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ECOLOGICAL STUDIES OF SAURASHTRA COAST AND NEIGHBOURING ISLANDS: I. DIU ISLAND

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ABSTRACT

The plant ecology of Diu, an island of irregular outline, situated in 20°43′ N & 71°02′ E and separated from the southern extremity of the peninsula of Saurashtra by a narrow channel on western shore of India is presented in this paper. Several plant communities are grouped into three ecosystems : Rock-strand, Strand and Inland sandy plain. The community type is a sub-division of an ecosystem, that is, it is recognised by the features of both its plant cover and its habitat. Plant communities under each of the three abovementioned ecosystems are described and also analysis of rocks and soils presented in tabular form to study soil features in relation to vegetation.

INTRODUCTION

Our knowledge about the terrestrial ecology of islands near the sea coast of India is still very limited. The few ecological investigations on island phanerogamic flora are from the islands of Wellingdon (Erlanson, 1936), Bombay and Salsette (Bharucha, 1950), Elephanta (Satyanarayan, 1959), Church (Srinivasan, 1960), Rameswaram (Rao *et al.* 1964 a) and Krusadi group of islands (Rao *et al.* 1964 b). Recently these studies have been extended to Saurashtra coastal areas. The present account relates to the land ecology of Diu island.

GENERAL DESCRIPTION OF THE AREA

Diu, an island forming portion of the former Portuguese possessions in western India is situated in 20°43′ N & 71°02′ E. It is an island of irregular outline and is separated from the southern extremity of the peninsula of Saurashtra in Gujrat state by a narrow channel through a considerable swamp. Its extreme length from east to west is about 11 km and the greatest breadth from north to south is 3 km and covers an area of 51 sq. km. On the north the narrow channel separating it from the mainland is practicable only for fishing boats and small craft. On the southern face of the island deep water is close beneath and it has a small but excellent harbour where vessels can safely ride at anchor in 2 fathoms of water.

The town of Diu stands at the east end of the island. Besides Diu town there are three large villages on the island, namely, Monakbara, with a fort commanding the channel on the west; Bachawara, on the north; and Nagwa, with a small fort commanding the bay, on the south.

CLIMATE

Average annual rainfall referring to the nearest meteorological observatory at Jafarabad (Anon., 1884) is approximately 42 inches (1067 mm). Almost the whole of the annual rainfall which is due to the south-west monsoon comes during June to October; July being the rainiest month. Mean of daily maximum temperature is more than 80°F and that of daily minimum temperature more than 70°F. Mean of relative humidity figures are also very high (approximately 75%). The climate accordingly is typical of humid subtropical with concentration of precipitation in the warm season. The high humidity in conjunction with the high temperatures produces a sultry, oppressive condition in contrast to dry summer heat. Sensible temperatures, therefore, are commonly higher in the humid—than in dry-summer subtropics even when the thermometer registers the same. Due to the sea-breeze, however, the severeness of the weather is counteracted to a considerable extend and the climate of the island is generally known to be salubrious.

GEOLOGY AND SOILS

The island is made up of a marine member of the post-tertiary group (l.c. 1884), occurring in the shape of an earthy chalky grit, very porous and friable and of a dirty, mottled, coffee stained appearance and light ashy colour. Beds of this marine member first appear to the west of Diu island, where they form a narrow band along the coast with an increasing importance and development towards the west, though not probably attaining a much greater thickness than 20 m anywhere. This stone though porous is much esteemed along the coast for building purposes. These beds are seen resting on the abraded surface of the miliolite or Porbander stone, a somewhat coarse grit, highly chalky and abounding in foraminifera. The south face of the island presents a line of dolomitic limestone cliffs of moderate height washed and hollowed by the sea into caverns. The surface of the island is more or less honeycombed with querries, the stone having been used in making the forts, churches, monasteries and other buildings of which the island is full.

It can hardly be said that any soil is present in the Diu island. Rock outcrop is visible generally in the island. Only in some small scattered patches a very thin cover of light brown loamy sand to sandy loam soil can be seen. Due to non-presence of the soil there is very little agriculture in the island. On the southern shore wind blown

white quartz derived sand in the form of sand hills is present adjacent to the rocky cliffs. This sand has extended inward forming covers of a few feet thick in some cases, which gives support to coconut palms and other trees.

METHODS

The island's Vascular flora was studied in different seasons during the years 1962-63 (Rao *et al.* 1964c). As the island is well inhabitated the influence of human beings on the plant cover prevailing in the island was clearly understood and taken into consideration. Kassas' method (1957) of using Braun Blanquet's (1932) method of description is adopted while describing plant communities grouped into three ecosystems: Rock strand, Strand and Inland sandy plain. Thus the natural vegetation is analysed into several plant communities grouped into the above three ecosystems. Each community type is recognised by its plant cover and habitat. The plant cover is identified by its dominant species and habitat by its edaphic features. For each community type five stands have been worked out. The species present in the stand are listed with indices of cover-abundance and Sociability as described by Braun Blanquet (l.c.). Throughout Braun Blanquet's description is used but not his concept of 'association' nor his method of classification. Each stand is a uniform sample site with uniform distribution of the dominant species and uniform habitat. Two figures ranging from 1 to 5 were given to each species. The first indicated the dominance of the species in the stand according to the following scale:

