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AN OUTLINE OF THE COASTAL VEGETATION OF INDIA

T. ANANDA RAO AND A. R. K. SASTRY

Botanical Survey of India, Howrah

ABSTRACT

In this paper, the Coastal Vegetation of India is described in detail with regard to its sub-types, the taxa components in each and also its phytogeographical affinities.

INTRODUCTION

The vegetation and flora of the Indian coastline have not been discussed 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 ecosystems 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 salt water milieu grow in this sensitive ecosystem.

This paper on the whole is a summary account of our work devised progressively without undue consideration being paid to any particular published papers in the past as well as in the present. Its merit as a classificatory account to the coastal flora of India needs special mention. 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 proposed here to demonstrate the different eco-floristic zones or set of zones, although with much overlapping, is preliminary, in particular as regards the delimitations, but it may nevertheless serve its purpose.

COASTAL ENVIRONMENT

The nearly 5,690 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 southernmost end respectively. The west coast line is long and more or less straight starting from Cape Comorin in the south to the 20° parallel N and includes two peninsulas, Saurashtra and Kutch and is spread into the states of Gujarat, Maharashtra, Karnataka (Mysore) and Kerala. The east coast runs in wide curves changing directions from north to north-east from 16° parallel N and is covered in the states Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. In general the seaboards are wider along the east coast rather than in the west coast. Between the coast line and the adjacent plains lie the following two major inshore ecosystems: Strand and Estuary.

The coastal geology is varied. On the west coast along the Kutch shore recent deposits of newer alluvium are met with. Over the western shore of Saurashtra too, the newer alluvium is the most important formation with small pockets of a forminiferal limestone known as Mileolite (Porbandar sandstone), and of rocks which have been correlated with the Gaj series (of Sind) of the Lower Miocene age; these are exposed horizontal beds of several hundred meters in thickness and the constituents are highly fossiliferous, consisting of clays, sandstones

and conglomerates. The Deccan Traps dominate the Maharashtra coast. Further south along the Karnataka and Kerala shores up to Kanyakumari the most important formation is recent alluvium, though Pleistocene alluvium, Archaean gneissic complex, laterites and Miocene sandstones (Warkalli beds) are also encountered. On the east coast, along the shores of Tamil Nadu, Andhra Pradesh and Orissa, once again recent alluvium predominates; Archaean gneiss and Cretaceous sediment overlaid by Tertiary formations (Miocene Cuddalore-Sandstones) are seen at certain places. The Sunderbans in the West Bengal are in the recent alluvial tract.

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, Sub-humid, Semiarid and Arid as already recognized by Thornthwaite (1948). It is arid in the extreme north of west coast in the vicinity of Kutch and Okha-Dwaraka shores. Further down and along the south western shores stretching into the states of South Gujarat, Maharashtra, Karnataka and Kerala, humid climate exists. In the east, the Bengal basin chiefly the Sunderbans region falls under humid type of climate. The Utkal and Circar coast experiences moist sub-humid climate. Further southwards it gets drier; the coromandel coast enjoys a dry sub-humid climate and the Ramanathpuram district in the extreme south is under a semi-arid regime.

Despite this 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. The nature of vegetation is greatly influenced by the upland sandy relief which alters the influence of climate and the properties of soils due to variations in environmental factors. On the contrary the 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.

VEGETATION

The coastal vegetation forms a distinct soil-vegetation complex. The classification proposed by Champion and Seth (1968) and modified by Rao and Sastry (1972, 1974) has been followed here. The Indian coastal vegetation type can be categorised into the following two subtypes: Strand vegetation and Estuarine borderland vegetation.

I. Strand vegetation

It is characterised by open-mat-forming pioneers in varying proportions closely followed by scattered herbs, shrubs and trees dispersed on a relief beyond the high tide limit designated 'supra-littoral zone' or 'backshore'. This is further divisible into the following 3 subtypes: sand, rock and coral strands which correspond to the underlying substratum and show marked differences in the vegetation pattern and floristic composition. Further in each subtype there are zonations which include the open pioneer zone, the closed herbaceous zone, the middle mixed or bushy zone and the inner woodland zone; each of them exhibit characteristic plant groupings.

A. *Strand sand*: In this subtype, in the open pioneer zone which lies away from the drift line the mat-forming species are *Canavalia maritima* (Aubl.) Thou., *Ipomoea pescaprae* (L.) R. Br., *Spinifex littoreus* (Burm. f.) Merr. (Occurs in all the three zones), *Cyperus pedunculatus* (R. Br.) Kern, *C. arenarius* Retz., *Launaea sarmentosa* (Willd.) Alst. (Occurs in herbaceous zone also) associated with a few grasses like *Sporobolus virginicus* (L.) Kunth, and *Zoysia matrella* (L.) Merr. in relative abundance. This zone is succeeded by a herbaceous zone which is

characterised by the presence of herbs like *Aristolochia bracteata* Retz., *Asparagus dumosus* Baker, *Borreria articularis* (Linn. f.) F. N. Will., *Enicostema hyssopifolium* (Willd.) Verd., *Euphorbia rosea* Retz., *Geniosporum tenuiflorum* (L.) Merr., *Psilostachys sericea* Hook. f., *Gloriosa superba* L., *Goniogyna hirta* (Willd.) Ali, *Halopyrum mucronatum* (L.) Stapf, *Ipomoea pes-caprae* (L.) R. Br., *Launaea sarmentosa* (Willd.) Alst., *Polycarpaea corymbosa* Lamk., *Lotus garcinii* DC., *Peplidium maritimum* Wettest., *Perotis indica* (L.) O. Ktze., *Phyllanthus rotundifolius* Klein, *Polycarpon prostratum* (Forsk.) A & S., *Sesamum prostratum* Retz., *Spinifex littoreus* (Burm. f.) Merr., and *Trachys muricata* (L.) Pers. ex Trin. This zone is succeeded by a middle mixed or bushy zone in which the strand shrubs and under shrubs like *Allmania nodiflora* (L.) R. Br., *Borreria articularis* (Linn. f.) F. N. Will., *Calotropis procera* (Ait.) R. Br., *C. gigantea* (L.) R. Br., *Capparis decidua* (Forsk.) Edgew., *Cassia auriculata* L., *Clerodendrum inerme* Gaertn., *Crotalaria trifoliastrum* Willd., *Dodonaea viscosa* Jacq., *Oldenlandia umbellata* L., *Perotis indica* (L.) O. Ktze., *Phyllanthus maderaspatensis* L., *Senra incana* Cav., *Sericostoma pauciflorum* Stocks ex Wt., *Spinifex littoreus* (Burm. f.) Merr., *Synostemon bacciforme* (L.) Web., *Tamarix* sp., *Tephrosia hirta* Ham., *T. lanceolata* Grah. ex Wt. & Arn., *T purpurea* Pers. and *Vitex negundo* L. form chief components. This zone which is an admixture of shrubs, herbs and creepers, gradually merges with a few species attaining tree stature to form an open inner woodland zone. The commonly noticeable trees and plants with arborescent habit are *Acacia planifrons* Wt. & Arn., *Borassus flabellifer* L., *Barringtonia asiatica* (L.) Kurz, *Calophyllum inophyllum* L., *Euphorbia nivulia* Buch.-Ham., *Grewia tenax* (Forsk.) Fiori, *Hibiscus tiliaceus* L., *Hyphaene indica* Becc., *Pandanus odoratissimum* Linn. f., *Phoenix sylvestris* (L.) Roxb., *Pongamia pinnata* (L.) Pierre, *Premna latifolia* Roxb., *Syzygium ruscifolium* (Willd.) Sant. et Wagh, and *Thespesia populnea* (L.) Sol. ex Correa. Besides, *Anacardium occidentale* L., *Casuarina equisetifolia* Forst., *Cocos nucifera* L., *Morinda citrifolia* L. and *Pithecellobium dulce* (Roxb.) Benth. are some of the commonest cultivated trees. *Prosopis juliflora* DC., forms gregarious, dense thickets over extensive areas in certain places in Saurashtra and Tamil Nadu.

