

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

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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 $20^{\circ}52' : 21^{\circ}45'$ and $71^{\circ}25' : 72^{\circ}12'$; ecological aspects are presented on an ecosystem basis. Plant communities grouped under ecosystems and analyses of soils are described to study soil features in relation to vegetation. A list of the coastal plants is prepared to record 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 192 km long and lies between $20^{\circ}52' : 21^{\circ}45'$ and $71^{\circ}25' : 72^{\circ}12'$. This region presents a succession of rock cliffs of moderate height sometimes hollowed by the sea into caverns. Occasionally, the rocky foreshore is intercepted 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 $20^{\circ}52' : 71^{\circ}25'$ 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 $21^{\circ}5' : 71^{\circ}40'$ 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 Dungar, 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 $21^{\circ}22' : 72^{\circ}04'$ 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 20 km from Talaja. The coast line is made up of conglomerate rock and the erosion by sea is severe. Gogha is situated at $21^{\circ}41' : 72^{\circ}17'$ 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 $21^{\circ}45' : 72^{\circ}12'$. 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 50 years (1891-1940) is given elsewhere (Rao *et al.* 1965). 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 traps consisting of basalts and dolerites and also felstones, trachytes, trachy-felsites, diorites, obsidians, pitchstones, granophyre, trachylite and palagonite rock are exposed at Bhavnagar and extend up to Talaja and Mahuva. Gaj Beds consisting of limonitic 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 recognised: *Ipomoea pes-caprae*, *Sesuvium portulacastrum*, *Psilostachys 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 Victor Albert Port. Sometimes, it is found growing in sandy-saline areas also where its chief associates are *Aeluropus lagopoides* and *Sporobolus* sp. Another significant community in dune-strand habitat, especially on sandy humps is *Psilostachys 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 twos and threes or rarely scattered in a limited space. Its other associates are *Launaca sarmentosa* and *Borreria articularis*. 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 contents 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 (14.30-33.06% CaCO_3) (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 pauciflorum* 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 zeylanica*. *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 pauciflora*. It occurs sporadically at Mahuva and Gopnath shores, and rarely seen near Bhavnagar coast.

TABLE I : Summary of Topographic conditions in the Coastal belt from Jafarabad to Bhavnagar

Units	Topographic zones	Landforms	Topographic facets	Vegetation
1.	Shore	A. Foreshore	1. Sandy beaches	<i>Ipomoea pes-caprae</i> (L.) Sweet <i>Sesuvium portulacastrum</i> L.
		B. Circum Foreshore: Marsh	2. Saline muddy flats	<i>Avicennia marina</i> var. <i>acutissima</i> Stapf & Mold. <i>Salicornia brachiata</i> Roxb. <i>Suaeda nudiflora</i> Moq.
			3. Saline sandy flats	<i>Aeluropus lagopoides</i> (L.) Trin ex Thw. <i>Atriplex stocksii</i> Boiss.
			4. Salt pans	<i>Cressa cretica</i> L.
		:Cliff	5. Rocky sandy	<i>Lindenbergia indica</i> (L.) O. Ktze. <i>Kickxia ramosissima</i> (Wall.) Janchar <i>Polycarpha spicata</i> Wt. & Arn. <i>Portulaca quadrifida</i> L.
2.	Sand-Dunes	C. Foredune	6. Seaward slope	<i>Psilostachys sericea</i> (Koen. ex Roxb.) Hook. f. <i>Borreria articularis</i> (L. f.) F. N. Will.
			7. Crest	<i>Tephrosia purpurea</i> Pers. <i>Echinops echinatus</i> DC. <i>Pulicaria angustifolia</i> DC. <i>Aerva lanata</i> Juss.
			8. Heel	<i>Ipomoea pes-caprae</i> (L.) Sweet
		D. Backdune	9. Crest	<i>Aerva lanata</i> Juss. <i>Calotropis procera</i> R. Br.
			10. Landward slope	<i>Jatropha gossypifolia</i> L. <i>Euphorbia bombaiensis</i> Sant. <i>Borreria articularis</i> (L. f.) F. N. Will. <i>Rostellularia procumbens</i> (L.) Nees <i>Lepidagathis trinervis</i> Wall. ex Nees <i>Sericostoma pauciflorum</i> Stocks <i>Enicostema hyssopifolium</i> (Willd.) Verd.
			11. Heel	<i>Striga gesneroides</i> (Willd.) Vatke <i>S. lutea</i> Lour. <i>Pedalium murex</i> L. <i>Vernonia cinerea</i> Less.
			12. Swale	<i>Tribulus terrestris</i> L. <i>Corchorus depressus</i> (L.) Stocks <i>Alysicarpus longifolius</i> (Rottl.) Wt. & Arn. <i>Taverniera cuneifolia</i> L. <i>Flaveria australasica</i> Hook. <i>Trichodesma indicum</i> (L.) Lehm.
			13. Interdunal 'Talav'	<i>Cyperus pangorei</i> Rottb. <i>Fimbristylis dichotoma</i> (L.) Vahl <i>Chloris virgata</i> Sw. <i>Cynodon dactylon</i> Pers.
	Slacks	Depression Circum areas		
3.	Inland plains	Flat Board	Inner : (facing dunes or sandy bar)	<i>Hyphaene indica</i> Becc. <i>Commiphora wightii</i> (Arn.) Bhandari <i>Maytenus emarginata</i> (Willd.) Ding-Hou
			Middle	<i>Euphorbia nivulia</i> Buch.-Ham.
			Outer	<i>Solanum arundo</i> Mattei <i>Ficus</i> sp. <i>Barleria prionotis</i> L. <i>Solanum surattense</i> Burm. f. <i>Evolvulus alsinoides</i> Wall. <i>Tragia involucrata</i> L. <i>Clitoria ternatea</i> L. <i>Acacia senegal</i> Willd. <i>A. nilotica</i> (L.) Del.