1. Covering very feeble
2. Species covering from 1/20 to 1/4 of the area studied
3. Species covering from 1/4 to 1/2 of the area studied
4. Species covering from 1/2 to 3/4 of the area studied
5. Species covering more than 3/4 of the area studied

The second figure indicated sociability. Five degrees of sociability are recognised as follows:

1. Shoots growing singly
2. Shoots growing singly in smaller groups
3. Shoots growing singly in greater groups
4. Shoots growing singly in small colonies
5. Shoots growing singly in pure colonies

The + sign indicated that species in the area were represented by one or two individuals only.

To study soil features in relation to plant communities soil samples were analysed for mechanical composition, pH, organic matter content, total dissolved solids, sodium chloride and calcium carbonate contents by the methods referred to by Rao *et al.* (1964 a) except that pH determinations were made by the Cambridge direct reading pH indicator on 1 : 5 soil : water suspensions.

VEGETATION AND SOIL

The existing vegetation based upon the ecosystem is studied under the following heads:

1. Rock-strand
2. Strand
3. Inland sandy plain

ROCK-STRAND

General features:

Exposed flat rocks with holes and crannies often filled up with sandy soil are very often seen near the sea shore. Such a habitat supports, only in the crevices a limited number of annuals or perennials. The dominating plants exhibit suffruticose habit. On exposed creviced rocks near the fore shore above the tidal level *Statice stocksii* forms the dominant pure association closely followed by a mixed population of *Lepidagathis trinervis* and *Sericostoma pauciflorum* exhibiting dome shaped hemi-spherical mounds on the rocks. Plants of prostrate or stunted habit such as *Portulaca quadrifida, Andrographis echioides, Lindenbergia indica* and *Polycarpaea spicata* are very frequently found in this habitat especially in the small crevices. The above plants develop either creeping or stunted life-form due to constant exposure to wind and insolation and at no time they form a thick vegetal cover on the rocky surface.

Under rock-strand ecosystem six sub-divisions or community types have been recognised: (Table 1)

1. Community of *Statice stocksii*
2. Community of *Fagonia cretica*
3. Community of *Pulicaria wightiana*
4. Community of *Sericostoma pauciflorum*
5. Community of *Lepidagathis trinervis*
6. Community of *Atriplex stocksii*

1. Community of *Statice stocksii* (Stands 1-5):

Stands 1-5 represent typical rock-strand vegetation. On exposed creviced rocks near the foreshore above the tidal level *Statice stocksii* forms the dominant pure association. Sometimes they are found mixed up with *Atriplex stocksii* and *Polycarpia spicata*. Landward creviced rocks exhibit a mixed population of *Fagonia cretica, Pulicaria wightiana, Lepidagathis trinervis, Sericostoma pauciflorum, Andrographis echioides, Lindenbergia indica, Enicostemma verticillatum* and *Portulaca quadrifida*. Slight interior, not far off from the foreshore where the soil is more sandy than rocky one can see a limited number of *Statice stocksii* mixed up with *Heliotropium* spp., *Dipteracanthus patulus, Clerodendrum phlomidis, Leucas aspera, Celosia argentea, Aerva lanata, Hibiscus micrantha, Crotalaria retusa, Glinus oppositifolius, Trianthema decandra*

and *Echinops ehinatus*. The shrubby species are represented by *Clerodendrum phlomidis, Zizyphus nummularia* and *Calotropis procera* found scattered here and there.

2. Community of *Fagonia cretica* (Stands 6-10):

Stands 6-10 represent the next best community well represented on the creviced rocks. They have a wide range of habitat. From foreshore to inland they are found growing often mixed up with *Sericostoma pauciflorum, Andrographis echioides, Enicostemma verticillatum* and *Aerva lanata.*

3. Community of *Pulicaria wightiana* (Stands 11-15):

A community which thrives well on gravelly sandy soil. Found scattered all over the area. Often they are found in association with *Portulaca quadrifida, Andrographis echioides, Trianthema decandra, Heliotropium* spp. and *Dipteracanthus patulus.*

4. Community of *Sericostoma pauciflorum* (Stands 16-20):

Sericostoma pauciflorum exhibits suffruticose habit and often found mixed up with *Lepidagathis trinervis, Lindenbergia indica* and *Portulaca quadrifida.* Towards the seaward side the other common associates are *Statice stocksii* and *Atriplex stocksii.*

5. Community of *Lepidagathis trinervis* (Stands 21-25):

Pure formation of *Lepidagathis trinervis* was noticed towards the landward side. Together with *Sericostoma pauciflorum* they form a conspicuous feature of the landscape. The other commonly associated plants are *Trichodesma indicum, Heliotropium* spp. and the shrubby *Calotropis procera.* The other interesting associate is the parasitic *Striga gesneroides.*

6. Community of *Atriplex stocksii* (Stands 26-30):

The seaward creviced rocks harbour *Atriplex stocksii* in pure stands. They form extensive patches and occupy inhospitable areas. Sometimes they are found mixed up with *Portulaca quadrifida, Enicostemma verticillatum* and *Polycarpaea spicata.*

The chemical composition of the hard rock exposed near the sea shore is as under:

Loss on ignition	34.61%
SiO_2 + I.R.	13.25%
R_2O_3	6.48%
CaO	17.27%
MgO	18.52%

The above analysis indicates that the nature of the rock is dolomitic limestone with impurities of SiO_2 and R_2O_3 etc.