B. *Strand rock*: This rocky relief is distributed along the coast and is more predominant along the west coast rather than the east coast. Bordered by the Western Ghats of high relief the west coast strand is subjected to heavy quantum of rainfall. In Saurashtra and Kutch, the rocky relief consists of rocks which are several metres in thickness of Miocene age having highly fossiliferous, clayey conglomerates of sandstone origin, while in the south-ward extension of the Ghats in Kerala region, igneous rocks constitute the rock strand. At places, overhanging exposed cliffs composed of a topmost laterite, middle region of sandstones, sandy clays and lithomarge, alum clay and a bottom bed of black carbonaceous clay with pieces of wood and lignite are noticeable. The interesting feature of the rocky relief is the occurrence of a few species showing a preference to this habitat along with local or inland plants growing under similar situations. The three distinct features exhibited by this strand are the formations of steep slopes with pot holes, solution cups and crannies; wave cut rocky shore with undulating upper surface having crevices and land-ward rocky sandy strand gradually merging with the upland relief. These transitions are accompanied by a change in the floristic composition which is as follows:

(i) In the Sea ward wave cut pot holes, solution cups and crannies as in Saurashtra region, a few plants that can withstand this situation are *Atriplex stocksii* Boiss. (Occurs in Euhaline zone also), *Fagonia cretica* L.,

(Occurs in inland Desert too), *Limonium stocksii* (Boiss.) O. Ktze. and *Polycarpaea spicata* Wt. & Arn. (ii) The Summit flat or undulating topography with a thin mantle of sand in the crevices in which *Enicostema hyssopifolium* (Willd.) Verd., *Indoneesiella echioides* (L.) Sreem., *Kikxia ramosissima* (Wall.) Janch., *Lindenbergia indica* (L.) O. Ktze., *Limonium stocksii* (Boiss.) O. Ktze., *Pavonia patens* (Andr.) Chiov., *Portulaca quadrifida* L., *Pulicaria angustifolia* DC. and a few other taxa are commonly noticeable. (iii) In middle slope zone the thickness of sandy mantle increases over the rocky substratum. Bushy and shrubby plants such as *Calotropis procera* (Ait.) R. Br., *Capparis decidua* (Forsk.) Edgew., *C. cartilaginea* Dcne., *Helichrysum cutchicum* (Cl.) Rolla et Desh., *Jatropha gossypifolia* L., *Sericostoma pauciflorum* Stocks ex Wt. and *Tephrosia purpurea* Pers. are usually seen here. (iv) On the inland but adjacent to middle slope are found *Blumea obliqua* (L.) Druce, *Convolvulus auricomus* (Rich.) Bandh., *Goniogyna hirta* (Willd.) Ali, *Hibiscus ovalifolius* Vahl, *Heliotropium tuberculosum* Boiss., *Indigofera cordifolia* Heyne ex Roth, *Polygala erioptera* DC., *Polycarpaea corymbosa* (L.) Lamk., *Pulicaria foliosa* DC., *Schweinfurthia sphaerocarpa* Braun, *Sida ovata* Forsk. and *Taverniera cuneifolia* Arn.

As stated earlier, the east coast, primarily a deltaic type, is intercepted by rocky promontories only at certain places. The flora in this region is invariably a mixture of coastal and local inland plants and characteristically devoid of any true rock strand taxa of the west coast like *Limonium stocksii* (Boiss.) O. ktze. and *Polycarpaea spicata* Wt. & Arn. Moreover, the extension of rocky promontary or head land into the sea which is subjected to constant wave action is devoid of any angiosperm flora and only marine algae make their appearance. The rocky relief sloping towards inland with thin mantle of sand in the crannies, pot-holes, and crevices without much clay and organic matter supports only a sparse growth of herbaceous plants such as *Blepharis repens* (Vahl) Roth, *Euphorbia thymifolia* L., *Goniogyna hirta* (Willd.) Ali, *Portulaca tuberosa* Roxb. and *Vernonia cinerea* (L.) Less. The rocky relief further towards the inland side with less rocky and more gravelly substratum gives rise to low scrub vegetation mainly composed of spiny thickets of *Barleria prionitis* L., *Carissa spinarum* L., *Toddalia asiatica* (L.) Lamk. and shrubs like *Dichrostachys cinerea* Wt. & Arn., *Euphorbia tirucalli* L., *Jatropha gossypifolia* L., *Lantana camara* L. var. *aculeata* (L.) Mold., *Maba buxifolia* Pers., *Sapindus emarginatus* Vahl (tree) and herbs like *Acalypha indica* L., *Caralluma attenuata* Wt., *Echinops echinatus* Roxb., *Indoneesiella longipedunculata* (Sreem.) Sreem., *Mollugo pentaphylla* L. and *Polygala arvensis* Willd.

C. *Strand coral*: This is of restricted occurrence and is distributed in the islands and reefs situated in the Gulf of Mannar, Mandapam vicinity and Krusadi groups of islands, and also along Oceanic islands like Laccadive, Amindivi groups and Andaman-Nicobar islands. The coral strand consists of coral reef, forameniferal sand, clays and shell deposits. The vegetation in this habitat also exhibits zonations into open pioneer, closed herbaceous and inner woodland zone. *Atriplex stocksii* Boiss., *Avicennia officinalis* L., *Cordia subcordata* Lamk., *Pemphis acidula* Forst., *Salicornia brachiata* Roxb. and *Suriana maritima* L. usually grow in the pioneer zone. The raised ridges with coral debris and coral sand lying in between the open pioneer zone and the closed herbaceous zone exhibit characteristic flora by the growth of seedlings of *Pemphis acidula* Forst. and *Cyperus pachyrrhizus* Nees. The herbaceous plants in this zone are *Cymbopogon caesius* Stapf, *Eragrostis riparia* Nees, *E. plumosa* Link, *E. viscosa* Trin., *Halopyrum mucronatum* Stapf, *Launaea sarmentosa* (Willd.) Alst., *Pemphis acidula* Forst., *Scaevola plumieri* Vahl, *Sporobolus tremulus* (Willd.)

Kunth and *Suriana maritima* L., *Excoecaria agallocha* L. and *Lumnitzera racemosa* Willd. are also found occasionally although they remain somewhat stunted. The inner woodland zone which lies in proximity to the hinterland region harbours small trees and bushes to give rise to a woodland formation with *Guettarda speciosa* L., *Messerschimidia argentea* (Linn. f.) John, *Thespesia populnea* (L.) Sol. ex Corr. and *Dodonaea viscosa* Jacq. The only grass reported in this strand is *Thuarea involuta* (Forst.) R. Br. that too in the Laccadive and Minicoy groups of islands.