TABLE II : Analysis of Soil samples collected from parts of Jafarabad to Bhavnagar coast

Soil sample no.	Location	Depth of sampling cm	Vegetation cover	Soil colour	Mechanical composition				Soil texture	pH	Organic matter %	T.S.S. %	NaCl %	CaCO ₃ %
					Clay %	Silt %	Fine sand %	Coarse sand %						
706	Gopnath coast	0-5	Mixed community of vegetal cover	Light brown	32.60	13.80	42.90	10.70	Sandy clay	7.8	2.14	0.0900	0.007	36.95
707	Victor Albert Port	0-10	<i>Psilostachys sericea</i>	Light brown	5.60	1.80	58.64	33.96	Sand	8.0	0.19	0.0275	0.007	33.06
708	-do-	0-10	Salt marsh	Black	17.75	17.50	58.33	6.42	Sandy loam	8.5	1.49	2.6850	1.029	14.88
709	-do-	0-10	Mixed community of vegetal cover	Dark grey	22.45	40.50	29.84	7.21	Loam	8.6	3.57	0.9900	0.284	23.72
710	Jafarabad coast	0-4	Salt marsh	Light brown	13.05	47.55	30.06	9.34	Loam	8.6	2.59	0.3075	0.0149	15.24
711	Jafarabad coast profile	0-15	<i>Hyphaene indica</i>	Light grey	8.60	6.70	80.94	3.76	Loamy sand	8.5	0.68	0.1850	0.007	37.69
712	-do-	15-45	-do-	-do-	1.15	7.30	87.17	4.38	Sand	7.8	0.13	0.0850	0.007	35.36
713	-do-	45-75	-do-	-do-	7.05	6.20	82.95	3.80	Loamy sand	8.2	0.51	0.1000	0.007	35.63
714	-do-	75-105	-do-	-do-	7.50	4.10	84.66	3.74	Loamy sand	8.1	0.64	0.0900	0.007	36.27
715	Mahuva Port	0-10	Sandy strand vegetation	-do-	4.60	1.35	61.79	32.26	Sand	8.2	0.03	0.1300	0.007	14.30
716	Bhavnagar old port area	0-10	Saline Flat	Black	14.00	61.85	23.82	0.33	Silt loam	7.7	5.59	3.4950	1.566	12.79

Infrequently it is associated with *Rostellularia procumbens* or *Lepidagathis trinervis*. *Heylandia latifolia*, *Taverniera cuneifolia*, *Convolvulus glomeratus*, *Polygala eriopetra*, *Striga orobanchoides* and *Eleusine aegyptiaca* 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 vegetal cover of the cliff is sparsely distributed. The interesting plants noticed here are *Polycarpaea spicata*, *Kickxia ramosissima*, *Lindenbergia urticaefolia*, *Enicostema hyssopifolium*, *Portulaca quadrifida*, *Tridax procumbens* and *Pulicaria angustifolia*. These form a mixed community and do not exhibit zonal distribution. Scattered all along exposed rocks, certain species like *Polycarpaea spicata* and *Enicostema hyssopifolium*, develop succulent parts as an adaptive feature. A point of distributional interest is the further extension of *Polycarpaea 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. *acutissima* 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: *Aeluropus lagopoides*, *Atriplex stocksii*, *Cenchrus biflorus* and *Cressa cretica*.

Aeluropus 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 *Aeluropus 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 FLATS

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 *Clerodendrum phlomoides*, *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*, *Maytenus emarginata*, *Commiphora wightii*, *Solanum arundo* and *Hyphaene indica* community.

