

# CORAL REEF FLORA OF THE GULF OF MANNAR AND PALK BAY

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## ABSTRACT

The flora of the coral reefs occurring in the Gulf of Mannar and Palk Bay areas around Mandapam was studied, selecting transects from shore to the fringing reefs. Marine algae and seagrasses growing on the transects were sampled at five-metre intervals and a total number of 1850 samples was taken all along the 19 transects surveyed.

Physical conditions of the transects and relative abundance of the algae and seagrasses are given, along with a list of macroscopic forms present in the quadrat samples. Distribution of the important and common algae like *Halimeda*, *Caulerpa*, *Ulva*, *Microdictyon*, *Padina*, *Pocockiella*, *Sargassum*, *Turbinaria*, *Gelidiella*, *Amphiroa*, *Gracilaria* etc. and sea grasses is described. Influence of the nature of substratum and other environmental conditions on the algal distribution are discussed.

## INTRODUCTION

Our knowledge of the coral reef flora of the Gulf of Mannar and the Palk Bay is based on the publications of Iyengar (1927) Boergesen (1937*a*, 1937 *b*; 1938) and Chacko *et al.* (1955). These earlier investigations are of a taxonomic nature and detailed studies on the ecological conditions of the coral reef areas and the distribution of the flora are, however, lacking. During an investigation of the economic seaweeds of Mandapam area an attempt has been made to survey the vegetation of the coral reefs and the shallow lagoons formed between the reefs and the mainland. The results of this survey form the subject of this communication.

## MATERIALS AND METHODS

Mandapam lies 79° 8' E, 9° 17' N, on a narrow strip of land projecting from the southeast coast of India, with the Gulf of Mannar to the south and the Palk Bay to the north. At the end of this peninsular extension is Pamban Island which is connected to the mainland by a railway bridge. Fringing coral reefs occurring in the Gulf of Mannar and the Palk Bay near Mandapam are shown in Fig. 1.

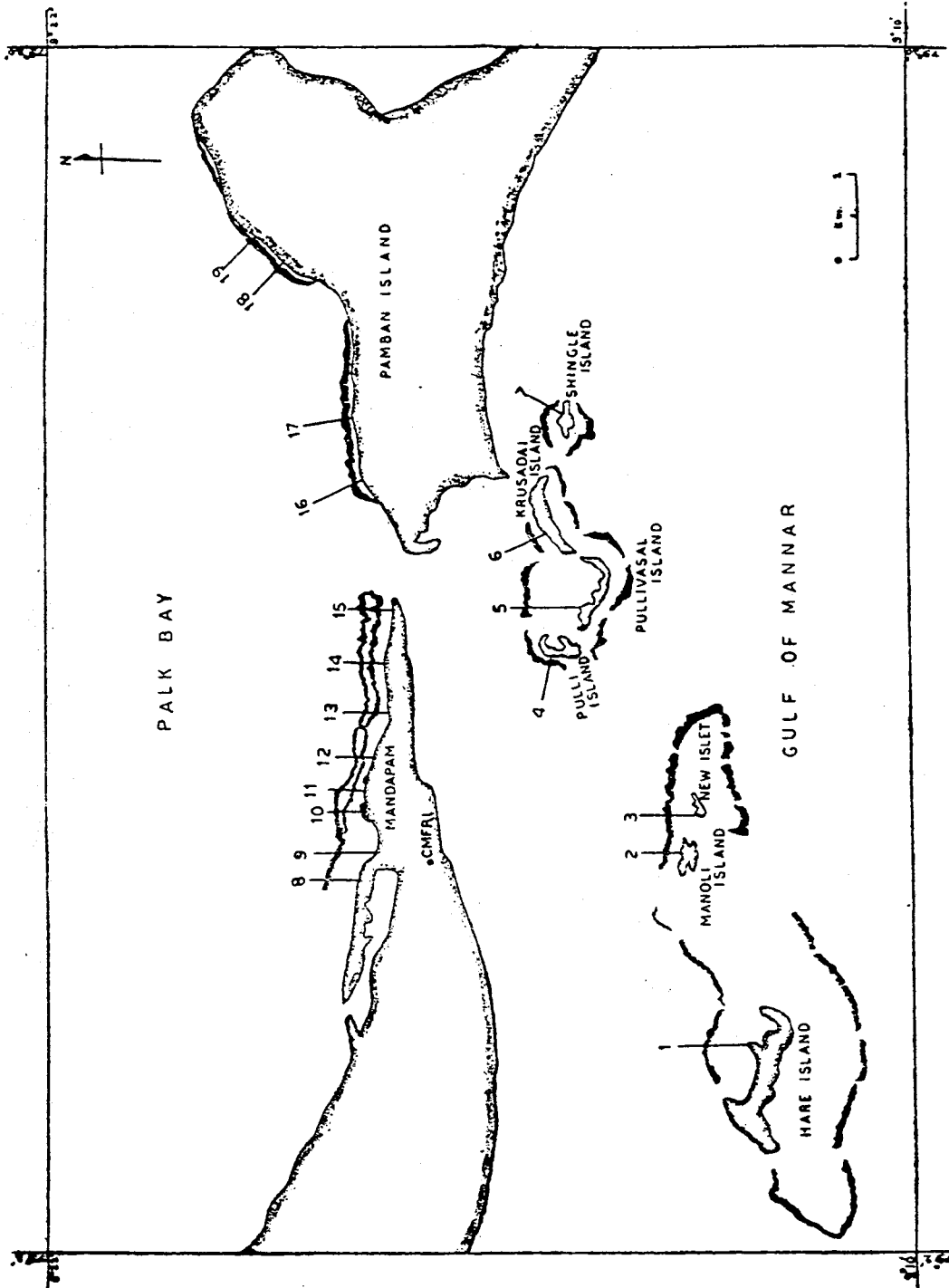


FIG. 1. Map of Mandapam area showing the position and number of the traverses surveyed.