On the old fort walls built of rock especially in the crevices the following plants are found: *Lindenbergia urticaefolia, Pulicaria angustifolia, Cissus quadrangularis, Andrographis echioides, Ipomoea pentaphylla, Dichanthium annulatum, Euphorbia heterophylla* and *Heliotropium zeylanicum.*

The nature of the rock from fort walls is sand stone containing impurities of $CaCO_3$, $MgCO_3$ and R_2O_3 with the chemical analysis as under:

Loss on ignition	25.76%
SiO_2 + I.R.	41.00%
R_2O_3	3.57%
CaO	14.77%
MgO	11.92%

STRAND VEGETATION

Sandy beaches of limited extension are sometimes intercepted in between rocky shore line. The foreshore is free from vegetation. However, on the beach ridges or sandy bars a pure stand of *Ipomoea pes-caprae* or *Halopyrum mucronatum* is frequently found growing almost to the exclusion of other local strand plants. Closely situated to sandy beaches are the sandy spots or flats extending inland with a mixed population of local strand flora. They are not true Halophytes or Psammophytes. But they are inland plants found growing on sandy situations.

Under strand ecosystem four sub-divisions or community types have been recognised: (Table 2)

1. Community of *Ipomoea pes-caprae*
2. Community of *Halopyrum mucronatum*
3. Community of *Cyperus arenarius*
4. Community of *Convolvulus microphyllus*

1. Community of *Ipomoea pes-caprae* (Stands 1-5):

This tropical sand binder is almost the only well established plant found on the foreshore. It forms extensive patches all over the foreshore. The other common accociates are *Cyperus arenarius, Halopyrum mucronatum* and *Launea sarmentosa.*

2. Community of *Halopyrum mucronatum* (Stands 6-10):

Large clumps of this grass on the sandy bars forms a significant feature of the strand flora. They form gregarious patches and sometimes extend towards the landward areas also. Towards the landward side they are found mixed up with *Convolvulus microphyllus* and *Heylandia latebrosa.*

3. Community of *Cyperus arenarius* (Stands 11-15):

This community type is fairly common all over the sandy bars. Towards the sea side they are found growing along with *Ipomoea pes-caprae* or *Halopyrum mucronatum* and towards the landward side their main associates are *Launea sarmentosa* and *Heylandia latebrosa.*

TABLE

Floristic composition of 30 stands representing Rocky-strand of *Fagonia cretica*, III. Community of *Pulicaria wightiana*, of *Lepidagathis trinervis*, VI. Community

	I						II					
Rocky-Sandy spp.	1	2	3	4	5	Pr	6	7	8	9	10	Pr
Statice stocksii	3.2	4.4	4.2	5.1	4.1	100	—	—	1.1	—	2.1	40
Fagonia cretica	1.1	—	3.1	2.4	1.1	80	5.4	3.5	4.3	3.5	5.1	100
Pulicaria wightiana	1.1	2.1	—	—	—	40	2.1	2.1	—	—	—	40
Sericostoma pauciflorum	—	3.1	—	—	2.2	40	3.1	2.1	3.1	—	—	60
Lepidagathis trinervis	1.1	1.3	—	—	—	20	—	1.1	—	2.1	—	40
Atriplex stocksii	—	—	1.1	+.2	—	40	—	—	1.1	—	2.3	40
Portulaca quadrifida	1.1	—	2.4	—	1.1	60	2.2	—	—	—	1.1	40
Andrographis echioides	—	2.3	—	—	—	20	—	2.1	2.1	—	2.3	60
Lindenbergia indica	+.1	—	4.1	—	2.5	60	—	—	1.3	—	2.1	40
Polycarpia spicata	2.4	—	2.4	—	3.1	60	2.1	1.1	—	—	—	40
Enicostemma verticillatum	+.1	—	1.2	—	—	40	—	—	+.1	2.1	4.2	60
Trichodesma indicum	2.1	—	1.1	—	—	40	—	—	—	1.1	—	20
Heliotropium zeylanicum	—	+.+	—	—	2.3	40	+.1	2.1	+.1	—	—	60
H. undulatum	+.2	—	3.1	—	—	40	—	—	1.1	—	2.1	40
Dipteracanthus patulus	+.+	2.1	—	—	—	40	—	—	—	—	1.1	20
Clerodendrum phlomidis	—	2.1	3.1	2.1	—	60	—	1.1	—	—	—	20
Leucas aspera	—	—	1.3	—	—	20	1.1	—	—	—	—	20
Celosia argentea	—	1.1	—	—	—	20	—	—	3.1	—	—	20
Aerva lanata	+.3	3.1	2.1	—	—	60	+.1	1.1	—	+.1	—	60
Hibiscus micranthus	—	—	1.1	—	—	20	—	—	—	—	—	—
Zizyphus nummularia	1.2	—	—	—	—	20	—	—	1.1	—	—	20
Crotalaria retusa	—	3.1	—	1.1	—	40	—	—	—	—	—	—
Glinus oppositifolius	1.1	—	1.2	—	+.1	60	—	—	—	—	1.1	20
Trianthema decandra	—	1.1	—	—	—	20	—	—	—	—	—	—
Catharanthus roseus	—	—	—	—	—	—	—	—	—	—	—	—
Calotropis procera	—	—	3.1	—	—	20	1.2	—	—	—	—	20
Merremia quinquefolia (on fort walls)	1.1	—	2.1	—	1.1	60	—	—	—	—	—	—
Cissus quadrangularis (on fort walls)	2.1	—	1.1	—	1.2	60	1.1	2.1	3.1	—	—	60
Pulicaria angustifolia (on fort walls)	2.2	2.1	3.1	—	4.1	80	1.3	—	—	2.1	—	40
Tridax procumbens (on fort walls)	—	3.2	—	3.1	—	40	—	3.4	—	1.2	—	40
Echinops echinatus	—	—	—	1.2	—	20	—	—	—	—	—	—
Striga gesneroides	1.1	1.1	—	—	—	40	—	1.1	—	3.1	—	20