Euphorbia nivulia 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 spici-gera* 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 *Pupalia lappacea* and *Asparagus gonocladus*.

Solanum arundo 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 millets 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

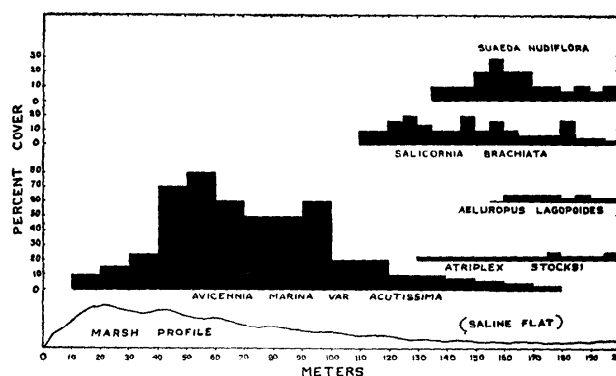


Fig. 1. Percentage cover of the Salt Marsh in a belt transect over the Salt Marsh profile from the foreshore at Bhavnagar, Saurashtra.

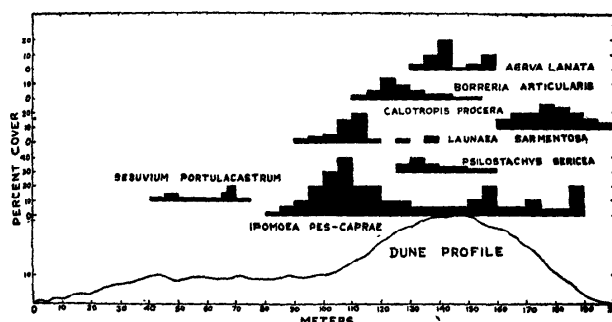


Fig. 2. Percentage cover of the Strand/Dune plants in a belt transect over a coastal strip, Mahuva, Saurashtra.

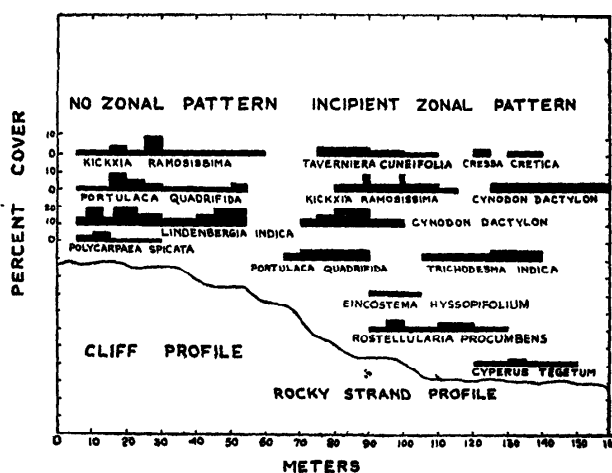


Fig. 3. Percentage cover of the cliff vegetation in a belt transect over the cliff/rocky strand profile over the coastal strip at Jafarabad, Saurashtra.

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

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

LIST OF COASTAL PLANTS

CARYOPHYLLACEAE

- Polycarpaea spicata** Wt. & Arn.
Victor Albert Port. *Rao* 2171.

PORTULACACEAE

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

POLYGALACEAE

- Polygala erioptera** DC.
Gopnath. *Rao* 2099.

MALVACEAE

- Pavonia zeylanica** (L.) Cav.
Gopnath. *Rao* 2103, 2120.
Sida cordifolia L.
Jafarabad. *Rao* 2221.
S. multicaulis Cav.
Gopnath. *Rao* 2126.

TILIACEAE

- Corchorus depressus** (L.) Stocks
Gopnath. *Rao* 2234.
C. trilocularis L.
Gopnath. *Rao* 2108.

BURSERACEAE

- Commiphora wightii** (Arn.) Bhandari
Gopnath, Jafarabad. *Rao* 2087, 2835.

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, 2188.
Alysicarpus longifolius (Rottl.) Wt. & Arn.
Gopnath. *Rao* 2118.
Arachis hypogaea L.
Gopnath (Cultivated). *Rao* 2147.
Clitoria ternatea L.
Gopnath. *Rao* 2121, 2028.

Crotalaria medicaginea Lamk.

Mahuva. *Rao* 2233.

Desmodium sp.

Gopnath. *Rao* 2118.

Indigofera trifoliata Linn.

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

Taverniera cuneifolia Arn.

Gopnath. *Rao* 2095.

Tephrosia strigosa (Dalz.) Sant. & Mahesh.

Gopnath. *Rao* 2132.

T. purpurea (L.) Pers.

Gopnath. *Rao* 2143, 2235, 2130.

Zornia gibbosa Span.

Talaja. *Rao* 2150.

