief outline on the sanctioned action plan for various areas for conservation and management of mangroves are as follows :

Sundarbans (West Bengal)—Financial assistance has been sanctioned to West Bengal Government for conservation and management of the Sundarban mangroves, natural regeneration of the area, afforestation, plant raising in nurseries, protection and watch and ward programme.

Goa—Financial assistance has been sanctioned to the Government of Goa for conservation and management of mangrove ecosystem including plantation, replantation, fencing and watch and ward programme.

Bhitarkanika (Orissa)—Financial assistance was given to the Orissa Government for conservation and management of Bhitarkanika mangroves which includes fencing, monitoring-cum-watch towers and Noctavision (night viewing by binocular).

Andaman & Nicobar—Financial support has been approved for conservation and management of mangroves in Andaman and Nicobar Islands which includes status survey and identification of critical mangroves areas, formulation of strategies for afforestation of degraded mangroves including socio-economic survey, eco-preservation, restoration and awareness programme.



The historic building in the Hookitola coast, Orissa, built by George-III, is being protected by the plantation of mangroves surrounding the building

Plantation of *Rhizophora apiculata* Bl. and *R. mucronata* Poir. in the Pichabaram river bank





Cutting of artificial canal along the mangrove lands, for preventing the growth of salt marshes at Pichavaram

Plantation of mangroves palm, *Nypa fruticans* Wurmb. in Andaman





Establishment of the Mangrove interpretation Centre, of the Sundarban biosphere reserve, for generating awareness about the mangroves resources

Plantation of mangroves seedlings in Sundarbans, for protecting the river banks





A mangroves plantation in its fifth year, protects the river banks in Sundarbans

Plantation of mangroves by Swaminathan Research Foundation, Sundarbans for porrecting the river banks



Gulf of Kuchchh—Annual Sanction has been approved for conservation and management of mangrove in Gulf of Kuchchh which includes plantation in 100 ha.

Mahanadi Delta—Financial support has been given to the Government of Orissa for conservation and management of mangroves in the Mahanadi Delta which includes survey and demarcation, fencing, trenching, restocking of mangroves and construction of watch-towers.

Pichavaram—Annual sanction has been approved for conservation and management of Pichavaram mangroves which includes eco-preservation restoration and recreation programmes.

Vembanad—A sanction has been approved for Vembanad mangroves which includes propagule collection and nursery development.

Krishna, Godavari and Coringa—Financial support has been given for Krishna Estuary, Godavari Delta and Coringa which includes demonstration, protection and reforestation programme.

This management and conservation practices have met with success by establishing biosphere reserves, sanctuaries and other nature reserves. In the Bhitarkanika Mangrove Sanctuary, natural population of *Heritiera*, *Excoecaria*, *Avicennia* and *Phoenix* has steadily increased. Increased population of Open Billed storks from 1,000-3,000, Olive Ridley turtles from 1-2 lakhs and crocodiles from 100-350 are very interesting but on the other hand, the Mahanadi delta mangrove ecosystem located in the Kujang forest division which is the pristine mangrove resource of Orissa has not been successfully conserved. Since the Orissa mangrove system seems to be a zone with the largest number of mangroves species diversity in India, an urgent and effective conservation policy is needed to save this region.

In the Sundarbans, success of conservation activities are spectacular and the best of this measure is perhaps the increased tiger population from 135 to 264 (1983 census). Increased population of other endangered animals such as fishing cat, estuarine crocodile, and Olive Ridley turtles is also encouraging.

Except the plant population of *Heritiera fomes* and *Rhizophora mucronata* which have been diminished due to lack of fresh water flow, all other mangrove species of *Avicennia*, *Excoecaria*, *Phoenix*, etc. are increasing successfully in natural condition.