Quantitative surveys were made in August 1965 and from April to August 1968, on 19 traverses selected in the Gulf of Mannar and Palk Bay around Mandapam (Fig. 1). Vegetation on the traverses covering the coral reef and the lagoon was sampled at five-metre intervals with a metre square quadrat. Details of the method employed in this survey have been given in an earlier account (Rao, 1968). Samples on the traverses chosen near New Islet, Manauli and Pullivasal Islands were taken from the low-water levels as extensive inshore areas are exposed during low tides. Information on the length of the traverses and number of samples taken on each traverse is given in Table 1. Data on the depth (measured by sounding lead), nature of the bottom and area covered by the sea grasses were also gathered at each sampling spot.

TABLE 1. *Details of the transect survey with density of algae.*

Locality	Transect No.	Length of the transect (m)	Samples taken on the transect	Fresh weight of algae obtained in the samples (kg)	Mean density (kg/m)
<i>Gulf of Mannar</i>					
Hare Island	1	635	127	103.8	0.82
Manauli Island	2	370	74	32.0	0.43
New Islet	3	560	112	78.5	0.70
Pulli Island	4	175	35	40.5	1.16
Pullivasal Island	5	525	105	112.7	1.07
Krusadai Island	6	430	96	63.9	0.67
Shingle Island	7	235	47	17.9	0.38
<i>Palk Bay</i>					
Mandapam	8	600	120	9.2	0.08
"	9	900	180	23.6	0.13
"	10	300	60	22.5	0.38
"	11	300	60	25.4	0.42
"	12	450	90	13.4	0.15
"	13	450	90	50.9	0.57
"	14	700	140	63.1	0.45
"	15	600	120	42.1	0.35
Pamban Island	16	175	35	14.8	0.42
"	17	155	31	29.7	0.96
"	18	140	28	24.7	0.88
"	19	150	30	16.9	0.56

The fresh weight of the alga per metre square (density) was taken as the quantitative measure to follow the distribution of the algae on the traverses and for the sea grasses the area covered by the grass within the quadrat was used as the

quantitative measure. On the coral reefs the depth was measured only from the bottom and not above the coral heads. All depth recordings were corrected to the zero level of the tide.

#### OBSERVATIONS

Observations on the physical conditions of the traverses, composition, relative abundance of the flora and on the distribution of the important and more common plants growing on the traverses are presented below. Quantitative data collected on the algae and sea grasses growing on Traverses - 2, 4, 5, 13 and 15 are plotted in Figs. 2 to 6, to show the general trends in the distribution of the flora of the coral reefs and the lagoons. Profiles of the traverses are drawn in each figure (Figs. 2 to 6) to show the physical conditions across the traverses surveyed.

##### *Physical conditions of the traverses:*

Each traverse can be divided into two sections, namely, the lagoon and the reef. The width of the lagoon and the position of the reef on the traverses varied from place to place. On Traverses - 4 to 6 and 7 in the Gulf of Mannar area and on Traverses - 16 to 19 in the Palk Bay area, the coral reef is situated very near to the shore with the width of the lagoon varying between 10 and 50 m (Fig. 2). On Traverse - 2 near Manauli Island and on Traverses 8, 10 to 13 and 15 in the Palk Bay, the reef is present at distances from 150 to 240 m and on Traverses 1, 3, 5 and 14 from 400 to 600 m from the shore. Only on Traverse - 9 the coral reef is present at a distance of about 800 m from the shore.

The reef is composed of lime stones of dead or fossilised corals in the form of boulders and platforms of different sizes and shapes. Live corals were seen on these coral heads with their density varying from one place to the other. Sandy patches are present in between the scattered coral heads and they are often covered with pebbles and coral fragments. On many traverses the bottom of the lagoon is composed of coarse or fines and with shells and coral pieces scattered here and there. Muddy substratum was observed on Traverse - 5 (Fig. 4) and in some parts of the lagoon on Traverses - 2, 3, 8, 13 and 15 (Figs. 2, 6). As shown in Fig. 3, the sea floor beyond the outer edge of the reef was also found to be muddy in many areas surveyed. Isolated boulders or patches of dead corals were seen all along the lagoon section of the Traverses - 1, 3 and 9 and definite dead coral zones were observed on Traverses - 5 and 10 in the near-shore areas extending from shore to 150 - 250 m distance (Fig. 4).

In general the sublittoral areas surveyed are very shallow, with the depth ranging from 0.5 to 2.5 m. Maximum depth recorded over the traverses is about 2.8 m below the zero level of the tide. Depth increased suddenly from the seaward side of the reef (Fig. 3). Water level above the coral reef varies according to the height of the boulders. In certain localities coral rocks at the crest of the reef get exposed during the low-water periods.