AIZOACEAE

Sesuvium portulacastrum L.

Victor Albert Port, Gopnath. *Rao* 2155, 2180, 2245, 2251.

RUBIACEAE

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

Jafarabad, Victor Albert Port. *Rao* 2218, 2173.

COMPOSITAE

Echinops echinatus DC.

Bhavnagar. *Rao* 2255.

Eclipta prostrata (L.) L.

Gopnath. *Rao* 2111.

Flaveria australasica Hook.

Jafarabad. *Rao* 2219.

Glossocardia boswallea (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.

ASCLEPIADACEAE

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, 2231, 2104.

SOLANACEAE

Datura metel L.

Gopnath. *Rao* 2226.

Solanum surattense Burm. f.

Bhavnagar, Mahuva, Gopnath. *Rao* 2256, 2246, 2100, 2133.

S. arundo Mattei

Victor Albert Port, Talaja. *Rao* 2163, 2086.

SCROPHULARIACEAE

Kickxia ramosissima (Wall.) Janch.

Jafarabad. *Rao* 2209.

Lindenbergia indica (L.) O. Ktze.

Victor Albert Port. *Rao* 2172.

Striga gesnerioides (Willd.) Vatke

Mahuva, Gopnath. *Rao* 2244, 2098.

S. lutea Lour.

Mahuva. *Rao* 2239.

GENTIANACEAE

Enicostema hyssopifolium (Willd.) Verd.

Gopnath, Jafarabad, Mahuva. *Rao* 2109, 2204, 2254.

ACANTHACEAE

Andrographis echinoides (L.) Nees

Talaja. *Rao* 2082.

Barleria prionitis L.

Mahuva, Gopnath. *Rao* 2242, 2088.

Blepharis molluginifolia Pers.

Talaja. *Rao* 2085.

Dipteracanthus patulus (Jacq.) Nees

Jafarabad. *Rao* 2207.

Elytraria acaulis (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. **acutissima** Stapf & Mold.

Bhavnagar. *Rao* 2000.

Lantana indica L.

Victor Albert Port, Gopnath. *Rao* 2190, 2102.

LABIATAE

Ocimum americanum L.

Gopnath. *Rao* 2143.

NYCTAGINACEAE

Boerhavia diffusa L.

Jafarabad, Gopnath. *Rao* 2212, 2127.

AMARANTHACEAE

Aerva lanata (L.) Juss.

Mahuva, Jafarabad. *Rao* 2252, 2197.

Psilostachys sericea (Koen. ex Roxb.) Hook. f.

Victor Albert Port. *Rao* 2167.

Pupalia lappacea (L.) Juss.

Gopnath. *Rao* 2140.

CHENOPODIACEAE

Atriplex stocksii Boiss.

Jafarabad, Victor Albert Port. *Rao* 2216, 2179.

Salicornia brachiata Roxb.

Bhavnagar, Victor Albert Port. *Rao* 2001, 2157.

Suaeda nudiflora Moq.

Jafarabad, Bhavnagar, Victor Albert Port. *Rao* 2226, 2228, 2257, 2156, 2002.

EUPHORBIACEAE

Acalypha indica L.

Talaja, Gopnath. *Rao* 2084, 2303.

Euphorbia bombaiensis Sant.

Jafarabad. *Rao* 2169.

Jatropha gossypifolia L.

Gopnath, Jafarabad. *Rao* 2144, 2220.

Phyllanthus amarus Schum. & Thonn.

Jafarabad. *Rao* 2213.

Tragia involucrata var. **cannabina** Hook. f.

Gopnath. *Rao* 2089.

PALMAE

Hyphaene indica Becc.

Jafarabad. *Rao* 2196.

Phoenix dactylifera L.

Gopnath. *Rao* 2142.

LILIACEAE

Asparagus gonocladus Baker

Mahuva, Victor Albert Port, Gopnath. *Rao* 2238, 2193, 2091.

TYPHACEAE

Typha angustata Bory & Chaub.

Gopnath. *Rao* 2149.

CYPERACEAE

Cyperus pangorei Rottb.

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, 2229, 2184, 2003.

Apluda varia L.

Gopnath. *Rao* 2090.

Cenchrus biflorus Roxb.

Mahuva, Victor Albert Port. *Rao* 2248, 1267, 2170.

Chloris virgata Sw.

Victor Albert Port. *Rao* 2191.

Digitaria adscendens (H.B.K.) Henr.

Mahuva coast. *Rao* 2249.

Eragrostis pilosa (L.) P. Beauv.

Bhavnagar. *Rao* 2004.

Melanocenchris abyssinica L.

Gopnath, Victor Albert Port. *Rao* 2112, 2192.

Sporobolus virginicus (L.) Kunth

Victor Albert Port. *Rao* 2232.

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