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 forest communities and habitats observed in the coastal area of Saurashtra from Jafarabad to Bhavnagar between 1962 and 1965. The ecological aspects are presented on an ecosystem basis. Plant communities grouped under ecotones and analysis of their floristic characteristics is studied. A list of the coastal plants is prepared and their distribution described.

GENERAL DESCRIPTION OF THE AREA

Physical features of the Saurashtra coast have been described by Rao et al. (1964). The coastal belt from Jafarabad to Bhavnagar is about 352 km long and lies between 21°26' and 22°15'. The coast is rugged with coastal cliffs of moderate height sometimes followed by the sea into coves. Occasionally, the rocky shoreline is intersected by sandy shore lines formed by mangroves. The coast line from Jafarabad to Bhavnagar has been studied with special reference to Jafarabad, Victor Albert Port, Mahuva, Talaja, Gopanath, Gogha and Bhavnagar and their environs. Jafarabad is a sea port situated at 21°19' and 21°25' on a creek about 12 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 22°15' and 22°40' on the west bank of the river Mahuva. About 3 km from the town is the port. Rocky cliffs and a sandy foreshore are the prevailing habitats in this area. Another area 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 marshes towards the interior. Talaja which lies at 22°22' and 22°40' is 36 km south of Bhavnagar. Here, the coast line is mostly rocky. Gopanath is situated on the sea shore at a distance of about 16 km from Talaja. The coast line here is made up of conglomerate rock and the erosion by sea is severe. Gogha is situated at 22°31' and 22°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 rugged, shelving mangrove thickets and inland salt marshes. Bhavnagar town and port on the Gulf of Cambay is situated at 21°45' and 22°15'. 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 89 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 (1911-1961) is given elsewhere (Rao et al. 1963). 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.

GEOLGY AND SOIL

Deccan traps consisting of basalts and dolerites and also lava flows, trachytes, trachyte-porphyries, diorites, obsidians, pumices, granophyres, trachylytes 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, Gopanath, 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 mullers 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.

Trips were undertaken in the months of September/October 1962, March/April 1963, January/February 1964 and September/October 1964. The data for the theestic composition were collected by means of a series of contiguous belt transects; square metre quadrants 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., 1964d) and sketched in scale on cards 10 cm square. Other methods (Rao et al., 1964a) were adopted 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 & Shunware, 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 teleographic 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 portulacenum, Parkinsonia sericea and Calotropis procera communities.
TABLE I: Summary of Topographic units in the Coastal belt from Aghihadi to Bhaneagar

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topographic forms</th>
<th>Landforms</th>
<th>Topographic forms</th>
<th>Vegetation</th>
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<td>2. Sandy dunes</td>
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<td>3. Sandy dune</td>
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<td>4. Salt pans</td>
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<td>5. Rocky study</td>
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<td>6. Seaward slope</td>
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<td>12. Swale</td>
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<td>13. Interdunal “Talus”</td>
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<td>14. Flat bed</td>
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<td>15. Inland plain</td>
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<td>16. Flat flood</td>
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<td>17. Outer</td>
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**Notes:**
- Autumn succulent (L.) Seria, 2. autumn succulent L.
- Aegilops deschampsii (L.) Trin. ex Thw.
- Amaranthus spinosus L.
- Aegilops spectabilis (L.) Trin. ex Thw.
- Aegilops spectabilis (L.) Trin. ex Thw.
- Aegilops spectabilis (L.) Trin. ex Thw.
- Aegilops spectabilis (L.) Trin. ex Thw.

**Vegetation:**
- Aegilops spectabilis (L.) Trin. ex Thw.
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- Aegilops spectabilis (L.) Trin. ex Thw.
- Aegilops spectabilis (L.) Trin. ex Thw.
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<th>Soil sample no.</th>
<th>Location</th>
<th>Depth of sampling cm</th>
<th>Vegetation cover</th>
<th>Soil colour</th>
<th>Mechanical composition (Clay)</th>
<th>Soil texture</th>
<th>pH</th>
<th>Organic matter</th>
<th>%</th>
<th>T.S.S.</th>
<th>%</th>
<th>NaCl</th>
<th>%</th>
<th>CaCO₃</th>
<th>%</th>
<th>Sand</th>
<th>%</th>
<th>Loamy sand</th>
<th>%</th>
<th>Loamy sand</th>
<th>%</th>
<th>CaCO₃</th>
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<td>Mixed community of vegetal cover</td>
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<td>Sandy clay</td>
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<td>Palustrine reeds</td>
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<td>Loam</td>
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<td>713</td>
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<td>Loamy sand</td>
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<td>714</td>
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<td>7.56</td>
<td>Loamy sand</td>
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<td>715</td>
<td>Malwasa Port</td>
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<td>Sandy grass and vegetation</td>
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<td>4.69</td>
<td>Sand</td>
<td>8.2</td>
<td>0.05</td>
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<td>716</td>
<td>Bhavnagar old port area</td>
<td>0-10</td>
<td>Saline Estu</td>
<td>Rock</td>
<td>14.00</td>
<td>Salt clay</td>
<td>7.7</td>
<td>5.28</td>
<td>3.4950</td>
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Infrequently it is associated with Rasttella uncola, Rastrella filiformis, Lepidogalaxias triseriata, Heylandia latifolia, Tamarix sp., Conocarpus glomeratus, Polygala ericetorum, Striga orbiculata and Eleocharis engelmannii. The following communities are recognized: Avicennia marina var. acutiflora 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 recognized: Aeluropus lagopoides, Amphilex totcheri, Conocarpus erectus and Cressa cribrata.