*Composition and abundance of the flora.*

Algae and sea grasses identified from the samples are listed below.

## Green algae:

*Ulva lactuca*  
*U. reticulata.*  
*Cladophora* sp.  
*Chaetomorpha* sp.  
*Neomeris annulata.*  
*Acetabularia moebii.*  
*Halicystis boergesenii.*  
*Valonia aegagropila.*  
*Boergesenia forbesii.*  
*Microdictyon agardianum.*  
*Struvea delicatula.*  
*Caulerpa cupressoides.*  
*C. fergusonii.*  
*C. mexicana.*  
*C. micropysa.*  
*C. peltata.*  
*C. racemosa.* v *clavifera*  
*C. racemosa.* v *coryneflora.*  
*C. scalpelliformis.*  
*C. serrulata* v *typica*, forma *lata.*  
*C. sertularioides* forma *brevipes.*  
*C. sertularioides* forma *longiseta.*  
*C. taxifolia.*  
*C. verticillata.*  
*Udotea javensis.*  
*Halimeda opuntia.*  
*H. tuna.*  
*Codium* sp.

## Brown algae:

*Dictyota* spp.  
*Padina commersonii*  
*P. gymnospora*  
*P. pavonia*

*P. tetrastromatica*  
*Pocockiella variegata.*  
*Pocockiella* sp.  
*Hydroclathrus clathratus.*  
*Chnoospora implexa.*  
*Hormophysa triquetra.*  
*Sargassum* sp.  
*Turbinaria conoides.*  
*T. ornata.*

## Red algae:

*Gelidiella acerosa.*  
*Gelidium pusillum.*  
*Amphiroa fragilissima.*  
*Chondrococcus harnemanni.*  
*Gracilaria crassa.*  
*G. foliifera.*  
*G. lichenoides.*  
*Hypnea* spp.  
*Champia globulifera.*  
*Wrangelia argus.*  
*Ceramium* spp.  
*Centroceras clavulatum.*  
*Spyridia filamentosa.*  
*Martensia fragilis.*  
*Roschera glomerulata.*  
*Leveillea jungermannioides.*  
*Chondria dasyphylla.*  
*Acanthophora spicifera.*  
*Laurencia obtusa.*  
*L. papillosa.*

## Sea grasses:

*Cymodocea* sp.  
*Diplanthera wrightii.*  
*Syringodium filiforme.*  
*Halophila ovalis.*

Percentage frequency values have been calculated for the algae and sea grasses found in the quadrat samples to assess the relative abundance of the plants listed above. *Halimeda opuntia* is the dominant constituent of the flora as it was observed

in 20.44% of the samples collected. Sea grasses occurred in 15.75% of the samples, *Caulerpa* spp. in 13.41%, *Sargassum* spp. in 13.10%, *Amphiroa fragilissima* in 10.5% and *Gracilaria lichenoides* in 9.74% of the samples, indicating that these plants are the other conspicuous elements in the flora of the coral reef areas studied. Species of *Padina*, *Dictyota*, *Turbinaria*, *Hypnea*, *Ulva*, *Halimeda tuna*, *Chnoospora implexa*, *Acanthophora spicifera*, *Gracilaria crassa* and *Gracilaria foliifera* are less abundant and they were encountered in 4 to 8% of the quadrat samples. The rest of the algae are rare forms and the frequency values ranged from 0.1 to 3.1%.

#### *Distribution of the flora*

From the data obtained on the fresh weight of the algae on each traverse and mean density (Table 1) it is evident that the abundance of the algal flora varies from one place to the other. As shown in Table 1, luxuriant growth of algae with a mean density of 0.7 to 1.16 kg./m<sup>2</sup> was observed on traverses selected near Hare Island, New Islet, Pulli and Pullivasal Islands in the Gulf of Mannar and on Traverses - 17 and 18 in the Palk Bay. On the other traverses the algal growth was scarce and the mean density of the vegetation varied from 0.08 to 0.67 kg./m<sup>2</sup>.

The species composition on the reef was found to be different from that in the lagoon. *Ulva reticulata*, *Halimeda opuntia*, *H. tuna*, *Caulerpa racemosa* v *clavifera*, *Pocockiella* sp., *Chnoospora implexa*, *Sargassum* spp., *Turbinaria conoides*, *T. ornata*, *Gelidiella acerosa*, *Chondrococcus harnemanni* and many other forms occurred on the coral reef and some species of *Caulerpa*, *Microdictyon agaridium* and *Amphiroa fragilissima* in the lagoon area (Fig. 5). Species of *Dictyota*, *Padina* and *Gracilaria foliifera* were noted in all the samples obtained from the lagoon and the reef, except on Traverse - 13 (Fig. 5) where *Padina* was observed only in the lagoon section. Though *Gracilaria lichenoides* was met with both in the lagoon and the reef, maximum densities were recorded from the lagoon area (Figs. 5,6). Fully grown algae were also seen as loose-lying forms in certain parts of the lagoon.

Sea grasses were observed mainly in the lagoon section of the traverses. On Traverses - 8, 9, 12 to 14 they were seen as dense beds (Fig. 5), starting from 10-40 m to a distance of 150-300 m. *Cymodocea* is the dominant member among the four genera observed on the traverses. These marine angiosperms occurred as scattered patches in the lagoons covered with coral heads (Traverses 1 and 3) and they are absent in places where the coral reef is very near to the shore (Traverses-16 to 19).

