

ECOLOGICAL STUDIES OF SAURASHTRA COAST AND NEIGHBOURING ISLANDS. V. JAFARABAD TO BHAVNAGAR COASTAL AREA

T. ANANDA RAO AND A. K. MUKERJEE

Botanical Survey of India, Calcutta

ABSTRACT

This paper is an ecological account of the plant communities and habitats observed in the coastal areas of Saurashtra from Jafarabad to Bhavnagar between 20°52' : 21°45' and 71°25' : 72°12'. Ecological aspects are presented on an ecological basis. Plant communities grouped under euryecene and analysis of soils are described to study soil features in relation to vegetation. A list of the coastal plants is prepared to reveal their distribution.

GENERAL DESCRIPTION OF THE AREA

Physical features of the Saurashtra coast have been described by Rao *et al.* (1964b). The coastal belt from Jafarabad to Bhavnagar is about 100 km long and lies between 20°52' : 21°45' and 71°25' : 72°12'. This region presents a succession of rock cliffs of moderate height sometimes hollowed by the sea into caverns. Occasionally, the rocky foreshore is interrupted by muddy shore lined by mangroves. The coast line from Jafarabad to Bhavnagar has been studied with special reference to Jafarabad, Victor Albert Port, Mahuva, Talaja, Gopnath, Gogha and Bhavnagar and their environs. Jafarabad is a sea port situated at 20°52' : 71°25' on a creek about 1.6 km distant from the Arabian Sea. The coast line is made up of rocky cliffs with sandy beaches of very limited extension. Mahuva lies at 21°5' : 71°40' on the west bank of the river Malan. About 3 km from the town is the port. Rocky cliffs and a sandy foreshore are the prevailing habitats in this area. Another port is Victor Albert Port which is approachable from the village Dungan, situated at a distance of about 20 km from Mahuva. The coast line here is partly rocky and partly sandy, with salt marsh towards the interior. Talaja which lies at 21°22' : 72°04' is 50 km south of Bhavnagar. Here the coast line is mostly rocky. Gopnath is situated on the sea shore at a distance of about 30 km from Talaja. The coast line is made up of conglomerate rock and the erosion by sea is severe. Gogha is situated at 21°41' : 72°17' on the Gulf of Cambay. Towards the north of this village is a black salt marsh, extending to the Bhavnagar creek and along the south lies another salt marsh. The coast line is muddy, sheltering mangrove thickets and inland salt marshes. Bhavnagar town and port on the Gulf of Cambay is

situated at 21°45' : 72°12'. The coast line is similar to Gogha lined by mangroves and salt marshes. Saline flats are often seen near the sea coast.

CLIMATE

On this coast line the average annual rainfall is 59 cm, but at Jafarabad it is 106 cm. The rainfall data for Jafarabad, Mahuva, Talaja and Gogha and the meteorological data for Bhavnagar based on observation for 30 years (1891-1920) is given elsewhere (Rao *et al.* 1966). It will be seen from this table that the rainfall is during the south-west monsoon from June to September followed by a long dry spell. The temperature remains high almost throughout the year. This type of climate may be described as semi-arid type.

GEOLOGY AND SOIL

Deccan trap consisting of basalts and dolerites and also felsites, trachytes, trachydolites, diorites, obsidians, pitchstones, granophyre, trachylite and palagonite rock are exposed at Bhavnagar and extend up to Talaja and Mahuva. Gaj Beds consisting of limestonic limestone, sandstone, grit, conglomerate, yellowish clays and marls are exposed all along this coast as a narrow strip. Laterites are found between the Deccan trap and Gaj beds in many localities in this coastal area. Alluvium occurs in the vicinity of the river deltas and wind blown sands in localised patches near Jafarabad, Victor Albert Port and Mahuva.