II. Estuarine vegetation

The estuarine borderland vegetation is characterised by dense and gregarious growth of woody plants, shrubs and succulent herbs in varying proportions dispersed on a relief lying under constant influence of tidal and fresh water resources. In India this type of vegetation is predominant in the deltaic regions and riverine mouths along the east coast whereas it is confined to sea-inlets, small river mouths, lagoons, bays and back-water systems along the west coast. The major Indian estuaries are the Gangetic Sunderbans complex with Hooghly-Hariabhanga estuarine system, the Burhabalang estuary, the Mahanadi estuarine complex in between Devi and Dhamra rivers, the Godavari and Krishna estuarine systems and the shallow Cauvery estuarine system. The mangroves in the east coast not only attain a good sociability, density and stature but also are composed of a relatively good number of species, the Sunderbans having the highest number whereas along the west coast they are poor in quality, extent and species composition. A gradual decrease in number of species starting from the Sunderbans to the Cauvery estuary in the down south is also noticeable.

The estuarine vegetation can be categorised under two distinct soil-vegetational types and they are Euestuarine and Proestuarine. In the euestuarine type, the plants grow on area situated closest to the estuarine water and the land is subjected to the rhythm of tides. The proestuarine type is a composite type in which the vegetation is related to the nature of the relief and tidal influence and shows correspondingly three distinct vegetational subtypes, namely Tidal mangrove, Prohaline and Euhaline. The tidal mangrove is characterised by the presence of abundantly and luxuriantly growing scrubs and tree species of mangroves dispersed on a low lying shallow relief which is under constant ebb and flow of tides. The prohaline subtype is best represented by the dense growth of salt tolerant fresh water taxa since in this zone, there is an equal mixing of fresh water from the rivers and salt water from the tides. The third subtype, the euhaline is characterised by the presence of highly salt tolerant plants which grow on a relief that is situated above the tide level and usually remains dry with salt incrustation. The floristic compositions in the above zones although show apparent similarities, very often differ to a certain extent from place to place, obviously depending on tidal influence, seepage and topographical situations and also the amount of rainfall received in these areas.

In the Gangetic Sunderbans of West Bengal, the euestuarine type is composed of gregarious growth of the feather palm, *Nypa fruticans* Wurmb and *Phoenix paludosa* Roxb. Of these two, the latter occurs in pure formations along the elevated fringes and drier border lands of protected tidal streams, while *Aegialitis rotundifolia* Roxb., a graceful shrub with shining orbicular leathery leaves, abundantly grows in pure stands in inundated areas nearer the sea. *Porteresia coarctata* (Roxb.) Tateoka, a tall grass is the first to occupy the newly formed tidal flats along the mouths of estuaries. It is rather a pioneer grass of the estuarine regions.

The tidal mangrove of the proestuarine

complex type is best represented by species like *Aegiceras corniculatum* Blanco, *Avicennia alba* Bl., *Ceriops decandra* (Griff.) Ding Hou, *Kandelia candel* (L.) Druce, *Rhizophora mucronata* Lamk., *Xylocarpus granatum* Koenig, of which *Rhizophora mucronata* Lamk. is more common towards the seaward side. Behind this zone, salt tolerant fresh water plants such as *Amoora cucullata* Roxb., *Brownlowia tersa* (L.) Kosterm., *Bruguiera gymnorrhiza* (L.) Lamk., *Clerodendrum inerme* Gaertn., *Excoecaria agallocha* L., *Heritiera fomes* Buch.-Ham., *Lumnitzera racemosa* Willd., *Pongamia pinnata* (L.) Pierre, *Sonneratia apetala* Buch.-Ham. grow densely and luxuriantly forming a closed forest. *Caesalpinia bonduc* (L.) Roxb., *C. crista* L., *Dalbergia spinosa* Roxb., *D. candenatensis* Prain, *Derris trifoliata* Lour. spreading with prickly rambling branches on these trees also grow in this zone making it impenetrable. The tidal mangrove and prohaline types merge gradually with imperceptible mixing of species of *Avicennia, Bruguiera, Lumnitzera* etc. common to both the types. In the cleared forest patches where secondary conditions set in, the invasion of the so-called mangrove fern, *Acrostichum aureum* L. in extensive gregarious patches with erect fronds having rusty brown terminal fertile pinnae, becomes an interesting feature. The elevated, degraded, extensive saline blanks lie away from regular tidal inundation and usually, remain dry with salt incrustations. This euhaline zone supports a very sparse growth of a few taxa which are the following: *Acanthus ilicifolius* L., *Aeluropus lagopoides* (L.) Trin. ex Thw., *Atriplex repens* Roth, *A. stocksii* Boiss., *Cressa cretica* L., *Salicornia brachiata* Roxb., *Sporobolus virginicus* (L.) Kunth, *Suaeda maritima* Dumort., *S. nudiflora* Moq. and *Zoysia matrella* (L.) Merr.

Along the Utkal coast in the euestuarine zone between the Devi and Dhamra rivers, *Aegialitis rotundifolia* Roxb., *Phoenix paludosa* Roxb. and *Porteresia coarctata* (Roxb.) Tateoka form pure or mixed stands whereas in the Burhabalang tidal estuary, *Rhizophora mucronata* Lamk. grows in this zone along the seaward fringes while *Phoenix paludosa* Roxb. grows well in the elevated dry border lands. *Nypa fruticans* Wurmb does not seem to occur further south of the Sunderbans and is yet to be discovered in the Coromandel coast.

The common species of the tidal mangrove zone are *Avicennia marina* Vierh., *A. officinalis* L., *Bruguiera cylindrica* (L.) Bl., *B. parviflora* (Roxb.) W. & A. ex Griff., *Ceriops decandra* (Griff.) Ding Hou, *C. tagal* (Perr.) Robin., *Kandelia candel* (L.) Druce, *Rhizophora mucronata* Lamk. and *Xylocarpus granatum* Koenig which gradually merge with the taxa of prophaline zone where the salt tolerant fresh water taxa such as *Amoora cucullata* Roxb., *Brownlowia tersa* (L.) Kosterm., *Cynometra mimosoides* Wall., *Derris trifoliata* Lour., *D. scandens* Benth., *Excoecaria agallocha* L., *Finlaysonia obovata* Wall., *Flagellaria indica* L., *Heritiera fomes* Buch.-Ham., *H. littoralis* Dryand., *Hibiscus tiliaceus* L., *Lumnitzera racemosa* Willd., *Merope angulata* (Kurz) Swingle, *Pandanus odoratissimum* Linn. f., *Parsonsia helicandra* Hk. & Arn., *Premna integrifolia* L., *Sonneratia apetala* Buch.-Ham., *S. griffithii* Kurz, *S. caseolaris* (L.) Engl. and *Tamarix gallica* L. grow well forming a dense canopy. Of these, species of *Heritiera, Lumnitzera* and *Sonneratia* attain appreciable height and girth. *Acrostichum aureum* L. grows in open forest clearings.