In the distribution of the algae certain variations were found in relation to the substratum and other physical conditions of the area and maximum densities were recorded for many species at certain spots on the traverses. Dense growth for *Microdictyon* and *Amphiroa* was noticed on the sea grass beds (Figs. 2,5), whereas other algae like *Caulerpa scalpelliformis* (Fig. 6), *Gracilaria lichenoides* and *Ulva lactuca* (Fig. 5) showed their highest development on the sandy and muddy areas of

the lagoon. Similarly, *Sargassum* and *Turbinaria* species are concentrated at the shoreward parts of the reef (Figs. 2,5) and *Chnoospora implexa*, *Pocockiella* sp. *Chondrococcus harnemanni* and *Ulva reticulata* (Figs. 2,3) at the central part or at the outer edge of the reef. *Gelidiella acerosa* was observed on traverses selected near Pulli and Pamban Islands where the reef is very near the shore (Fig. 3). Distribution

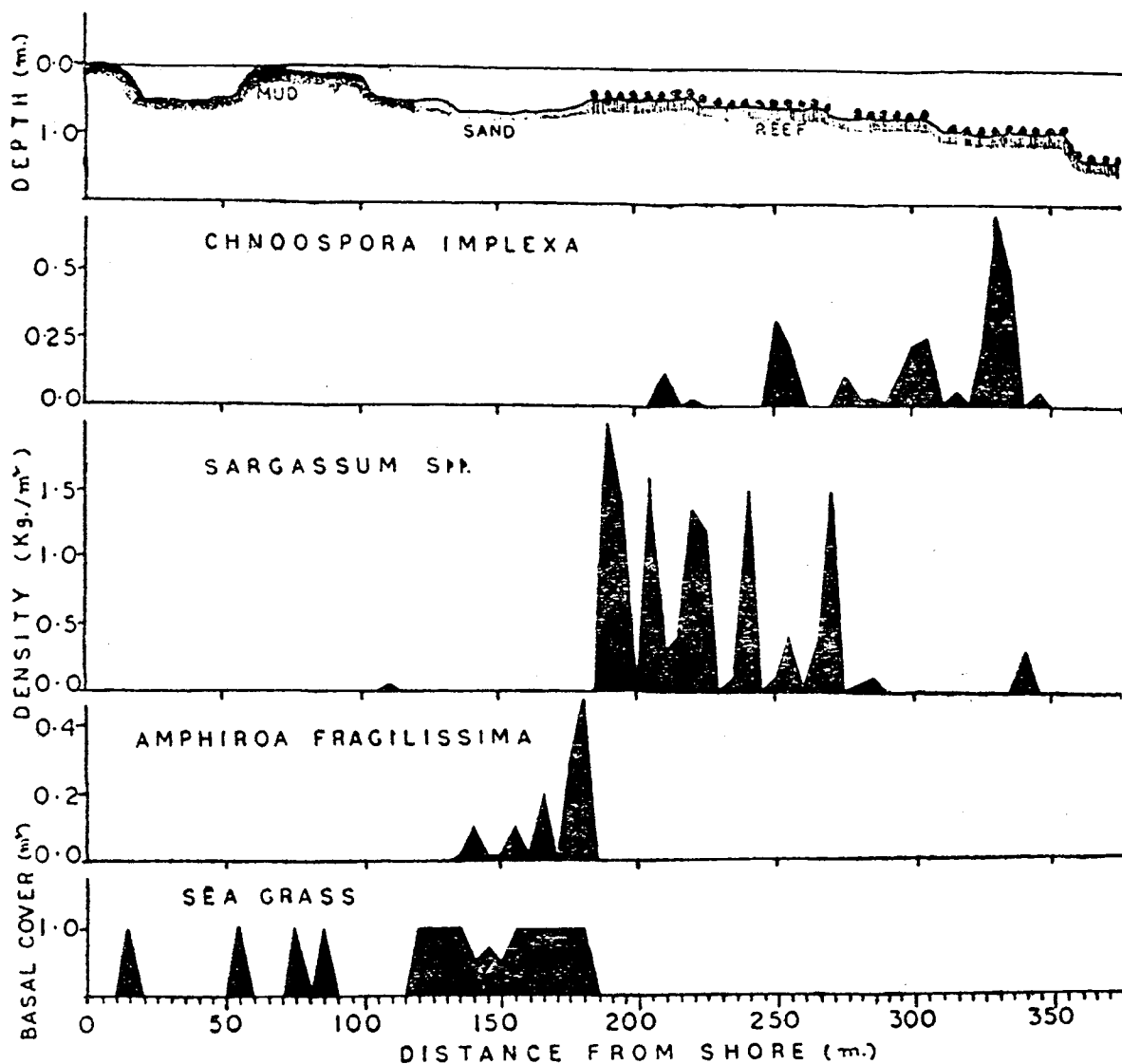


FIG. 2. Distribution of the flora on Traverse—2.