The coast line at Bhavnagar and Gogha consists of muddy tidal flats sheltering the mangrove thickets with occasional interruption by rocky cliffs. At Talaja, Gopnath, Mahuva, Victor Albert Port and Jafarabad the frequency of muddy tidal flats generally decreases but the rocky outcrop with a thin

layer of sand or soil in the crevices is prevalent. Low-lying rock in some locations is covered by wind blown sand giving rise to sand humps. The rocky foreshore is followed by lateritic soil in which millets and ground-nuts are cultivated (Table I).

METHODS

This account is based on the data collected during four visits in different seasons of 1962-64.

Tours were undertaken in the months of September/October 1962, March/April 1963, January/February 1964 and September/October 1964. The data for the floristic composition were collected by means of a series of contiguous belt transects/square metre quadrats running at right angles across a typical segment of the coast over the marsh or cliff or sandy strand/dune habitats. The belts were 50 m apart and varied from 10 to 200 m in length depending on the features to be studied. The results are tabulated only for cover data which is estimated following Braun-Blanquet (1932) in part (Rao et al. 1964b) and sketched in scale on cards 10 dm square. Other methods (Rao et al. 1964a) were adapted for describing plant communities grouped under ecosystems.

Soil samples were collected from different ecosystems in this coastal area and analysed in the laboratory for their characteristics to study relationships, if any, between vegetation and soil features with a view to build up the spectrum of soil types and corresponding vegetation in coastal habitats. (Rao & Shanware, 1967).

VEGETATION AND SOIL

Based upon the vegetation, edaphic features and other habitat factors the following ecosystems in this coastal area have been recognized: I. Strand; II. Salt marsh; III. Semi arid coastal plain.

I. Strand Ecosystem

The strand vegetation is directly affected by the presence of sea. The vegetal cover is studied under the three topographic zones: (1) Sandy strand/Dune-strand; (2) Rocky strand and (3) Rocky or cliff.

1. *Sandy strand/Dune-strand*: This habitat does not cover extensive areas all along the shore line. It is often broken by rocky cliffs or muddy shores. The following plant communities are recognized: *Ipomoea pes-caprae*, *Sesuvium portulacastrum*, *Palaestachys sericea* and *Calotropis procera* communities.

The pioneer colonist on a bare sandy shore is *Ipomoea pes-caprae* community. It forms extensive patches and often grows in pure stands, thereby protecting the underlying sand from wind and waves. Next to this community is *Sesuvium portulacastrum*; though scattered, it is conspicuous by its vigorous growth and fleshy green parts. Its abundance was noticed at Gopnath and Vione Albert Port. Sometimes, it is found growing in sandy-saline areas also where its chief associates are *Actinopus jagopoides* and *Sporobolus* sp. Another significant community in dune-strand habitat, especially on sandy humps is *Palaestachys sericea*. This apparently endemic herb on sea shore sand is located at several places along the sea coast in Southern Saurashtra. It occurs in groups of two or three or rarely scattered in a limited space. Its other associates are *Lumnaca sarmatensis* and *Borreria articulularis*. Another type of community often seen in this facet is *Calotropis procera*. It grows on the sea sand towards the landward side and is found in groups usually forming pure stands.

The soil is sandy. The pH of soil samples indicates moderate alkalinity. Organic content are very low (0.03-0.19%). The contents of total dissolved solids and sodium chloride indicate that the habitat is not under the direct influence of sea water. The soils are highly calcareous (14.3-33.6% CaCO₃) (Table II).

2. *Rocky sandy*: It is composed of a thick rocky substratum with a thin mantle of sea sand of varying depth. This habitat is more or less common all along the coastal line. Depending on the depth of the sea sand deposition, the vegetal cover is composed of mixed population of interesting plant communities. The following are the main plant communities recognized: *Tephrosia purpurea*, *Jatropha gossypifolia*, *Sericostoma paniciforme* and other mixed communities.

Tephrosia purpurea forms an extensive belt all along the rocky strand habitat. The bushes are low and form good vegetal cover for a long distance. It is often found in association with *Trichodesma indicum* and *Pavonia sylvanica*. *Jatropha gossypifolia* is the next best widely spread plant community in this belt forms extensive stands and low bushy thickets. This introduced plant appears to be fast spreading all along the Indian shores. The next community is that of *Sericostoma paniciforme*. It occurs sporadically at Mahuva and Gopnath shores, and rarely seen near Bhavnagar coast.

