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Nature and Distribution of the Littoral Algae and Sea Grasses of the South-west Coast of India

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The occurrence of 127 forms of algae, comprising 60 genera; 13 belonging to Chlorophyta, 11 to Phaeophyta and 36 to Rhodophyta has been reported from the south-west coast of India. One hundred species have been identified up to the species level, of which 30 belong to Chlorophyta, 13 to Phaeophyta and 57 to Rhodophyta. Three species are restricted to the estuarine habitat. Six species of sea grasses have also been collected and identified. Twenty stations were chosen for the qualitative survey of algal elements, of which four were typical to estuaries. Seven species are new to the Indian coast. Some species exhibited restricted distribution in the area surveyed. The nature of distribution of algae in the intertidal zones is discussed at the four representative stations. Such a study is new to the Kerala coast.

Key Words: Littoral algae, Sea grasses, Chlorophyta, Phaeophyta, Rhodophyta

Introduction

The first records on the marine algae of India were as part of the results of the explorative voyages undertaken by visitors in the seas around India. Thus, Boergesen collected algae from the east-west coast of India and published a series of papers on Chlorophyta, Phaeophyta and Rhodophyta of India (Boergesen 1930, 1931, 1932a,b, 1933 a,b, 1934a,b, 1935, 1937a,b and 1938). Since then several attempts have been made to survey the marine algal resources along the Indian coasts (Koshy & John 1948, Chacko & Malu Pillai 1958, Parasannavarma 1959, Desai 1967, Umamaheswara Rao & Sreeramulu 1970, Chauhan & Krishnamurthy 1968, Untawale & Dhargalkar 1975, Chauhan & Mairh 1978, Subba Rao et al. 1983, Agadi 1983 and Jagtap 1983). Biswas (1945), reviewed the marine algae and Srinivasan (1960) gave detailed accounts of 162 genera and 413 species occurring along the east and west coasts of India.

Nearly 624 species of marine algae have so far been reported from the Indian coasts (Untawale et al. 1983). But the algal resources of Kerala coast have not received the attention of workers until recently. Sobha and Nair (1983) reported the occurrence of 44 species of algae and 3 species of sea grasses along the Kerala coast.

The present paper deals with the results of a survey of algae at 20 stations and the nature of their distribution in the intertidal zone at four representative stations, viz. Cape Comorin, Kovalam, Quilon and Tikkodi.

Material and Methods

Twenty representative stations (figure 1) were chosen and a detailed survey of the littoral flora was carried out during 1984–85. Littoral flora were collected from all the above-mentioned stations and most of them were identified. Specimens were preserved in formalin. The preserved specimens and the herbarium sheets are kept in the Department of Aquatic Biology and Fisheries, University of Kerala.

Based on the observations of the detailed survey at all the above-mentioned stations, four representative stations, viz. Cape Comorin, Kovalam, Quilon and Tikkodi were selected for the study of the intertidal distribution of algal species. For convenience, the intertidal area was divided into three zones namely the high,