1

habitat : I. Community of *Statice stocksii*, II. Community
IV. Community of *Sericostoma pauciflorum*, V. Community
of *Atriplex stocksii*. (Pr. =percent)

III						IV						V						VI					
11	12	13	14	15	Pr	16	17	18	19	20	Pr	21	22	23	24	25	Pr	26	27	28	29	30	Pr
—	1.1	—	—	—	20	—	3.1	—	+.1	—	20	—	—	—	—	—	—	—	—	—	—	—	—
—	—	2.3	—	—	20	—	1.1	—	2.1	—	40	—	—	—	—	—	—	—	—	—	—	—	—
3.1	4.1	3.1	4.4	4.3	100	—	—	—	1.1	—	20	—	—	—	—	—	—	—	1.2	—	3.1	—	40
—	2.2	1.1	—	—	40	4.5	4.5	3.4	5.2	2.3	100	1.1	1.2	2.2	—	—	60	2.1	2.1	—	—	—	40
—	—	5.1	—	2.3	40	2.2	—	—	1.1	—	40	5.4	3.5	4.5	2.4	3.2	100	—	1.1	—	2.1	—	40
—	—	—	—	—	—	—	—	—	2.4	—	20	1.1	—	—	—	—	20	3.2	4.1	5.1	3.1	3.4	100
—	2.1	—	1.1	3.2	60	—	1.1	—	2.1	—	40	—	1.1	—	+.+	—	40	1.1	2.1	3.1	2.1	—	80
—	—	—	—	—	—	—	—	—	1.3	—	20	—	—	2.3	—	—	20	—	—	—	—	2.1	20
—	2.1	—	2.1	—	40	—	—	2.1	1.1	1.1	60	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	1.3	1.2	40	—	—	—	—	—	—	—	—	—	—	—	—	1.+	+.+	—	—	—	40
2.1	—	—	—	—	20	—	1.1	—	—	+.+	40	—	—	1.3	—	2.1	40	—	—	1.1	3.2	—	40
+.1	—	—	2.1	—	40	—	—	—	1.1	—	20	1.1	—	2.1	—	1.1	60	—	—	+.1	—	—	20
—	—	1.3	—	2.+	40	1.1	—	2.3	—	—	40	—	—	2.1	—	1.1	40	—	2.3	—	—	1.2	40
—	1.1	—	2.1	—	40	—	—	—	—	—	—	—	1.1	—	—	2.3	40	—	—	+.1	—	—	20
—	—	1.1	—	+.+	40	—	—	1.1	—	—	20	—	—	—	—	—	—	—	2.1	—	—	—	20
—	—	—	1.1	—	20	—	2.3	—	—	—	20	—	—	1.1	—	—	20	—	—	—	—	—	—
—	—	1.1	—	—	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	2.1	2.1	—	—	40	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	3.1	—	20	—	—	—	1.1	—	20	—	—	—	—	—	—	1.1	—	—	—	—	20
—	2.1	—	—	—	20	—	—	—	—	—	—	—	1.2	—	—	—	20	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.1	—	2.1	—	40
—	—	2.2	—	—	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	+.+	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	2.1	—	1.1	—	40	—	1.1	—	—	—	20	—	—	—	1.1	—	20	—	—	—	—	—	—
—	—	1.1	—	—	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1.1	—	—	—	—	20	—	1.2	—	—	—	20	1.1	—	—	—	—	20	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	1.3	—	—	2.1	40	—	—	2.1	—	—	20	—	—	—	—	—	—	—	—	—	—	—	—
1.2	—	—	—	—	20	1.1	2.1	—	—	—	40	—	—	—	—	—	—	—	—	—	1.2	—	20
1.1	1.2	—	—	—	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	1.2	1.1	40	1.2	—	—	1.1	—	40	1.1	2.1	2.1	1.1	—	80	—	1.1	—	2.1	—	20