TABLE 1.—Summary of Topographic conditions in the Coastal belt from Lakshadweep to Diu.

Unit	Topographic area	Landforms	Topographic Zones	Vegetation	
1.	Shore	A. Forebare	1. Sandy beaches	<i>Sesuvia portulacastrum</i> (L.) Suess <i>Sesuvia portulacastrum</i> L.	
			B. Circum Forebare: Mound	2. Saline muddy flat	<i>Sesuvia maritima</i> var. <i>andulata</i> Stapf & Mull. <i>Suaeda frutescens</i> Roub. <i>Suaeda frutescens</i> Moq.
				3. Saline sandy flat	<i>Sesuvia frutescens</i> (L.) Trin. ex Thunb. <i>Suaeda frutescens</i> Moq.
				4. Salt pans	<i>Suaeda frutescens</i> L.
				5. Rocky study	<i>Leptocarpus indicus</i> (L.) O. Kunt. <i>Kalidium gracile</i> (Wall.) Juncac <i>Pectocarpus spicatus</i> Wt. & Arn. <i>Pectocarpus pumilus</i> L.
2.	Sand-Dunes	C. Forebare	6. Seaward slope	<i>Panicum polyanthes</i> (Roxb. ex Rostk.) Hook. f. <i>Bertholletia aristata</i> (L.) F. N. W.	
			7. Crest	<i>Vallisneria spiralis</i> Pers. <i>Echinochloa crusgalli</i> DC. <i>Pennisetum polyanthes</i> DC. <i>Azida indica</i> Juss.	
			8. Heel	<i>Sesuvia portulacastrum</i> (L.) Suess	
		D. Backland	9. Crest	<i>Azida indica</i> Juss. <i>Calanthe pinnatifida</i> R. Br.	
			10. Landward slope	<i>Imperata cylindrica</i> L. <i>Echinochloa crusgalli</i> DC. <i>Bertholletia aristata</i> (L.) F. N. W. <i>Bambusa nana</i> (L.) Nees <i>Lopholobos inermis</i> Wall. ex Nees <i>Syntherisma ampullacea</i> Benth. <i>Azadirachta indica</i> (Willd.) Verh.	
			11. Heel	<i>Sida acuta</i> (Willd.) Vahl S. <i>Sida acuta</i> L. <i>Pennisetum polyanthes</i> DC. <i>Pennisetum polyanthes</i> DC.	
	Blade	Deposition Circum areas	12. Swale	<i>Tridax indica</i> L. <i>Cordia alliodora</i> (L.) Brack. <i>Azadirachta indica</i> (Willd.) Verh. & Arn. <i>Tournefortia argentea</i> L. <i>Pennisetum polyanthes</i> DC. <i>Panicum polyanthes</i> (L.) Rich.	
			13. Interdunal "Talus"	<i>Cyperus pennisetoides</i> Roth. <i>Leptocarpus indicus</i> (L.) Vahl <i>Cyperus pennisetoides</i> Sw. <i>Quercus laevis</i> Pers.	
			Inner: (Facing dunes or sandy flat)		<i>Hypochaeris indica</i> Benth. <i>Cassipourea vagabunda</i> (Arn.) Branderi <i>Magnolia zambanica</i> (Willd.) Ding-Hou
				Middle	<i>Euphorbia nutans</i> Buch-Ham.
	3.	Inland plain	Flat Board	Outer	<i>Solanum torresianum</i> Mansf. <i>Ficus sp.</i> <i>Berberis graveolens</i> L. <i>Solanum torresianum</i> Benth. f. <i>Euphorbia nutans</i> Willd. <i>Tridax indica</i> L. <i>Quercus laevis</i> L. <i>Azadirachta indica</i> (Willd.) Verh. <i>A. indica</i> (L.) Desf.