Some of the successful conservation practices in the Sundarban mangroves are :

- (1) Core area of the Tiger reserve over 1,330 sq. km in the Sundarban has been legally protected from any kind of exploitation.
- (2) Buffer zone forest products are given to the local people staying only at the forest fringes for a sustained protection and conservation.
- (3) As many as 1800 nos. of Forest Protection Committees with the help of three-tier panchayat system have been established for guarding 260 thousand hectares of degraded forests in exchange of 25% of forest produce as fructuary benefits. These people with all facilities and employment are helping in the conservation of the Sundarban biosphere for sustainable economic development.
- (4) To combat the age-old problem of the Sundarban when some of the tigers become man-eaters, a special measure has been invested by preparing electrically charged clay model of wood cutters, honey collectors or fisherman to minimise such problem. The permit for collection *Phoenix paludosa* which is the preferred den for tiger has been stopped.
- (5) Successful prevention of the river bank erosion by plantation and by "bamboo porcupines".
- (6) Local training has been given to the folk, to throw the balance of "Ichthyoplanktons" to the creek water, after the collection of post larval tiger-prawns, for protection of lesser mullet and prawn. Through the panchayats, tide-fed aquaculture has been established by plantation of mangrove species along the inter-tidal banks successfully
- (7) A special apiculture system has been established for the fringe communities for culturing the honey bee in the apiary-boxes for getting honey for 6 months in a year successfully and to avoid the confronting man-eating tigers in the forest during honey collection.

In addition to the above, several miscellaneous conservation practices have been undertaken in the Sunderban mangroves such as tide-fed mariculture for crabs and edible oysters, mushroom culture, distribution of fuel-efficient chulha, introduction of solar cooker, poultry, piggery-feed, audio-visual lecture, awareness and ecodevelopment programmes, mangrove arboretum, marine parks and several research and monitoring activities.

Future Direction :

In spite of various conservation measures, the never-ending demand of the socio-economic structure and changing environmental conditions, there must be some future recommendations and directions to enhance the conservation process of the mangrove ecosystem whose products are commercially, economically and environmentally important for many countries. Possible directions may be mentioned as follows:

- (1) Development of comprehensive Database for quantitative and qualitative information on mangroves.
- (2) Declaration of 10 km stretch of estuarine or coastal mangroves areas as protected place for reducing cyclone.
- (3) Sustained yield management of buffer zone mangrove forests may be operated for 20-30 years cycle. Sustained yield management of estuarine fisheries may be developed.
- (4) Aquaculture practices must be scientifically controlled.
- (5) Creation of mass awareness programme by the name of mangrove Development Camp or Mangrove protection or Conservation Camp must be organised in the field with the help of school & college students, for spreading awareness regarding rare & vulnerable plants and animals of the mangrove ecosystem.
- (6) Plantation of firewood species exclusively mangroves along the buffer zone.
- (7) Diversion of creeks & blocking the salt water flow by pollutants and oil spills must be avoided while construction of various developmental activities within the 10 km distance from the estuary.
- (8) Promoting research activities for developing better technology for successful conservation.
- (9) Education and Training : More number of experts are necessary after suitable training on these fields for better management.
- (10) International Survey Team : As the species diversity, ecosystem diversity and genetic diversity of the mangroves are remarkable and very little chances are available to observe the specific characteristic and ecological behaviour of the individual species in different countries, it would be helpful for establishment of International Survey Team for extensive field studies in different countries.

A unique experiment is being tried during the last few years to see the efficacy of mangrove for controlling erosion in the coastal areas. It was felt that instead of engineering measures at the huge cost, biological measures could give better results at much less expenditure. Accordingly, massive mangrove plantation was started in 1990 in Nayachar Island near Haldia and Haldia river banks to control erosion. This Plantation is thriving well and has already shown very encouraging results in controlling erosion and protection of river banks. This vegetation is also helping in mitigating the air and water pollution emanating from the industries and habitation in the developing town of Haldia and neighbourhood.

Ports and harbours can contribute much in the efforts of coastal protection by planting mangrove in their respective areas. In fact, there has been large scale destruction of mangrove forest while constructing or expanding port and harbour facilities. Port and harbour administration will be paying back its debt while they reforest the areas with mangrove plantations and see that the coastal environment is upgraded by reforestation and afforestation.

In coastal zone management, the activities to be studied can broadly be under, development of agriculture, fishing, rural and urban development, industries, tourism and communication and transport network. In all these groups, there are various activities which affect the coastal environment. Some of the important ones are - residences, solid and liquid waste disposal, irrigation and water supply, use of pesticides and fertilizers, crop pattern, roads, railways, pipelines,

communication network, industries, oil refining, mining, fishing, sea ports, airports, land and marine oriented recreation, etc.