4. Community of *Convolvulus microphyllus* (Stands 16-20):

This creeper commonly occupies a borderline between pure strand flora and inland flora. They can tolerate sandy habitat to certain extent. This communiy type is often found in association with the other local strand flora viz. *Lotus garcini, Launea sarmentosa* and *Heylandia latebrosa.*

Analysis of the soil samples collected from the strand habitat under different plant communities is given in Table 3.

The texture of the white to dull white wind blown quartz derived sand from the sandy strand habitat on the southern shore of the island is fine sand. It contains many shell fragments and is highly calcareous with $CaCO_3$ contents of 23.38-29.16%. The pH values of sands under different plant communities vary between 7.7-8.0 and indicate moderate alkalinity. Organic matter contents (0.28-0.43%) are low. Total dissolved solids (0.069-0.108%) and Sodium chloride contents (0.015-0.026%) are also low indicating some sea water spray only but no inundation with the same. The above data shows that there is not appreciable difference in the characteristics of sand under different plant communities of this habitat.

TABLE 2

Floristic composition of 20 stands representing strand vegetation : I. Community of *Ipomoea pes-caprae*, II. Community of *Halopyrum mucronatum*, III. Community of the *Cyperus arenarius*, IV. Community of *Convolvulus microphyllus*. (Pr. = percent)

	I						II						III						IV					
Strand spp.	1	2	3	4	5	Pr	6	7	8	9	10	Pr	11	12	13	14	15	Pr	16	17	18	19	20	Pr
Ipomoea pes-caprae	4.1	3.1	2.1	4.1	4.4	100	+.+	1.2	3.1	2.1	—	60	—	—	1.1	—	—	20	—	—	—	1.2	—	20
Halopyrum mucronatum	—	1.1	—	—	—	20	1.1	3.1	4.2	5.1	3.1	100	—	2.1	—	—	—	20	—	1.3	—	2.1	—	40
Cyperus arenarius	3.1	—	+.1	—	—	40	—	—	1.1	—	—	20	5.1	3.1	5.1	5.2	3.1	100	—	—	1.1	—	—	20
Convolvulus microphyllus	1.1	—	1.1	—	2.3	60	—	—	—	3.2	—	20	2.1	2.1	2.1	—	1.1	80	2.1	5.2	4.1	3.4	1.1	100
Lotus garcini	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+.+	1.1	—	—	—	40
Launea sarmentosa	—	2.1	—	—	—	20	—	—	—	—	—	—	—	2.1	2.1	2.2	—	60	—	—	2.3	1.2	—	40
Indigofera linnaei	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Heylandia latebrosa	—	—	—	—	—	—	—	2.1	—	—	—	20	—	—	2.1	2.1	—	40	—	+.3	2.2	1.1	—	60

TABLE 3

Soil sample No.	447	448	449	450
Location	Southern shore sandy strand habitat	Southern shore sandy strand habitat	Southern shore sandy strand habitat	Southern shore sandy strand habitat
Depth of sampling in cm	0-10	0-10	0-10	0-10
Vegetation cover	*Ipomoea pes-caprae*	*Halopyrum mucronatum* and *Ipomoea pes-caprae*	*Cyperus arenarius* and *Convolvulus microphyllus*	*Convolvulus microphyllus* and *Lotus garcini*
Soil colour	white	dull white	dull white	white
Clay %	1.1	1.4	2.4	1.9
Silt %	2.3	3.8	1.5	3.1
Fine sand %	93.7	84.6	87.2	79.8
Coarse sand %	2.9	10.2	8.9	15.2
Soil texture	Fine sand	Fine sand	Fine sand	Fine sand
pH	7.8	8.0	7.8	7.7
Organic matter %	0.43	0.37	0.28	0.31
Total dissolved solids %	0.108	0.086	0.069	0.084
Sodium chloride %	0.018	0.015	0.026	0.016
Calcium carbonate %	28.52	26.71	23.38	29.16

INLAND SANDY PLAIN

Towards the inland on a thin mantle of sand deposited on gravelly soil one could see a mixed population of herbaceous plants like *Enicostemma verticillatum, Lotus garcini, Cassia italica, Euphorbia hirta, Heylandia echinatus, Pedalium murex, Heliotropium zeylanicum, Leucas aspera* and *Jatropha gossypifolia.* The scrubs are represented by *Calotropis gigantea, Euphorbia neriifolia, Clerodendrum phlomidis* and *Capparis decidua.* They are

TABLE 4

Floristic composition of 10 stands representing the inland sandy plain vegetation.
(Pr. = percent)