TABLE II: Analysis of Soil samples collected from parts of Affiliated to Bhavnagar case

Soil sample no.	Location	Depth of sampling in cm.	Vegetation cover	Soil colour	Mechanical composition			Soil texture	pH	Organic matter %	N.P.S. %	M.O.D. %	CaCO ₃ %	
					Clay %	Silt %	Coarse sand %							
705	Gopnath coast	0-5	Mixed community of tropical forest	Light brown	32.60	31.80	42.60	10.70	Sandy clay	7.5	2.14	0.0900	0.067	96.33
707	Vichar Alberg Fort	0-10	Palm-orchid forest	Light brown	5.60	1.85	58.64	35.96	Sand	9.0	0.39	0.0275	0.067	33.66
708	do	0-20	Salt marsh	Black	17.75	17.30	58.55	6.42	Sticky sand	8.5	1.45	2.6850	1.010	14.29
709	do	0-10	Mixed community of tropical forest	Dark grey	22.45	46.55	29.04	7.31	Loam	8.6	5.37	0.0600	0.224	95.72
710	Jadabhai coast	0-4	Salt marsh	Light brown	13.05	47.35	39.50	9.94	Loam	8.6	2.29	0.0113	0.0149	33.16
711	Jadabhai coast profile	0-15	<i>Hygssoma indica</i>	Light grey	0.69	6.70	80.24	3.15	Loamy sand	8.5	0.60	0.1055	0.052	37.09
712	do	15-45	do	do	1.15	7.30	87.17	4.58	Sand	7.8	0.13	0.0550	0.005	5.38
713	do	42-75	do	do	7.03	6.20	82.56	3.80	Loamy sand	8.2	0.55	0.0060	0.027	35.61
714	do	75-103	do	do	7.50	3.10	84.66	3.74	Loamy sand	8.1	0.64	0.0080	0.010	36.51
715	Mahavea Fort	0-10	Sandy coastal vegetation	do	4.60	1.25	61.70	51.26	Sand	8.2	0.05	0.1000	0.010	14.50
716	Bhavnagar old port area	0-10	Salt marsh	Black	14.70	51.85	29.82	3.51	Silt loam	5.7	2.39	3.4920	1.065	12.79

frequently it is associated with *Rostkildoria procumbens* or *Lepidagathis triseriata*. *Heylandia laterosa*, *Taverniera coccifolia*, *Convolvulus glomeratus*, *Polygala eriopetala*, *Styris orobanchoides* and *Fleurose argyropnea* are the other herbaceous members noticed in this habitat. They form a 'mixed group' and at no time constitute a major component of the habitat.

The soil is sandy clay to loamy. pH values exhibit mild to moderate alkalinity. Organic contents range between 2.14-3.57% which is considerably high. Values of total dissolved solids and sodium chloride indicate that at Gopnath coast, the soil is not under the direct influence of the sea water but at Victor Albert Port it is directly under the influence of sea water. The calcium carbonate content of the soils of this habitat is high (23.72-36.95%) (Table II).

3. *Rocky or Cliff*: This habitat is exposed due to the influence of tidal waves. Often they are beaten by huge tides and form an important facet of the coastal area. Due to constant wave action, the solid rocks are broken, and especially along the sea facing rocks, crannies or pot holes with slight accumulation of sea sands are developed. The vegetative cover of the cliff is sparsely distributed. The interesting plants noticed here are *Polycarpha spicata*, *Kickxia canariensis*, *Lindenbergia urticacifolia*, *Emicostema hysopifolium*, *Portulaca quadrifida*, *Tridax procumbens* and *Pubicaria angustifolia*. These form a mixed community and do not exhibit zonal distribution. Scattered all along exposed rocks, certain species like *Polycarpha spicata* and *Emicostema hysopifolium*, develop succulent parts as an adaptive feature. A point of distributional interest is the further extension of *Polycarpha spicata* towards Victor Albert Port shore. Its presence in other stations in Saurashtra has been reported (Rao *et al.* 1964a, b); however, beyond Victor Albert port this species has not been noticed so far except for its occurrence in Krusadi group of islands (Rao *et al.* 1963).