The chiefly recorded plants that grow in the euhaline zone are *Acanthus ilicifolius* L., *Clerodendrum inerme* Gaertn., *Salicornia brachiata* Roxb., *Suaeda nudiflora* Moq., *S. monoica* Forsk., *Sporobolus virginicus* (L.) Kunth and *Zoysia matrella* (L.) Merr. *Aeluropus lagopoides* (L.) Trin. ex Thw. although common throughout the east coast, remains to be recorded from Utkal (Orissa) coast.

In the Coringa tidal estuary of the Godavari estuarine complex in Andhra Pradesh,

Porteresia coarctata (Roxb.) Tateoka, a pioneer grass is seen occupying the newly formed silt deposits in the intertidal region. The tidal mangrove taxa are also comparatively few in number and *Avicennia alba* Bl., *Rhizophora mucronata* Lamk. and *R. apiculata* Bl. form the chief components occupying the sheltered banks of the side creeks. Under more fresh water influx and influence, *Avicennia alba* Bl., *A. officinalis* L., *Bruguiera gymnorrhiza* (L.) Lamk., *Ceriops decandra* (Griff.) Ding Hou, *Excoecaria agallocha* L., *Hibiscus tiliaceus* L., *Lumnitzera racemosa* Willd., *Sonneratia apetala* Buch.-Ham. and *Xylocarpus granatum* Koenig grow well attaining a height of 8-10 m. These are overgrown by climbers like *Caesalpinia crista* L., *Dalbergia spinosa* Roxb., *Derris trifoliata* Lour. forming dense impenetrable thickets. *Ipomoea macrantha* Roem. et Sch. with large cordate leaves and funnel-shaped white flowers forms a conspicuous feature. *Clerodendrum inerme* Gaertn., dense tufts of the grass *Myriostachya wightiana* Hook. f. and the sedge *Cyperus rotundus* L. grow luxuriantly along the water margins. In the upland dry areas that lie immediately behind the tidal forests the vegetation changes sharply within a short distance and the area supports sparse growth of halophytic species such as *Acanthus ilicifolius* L., *Aeluropus lagopoides* (L.) Trin. ex Thw., *Cressa cretica* L. and *Clerodendrum inerme* Gaertn.

In the Vellar estuary, the euestuarine taxa are absent. Only *Aegiceras corniculatum* Blanco, *Avicennia officinalis* L., *A. marina* Vierh., *Ceriops decandra* (Griff.) Ding Hou, *Rhizophora mucronata* Lamk., *R. apiculata* Bl. usually form the vegetation in the tidal mangrove zone, while *Bruguiera cylindrica* (L.) Bl., *Dalbergia spinosa* Roxb., *Derris trifoliata* Lour., *Lumnitzera racemosa* Willd., *Sonneratia apetala* Buch.-Ham. and *Xylocarpus granatum* Koenig. become the more conspicuous taxa of the prohaline zone. As found elsewhere, on dry elevated euhaline alkali blanks, *Aeluropus lagopoides* (L.) Trin. ex Thw., *Arthrocnemum indicum* (Willd.) Moq., *Cressa cretica* L., *Salicornia brachiata* Roxb., *Sesuvium portulacastrum* L. and *Suaeda nudiflora* Moq. commonly grow. *Acanthus ilicifolius* L. and *Clerodendrum inerme* Gaertn. are the only shrubby species that grow in these areas.

The west coast estuarine vegetation which is mostly along banks of the back water systems (in Malabar coast), the euestuarine taxa are completely absent. The commonly noticeable tree species that grow in the tidal mangrove zone are *Avicennia officinalis* L., *A. alba* Bl., *Rhizophora mucronata* Lamk. and *R. apiculata* Bl. The components of the prohaline zone are *Barringtonia racemosa* Roxb., *Bruguiera gymnorrhiza* (L.) Lamk., *Cerbera manghas* L., *Hibiscus tiliaceus* L., *Sonneratia apetala* Buch.-Ham.; under disturbed conditions *Ceropegia tuberosa* Roxb., *Gloriosa superba* L., *Tylophora tenuis* Bl., *Vitis vitigenia* Ktze., *V. quadrangularis* Wall. are some of the frequently seen climbers rooted in not so saline soils while *Crinum asiaticum* L., *Parsonsia helicandra* Hk. & Arn., *Sphenoclea zeylanica* Gaertn., *Xyris indica* L. form the herbaceous growth in this zone. *Pandanus odoratissimum* Linn. f. occurs in large clumps where the soil is sandy while the fern *Acrostichum aureum* L. occurs usually in disturbed areas and forest clearings indicating the development of secondary edaphic conditions.

The estuarine vegetation in Karnataka and Maharashtra states exhibits notable similarities in floristic composition. The euestuarine zone is not represented and the predominant prohaline taxa of the tidal mangroves are the following: *Aegiceras corniculatum* Blanco, *Avicennia alba* Bl., *A. officinalis* L., *Bruguiera gymnorrhiza* (L.) Lamk., *Clerodendrum inerme* Gaertn., *Excoecaria agallocha* L., *Lumnitzera racemosa* Willd., *Rhizophora mucronata* Lamk. and *Sonneratia apetala* Buch.-Ham., *Acanthus ilicifolius* L., *Aeluropus lagopoides* (L.) Trin. ex Thw., *Arthrocnemum indicum* (Willd.)

Moq., *Atriplex stocksii* Boiss., *Fimbristylis cymosa* R. Br., *Scirpus ferrugineus* L., *Sporobolus virginicus* (L.) Kunth, *Suaeda nudiflora* Moq. are the common taxa noticeable in the euhaline zone. *Acrostichum aureum* L., *Cynometra mimosoides* Wall., *Heritiera littoralis* Dryand. form a conspicuous mosaic of the prohaline belt of the estuarine vegetation in the coastal Karnataka which in turn are absent in the north Konkan coastal belt and upwards.

In Saurashtra, the estuarine vegetation is rather poor and not luxuriantly developed. *Urochondra setulosa* (Trin.) Hubb., a spiny grass forms more or less pure formations in the euestuarine zone. *Aegiceras corniculatum* Blanco, *Avicennia officinalis* L., *A. marina* Vierh., *Rhizophora mucronata* Lamk., *R. apiculata* Bl. usually represent tree species in the tidal mangrove type. *Bruguiera gymnorrhiza* (L.) Lamk., *Salvadora persica* L., *Tamarix troupii* Hole, and the climber, *Tylophora indica* Merr. are usually associated with *Cenchrus biflorus* Roxb. and *Fimbristylis cymosa* R. Br. forming the chief floristic components in the prohaline zone. The euhaline zone is constituted by plants like *Atriplex stocksii* Boiss., *Cressa cretica* L., *Salicornia nudiflora* Moq. often mixed up with common grasses like *Aeluropus lagopoides* (L.) Trin. ex Thw., and *Sporobolus tremulus* (Willd.) Kunth, which usually grow on dry saline 'blanks' that lie in the upland relief.