	1	2	3	4	5	6	7	8	9	10	Pr.
Thespesia populnea	3.1	—	1.1	—	—	—	1.1	—	—	—	30
Delonix elata	—	—	—	2.1	—	—	—	—	—	—	10
Pongamia pinnata	—	1.3	—	—	3.1	—	—	1.1	—	—	30
Salvadora persica	1.1	—	—	3.2	—	—	1.1	—	—	—	30
Cadaba fruticosa	—	2.3	3.1	2.1	—	—	—	1.1	—	1.2	50
Hyphane indica	1.1	—	—	—	—	2.1	—	3.1	—	—	30
Parkinsonia aculeata	—	—	—	—	—	—	1.2	—	—	—	10
Cassia italica	—	2.1	—	—	—	1.1	—	—	—	—	20
Cocculus hirsutus	1.2	—	1.1	—	—	—	—	—	1.1	—	40
Tinospora cordifolia	—	1.1	1.1	—	—	—	1.1	—	—	—	30
Capparis sepiaria	—	—	—	—	—	—	1.1	—	—	—	10
Bergia odorata	—	—	1.1	—	—	—	—	2.2	—	—	20
Pavonia patens	—	—	—	—	—	—	3.2	—	1.2	—	20
Corchorus trilocularis	—	—	2.1	—	—	—	—	—	—	—	10
Cayrota carnosa	—	—	1.1	—	—	—	—	—	—	—	10
Vernonia cinerea	1.1	—	3.2	—	—	2.1	—	4.1	—	—	40
Euphorbia neriifolia	3.1	2.1	1.1	—	—	—	2.1	3.1	—	—	50
Jatropha gossypifolia	1.1	1.1	2.1	3.1	—	—	—	3.2	—	—	50
Euphorbia hirta	3.1	2.1	3.2	1.1	—	—	—	—	1.1	—	50
E. thymifolia	—	1.1	—	2.1	—	3.1	2.1	—	—	—	40
E. heterophylla	2.1	1.2	2.3	3.2	—	—	3.1	2.1	—	—	60
Acalypha indica	1.1	2.1	1.1	1.1	—	1.1	2.2	—	—	—	60
Dactyloctenium aegypticum	—	—	—	1.1	—	—	—	1.2	2.1	—	30
Eragrostis ciliaris	—	—	—	1.1	—	1.1	1.3	3.1	—	—	40
Commelina haskarlii	—	—	—	—	—	—	1.1	—	—	1.1	20
Amaranthus tricolor	1.1	—	2.3	—	—	2.1	—	—	—	—	30

widely scattered and at no place they were found to form thickets of considerable significance. Sometimes, occasionally though not frequently one could see *Ficus* sp., *Salvadora persica* and *Thespesia populnea.* Other plants of tree habit are the palms chiefly *Hyphane* sp. and *Cocos nucifera* found scattered all over the island. (Table 4).

In the interior the vegetation is very much disturbed. Most of the available areas have been cleared for cultivation or for construction of fort walls, townshipment and big buildings for the maintenance of the military installations. The commonly seen hedge plants are *Lantana indica, Maerua arenaria* var. *scabrida, Cordia rothii, Cordia myxa, Cadaba fruticosa, Clerodendrum phlomidis, Capparis sepiaria, Pongamia pinnata* and *Euphorbia neriifolia.* Amidst their shade the following plants are met with: *Barleria prionitis,*

Alternanthera sessilis, Pupalia lappacea and *Apluda mutica.*

Analysis of soil samples from a profile in the inland sandy plain is given in Table 5.

TABLE 5

Soil sample No.	451	452	453
Location	Inland sandy plain	Inland sandy plain	Inland sandy plain
Depth of sampling	0-10	10-30	30-90
Vegetation cover	*Jatropha gossypifolia ; Calotropis gigantea ; Euphorbia neriifolia ; Clerodendrum phlomidis* and *Capparis decidua*		
Soil colour	light brown with blackish tinge	light brown	light brown
Clay %	2.6	4.1	9.2
Silt %	15.4	29.5	37.1
Fine sand %	76.7	62.3	49.5
Coarse sand %	5.3	4.1	4.2
Soil texture	loamy sand	sandy loam	sandy loam
pH	7.6	7.6	7.6
Organic matter %	2.70	0.87	0.67
Total dissolved solids %	0.178	0.165	0.120
Sodium chloride %	0.076	0.035	0.029
Calcium carbonate %	1.30	1.80	3.75

The soil from the inland sandy plain present in layers upto about 90 cm deep over the under-lying rock is different from the sand of the beach habitat. It is light brown with blackish tinge in colour. The surface soil from the profile studied in the inland is loamy sand but downwards the soil changes to sandy loam in texture. The $CaCO_3$ content of the samples from the profile increasing from 1.30% from surface to 3.75% downwards is much lower in comparison to the beach sands. The organic matter content of the surface soil (2.70%) is fairly high and decreases to 0.87% and 0.67% downwards. The pH value at 7.6 remains constant throughout the profile and as such no relationship between organic matter and pH is indicated. Total dissolved solids and sodium chloride decrease from top to bottom. The values of total dissolved solids and sodium chloride contents 0.178% and 0.076% in the surface soil fall to 0.120% and 0.029% downwards. Their concentration is fairly low. Soils at the surface and upto 30 cm depth were absolutely dry but after that they were found to be a little moist.