Aeluropus lagopoides community: It is abundant on saline areas and its chief associates are Sesamum orientale and Sporobolus sp. It is a widely spread community in parts of Saurashtra coast.

Amphilex totcheri 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.

Conocarpus erectus community: Along similar saline coastal situations, it is abundant and forms the chief component of stands.

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

SALINE PLAINS

This habitat forms extensive plain belts, often under the influence of tides. Suaeda radula 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 Chloris quadrangularis, Eragrostis pilosa, Sporobolus virginicus and Typhophora indica.

The soils are sandy loam, loam and silty 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 (1.49-5.39%). 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% CaCO₃) (Table II).

III. Semi-Arid Coastal Plain

The chief component of the flora of this area include the following plant communities: Euphorbia nicaula, Maytenus emarginata, Commiphora wightii, Salsola norrida and Hyphaene indica community.
Esphorbia minuta 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.

Meyema emergenta community. It is the next best type of plant community found in this area. Sometimes it is found mixed with Prosopis spingetos and forms the important tree community of the coastal landscape. It is found scattered and often subjected to biotic interference.

Cusumphora virens community. It is stunted in stature and malformed; however, under protection, it attains good growth. Its associates are Parkinsonia aculeata and Asparagus ganaciae.

Salicornia arenaria 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 usually absent all along the coastal plain up to Bhavnagar. Evidently it has not spread widely as found along the coastal plains of Kutch, Delwada etc.

The soils are sandy to loamy sand in texture with mild to moderate alkalinity. Organic matter of the profile is low (0.13±0.08%). 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 are calcareous (35.36-37.65% CaCO₃) (Table II).

CONCLUSIONS

The coast line has been studied at Jafarabad, Victor Albert Port, Mahuva, Talaja, Gopurath, 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 and 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 coastal marsh vegetation. (Fig. 1). Similarly the zonation pattern is visible along strand/dune habit.
LIST OF COASTAL PLANTS

**CARYOPHYLLACEAE**

Polycarpon epica - W. & Arn.  
Gopnath, Victor Albert Port, Rao 2174.

**PORTULACACEAE**

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

**POLYGALACEAE**

Polygala eriopetala DC.  
Gopnath, Rao 2099.

**MALVACEAE**

Passonia sylviaca (L.) Cav.  
Gopnath, Rao 2103, 2126.

Sida cordifolia L.  
Jafarabad, Rao 2221.

S. multifida Cav.  
Gopnath, Rao 2126.

**TILIACEAE**

Cochlospermum tomentosum (L.) Stocks  
Gopnath, Rao 2274.

C. trifolium L.  
Gopnath, Rao 2108.

**BUREJERACEAE**

Camphoros wightii (Arn.) Bhandari  
Gopnath, Jafarabad, Rao 3087, 2835.

**CELASTRACEAE**

Meynus emarginata (Wild.) Ding-Hou  
Gopnath, Rao 2219.

**LEGUMINOSAE**

Acacia nilotica (L.) Del.  
Gopnath, Victor Albert Port, Rao 2096, 2088.

A. senegal Willd.  

Alysicarpus longifolius (RottL.) Wt. & Arn.  
Gopnath, Rao 2178.

Arachis hypogaea L.  
Gopnath (Cultivated), Rao 2147.

Crotalaria medicoginea Lamk.  
Mahua, Rao 2233.

Desmodium sp.  
Gopnath, Rao 2118.

Indigofera trifoliata Linn.  
Victor Albert Port, Mahua, Gopnath, Rao 2188, 2240, 2119.

Taverniera cuneifolia Arn.  
Gopnath, Rao 2095.