Certain development work and industry which are being undertaken in the coastal areas require special attention. A number of thermal plants have been set up in the coastal areas. More are coming up and being planned to be sited close to the sea. These are mostly due to the economic advantages of carrying coal from the coal mining areas by sea transport to the thermal plants and generation of power in the areas of consumption, avoiding loss of power in transmission. There are also other factors like easy availability of land and water. The thermal plants cause serious threats to the coastal environment such as: Discharge of hot water can harm the aquatic flora and fauna. Ash may be dumped in the sea water causing damage to water quality and sea bed contours or may cause undesirable landfills. Fly ash and emission may cause air pollution and harm the flora and fauna. All these require strict control, particularly as these plants are rather away from watchful eyes of the administration and environmentally vigilant people.

In addition to the coal based thermal plants, atomic power plants are coming up in the coastal areas. It is necessary to have proper environmental impact assessment (EIA) and comprehensive environmental management plan (EMP) to see that the hazards and pollution are under control and mitigating measures are taken. One very important aspect is regarding disposal of nuclear waste in the sea water. Such wastes dumped in the sea may cause disaster and watch has to be kept against such occurrence.

Quarrying operation in the coastal areas is on the increase. Rocks are being blasted, excavated and extracted affecting the natural ranges of the water flow and flora and fauna. Corals are being removed to be used as building and construction material for roads and housing.

In coastal areas the main occupation of the people are agriculture and fishing. High salinity, submergence of land by tidal water and disturbed climatic condition like strong wind and cyclones affect the agriculture adversely all along the coastal belt. Unplanned agriculture also leads to soil erosion where soils are being washed away to sea. This causes loss of fertile top soil and causes further erosion by quick

water run off. Most of the coastal areas have only one crop a year. Cash crop is grown in some coastal belt. Cashew nuts, arca nuts, coconuts, bananas, etc. are cultivated in these areas. For economic benefit of the people in the coastal belts, agriculture should be planned in a manner to suit the geographical and physical conditions of the coastal areas.

Extensive and intensive ground water exploitation in some coastal areas in the country has resulted in salinity incursion. When water below the land surface is taken out by tubewells in large quantity and the aquifers do not get adequately recharged, the vacuum gets filled up by the flow of saline water from the sea. This makes the land saline and unfit for agriculture. It is, therefore, essential to make proper plan for extraction of ground water, if necessary for irrigation and other purposes, so that salinity incursion does not take place.

Fishery is the main occupation of the people living at the land fringe in the coasts. The entire coastline of the country is dotted with fishing villages. The fishing boats and the tackle are mostly primitive. Now fishing trawlers, mechanised boats and nylon nets are generally coming into use. Modern fishing harbours have been constructed in the important fishing areas. It is necessary to ensure that fishing resources are not over-exploited and adequate time and opportunity are given for natural replenishment of stock. The spawning and breeding grounds for fishes in the sea have to be protected. Fishing in these identified areas should be strictly forbidden. There have been poaching in the Indian coastal waters by fishermen of foreign countries. They come in sophisticated trawlers with deep sea trawling and dragnets and fish extensively in Indian coastal waters. Indian Coast Guard should keep watchful vigil against such poaching.

Brackish water pisciculture has excellent potentials in the coastal land. Of the different varieties of aquatic animals which can be farmed in brackish water, prawn has been found to be economically most important. Its spawn can be cultured in hatcheries, the parent breed being drawn from the sea. The spawns can be grown into adults in brackish water ponds extensively for marketing in the country and abroad. Brackish water ponds can provide excellent facilities for pisciculture of different varieties of fish. This can be both primary and subsidiary occupations and will

provide the much needed economic support to the agriculture and fishing communities in the coastal areas.

Questions have been raised in some cases about the wisdom of use of chemical dispersants for controlling major oil-spills. Use of micro-organisms may be a possible solution. Dr. Ananda Chakravarty, an Indian Scientist of international repute has claimed to have developed a "Superbug" that thrives on hydrocarbons and has reportedly offered to clean the seas after the Gulf War.