SYSTEMATIC CENSUS

MENISPERMACEAE

Cocculus hirsutus (L.) Diels
A climber on hedges. *Rao* 1964.

Tinospora cordifolia (DC.) Miers
A climber on bushes. *Safui* 2530.

CAPPARIDACEAE

Cleome viscosa L.
An erect herb in waste places. *Rao* 1992.

Cadaba fruticosa (L.) Druce
A wiry shrub along the hedges. *Rao* 1960.

Capparis decidua (Forsk.) Edgew.
A bushy shrub found in the rocky crevices along the road sides. *Safui* 2528.

C. sepiaria L.
A climbing shrub. *Rao* 1946.

CARYOPHYLLACEAE

Polycarpaea spicata Wt. & Arn.
A herb on sandy areas and rocky crevices. *Rao* 2307.

PORTULACACEAE

Portulaca quadrifida L.
A prostrate herb in the rocky crevices. *Rao* 2309.

ELATINACEAE

Bergia odorata Edgew.
A woody prostrate plant spreading on moist places especially cultivated areas. *Rao* 1961.

MALVACEAE

Thespesia populnea Soland. ex Correa
A branched tree on road side, planted. *Rao* 1939.

Abutilon indicum Sweet
A shrub near hedges. *Rao* 1945.

Pavonia patens (Andr.) Chiov.
A semi-erect herb near hedges. *Safui* 2522.

Hibiscus micranthus L.
An undershrub in rocky crevices near shore. *Rao* 1993.

TILIACEAE

Corchorus trilocularis L.
An erect undershrub near hedges. *Rao* 1991.

C. depressus (L.) Stocks
A prostrate shrub on sand mixed rocky area. *Rao* 1948.

ZYGOPHYLLACEAE

Fagonia cretica L.
An undershrub near sandy rocks and slacks. *Safui* 2524.

RHAMNACEAE

Zizyphus nummularia (Burm. f.) Wt. & Arn.
A shrub near rocky places. *Safui* 2504.

VITACEAE

Cissus quadrangularis L.
A climber especially on fort walls. *Rao* 1936.

Cayratia carnosa (Lamk.) Gagnop.
A climber on hedges. *Rao* 1937.

LEGUMINOSAE

Heylandia latebrosa DC.
A prostrate herb on the slacks. *Safui* 2525.

Crotalaria retusa L.
A sub-erect herb on hard sandy grounds. *Safui* 2497.

Lotus garcini DC.
A semi-erect herb on sandy banks near sea shore. *Rao* 2301.

Indigofera linnaei Ali
A semi-erect plant on sandy areas. *Rao* 1978 & 1999.

I. linifolia Retz.
A sub-erect herb on hard sandy grounds. *Safui* 2531.

Parkinsonia aculeata L.
A tree on road sides. *Safui* 2493.

Delonix elata (L.) Gamble
A tree on sea-shore. *Safui* 2465.

Cassia italica (Mill.) Lamk. ex F. W. Andrews
A diffuse herb in open grounds. *Rao* 1980.

Pongamia pinnata (L.) Pierre
A branching tree near shore. *Safui* 2507.

AIZOACEAE

Glinus oppositifolius (L.) A. DC.
A semi-erect herb in rocky crevices. *Rao* 2305.

Trianthema decandra L.
A prostrate herb near sandy rocky places. *Rao* 1952.

COMPOSITAE

Vernonia cinerea Less.
A herb found in abundance. *Rao* 1959.

Pulicaria wightiana (DC.) Benth. ex Clarke
A herb found in rocky crevices & fort walls. *Rao* 1996.

P. angustifolia DC.
A herb found in rocky crevices and fort walls. *Rao* 1942.

Tridax procumbens L.
A herb found all over the island. *Rao* 1988.

Echinops echinatus Roxb.
A thistle like herb found in abundance along rocky and sandy shores. *Rao* 1954.

Launea sarmentosa (Willd.) Alston
A prostrate herb on sandy areas. *Safui* 2526.

PLUMBAGINACEAE

Statice stocksii Boiss
A suffruticose herb in rocky crevices near the sea-shore. *Rao* 1965.

SALVADORACEAE

Salvadora persica L.
A stunted tree near sea-shore. *Rao* 1944.

APOCYNACEAE

Catharanthus roseus (L.) G. Don (=*Lochnera rosea* Reichb.)
An undershrub in rocky crevices. *Rao* 1998.

ASCLEPIADACEAE

Calotropis gigantea R. Br.
A shrub found all over island. *Rao* 1940.

Pargularia daemia (Forsk.) Chiov.
A climber on hedges all over the island. *Rao* 1957.

GENTIANACEAE

Enicostemma verticillatum (L.) Engl. (=*E. littorale* Blume)
A herb on rocky and sandy shores. *Rao* 1953.