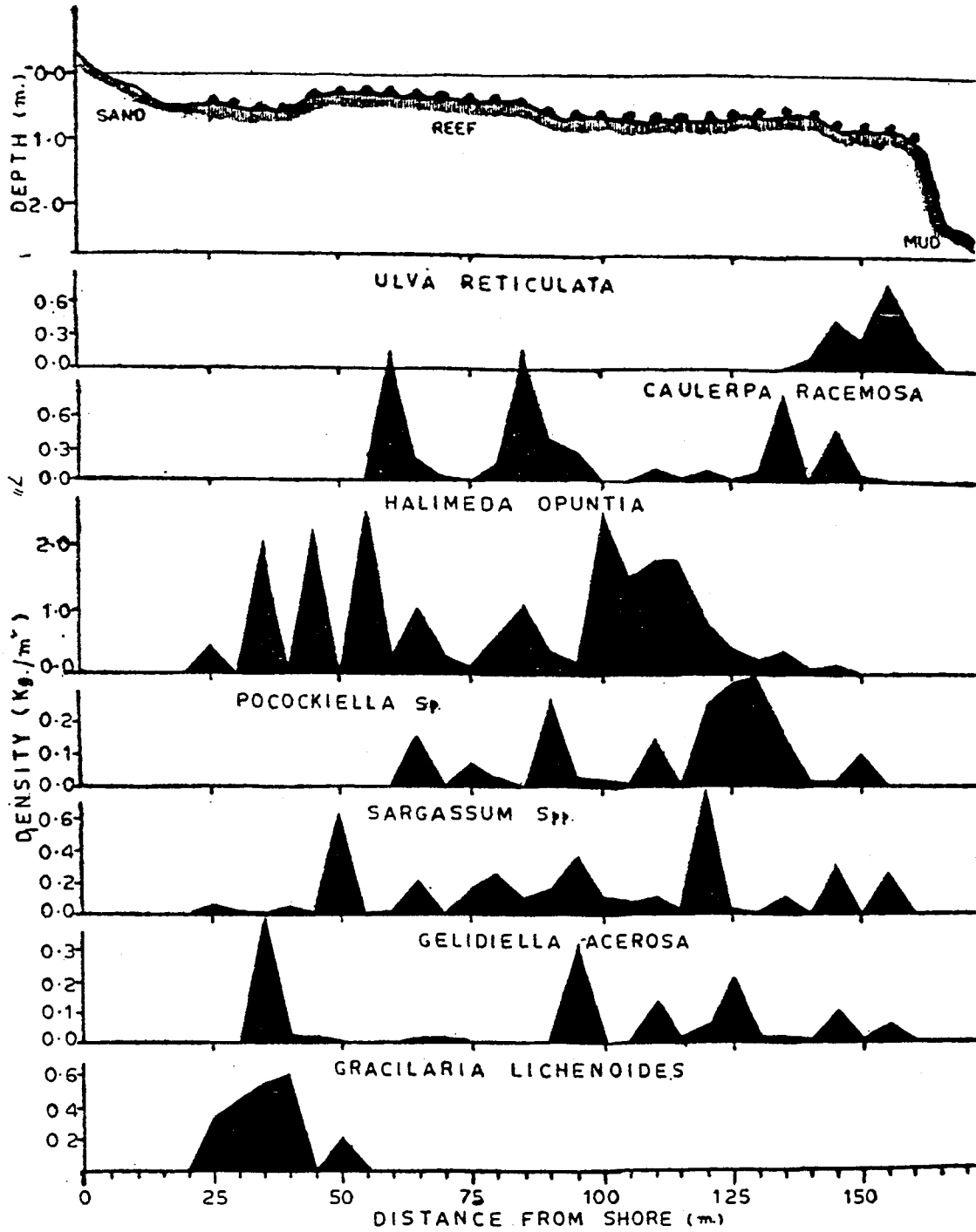


FIG. 3. Distribution of the flora on Traverse—4.