REGIONAL DISTRIBUTIONAL PATTERNS OF INDIAN COASTAL FLORA (RAO, 1974)

I. Strand vegetation

The West Bengal coast is divisible into Medinipur coast and Gangetic Sunderbans area, the Hooghly river dividing them. While the Sunderbans predominantly represent a tidal swamp mainly supporting an estuarine vegetation, the Medinipur sandy coastal belt consists of a strand flora mainly of *Borreria articularis* (Linn. f.) F. N. Will., *Ipomoea pes-caprae* (L.) R. Br., *Jatropha gossypifolia* L., *Launaea sarmentosa* (Willd.) Alst., *Polygala erioptera* DC. and *Sida cordifolia* L. The new additions to this flora are *Aeluropus lagopoides* (L.) Trin. ex Thw., *Cyperus arenarius* Retz., *Gisekia pharnaceoides* L., *Portulaca tuberosa* Roxb., *Rothia indica* (L.) Druce, *Spinifex littoreus* (Burm. f.) Merr., *Syzygium ruscifolium* (Willd.) Sant. & Wagh and *Trianthema triquetra* Rottl. ex Willd. However, it is interesting to note the total absence of the three widely spread Utkal coast elements *viz.*, *Euphorbia rosea* Retz., *Geniosporum tenuiflorum* (L.) Merr., and *Hydrophylax maritima* Linn. f., in the West Bengal coastal regions.

Along the Utkal sandy shores, *Euphorbia rosea* Retz., *Fimbristylis junciformis* Kunth, *Geniosporum tenuiflorum* (L.) Merr., and *Hydrophylax maritima* Linn. f. are the most commonly noticeable species of the strand flora. *Cyperus pachyrrhizus* Nees is known only in Utkal coast and is not recorded in the adjoining coastal regions of Medinipur and Andhra Pradesh in the south. On the contrary, *Aeluropus lagopoides* (L.) Trin. ex Thw., a very common grass recorded from several stations in West Bengal and also in Andhra Pradesh seems to be absent in Utkal coast. Similarly, *Enicostema hyssopifolium* (Willd.) Verd. has not been recorded from the coastal belt in Orissa and West Bengal.

In the Andhra Pradesh coast, the localised occurrence of *Psilostachys sericea* Hook. f. at Krishnapatnam near Nellore for the entire east coast is phytogeographically very interesting since this pretty herb is known to occur in restricted coastal areas in Saurashtra and further down at Bombay thus exemplifying disjunct distribution. Similarly, *Pachygone zeylanica* (Gaertn.) Sant. et Wagh, a strand climber, does not seem to extend further northwards of the Andhra Pradesh coast. *Dimorphocalyx glabellus* Thw., a member of Euphorbiaceae is another interesting plant which is reported from Visakhapatnam, although the plant occurs

in the Annamalai hills and in the scrub near Pondicherry in South India. *Sesamum prostratum* Retz., which occurs in the sandy coastal regions in Andhra Pradesh and Tamil Nadu has not extended further north of the Krishna river along the east coast. *Blepharis repens* (Vahl) Roth is a rare plant, only noticed in the sand-filled rock crevices at Visakhapatnam and Poodimadaka coastal areas. *Drosera burmanni* Vahl, *Eriocaulon xeranthemum* Mart., *Indigofera aspalathoides* Vahl, *Osbeckia zeylanica* Willd., *Stylosanthes mucronata* Willd., *Trachys muricata* Steud., *Trianthema triquetra* Rottl. & Willd., and the only coastal terrestrial orchid, *Eulophia epidendraea* Fisch., are some of the other rare plants.

The Tamil Nadu coastal belt which extends south of Pulicat Lake upto Cape Comorin exhibits similarities of vegetation to the Andhra Pradesh coast. However, a few strand plants like *Allmania nodiflora* R. Br., *Breweria evolvuloides* Choisy, *Heterostemma tanjorense* Wt. & Arn., *Nesaea lanceolata* Koeh., *Scaevola plumieri* Vahl, although frequent in certain localities in Tamil Nadu coast, are not reported from and does not seem to occur in the adjoining coastal belts in the Andhra Pradesh. *Halopyrum mucronatum* Stapf, wide spread in Saurashtra. Karnataka and Krusadi group of islands extends only up to the southern most tip of the peninsula and does not extend further north into Tamil Nadu and Andhra Pradesh along the east coast. *Pemphis acidula* Forst., a common plant in the islands in the Gulf of Mannar, is of restricted occurrence along the coral rocky belt near Tirunelvelly shore at the southern most tip of the peninsula.

The strand flora of the leading islands that lie in the Gulf of Mannar like Rameswaram, Krusadi, Shingle, Hare and Church is akin to that of Sri Lanka coast. *Pemphis acidula* Forst., forms pure strand scrub forests at several places in all these islands except in Rameswaram. The recent report of the occurrence of *Messerschimidia argentea* (Linn. f.) Johnst., (Rao *l.c.*) along the shores of Krusadi island is of considerable interest and appears to be a recent invasion from the nearby Sri Lanka strand flora. Other plants of distributional interest that occur in a few pockets in these islands are *Polycarpaea spicata* Wt. & Arn., a strand herb with a disjunct distribution in Saurashtra coast, Laccadive group of islands, Pamban, Tuticorin, in the south India and also in Jaffna (Sri Lanka) in Palk strait, *Cordia subcordata* Lam., and *Suriana maritima* L.

Along the Malabar coast (Kerala) on the western side of the peninsula, strand plants like *Canavalia maritima* (Aubl.) Thou., *Colubrina asiatica* Brongn., *Cyperus pedunculatus* (R. Br.) Kern, *Euphorbia rosea* Retz., *Parsonsia helicandra* Hk. & Arn., *Scaevola taccada* (Gaertn.) Roxb. and *Wedelia biflora* DC., are commonly noticeable. In addition, *Acrostichum aureum* L., *Calophyllum decipiens* Wt., and *Flagellaria indica* L., are the common plants which further extend into the Karnataka coast.

The noteworthy strand plants along Karnataka coastal region are *Crotalaria nana* Burm., *Cyperus pedunculatus* (R. Br.) Kern, *Euphorbia atoto* Forst., *Indigofera uniflora* Buch.-Ham., *I. aspalathoides* Vahl., *Neanotis carnosa* (Dalz.) Lewis, *Scaevola taccada* (Gaertn.) Roxb., *S. plumieri* Vahl, *Acrostichum aureum* L., and *Flagellaria indica* L., of which, *F. indica* L., sometimes occurs on rocky slopes near the sea. *Euphorbia rosea* Retz. and *Mucuna gigantea* DC., although common in the Malabar coastal region have not spread to the Karnataka coast.

The Konkan (Maharashtra) coast has limited sandy areas fringed with sparse strand flora. The raised saline sandy grounds are chiefly covered by *Aeluropus lagopoides* (L.) Trin. ex Thw., *Paspalum vaginatum* Sw., and *Sporobolus virginicus* Kunth. *Psilostachys sericea* Hk. f. has been recently reported from Juhu beach near Bombay. *Cyperus pedunculatus* (R. Br.) Kern is reported from Marmagao; further north of Goa its

occurrence is known only from the southern Saurashtra coast.