II. Salt Marsh

The salt marsh is chiefly composed of mangroves growing on low lying muddy shores and sandy saline areas under the influence of tides. The main feature of salt marsh vegetation is zonation. Mangroves form a distinct belt, followed by sandy saline areas and salt pans. *Mangrove belt*: Fringed along the low muddy shores, mangroves chiefly represented by

Avicennia marina community dominate parts of shores at Bhavnagar, Gopnath, Mahuva and Talaja. The following communities are recognised: *Avicennia marina* var. *aurizans* and *Salicornia brachiata*. Along the sea facing low lying shore the vegetation is composed of thickets of *Avicennia* closely followed by *Salicornia brachiata*. Towards landward side the soil is less sandy and saline. The following communities are recognised: *Arctostaphylos lagopoides*, *Atriplex stocksii*, *Cenchrus biflorus* and *Cressa cretica*.

Arctostaphylos lagopoides community: It is abundant on saline areas and its chief associates are *Sesuvium portulacastrum* and *Sporobolus* sp. It is a widely spread community in parts of Saurashtra coast.

Atriplex stocksii community: It is found scattered along saline areas adjoining the mangrove zone. Often forming a pure stand or found behind a pioneer zone of *Arctostaphylos lagopoides*.

Cenchrus biflorus community: Along moist sandy coastal situations, it is abundant and forms the chief component of swards.

Cressa cretica community: It is found in local spots or areas where total salinity is high and often forms a pure stand.

SALINE PLATS

This habitat forms extensive plain belts, often under the influence of tides. *Suaeda nudiflora* community is found growing in this zone. It has a prostrate growth form and forms scattered patches in the area surveyed. Fringing the marginal areas of the salt pan are communities of *Chenopodium phlamoides*, *Eragrostis pilosa*, *Sporobolus virginicus* and *Tylophora indica*.

The soils are sandy loam, loam and silt loam with mild to moderate alkalinity as indicated by their pH values. The organic matter contents are much higher than the soils from other habitats (1.49-5.59%). Dissolved solids and sodium chloride contents are very high as a result of direct influence of the sea except in sample no. 710 where the values are moderate. All the soils are moderately calcareous (12.79-15.24% CaCO_3) (Table II).

III. Semi-Arid Coastal Plain

The chief components of the flora of this area include the following plant communities: *Euphorbia nivulia*, *Marsippospermum emarginata*, *Commiphora wightii*, *Solanum arundinatum* and *Hyphaene indica* community.

Euphorbia nictitans community: Its occurrence is not so extensive as found in the coastal belts of arid zones of Saurashtra. The thickets shelter climbers and shade tolerant plants, often protecting them from browsing animals.

Maytenus emarginata community: It is the next best type of plant community found in this area. Sometimes it is found mixed with *Prosopis spicigera* and forms the important tree community of the coastal landscape. It is found scattered and often subjected to biotic interference.

Commiphora wightii community: It is stunted in stature and malformed; however, under protection, it attains good growth. Its associates are *Papalia lappacea* and *Asparagus gonocladus*.

Solanum arundinatum community: It is an exotic community found spreading fast all along the coastal plain forming bushes of considerable size and often in a pure stand.

Hyphaene indica community: It is located near Jafarabad coastal plain. A good number of plants are found growing together. But for this stand this community is totally absent all along the coastal plain up to Bhavnagar. Evidently it has not spread widely as found along the coastal plains of Kodinar, Delvada etc.

The soils are sandy to loamy sand in texture with mild to moderate alkalinity. Organic matter of the profile is low (0.13-0.68%). The values of total dissolved solids and sodium chloride show that the soil profile is not under direct influence of the sea. The soil samples of this profile is calcareous (35.36-37.69% CaCO_3) (Table II).