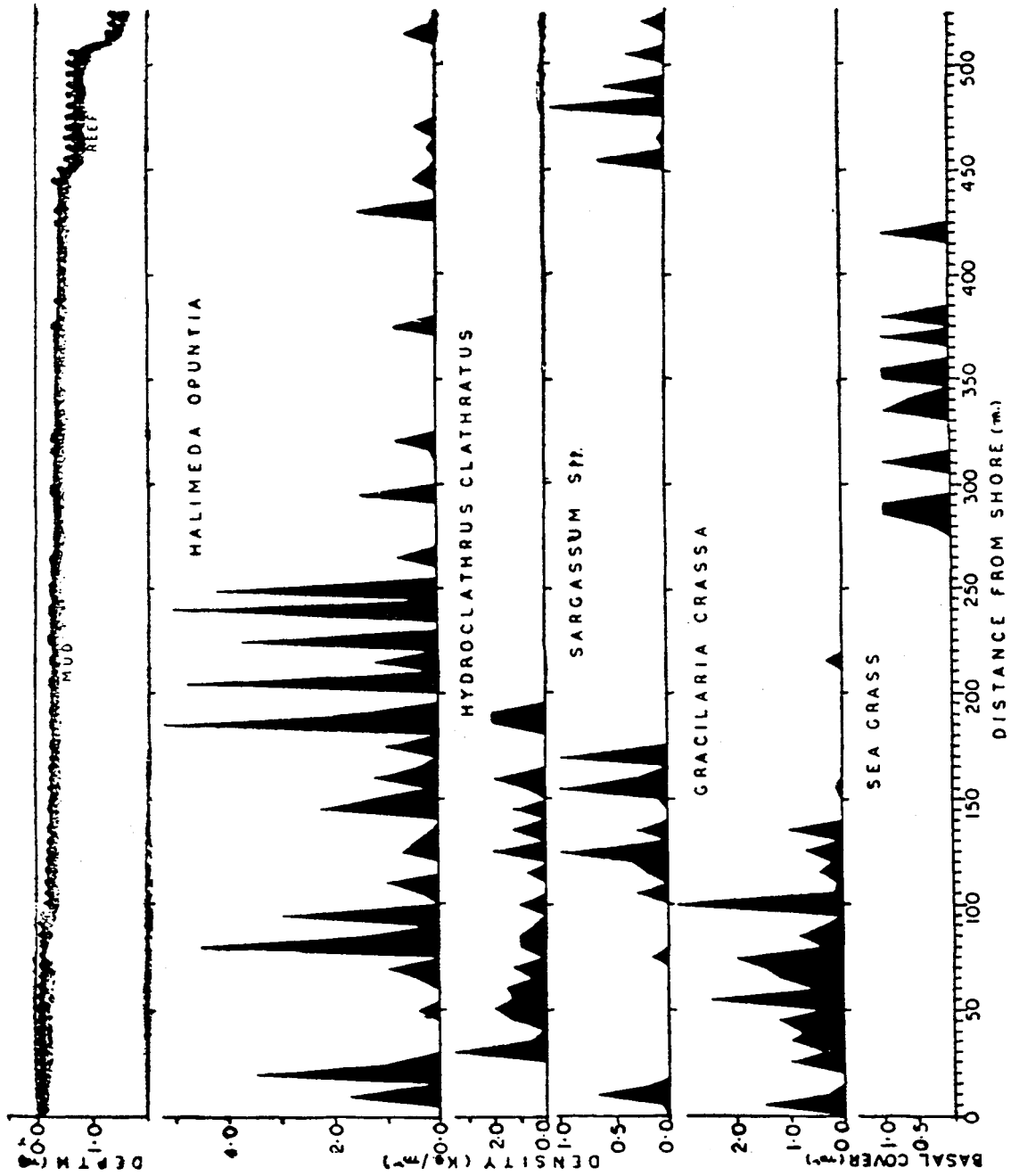


FIG. 4. Distribution of the flora on Traverse-5.

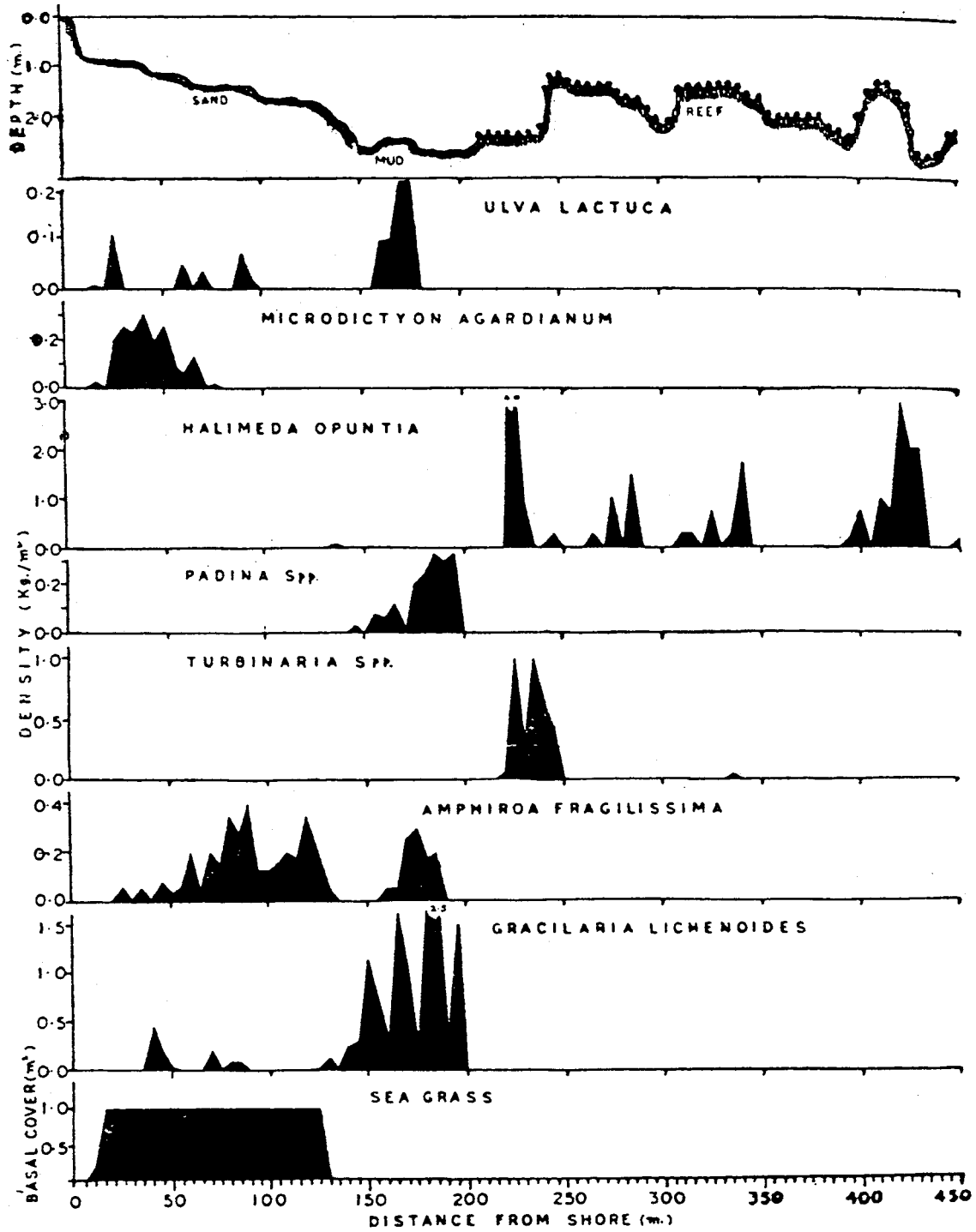


FIG. 5. Distribution of the flora on Traverse—13.