Tephrosia sanguinea (Dale.) Saut. & Mahesh.  
Gopnath, Rao 2173.

T. purpurea (L.) Pers.  
Gopnath, Rao 2143, 2133, 2139.

Zornia gibbosa Span.  
Talaja, Rao 2130.

**ASTERACEAE**

Sesuvium portulacastrum L.  
Victor Albert Port, Gopnath, Rao 2155, 2180, 2245, 2261.

**BERBERIDACEAE**

Boronia antarctica (L. f.) F. N. Will.  
Jafarabad, Victor Albert Port, Rao 2218, 2173.

**COMPOSITAE**

Echinops echinatus DC.  
Bhatnagar, Rao 2255.

Eclipta prostrata (L.) L.  
Gopnath, Rao 2111.

Flaveria anastatrica Hook.  
Jafarabad, Rao 2219.

Glossostegia bowalwana (L. f.) DC.  
Gopnath, Rao 2144.

Pulicaria angustifolia DC.  
Jafarabad, Rao 2225.

Sclerocephalus africanus Jacq.  
Talaja, Rao 2132.

Vernonia cinerea (L.) Leenh.  
Gopnath, Rao 2117.

**ASCLEPIADACEAE**

Tylophora indica (Burn. f.) Merr.  
Victor Albert Port, Rao 2164.

**BORAGINACEAE**

Sericostoma pauciflorum Stock.  
Mahua, Gopnath, Rao 2236, 2187, 2138.

Trichodesma indicum (L.) Lehm.  
Jafarabad, Gopnath, Rao 2220.

**CONVOLVULACEAE**

Convolvulus arvensis L.  
Gopnath, Rao 2148.
Cresia cretica L.

Evolutulus alboinoides (L.) L.

Ipomoea pes-caprae (L.) Sweet
Mahave, Jafarabad. Rao 2247, 2251, 2104.

Solanaceae

Datura metel L.
Gopnath. Rao 2226.

Solanum murattense Burm. f.
Bhavnagar, Mahave, Gopnath. Rao 2226, 2228, 2100, 2133.

S. arundo Mart.

Chropבחירות

Kirkia ramosissima (Wall.) Janch.

Linotheria indica (L.) O. Kunt.

Striga gesnerioides (Willd.) vanz.

S. lutea Linn.
Mahave. Rao 2239.

Gentianacées

Eunicostoma hyssopifolium (Willd.) Verdc.
Gopnath, Jafarabad, Mahave. Rao 2209, 2204, 2234.

Acanthaceae

Andrographis echioides (L.) Nees
Talaja. Rao 2082.

Barleria prionitis L.
Mahave, Gopnath. Rao 2241, 2088.

Helandra mollinifolia Pers.
Talaja. Rao 2089.

Dipteranthera patulus (Jacq.) Nees

Erythrina acacia (L. f.) Lindau
Talaja. Rao 2133.

Lepidagathis trinervis Wall. ex Nees

Rostellularia proculbens (L.) Nees

Verbenaceae

Avicennia marina var. acutissima Stapf & Mold.

Lantana indica (L.)

Labiatae

Ocimum americanum L.

Nyctaginaceae

Boerhavia diffusa L.
Jafarabad, Gopnath. Rao 2212, 2117.

Amaranthaceae

Aerva lanata (L.) Juss.

Psilostachys sericea (Korth. ex Roxb.) Heck. E.

Pupalia tappaca (L.) Juss.

Chenopodiaceae

Atriplux stockii Bals.

Salicornia brachiata Roxb.

Suaeda nudithora Murr.

Euphorbiaceae

Acalypha indica L.
Talaja, Gopnath. Rao 2084, 2305.

Euphorbia bumbacensis Sare.
Jafarabad. Rao 2169.

Jatropha gossypifoila L.
Gopnath, Jafarabad. Rao 2144, 2220.

Phyllanthus amarus Schurt. & Thonn.

Tragia involucrata var. cannabinica Hook. f.

Palmæ

Hyphaene indica Becc.

Phoenic dactylifera L.

Liliaceae

Asparagus gonorhizus Baker

Typhaceae

Typha angustata Bory & Chaub.
Gopnath. Rao 2249.

Cyperaceae

Cyperus pungre Rott.

Fimbristylis dichotoma (L.) Vahl
GRAMINEAE


Aplada varia L.


Cenchrus hispanicus Roxb.


Chloris virgata Sw.


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

Mahava coast. Rao 2249.

Eragrostis pilosa (L.) P. Beauv.

Blavagnac. Rao 2094.

Melanocnemis abyssinica L.


Sporobolus virginicus (L.) Kunth


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