Some Indian Scientists of NEERI have recently presented a technology for combatting oil-spills without using chemicals which is reported to be more versatile than the one developed by Dr. Chakravarty. Instead of developing one micro-organism or injecting several genes into it, a group of micro-organisms has been designed. This group or consortium of micro-organisms can be applied to our advantage to control pollution of various nature, apart from oil-spills. The research is based on identification and classification of micro-organisms based on their hydro-carbon utilisation-capability and other properties. Two bacterial consortium have been designed which can emulsify and degrade 60% to 70% crude oil in 48 hours. If specifically selected and isolated, these bacteria can be utilised for augmenting oil-recovery from the hydro carbon industry.

Biomedication is another area which has a vast commercial potential. It is a process that makes use of bio-technological routes for transformation, degradation and detoxification of toxic materials in waste.

Some of the coastal areas are subject to natural calamities of cyclones and tidal surges. Every year cyclones devastate village and agricultural fields particularly in the Eastern coast. Ports and shipping are affected. Lives are lost. Economy suffers from enormous damage. It calls for plans on permanent footing to meet such climatic conditions. Embankments to prevent inundation of villages, agricultural fields and ponds should be constructed. However, adequate environmental safeguards have to be ensured while planning the embankments. The coastal belt should have forests of appropriate species of flora which can function as wind breakers. Houses

in villages and towns in coastal areas should not be high. Their designs should take into consideration for the necessity of prevention of damages by wind and water.

(Source : Dr. A.C. Roy, 1995)

In coastal zone management, man and the environment have to find their due places in the holistic approach. Man's needs have to be met keeping in mind the requirements for sustainable development. It is necessary to conduct extensive studies into the physical conditions of the coastal areas and the socio-economic condition of the people inhabiting these areas. Environmental impact assesment(EIA) for the different types of activities and for major units of industry, beach resorts, ports and harbours, etc., should be conducted and appropriate environmental management plans (EMPs) should be drawn up. The Union Government, the Governments of the Coastal States, the Panchayats of the coastal areas, the voluntary organizations and above all the people of these areas are required to join hands in environmental protection, conservation and planned use of resources in the coastal land and sea.

Uncontrolled activities either on the waterfront or on the coastal lands may cause severe damage to the coastal ecosystem. Therefore a system of commands through the implementation of some legislation are needed to protect this fragile ecosystem. Various legislations in the national and international levels may serve the purpose for management practices when proper understanding of all the acts through the people's activities could be oriented in this direction.

1. The Territorial Waters, Continental Shelf, Exclusive Economic Zone and other Maritime Zone Act, 1976

It delineates (i) Territorial Water—an area from the baseline up to 12 nautical miles in the sea (ii) Contiguous Zone—extending up to 24 nautical miles (iii) Exclusive Economic Zone—up to 200 nautical miles from the coastal baseline.

The sovereignty of the country extends up to 200 nautical miles empowering the country to explore, exploit, conserve and manage all the resources; it also empowers to authorize, regulate and control scientific research within EEZ as also to preserve and protect marine environment and prevent/control marine pollution.

2. Environment Protection Act, 1986

The Coastal Regulation Zone (CRZ) rules of 1991 are direct outcome of EPA, 1986, whereby the activities within 500 meters of High Tide Line, are going to be regulated, with a classification including CRZ I, CRZ II and CRZ III. CRZ I include areas which are ecologically sensitive and prohibit construction within 500 meters; CRZ II include areas which are already developed up to or close to shoreline; CRZ III include areas which have not been particularly developed and fall under rural segment.

Besides CRZ rules, EPA 1986 also laid down disposal standards for various types of industries and hazardous substances.

3. Indian Ports Act, 1908

The operative section of act prohibits disposal of ballast, rubbish in the port on the shore. It also prohibits discharge of oil or oily mixture into the port water with a stipulation for punishing the master of the ship.

4. Merchant Shipping Act, 1958

The provision of the act dealing with control of pollution from oil or oil discharge was made during 1974 and later amended in 1985. It states that wastes from tankers are not to be discharged within 50 miles of the land. No sludge is permissible under this act; it also stipulates that oil bilge pumped (beyond 12 nautical miles) overboard should not contain more than 100 ppm of oil. Port authorities are to provide reception facilities to receive slops and dirty ballasts.