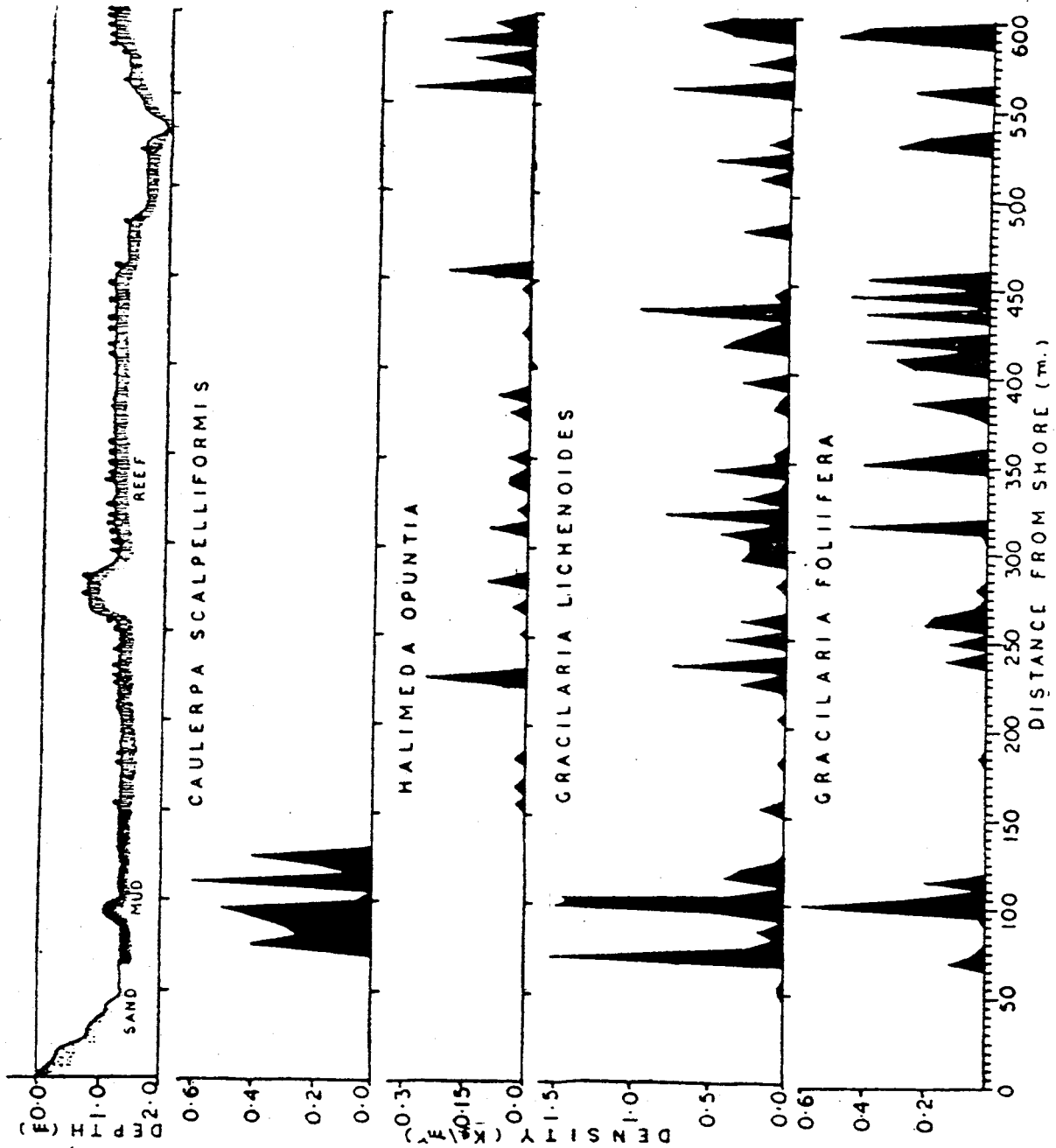


Fig. 6. Distribution of the flora on Traverse—15.

of the algae like *Gracilaria crassa* (Fig. 4), *Acanthophora spicifera*, *Laurencia papillosa* and *Hydroclathrus clathratus* was limited to the near shore coral rocks that are exposed during extreme low tides.

An examination of the data and figures further indicates the relationship existing between the substratum and species. Some species of *Caulerpa* such, as *C. racemosa* v *corynephora*, *C. sertularioides longiseta* and *C. verticillata*, were restricted to muddy areas, and *C. peltata*, *C. fergusonii*, *C. microphysa* to coral substratum. Algae like *Microdictyon* and *Amphiroa* were found associated with or attached to sea grasses. Occurrence of *Halimeda* and *Turbinaria* very near to the shore on Traverses 5 and 10 also suggests the importance of rocky substratum for the growth of these algae.