CONCLUSIONS

The coast line has been studied at Jafarabad, Victor Albert Port, Mahuva, Talaja, Gopnath, Gogha, Bhavnagar and their environs. At Bhavnagar and Gogha the coast lines consists of muddy tidal flats sheltering the mangrove thickets with occasional interruption of rocky cliffs. At other places the frequency of muddy tidal flats generally decreases; but a rocky outcrop with a thin layer of sand or soil in the crevices is prevalent. The low lying rocks in some locations are covered with wind blown sand giving rise to sandy humps. Rocky foreshore is immediately followed by lateritic soil in which millers and ground-nuts are commonly cultivated. To understand the composition and structure of marsh, strand/dune and cliff vegetation, cover data from the transects are assembled

graphically. The results show clearly the existence of zonation pattern of plant distribution along the

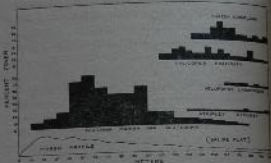


FIG. 1. Percentage cover of the Salt Marsh in a belt transect over the Salt Marsh profile from the foreshore at Bhavnagar, Saurashtra.

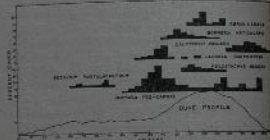


FIG. 2. Percentage cover of the Strand/Dune plants in a belt transect over a coastal strip, Mahuva, Saurashtra.

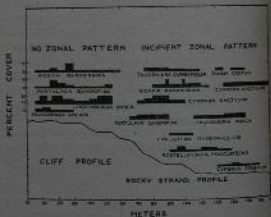


FIG. 3. Percentage cover of the cliff vegetation in a belt transect over the cliff/rocky strand profile over the coastal strip at Jafarabad, Saurashtra.

coastal marsh vegetation (Fig. 1). Similarly the zonation pattern is visible along strand/dune habi-

at (Fig. 2). However along the cliff and also to some extent on the rocky strand habitat the plant communities do not show zonal patterns in the distribution of plants (Fig. 3).

LIST OF COASTAL PLANTS

CARYOPHYLLACEAE

Polycarpha spicata Wt. & Arn.
Victor Albert Port. Rao 2171.

PORTULACACEAE

Portulaca quadrifida L.
Gopnath, Victor Albert Port. Rao 2177, 2214.

POLYGALACEAE

Polygala eriopetra DC.
Gopnath. Rao 2099.

MALVACEAE

Pavonia sylvatica (L.) Cav.
Gopnath. Rao 2103, 2120.

Sida cordifolia L.
Jafarabad. Rao 2221.

S. multicaulis Cav.
Gopnath. Rao 2126.

TILIACEAE

Cynchura depressa (L.) Stocks
Gopnath. Rao 2234.

C. trilobularis L.
Gopnath. Rao 2108.

RUBIACEAE

Commiphora wightii (Arn.) Bhandari
Gopnath, Jafarabad. Rao 2087, 2135.

CELASTRACEAE

Maytenus emarginata (Willd.) Ding-Hou
Gopnath. Rao 2129.

LEGUMINOSAE

Acacia nilotica (L.) Del.
Gopnath, Victor Albert Port. Rao 2096, 2188.

A. senegal Willd.
Gopnath, Victor Albert Port. Rao 2096, 2010, 2108.

Alysicarpus longifolius (Rottl.) Wt. & Arn.
Gopnath. Rao 2118.

Archie hypogaea L.
Gopnath (Cultivated). Rao 2147.

Cassia tenuica L.
Gopnath. Rao 2121, 2028.

Crotalaria medicaginea Lamk.

Mahuva. Rao 2233.

Desmodium sp.

Gopnath. Rao 2118.

Indigofera trilobata Linn.

Victor Albert Port. Mahuva, Gopnath. Rao 2188, 2240, 2119.

Taverniera cuneifolia Arn.

Gopnath. Rao 2095.

Tephrosia strigosa (Dulac) Sant. & Mahesh.

Gopnath. Rao 2132.

T. purpurva (L.) Pers.

Gopnath. Rao 2143, 2235, 2130.