In general the strand flora of Kutch coast is akin to that of the Sind in Pakistan. Some plants like *Heliotropium renifolium* Stocks, *Peganum harmala* L., *Scaevola taccada* (Gaertn.) Roxb., *Spinifex littoreus* (Burm. f.) Merr., and *Tamarix articulata* Vahl are confined to this region and they do not seem to have extended their distribution into the adjoining peninsular coast of Saurashtra. The north-west Saurashtra coast which corresponds to the arid region is botanically similar to the Kutch-Sind strand flora and the south-eastern part bordering the Gulf of Cambay to the Konkan coast. The chief examples of the Arabian strand elements distributed along the arid coastal region in Saurashtra are *Asparagus dumosus* Bak., *Astragalus prolixus* Sieb., *Capparis cartilaginea* Dcne., along with other Indian endemics like *Helichrysum cutchicum* (Cl.). Rolla et Desh., *Limonium stocksii* (Boiss.) O. Ktze. and *Lotus garcinii* DC. However, these plants become less common and gradually disappear in the south-eastern areas of the semi-arid zone in which the Indian, Malesian and Polynesian coastal elements such as *Borreria articularis* (Linn. f.) F. N. Will., *Canavalia maritima* (Aubl.) Thou., *Hydrophylax maritima* Linn. f., *Ipomoea pes-caprae* (L.) R. Br., *Launaea sarmentosa* (Willd.) Alst., *Psilostachys sericea* Hook. f., *Scaevola taccada* (Gaertn.) Roxb., *S. plumieri* Vahl and *Sesuvium portulacastrum* L. make their gradual appearance becoming more frequent towards the southern coastal regions of Gujarat state.

Along the southern Gujarat coast, (south of the Narmada), the strand flora exhibits striking similarities to the adjoining Konkan coast. The occurrence of *Spinifex littoreus* (Burm. f.) Merr., with its northern most distribution limit at Dumas, and *Zoysia matrella* (L.) Merr., at Daman, and the absence of *Calophyllum inophyllum* L., in Gujarat coast are of significant distributional interest. The Doum Palm, *Hyphaene indica* Becc. along the south-west coast of Saurashtra is of distributional interest since the palm is localised only in this area and does not extend into the adjoining coastal belt south of Daman.

II. Estuarine vegetation

Along the east coast, the richness of the estuarine complex in species composition, density, luxuriance and extent is considerable in the Sunderbans regions of West Bengal and in the Mahanadi estuarine complex in Orissa state. Further down in the Godavari, Krishna and Cauvery estuarine regions, the species composition diminishes gradually in a downward sequence. Great similarity in species composition is noticeable between the Sunderbans and Mahanadi deltaic areas in which *Aegialitis rotundifolia* Roxb., *Amoora cucullata* Roxb., *Avicennia officinalis* L., *A. alba* Bl., *A. marina* Vierh., *Brownlowia tersa* (L.) Koster., *Bruguiera cylindrica* (L) Bl., *B. parviflora* (Roxb.) W. & *A.*, *Ceriops decandra* (Griff.) Ding Hou, *C. tagal* (Perr.) Roxb., *Excoecaria agallocha* L., *Heritiera fomes* Buch.-Ham., *Lumnitzera racemosa* Willd., *Phoenix paludosa* Roxb., *Porteresia coarctata* (Roxb.) Tateoka, and *Rhizophora mucronata* Lamk. commonly grow. However, *Nypa fruticans* Wurmb, which is seen gregariously growing along the water margins of creeks in the Sunderbans does not seem to occur in the Mahanadi estuarine area. *Aegialitis rotundifolia* Roxb., *Amoora cucullata* Roxb., *Brownlowia tersa* (L.) Koster., *Heritiera fomes* Buch.-Ham., *Phoenix paludosa* Roxb. and *Acrostichum aureum* L. are some of the noteworthy plants that do not extend further south of the Mahanadi estuary. Along the west coast, species diversity is perhaps the highest along the Malabar coast, the commonest being *Avicennia officinalis* L., *Barringtonia racemosa* Roxb., *Bruguiera gymnorrhiza* (L.) Lamk., *Ceropegia tuberosa* Roxb., *Flagellaria indica* L., *Parsonsia helicandra* Hk. & Arn.,

Rhizophora apiculata Bl., and *R. mucronata* Lamk. *Acrostichum aureum* L. is to be seen only in Kerala and in Karnataka coastal areas for the entire west coast. *Cynometra mimosoides* Wall., *Heritiera littoralis* Dryand., and *Sonneratia caseolaris* (L.) Engl. are frequent along Karnataka coast and have not extended further north into Maharashtra state, where the mangroves are of a degraded type. *Urochondra setulosa* (Trin.) Hubb., a robust grass which occurs in tidal flats and along sea inlets in the Saurashtra region is not known to occur in other similar situations in the adjoining states. In Gujarat, Saurashtra and Kutch the mangrove species remain usually stunted and bushy. The commonly noticeable species in and near the tidal regions are *Aegiceras corniculatum* Blanco, species of *Avicennia, Bruguiera gymnorrhiza* (L.) Lamk., *Rhizophora apiculata* Bl., *R. mucronata* Lamk., *Salvadora persica* L. and *Tamarix troupii* Hole.

Halophytic species which occur in the elevated saline blanks that are subjected to only occasional tidal submergence are noticeable in almost all the parts of the mangrove regions in India. In many cases they are uniformly distributed; *Acanthus ilicifolius* L., *Aeluropus lagopoides* (L.) Trin. ex Thw., *Atriplex stocksii* Boiss., *Cressa cretica* L., *Salicornia brachiata* Roxb., *Suaeda nudiflora* Moq., *S. maritima* Dumort., *S. monoica* Forsk., are present almost throughout. However, a few species like *Myriostachya wightiana* Hk. f., *Nypa fruticans* Wurmb., and *Phoenix paludosa* Roxb., although commonly recorded in the tidal forests of the eastern peninsula and the Sunderbans, are altogether absent in the west coast tidal forests. Similarly *Juncus maritimus* Lamk. and *Urochondra setulosa* (Trin.) Hubb., are found only along western coast.

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An analysis of the Indian strand vegetation reveals that it is a mixture of Afro-Perso-Arabian/Western and Indo-Malayan/Eastern elements or Polynesian and Australian affinity. Besides, a few rare or endemic elements of localised or regional distribution also occur. Similarly the terrestrial estuarine flora distributed in the Euestuarine and Tidal mangrove zones is derived chiefly from Malesian and Polynesian islands. The taxa groupings in the prohaline zone are chiefly represented by Indo-Malayan plants. In the euhaline zone the majority of the taxa components are common to tropical coastal and inland salt lands (Fig. 1).

The strand flora of western alliance are represented by plants like *Asparagus dumosus* Baker, *Atriplex stocksii* Boiss., *Astragalus prolixus* Sieb., *Blepharis repens* (Vahl) Roth, *Calotropis procera* (Ait.) R. Br., *Capparis cartilaginea* Dcne., *Cyperus arenarius* Retz., *Enicostema hyssopifolium* (Willd.) Verd., *Goniogyna hirta* (Willd.) Ali, *Halopyrum mucronatum* (L.) Stapf, *Juncus maritimus* Lamk., *Limonium stocksii* (Boss.) O. Ktze., *Lotus garcini* DC., *Peplidium maritimum* Wettst., *Phyllanthus rotundifolius* Klein, *Polycarpaea spicata* Wt. ex Arn., *Polygala irregularis* Boiss., *Salvadora persica* L., *Synostemon bacciforme* (L.) Web., *Taverneira cuneifolia* Arn., *Urgenia congesta* and *Volutarella divaricata* Benth. These plants occur along the Gujarat coast and extend further westwards into Sind, Baluchistan, Iran, Egypt and East Africa.