BORAGINACEAE

Cordia rothii Roem. & Schult.
A tree along hedges. *Rao* 1947.

Trichodesma indicum R. Br.
A herb on sandy places. *Rao* 1972.

Heliotropium zeylanicum Lam.
A herb in rocky crevices. *Rao* 1956.

H. undulatum Vahl
A herb in rocky crevices. *Safui* 2532.

Sericostoma pauciflorum Stocks
A stunted shrub in abundance all along rocky sandy places. *Rao* 1937.

CONVOLVULACEAE

Convolvulus microphyllus Sieb.
A prostrate herb spreading on sandy areas. *Rao* 1962.

Merremia quinquefolia (L.) Hall. f.
A climber along hedges and also on fort walls. *Rao* 1990.

Ipomoea pes-caprae (L.) Sweet
A prostrate herb on sandy beaches. *Rao* 2310.

Cressa cretica L.
An erect herb on rocky-sandy moist fields. *Rao* 2302.

SOLANACEAE

Datura suaveolens H.B.K.
A shrub near waste places. *Rao* 1941.

Solanum arundo Mattei
A shurb with flowers. *Rao* 1949.

SCROPHULARIACEAE

Lindenbergia indica (L.) O. Ktze.
A herb found in abundance in rocky crevices near the exposed rocks and also in fort walls. *Rao* 1973 & 2311.

Striga gesneroides (Willd.) Vatke.
A parasitic herb on *Lepidagathis trinervis* Nees. *Rao* 1985.

PEDALIACEAE

Pedalium murex L.
A herb found in abundance along sandy wastes. *Rao* 1955.

ACANTHACEAE

Barleria prionitis L.
A shurb found in abundance all along shady hedges. *Rao* 1971.

Andrographis echioides (L.) Nees
A stunted herb in rocky crevices near sea-shore and also on fort walls. *Rao* 1984.

Lepidagathis trinervis Nees
A stunted diffuse plant on rocky coastal area; found in abundance. *Rao* 1986.

Dipteracanthus patulus (Jacq.) Nees
Erect herb; sometimes prostrates on rocky fields. *Rao* 1995.

VERBENACEAE

Lantana indica Roxb.
A fast spreading shrub along the road side. *Rao* 1933 & 2304.

Clerodendrum phlomidis L. f.
A shrub in abundance on rocky soil. *Rao* 1943.

LABIATAE

Leucas aspera Spr.
A herb on sandy rocky areas all over the island. *Rao* 1958.

NYCTAGINACEAE

Boerhavia diffusa L.
A running herb all over the island. *Rao* 2302.

B. verticillata Poir
A trailor and climber along hedges. *Safui* 2533.

AMARANTHACEAE

Aerva lanata Juss
A herb all along rocky-sandy areas. *Rao* 1950.

Celosia argentea L.
An erect herb on rocky wastes. *Rao* 1997.

Digera muricata (L.) Mart.
A semi-erect herb abundant in sandy waste fields. *Rao* 1989.

Amaranthus tricolor L.
A more or less prostrate herb on the sandy slacks. *Rao* 1976.

Pupalia lappacea Moq.
A herb found along the hedges. *Rao* 1974.

Achyranthes aspera L.
A herb all along the hedges. *Rao* 1981.

CHENOPODIACEAE

Atriplex stocksii Boiss
A semi-erect herb in abundance in rocky crevices along the sea shore and also near the fort walls. *Rao* 1970.

EUPHORBIACEAE

Euphorbia hirta L.
A semi-procumbent herb in abundance all over the island. *Rao* 1977.

E. neriifolia L.
A shrubby thicket much used by local people for fuel purpose. *Safui* 2508.

E. thymifolia L.
A prostrate herb on sandy-rocky wastes. *Safui* 2499.

E. bombaiensis Santapau
A herb in abundance near fort area. *Rao* 2306.

E. heterophylla L.
A herb in abundance near fort area. *Rao* 1975. A new record (*Rao* 1963).

Jatropha gossypifolia L.
A common plant throughout the island. *Rao* 1569.

Acalypha indica L.
A common herb in shade near rocky build up. *Rao* 2306.

COMMELINACEAE

Commelina hasskarlii C.B.Cl.
A prostrate herb in sandy waste fields. *Rao* 1994.

CYPERACEAE

Cyperus arenarius Retz.
A sedge on sandy areas near the sea-shore. *Rao* 1963.

GRAMINAE

Dactyloctenium aegyptium (L.) P. Beauv.
A stunted grass in rocky crevices. *Rao* 1967.

Eragrostis ciliaris (L.) R. Br.
Found common in rocky crevices and sandy wastes. *Rao* 1982.

Halopyrum mucronatum Stapf
A sand binder found on sandy sea-shore. *Rao* 1966.

Dichanthium annulatum (Forsk.) Stapf
A common grass.

Urochondra setulosa (Trin.) C. E. Hubbard
An erect grass on salt-water creeks. *Safui* 2529.

Aeluropus lagopoides (L.) Trin.
A runner found abundant in salty creeks. *Safui* 2527.

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