Zornia gibbosa Spurr.

Talaja. Rao 2150.

AIZOACEAE

Scorvium portulacastrum L.

Victor Albert Port, Gopnath. Rao 2155, 2180, 2245, 2151.

RUBIACEAE

Borreria articularis (L. f.) F. N. Willd.

Jafarabad, Victor Albert Port. Rao 2218, 2173.

COMPOSITAE

Echinops echinatus DC.

Bharnagar. Rao 2255.

Eclipta prostrata (L.) L.

Gopnath. Rao 2141.

Flaveria australasica Hook.

Jafarabad. Rao 2219.

Glossocardia bowwallenii (L. f.) DC.

Gopnath. Rao 2124.

Pulicaria angustifolia DC.

Jafarabad. Rao 2225.

Sclerocarpus africanus Jacq.

Talaja. Rao 2152.

Vernonia cinerea (L.) Lees.

Gopnath. Rao 2117.

ANGELIPIADACEAE

Tylophora indica (Burm. f.) Merr.

Victor Albert Port. Rao 2164.

BORAGINACEAE

Sericostoma pauciflorum Stocks

Mahuva, Gopnath. Rao 2236, 2187, 2138.

Trichodesma indicum (L.) Lehm.

Jafarabad, Gopnath. Rao 2220.

CONVOLVULACEAE

Convolvulus arvensis L.

Gopnath. Rao 2148.

- Cressa cretica* L.
Mahuva, Gopnath, Victor Albert Port. Rao 2237, 2131, 2182.
Evolvulus alsinoides (L.) L.
Gopnath. Rao 2131.
Ipomoea pes-caprae (L.) Sweet
Mahuva, Jafarabad. Rao 2247, 2251, 2164.

SOLANACEAE

- Datura metel* L.
Gopnath. Rao 2226.
Solanum surattense Borne. f.
Bhavnagar, Mahuva, Gopnath. Rao 2256, 2245, 2108, 2137.
S. arundo Martei
Victor Albert Port, Talaja. Rao 2163, 2086.

SCROPHULARIACEAE

- Kickxia ramosissima* (Wall.) Janch.
Jafarabad. Rao 2209.
Lindenbergia indica (L.) G. Ktze.
Victor Albert Port. Rao 2172.
Striga gesnerioides (Willd.) Vavil.
Mahuva, Gopnath. Rao 2244, 2098.
S. lutea Lour.
Mahuva. Rao 2259.

GENTIANACEAE

- Encostema hyssopifolium* (Willd.) Verh.
Gopnath, Jafarabad, Mahuva. Rao 2109, 2204, 2234.

AGANTHACEAE

- Andrographis echioides* (L.) Nees
Talaja. Rao 2082.
Barleria prismatis L.
Mahuva, Gopnath. Rao 2242, 2088.
Blepharis molluginifolia Pers.
Talaja. Rao 2085.
Dipteracanthus patulus (Jacq.) Nees
Jafarabad. Rao 2207.
Elytaria acutis (L. f.) Lindau
Talaja. Rao 2153.
Lepidagathis trinervis Wall. ex Nees
Jafarabad, Talaja. Rao 2200, 2154.
Rostellularia procumbens (L.) Nees
Gopnath, Victor Albert Port. Rao 2125, 2168.

VERBENACEAE

- Avicennia marina* var. *scutifolia* Stapf & Mold.
Bhavnagar. Rao 2000.
Lantana indica L.
Victor Albert Port, Gopnath. Rao 2190, 2102.

LABIATAE

- Ocimum americanum* L.
Gopnath. Rao 2143.

NYCTAGINACEAE

- Borhavia diffusa* L.
Jafarabad, Gopnath. Rao 2212, 2147.

ASARANTHACEAE

- Aerva lanata* (L.) Juss.
Mahuva, Jafarabad. Rao 2252, 2157.
Ptilotachys sericea (Koen. ex Roxb.) Hook. f.
Victor Albert Port. Rao 2167.
Pupalia lappacea (L.) Juss.
Gopnath. Rao 2148.