The eastern element, the distributional range of which covers Burma, Malay peninsula, Australia and Polynesia, is represented by *Allmania nodiflora* R. Br., *Bauhinia anguina* Roxb., *Borreria articularis* (Linn. f.) F. N. Will., *Calophyllum inophyllum* L., *Calotropis gigantea* Br., *Cordia subcordata* Lamk., *Cosmostigma racemosus* Wt., *Clerodendrum inerme* Gaertn., *Crotalaria laburnifolia* L., *Cyperus pedunculatus* (R. Br.) Kern, *Euphorbia atoto* Forst., *Fimbristylis cymosa* R. Br., *F. sericea* Br., *Ipomoea macrantha* Roem. et Sch., *I. pes-caprae* (L.) R. Br., *Heritiera littoralis* Dryand., *Ischaemum muticum* L., *Messerschimidia argentea* (Linn. f.) Johnst., *Morinda citrifolia* L., *Mu-*

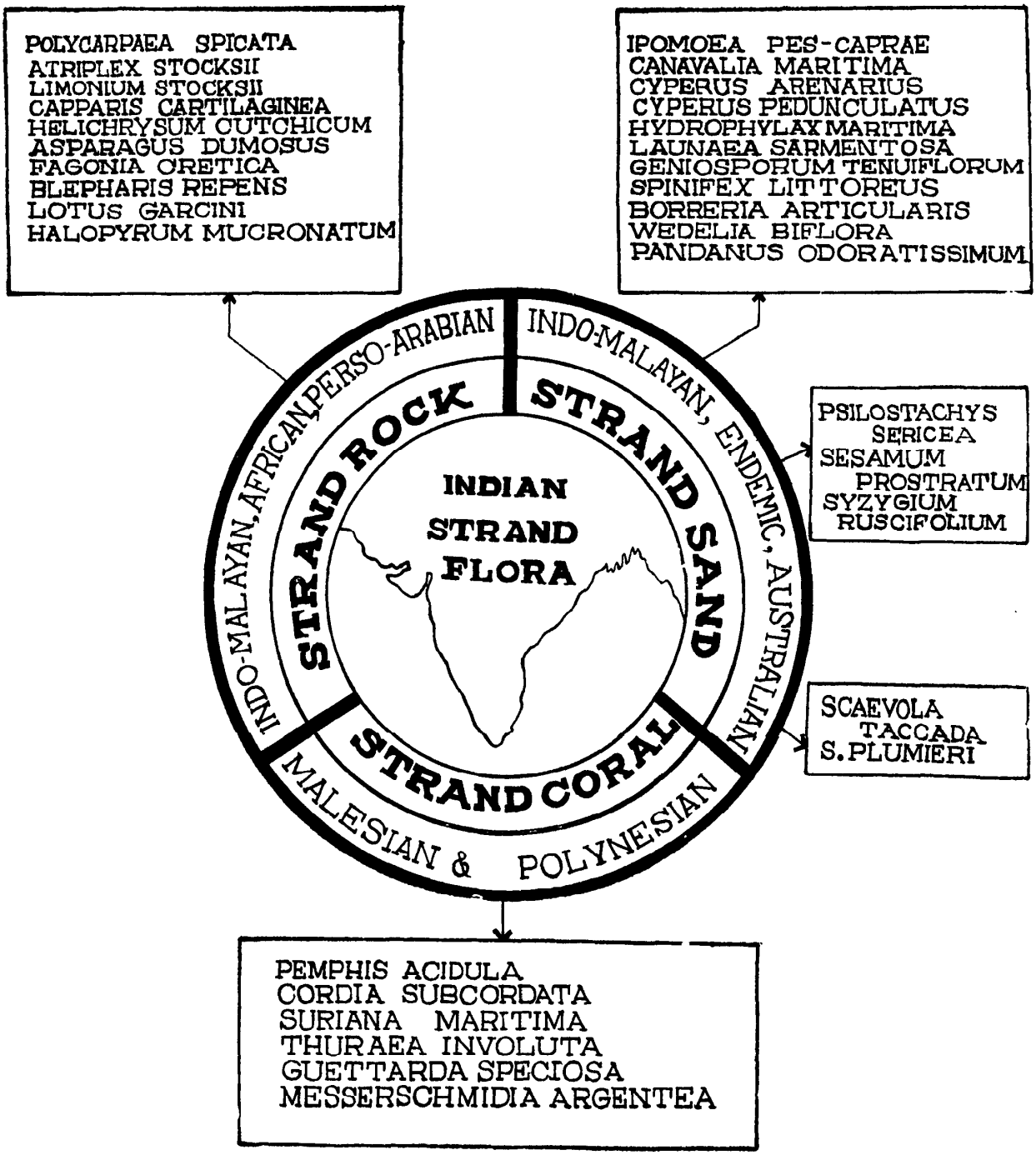

FIG. 1.

cuna gigantea DC., *Myriostachya wightiana* Hook. f., *Oldenlandia diffusa* Roxb., *Pachygone zeylanica* (Gaertn.) Sant. & Wagh, *Pandanus odoratissimum* Linn. f., *Parsonsia helicandra* Hook. et Arn., *Pemphis acidula* Forst., *Samadera indica* Gaertn., *Scaevola taccada* (Gaertn.) Roxb., *S. plumieri* Vahl, *Solanum trilobatum* L., *Scyphiphora hydrophyllacea* Gaertn., *Spinifex littoreus* (Burm. f.) Merr., *Tylophora tenuis* Bl., *Wedelia biflora* DC. and *Xyris indica* L. Many of the above mentioned plants extend up to south-western Indian peninsula from Malesian islands through Malacca, Mowlmein, Tenas-

serim, Sunderbans and the Coromandel coast. Some of them have also extended into the west-coast of India, Laccadive group of islands, Andaman and Nicobar group of islands and Sri Lanka.

Besides the above listed elements of western and eastern alliance, some noteworthy strand plants which almost occur all along the coasts of the tropical countries of both the hemispheres are *Cassytha filiformis* L., *Colubrina asiatica* Brongn., *Cressa cretica* L., *Flagellaria indica* L., *Hibiscus tiliaceus* L., *Ipomoea pes-caprae* (L.) R. Br., *Maba buxifolia* Pers., *Mollugo disticha* Ser., *Phyllanthus maderaspatensis* L., *Pisonia aculeata* L., *Ruppia maritima* L., *Scirpus maritimus* L., *Sesuvium portulacastrum* L., *Thespesia populnea* (L.) Sol. ex Corr., *Trianthema triquetra* Rottl. & Willd., and *Zornia gibbosa* Span. Interestingly enough, *Hernandia ovigera* L. which occurs throughout the tropics, is of doubtful occurrence along the Indian coast.