The act imposes heavy penalties (up to Rs. 10

lakh) or imprisonment upto 6 months for violation of provisions.

5. Coast Guard Act, 1978

The concern for marine and coastal waters has led to formation of a special force for protection of EEZ around India. The act stipulates further that Coast Guard should combat oil pollution beyond 5 km in the sea and perform surveillance duty against international dumping of oil or waste by ship/tanker. A national contingency plan to combat oil spill disaster is coordinated by the Coast Guard.

International Legislation

Besides national laws, the International Convention for the prevention of Pollution from ships, 1973, as modified by the protocol of 1978, is considered the most comprehensive of all treaties with regard to control of marine pollution from ships and offshore platforms. The convention now called MARPOL 73/78 deals with prevention of pollution by (i) oil, (ii) noxious liquid substances carried by tanker, (iii) harmful substances, (iv) sewage from ship, (v) garbage from ship.

Moreover previously techno-economic feasibility report would have sufficed the process of clearance but now any project listed under 29 sectors of EIA regulation (1994), especially those like (i) Ports and Harbours, (ii) Refineries, (iii) Petrochemical complex, (iv) Power plants, (v) Tourism project between 200-500 m of High Tide Level etc., must be processed through an impact assessment study for an environmental clearance.

MANAGEMENT STRATEGIES, FUTURE PROPOSAL AND APPROACHES TOWARDS THE CONSERVATION OF COASTAL AREAS

The importance of the coastal zone is illustrated by the fact that about 60% of the world's population live within 60 km of the sea (it is likely to increase to 75% by 2020). Coastal ecosystems have a variety of goods and services which have an economic value and thus they provide numerous livelihood opportunities, encouraging concentrations of population. The earth's most diverse habitats and productive ecosystems as inshore waters, estuaries, backwaters, lagoons, brackish water lakes, mangroves, corals etc., are found here and 95% of marine capture fisheries is derived from coastal waters. Thus it is not surprising that activities in the coastal zone in many countries make a significant contribution to the GDP of the national economy. The social, economic and environmental significance of the boundary between the land and ocean is now widely recognized. There are direct links between coastal environmental functions and the generation of goods, which may be used in more than one form of activity. There is high competition within the coastal zone between various stakeholders, which often results in conflicts, and degradation of the resource system. Having the high concentration of human settlement, it is the preferred site for urban development. Sustainable livelihoods for coastal communities are therefore dependant upon effective management of all interrelated activities in coastal areas to achieve optimal use of both living and non-living resources and equitable distribution of the benefits arising.

Coastal areas are very complex and exhibit a dynamic and fragile system with large number of potential biodiversity for sustainable livelihood, utilizing natural endowments, sea-trade, port facilities, large scale industrial, urban and tourism development and offshore and onshore hydro-carbon resources.

Problems of managing the areas are many and can be divided into problems that affect environmental values, aesthetic values, cultural values and bio-diversity values. Some of the major problems are pointed out below.

NATURE OF PROBLEMS :

1. High rate of population settlement pressure.
2. Continuous establishment and development of large/medium towns, cities, fishermen's villages and highways along the coastline.
3. Coastal erosion, specially due to south-west monsoonal waves in the Malabar coast, creates major problems in Karnataka and Kerala's coastal agriculture, damages roads, bridges and other constructions.
4. Coastal pollutants including solid and liquids from land and waters from rivers, estuaries, lagoons and backwaters with special references to domestic sewage, industrial effluents, river based sewages and effluents like chemicals, fertilizers, pesticides, synthetic detergents, etc.
5. Offshore oil prospecting, heavy metals like (Hg, Cd and Pb), Arsenic, Mercury, Nickel, etc and chlorinated hydrocarbons, DDT, Aldrin, etc. and discharge from ship and oil spill.
6. Problem of sea-bed mining, mining of sand and coral, various salt industries. Frequent establishment of religious-cum-tourism centres on sea beach and large scale disturbances of the sea beach due to unplanned development.
7. Large-scale encroachment due to industries, tourism and fisher folk's dwelling and other rehabilitations.
8. Indiscriminate destruction and removal of strand vegetation, mangroves, sea grasses, seaweeds, tropical rainforest for quick benefit of the livelihood.
9. Large-scale catch of prawn shrimp alongwith other important fish seeds.
10. Massive aquacultural activities and coastal fisheries.