CHENOPODIACEAE

- Atriplex stockii* Boiss.
Jafarabad, Victor Albert Port. Rao 2216, 2179.
Salicornia brachiata Roxb.
Bhavnagar, Victor Albert Port. Rao 2001, 2152.
Suaeda nudiflora Moq.
Jafarabad, Bhavnagar, Victor Albert Port. Rao 2226, 2228, 2157, 2156, 2092.

EUPHORBACEAE

- Acalypha indica* L.
Talaja, Gopnath. Rao 2084, 2395.
Euphorbia bombaiensis Sant.
Jafarabad. Rao 2169.
Jatropha gossypifolia L.
Gopnath, Jafarabad. Rao 2144, 2220.
Phyllanthus amarus Schum. & Thonn.
Jafarabad. Rao 2217.
Tragia involucrata var. *cannabina* Hook. f.
Gopnath. Rao 2089.

PALMAE

- Hyphaene indica* Becc.
Jafarabad. Rao 2156.
Phoenix dactylifera L.
Gopnath. Rao 2145.

LILIACEAE

- Asparagus gonocladus* Baker
Mahuva, Victor Albert Port, Gopnath. Rao 2155, 2193, 2091.

TYPHACEAE

- Typha angustata* Bory & Chaub.
Gopnath. Rao 2149.

CYPERAGRAE

- Cyperus pangorei* Roth.
Bhavnagar. Rao 2005.
Fimbristylis dichotoma (L.) Vahl
Victor Albert Port. Rao 2166.

GRAMINEAE

- Aeluropus lagopoides* (L.) Trin. ex Thw.
Bhavnagar, Jafarabad, Victor Albert Port. *Rao* 2259, 2259, 2152, 2002.
- Aploda varia* L.
Gopnath. *Rao* 2090.
- Cenchrus biflorus* Rendh.
Maluva, Victor Albert Port. *Rao* 2248, 1267, 2170.
- Chloris virgata* Sw.
Victor Albert Port. *Rao* 2191.
- Digitaria adscendens* (H.B.K.) Hout.
Maluva coast. *Rao* 2249.
- Eragrostis pilosa* (L.) P. Beauv.
Bhavnagar. *Rao* 2004.
- Melinis minutiflora* L.
Gopnath, Victor Albert Port. *Rao* 2112, 2192.
- Sporobolus virginicus* (L.) Kunth
Victor Albert Port. *Rao* 2137.

ACKNOWLEDGEMENTS

We wish to thank Rev. Fr. H. Santapan, Director, Botanical Survey of India for encouragement and Dr. K. Subramanyam, Joint Director for going through the manuscript.

REFERENCES

- BRAND-ELMSGRET, J. *Plant Sociology*. New York, 1932.
- RAO, T. A. AND K. R. AGGARWAL. Ecological studies of Saurashtra coast and neighbouring islands. I. Diu island. *Bull. bot. Surv. India* 6: 113-118, 1964 (3).
- AND —. Ecological studies of Saurashtra coast and neighbouring islands. II. Bet Island. *Ibid.* 8: 16-24, 1965 (5).
- AND —. Ecological studies of Saurashtra coast and neighbouring islands. III. Okhraj Island (part) to Diu coastal area. *Ann. bot. Soc. India* 13, 1964 (4).
- AND A. K. MUKHERJEE. Ecological studies of Saurashtra coast and neighbouring islands. IV. Piram Island. *Bull. bot. Surv. India* 10: 30-37, 1958 (2).
- AND P. G. SHANMUGAM. Ecological studies of Saurashtra coast and neighbouring islands. VI. An approach to the classification of Saurashtra islands—A resume. *Ibid.* 9: 1567.
- , K. R. AGGARWAL AND A. K. MUKHERJEE. Ecological studies on the Soil & Vegetation of Krishna group of islands in the Gulf of Mannar. *Ibid.* 9: 151-160, 1963.