#### DISCUSSION OF THE RESULTS

In the present survey, conducted near the coral reefs of the Gulf of Mannar and Palk Bay, a total of 61 species of algae has been collected and they are distributed among the three major groups as shown below:

	Green algae	Brown algae	Red algae	Total
Genera	14	8	17	39
Species	28	13	20	61

Members of the green algae are more than the other groups and many species present in the flora of the Gulf of Mannar and the Palk Bay have been reported from the Addu Atoll, Maldives in the Indian Ocean (Tsuda and Newhouse, 1966; Sigeo, 1966) and from the coral reef areas of the Pacific Ocean (Manton, 1935; Gilmartin, 1960; Tsuda, 1964; 1965; 1966 and Buggelin, 1965).

From the frequency of occurrence of different species in the quadrat samples, it is clear that *Halimeda opuntia* is the dominant member on the coral reefs of the Gulf of Mannar and Palk Bay. Species of *Caulerpa* and *Sargassum* are the other most common plants found on the reef and *Amphiroa fragilissima*, *Gracilaria lichenoides* and sea grasses in the lagoons occurring between the shore and the reef.

Ecological surveys have been made on the Low Isles reef (Manton, 1935) and at Addu Atoll (Sigeo, 1966) where the nature of the reef, depth and other conditions of the traverses are different from the reefs surveyed in the present study. However certain common features can be seen in the distribution of the flora in these coral reef areas. Manton (1935) observed dense algal growth on the exposed reef flat and the shallower part of the moat on the traverses surveyed by her. The physical conditions and composition of the flora of the reef flat and the moat are somewhat similar to those occurring on Traverses - 5 near Pullivasal Island (Fig. 4). As reported in the preliminary account of Sigeo (1966), definite zonation was not observed across the traverses surveyed in the Gulf of Mannar and Palk Bay, except for the variations in the composition and density of the vegetation on the reef and the lagoon.

From the observations made on the environmental conditions it is evident that the composition and density of the different species vary to a great extent with the nature of the substratum along the traverses (Figs. 2-6). Occurrence of luxuriant growth in the deeper parts of the lagoon (Fig. 5) and on the shoreward parts and other low-lying areas of the reef where the water level is high, would also indicate the influence of depth above the substratum on the growth and distribution of the flora.

#### SUMMARY

Flora of the coral reefs in the Gulf of Mannar and Palk Bay regions of Mandapam was studied using quantitative methods. Observations made on the physical conditions of the traverses surveyed, composition, relative abundance and distribution of the algae and sea grasses are given. Results obtained in this study suggest that the physical conditions like the nature of the substratum and water level above the substratum influence the distribution of the flora of the coral reef areas.

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#### REFERENCES

- BOERGESSEN, F. 1937a. Contribution to a South Indian marine algal flora I. *J. Indian bot. Soc.*, 16: 1-56.
- BOERGESSEN, F. 1937b. Contribution to a South Indian marine algal flora II. *J. Indian bot. Soc.*, 16: 311-375.
- BOERGESSEN, F. 1938. Contribution to a South Indian marine algal flora III. *J. Indian bot. Soc.*, 17: 205-241.
- BUGGELIN, R.G. 1965. A preliminary list of the algal flora of the Midway Island. *Atoll Res. Bull.*, No. 109: 1-11.
- CHACKO, P.I., MAHADEVAN S. AND GANESAN, R. 1955. A guide to the field study of the fauna and flora of Krusadai Island, Gulf of Mannar. *Contr. mar. biol. St. Krusadai Island*, 3: 1-16.
- GILMARTIN, M. 1960. The ecological distribution of the deep water algae of Eniwetok Atoll, *Ecology*, 41: 210-221.
- IYENGAR, M.O.P. 1927. Krusadai Island flora. *Bull. Madras. Govt. Mus. N.S.*, 1: 185-188.
- MANTON, S.M. 1935. Ecological surveys of coral reefs. *Scient. Rep. Gt. Barrier Reef Exped.*, 3: 273-312.
- RAO, M. UMAMAHESWARA 1968. The seaweed potential of the seas around India. *Symp. Living Resources. India*, Cochin, December 7-10.

- SIGEE, D.C. 1966. Preliminary account of the land and marine vegetation of Addu Atoll. *In* Reef studies at Addu Atoll, Maldives Islands (Ed-D.R. Stoddart). *Atoll Res. Bull.*, No. 116: 61-74.
- TSUDA, R.T. 1964. Floristic report on the marine benthic algae of selected islands in the Gilbert Group. *Atoll Res. Bull.*, No. 105: 1-13.
- TSUDA, R.T. 1965. Marine algae from Laysan Island with additional notes on the vascular flora. *Atoll Res. Bull.*, No. 110: 1-31.
- TSUDA, R.T. 1966. Marine benthic algae from the Leeward Hawaiian Group. *Atoll Res. Bull.*, No. 115: 1-13.
- TSUDA, R.T. AND J. NEWHOUSE. 1966. Marine benthic algae from Addu Atoll, Maldives Islands *In* Reef studies at Addu Atoll, Maldives Islands (Ed-D.R. Stoddart) *Atoll Res. Bull.*, No. 116 93-102.