11. Conversion of mangrove lands to agricultural land and fish culture.
12. Resettlement in the mangrove lands, construction of new ports, small chemical factories, dams and barrages.
13. Disturbance due to excessive tourism, recreational activities, settlement and destruction of natural resources in the beaches or establishment of industries and new energy production, hydel or wave energy, tidal power, etc.
14. Quarrying corals and using as construction materials.
15. Disposal of Nuclear wastes, establishment of thermal power plants close to sea, spread of fly ash and emission.

TECHNOLOGY AND STRATEGIES :

Following strategies must be followed for proper management of the coastal areas:

1. Reduction of natural supply of oxygen and nutrients to the coastal areas must be avoided.
2. Excessive discharge of nitrogenous compounds should be avoided.
3. Changes in natural salinity and temperature should be avoided.
4. Discharge of suspensible solid, hazardous chemicals, detergents, blockage and insoluble substrates must be prohibited.
5. Any change in the configuration of coastal water basin from structure or excavation should be avoided.
6. Storage component of ecosystem should always be protected.
7. Yearly repair and constant maintaining of river embankments and large-scale plantation of mangroves are very essential to avoid cyclone.
8. Large-scale afforestation with sand binding species is needed to stabilize sand dunes.
9. Tourism, industries, urban development, fishermen's villages, communication and

transport system must be managed by integrated management corresponding to problems oriented in different states and union territories by their respective departmental co-operation.

10. Proper management of coastal resources, improvement of coastal environments, investigation of coastal pollutions, improvement of socio-economic conditions, regular awareness and education and proper implementation of coastal acts are to be managed under integrated approach varied form state to state by the Government departments or NGOs.

Ministry of Environment and Forests, Government of India (1991) notified the Coastal Regulation Zone (CRZ) Act for protection of coastal environment in which

CRZ-I, clearly define areas between high tide level and low tide level as ecologically sensitive zone, where the rich biodiversity like mangrove, sea grasses, seaweeds, wildlife, heritage, beauty and genetic resources are to be conserved and protected as it is and construction activities are prohibited within 500 m.

CRZ-II belongs to areas already developed up to the shoreline but except permission for sewage treatment plant other new construction and development must be according to town and country planning regulations.

CRZ-III belongs to undisturbed areas of rural coastal zone and up to 200 m from the High Tide Level is to be earmarked as a zone for no development and no construction activities except prior permission from Ministry of Environment and Forests and permission may be obtained only for repair of existing horticultural gardens, parks, forestry and salt manufacturing units from sea water.

CRZ-IV belongs to island ecosystem. For rich biodiversity and speciation these areas are not to be disturbed within 200 m except some special case with proper approval of Ministry of Environment and Forests.

Besides these there are Indian Port Act (1908), Merchant Shipping Act (1958) and Coast Guard Act (1978) are the national legislations for managing the coastal problems.

LIMITATIONS OF THE EXISTING PROCESSES :

Some limitations may be followed in respect of Tourism development, Industries, Urban development, Fishing villages, Special area management and Transportation networks are :

1. Tourism development :

Environmental management of beach tourism development is vitally dependent upon the physical, chemical, biological characteristic of the land-sea interface area and special local condition, therefore its limitation is purely controlled by local conditions, mostly by the individual state.

2. Industrial Development :

This is related to performance characteristics, technology and resources used in the manufacturing processes, effluents and waste disposal, emissions, dust, odour and noise. These require adequate abatement, control and management technique under the approval of central and state pollution control board.

3. Urban Development :

All the urban land use activities require critical assessments for their environmental impacts. Disposal of town and other wastes, construction activities and structures, water resource management, denudation of vegetation or introduction of exotic flora and fauna, pollution, etc., are some of the important aspects, which require environmental management and safeguards. Environmental health issues related to lack of management of sanitary conditions affect the water quality and the land sea interface ecosystem critically. Therefore, it must be controlled by state and central government.