Apart from the western and eastern elements in the Indian strand vegetation, certain endemics are also noticeable some of which extend into Sri Lanka. *Helichrysum cutchicum* (Cl.) Rolla et Desh. is restricted to Saurashtra and Kutch regions; *Indigofera uniflora* Buch.-Ham. and *Oldenlandia pruinosa* O. Ktze. are found distributed only along the western coast. *Eulophia epidendraea* Fisch., *Heterostemma tanjorense* Wt. & Arn., *Oldenlandia schuteri* Hook. f. and *Sesamum prostratum* Retz. are strictly plants of the Coromandel coast. *Psilostachys sericea* Hook. f., with a disjunct distribution in Saurashtra and Bombay on the western side and at Nellore on the eastern side is of considerable interest. Some other plants such as *Crotalaria nana* Burm., *C. trifoliastrum* Willd., *Dimorphocalyx glabellus* Thw., *Dolichos ciliatus* Klein, *Geniosporum tenuiflorum* (L.) Merr., *Hydrophylax maritima* Linn. f., *Indigofera aspalathoides* Vahl, *Osbeckia zeylanica* Willd., and *Stylosanthes mucronata* Willd., are usually present along both the coasts and also extend into Sri Lanka. The strand flora of Sri Lanka is well represented on the southern shores of Tamil Nadu including the islands in the gulf of Mannar. Further, a few of them have spread north-westwards into the shores of Kerala, Mysore, Konkan and Kutch. They are *Cyperus pedunculatus* (R. Br.) Kern, *Halopyrum mucronatum* Stapf, *Polycarpaea spicata* Wt. & Arn., *Scaevola plumieri* Vahl, and *S. taccada* (Gaertn.) Roxb. Along the east coast the occurrence and spread of the above mentioned plants has not been recorded. Another distinct feature of the main land coastal area is the absence of plants like *Guettarda speciosa* L., *Hernandia ovigera* L., and *Thuraea involuta* (Forst.) R. Br., hitherto reported in Andaman, Nicobar, Laccadive and Sri Lanka islands.

The floristic elements of the estuarine borderland vegetation which constitutes a sub-type of the Indian coastal flora are akin to the near and far off shores and lack endemic or native elements. Further, their density, frequency, floristic composition, species number and gregarious habit change from the Gangetic Sunderbans down to the southern tip of the peninsula along the east coast and from Kanya Kumari (Cape Comorin) to Malabar upwards to Saurashtra-Kutch shores along the west coast. This change is mainly due to the disjunction of dominant individual species and it is not puzzling because it can be explained in terms of substrate requirements. The components of this unique soil vegetational complex in India do not require detailed comment, as almost all are derived from Malesian and Polynesian islands (Fig. 2).

It is now evident that in the Indian estuarine conditions the euestuarine zone possesses a few disjunct taxa of wide distribution. Further, the floristic components of the proestuarine complex are chiefly representative taxa of Indo-Malayan alliance of which, a few are circum-tropical halophytes

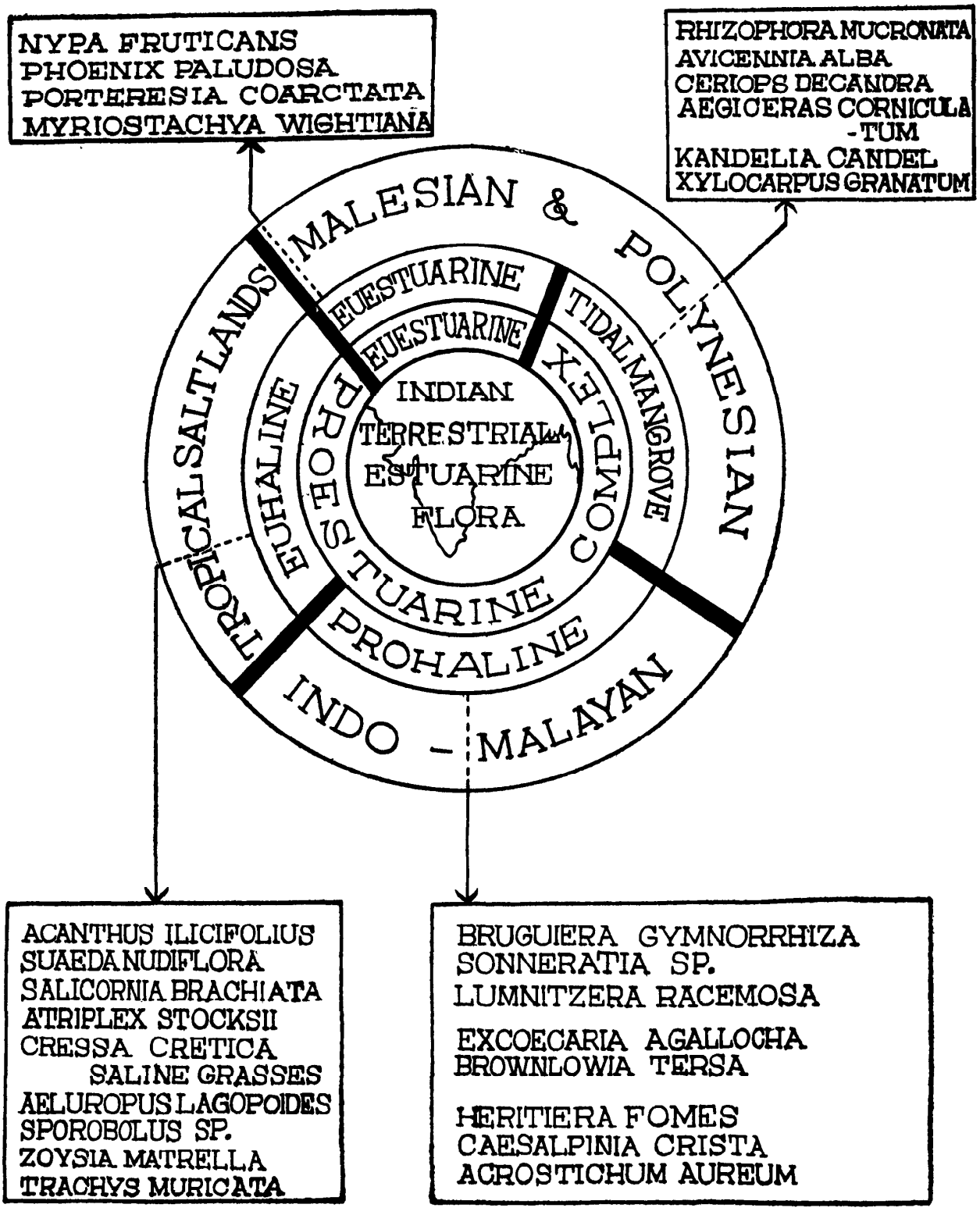

Fig. 2

mixed with a few salt tolerant local plants. In this connection the recent findings of two unrecorded taxa along the estuarine areas of the Mahanadi delta deserve special mention. Of these the occurrence of *Rhizophora stylosa* Griff. mixed up with *R. mucronata* Lamk. in the estuarine muddy banks of Orissa state is of distributional interest, be-

cause formerly it was reported to occur only from Philippines, Malaya and southwards to Australia. This mixed population is comparable to the situation prevalent in New Guinea for these two taxa. Another interesting find is *Sonneratia griffithii* Kurz, a taxon hitherto reported from the Burma-Malaya-Andaman area. Similarly, the occurrence of *Amoora cucullata* Roxb., *Ceriops tagal* (Perr.) Robin., *Intsia bijuga* (Colebr.) O. Ktze., *Xylocarpus moluccensis* (Lam.) Roem. and an overlooked taxa, *Bruguiera sexangula* (L.) Pers. in the tidal forests of Orissa is significant (Banerjee and Rao, in press). These new findings in the coastal areas emphasize the need for more intensive explorations along the Indian coasts.

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