4. Fishing Villages & Rural Areas :

Environmental health issues, introduction of exotic flora and fauna, agricultural production and farm technology, leachate from pesticides and fertilizers are some of the environmental management concerns. Other development pressures include the denudation of vegetation and tree covers, location of industrial

establishments associated with fisheries and others which are to be managed by local authorities.

5. Special Areas (Mangrove, Sea weeds, Sea grasses, Coral Reefs and Oceanic Island) :

It serves as rich biodiversity resources as well as save the inland properties and life from cyclone and storm. Mangrove, seaweeds, sea grasses, coral reefs and oceanic islands are very much useful for maintenance of the equilibrium and natural quality. It must be controlled and checked from urban and industrial development for aesthetic and high environmental value. Coral reefs are sensitive to water quality and oceanic islands are highly productive ecosystem. Limitations of these areas are related to special attributes. Therefore limitation should be under local and national government policies.

6. Transport network :

Highways, Rail, Airports, heavy vehicles increase various problems of noise, emissions, drips, vibration and demand extra land which have greater impact on aesthetic value of beaches and coast lines. These limitations must be controlled through state and central government policies.

SCOPE FOR IMPROVEMENT :

There are several scope for improvement of coastal living resources. Following priorities are important to note :

- Identification of the boundaries of the coastal zone
- Inventory and recognition of areas for particular biodiversity or other concern.
- Priority uses in particular areas and population.
- Permissible land and water use that have direct impact on coastal water.
- Description and Quantification of coast line.
- Characteristics of marine environment.
- Trends in production of fish.
- Present extent of exploitation of fishery resource.
- Impact of Aquaculture on the environment.
- Seaweed culture.

- Mollusc culture.
- Mangrove extent and distribution.
- Mangrove and soil conservation.
- Mangroves and fishes.

NEW APPROACHES :

Management of Coastal areas needs an integrating of various sectors. All the management systems are related to various factors concerning to the location, utilization and local problems, which act, interact, interfere and depend on this system. A total cooperation and correlation of all scientific, engineering, hydrological and biological input, planning vision, management capability and local people participation and success depend upon the efficient coordination and activities of various connected departments of state and the Central Government and other agencies.

Though there are various institutes in India conducting survey and identification of coastal and marine plant resources but recently Department of Ocean Development with the consultation of various scientists in India has estimated near about 44 locations in India to be declared as Ecologically Sensitive Coastal and Marine Zones. These areas need detailed survey, collection and monitoring for coastal and marine resources. List of the areas are as follows :

1. Sundarban, 2. Lothian Island, 3. Bhitarkanika,
4. Gahirmata, 5. Mahanadi Delta, 6. Hookitola & Bharkhanashi, 7. Jambu Island, 8. Kansardian, 9. Chilka Lake, 10. Godavari Delta, 11. Sarcomanto Island, 12. Coringa, 13. Krishna Delta, 14. Muthupalam, 15. Ellichiladibba, 16. Nizampatanam, 17. Pulicat Lake, 18. Kolleru Lake, 19. Cauvery Delta in Pichavaram, 20. Palk strait, 21. Palk Bay, 22. Gulf of Mannar, 23. Vedaranyam, 24. Tuticorin, 25. Asthamundi Lake, 26. Vembanad Lake, 27. Cochi, 28. Ernakulum, 29. Calicut, 30. Karwar, 31. Coondapur, 32. Honavar, 33. Ratnagiri, 34. Mangalore, 35. Malpae, 36. Gokaran, 37. Mumbai, 38. Goa, 39. Malvan, 40. Diu Islands, 41. Gulf of Cambay, 42. Saurashtra, 43. Gulf of Kuchchh, 44. Rann of Kuchchh.

Preparation of Database for coastal and marine plants with the help of sophisticated computer network is urgently necessary for monitoring the sustainable uses, protection and conservation of the valuable resources but before that, some gaps in the survey and identification of coastal and marine plants should be properly encountered. The following major gaps are to be studied urgently :

1. Mangroves and salt marshes in the backwaters and lagoons.
2. Detailed survey of coastal & marine fungi specially the Actinomycetes.
3. Survey and estimation for seasonal population and growth of phytoplankton and periphyton in coastal and marine ecosystem.
4. Micro and macro algae and sea grass population along the coral reefs.
5. Detail sea grass study along the west coast and lagoons.
6. Bacterial population and its seasonal pattern, especially in polluted water surface of marine and coastal lagoon waters.
7. Status survey of rare, threatened and endangered marine and coastal plant species.

In association with the above the following point must be taken as new approaches to the management and conservation systems.

- (i) Management of coastal resources, which are common properties.
- (ii) Ensure coastal protection (physical).
- (iii) Improve coastal environment.
- (iv) Carry out researches to gather knowledge about coastal process, pollution, socio-economic disposition and coastal biodiversity.
- (v) Increase awareness and education.

FUTURE SPECIFIC RESEARCH AND DEVELOPMENT :

About two-thirds of the world's population lives with in a narrow belt of land at the ocean edge. Such a concentration of people, with their associated industrial, recreational and transport activities creates pressure on

coastal resources so that there has been a demand for scientists, engineers and planners to develop an understanding of coastal processes and dynamic nature of the beach, dunes, cliffs, estuaries and deltas. In spite of the scientific effort spent over the last 100 years there is still much to be learnt and many attempted solution to problems of erosion, deposition and pollution are now recognized to have been inadequate.

The geomorphic and geological set up in these areas largely depend on the interplay between elastic sediments introduced from one direction by the rivers of variable magnitude and the strength of the wave/tide energy which acts in the opposite direction. On the other hand, the inter-tidal flats and wetlands are vital breeding, nursery and feeding areas for the majority of marine species.

In response to that, a good understanding between ever changeable landform features and related land use land cover (i.e., soil-vegetation-water interrelationship) pattern is very essential for maintaining the natural ecosystem, to the extent possible, of the coastal zone as well as marine environments, especially when the natural set up is largely threatened by various anthropogenic activities starting from checking the upland fluvial discharge, reclamation of coastal lowlands and wetlands, destruction of mangrove forests, coral reefs, etc. and discharge of pollutants.

In this respect, utilization of the aero-space data not only provides a wealth of subject specific information to the user community in a cost effective manner (considering both time and economic aspects) but also quality is much more improved than the traditional means of approaches.

Some of the important criteria should be given priorities for further Research and Development activities such as :

- i. Coastal mapping.
- ii. Morpho-dynamics and Morphology of coastal zone.
- iii. Littoral Zone and its biodiversity.

- iv. Coastal beach, dunes, tidal flat biodiversity.
- v. Onshore and offshore biodiversity, specially Mangroves, Sea grass, Seaweeds, Corals and other faunal diversity.
- vi. Island biodiversity specially endemic, rare and endangered species.
- vii. Constant monitoring methods by Remote Sensing application.

The conservation of biodiversity is increasingly receiving 'stepdaughter' treatment by many government authorities. The major reason is that, loss of biodiversity is a silent crisis, where most people do not understand the changes taking place. Persons who make decisions that affect coastal ecosystems are usually not aware of the consequences. Therefore, the paradigm underlying biodiversity conservation has to be more 'people-oriented' to gain support. Expatriates commonly lack in-depth knowledge and experience of the local society, situations and context, which inevitably is a recipe for failure. Implementation will only be successful if management plans are 'owned' and understood by all the relevant local groups of protagonists, including district administrators and private enterprises.

The holistic approach between man and environment should be the main objective. Man's needs have to be fulfilled through the processes of sustainable development. It is necessary to conduct extensive studies into the physical conditions of the coastal areas and the socio-economic condition of the people inhabiting these areas. Environmental Impact Assessment (EIA) for the different types of activities and for major units of industries, beach resorts, ports and harbours, etc. should be conducted and appropriate Environmental Management Plans (EMPs) should be drawn up. The Union Government, the Governments of the Coastal States, the Panchayats of the coastal areas and the voluntary organizations and above all the people of these areas are required to join hands in environmental protection, conservation and planned use of resources in the coastal land and sea.

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