Fig. 1

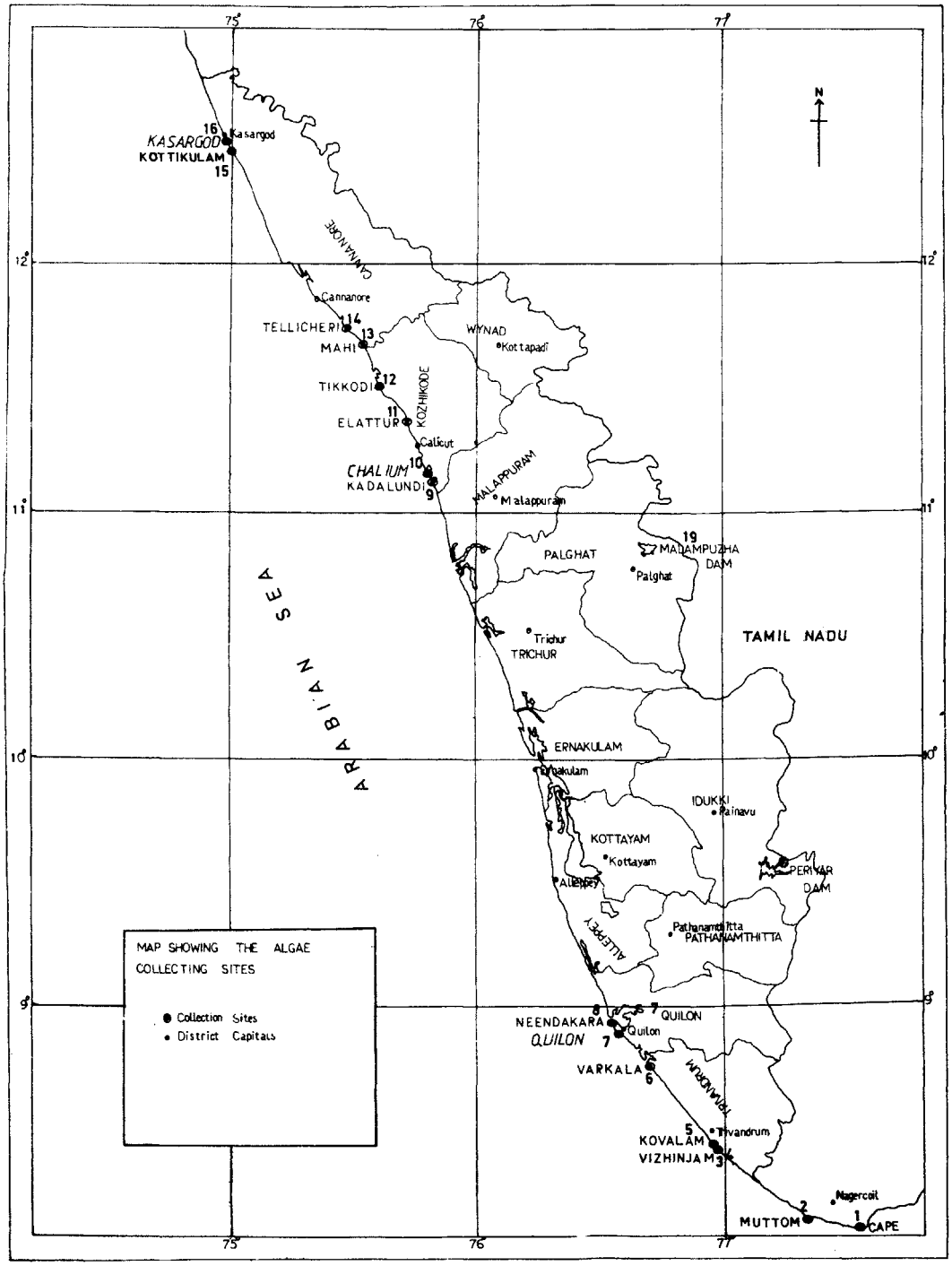

Figure 1

Three other stations were Ashtamudi (17), Perumathura (18), and Kanjiramkode (20)

the mid and the low tide regions. These four representative stations were chosen since they were found to be ideal algal habitats with rocky or coral substrata and a luxuriant growth of algae and good species representation. The details of these four stations are as follows:

Cape Comorin (8°4'45"N Lat. and 77°34'E Long.): This is a rocky shore interspersed with coral growth. Sandy pools occur here and there amidst these outcrops. There are no freshwater inlets in the vicinity of this station.

Kovalam (8°23'39"N Lat. and 76°57'E Long.): This is a precipitous rocky shore facing the full impact of the sea.

Quilon (8°52'N Lat. and 76°34' E Long.): It is a rocky shore with cracks and crevices. There are also rows of granite blocks supporting good algal growth.

Tikkodi (11°29'N Lat. and 75°37'E Long.): This station has an extensive rocky promontory with small bays of sand harbouring a rich algal vegetation.

Results and Discussion

During the present study, 127 forms of algae have been collected (table 1). Of these, 100 species have so far been identified up to the species level, of which 30 belong to Chlorophyta, 13 to Phaeophyta and 57 to Rhodophyta. These are assignable to 60 genera—13 belonging to Chlorophyta, 11 to Phaeophyta and 36 to Rhodophyta. Till date, as many as 250 genera were reported from different parts of India (Untawale et al. 1983).

Table 1 *A list of marine algae of Kerala Coast*

Sl. No.	Name of algae	Station															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	DIVISION-CHLOROPHYTA																
1.	*Monostroma* sp.	+															
2.	*Ulva fasciata* Dellile	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+
3.	*U. lactuca* Linn.							+									
4.	*Enteromorpha flexuosa* (Wulf.) J. Ag.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5.	*E. linza* (L.) J. Ag.	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+
6.	*Chaetomorpha antennina* (Bory) Kuetz.	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+
7.	*C. media* (C. Ag.)					+		+	+								
8.	*C. tortuosa* Kuetz.	+															
9.	*Spongomorpha indica*, Thivy & Visalakshmi							+					+				
10.	*Rhizoclonium kerneri* Stockm.												+				
11.	*Cladophora fascicularis* (Mertens) Kuetz.	+	+	+		+	+	+	+	+	+		+	+	+	+	+
12.	*Cladophora* sp.					+							+				
13.	*Cladophora* sp.					+											
14.	*Bryopsis hypnoides* Lamour.							+									
15.	*B. pennata* Lamour.	+	+	+	+	+						+	+	+	+		+
16.	*B. plumosa* (Hud.) Ag.											+	+				
17.	*Bryopsis* sp.				+	+											
18.	*Caulerpa crassifolia* (Ag.) J. Ag.					+											
19.	*C. clavifera* (Turn.) Ag.	+															
*20.	*C. corynephora* (Mont.) Web. V. Bosse	+															
21.	*C. peltata* Lamour.	+	+	+		+		+					+				+
22.	*C. parvula* Sved.	+	+	+	+	+											
23.	*C. racemosa* (Forssk.) V. Bosse			+	+	+											
24.	*C. sertularioides* (Gmel.) Howe.												+				

Table 1 *(Contd.)*

Sl. No.	Name of algae	Station														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
25.	*C. scalpelliformis* (R.Br.) V. Bosse	+	+	+									+				
26.	*C. taxifolia* (Vahl.) Ag.	+				+		+							+	+	
27.	*C. chemnitzia* (Esper) Weber-Van Bosse						+		+								
28.	*Codium* sp.	+	+														
29.	*Halimeda tuna* (Ell. et. sol.)	+	+														
30.	*Struvea anastamosans* (Harv.) Picone							+					+				
31.	*Valoniopsis pachynema* (Martns)Boergs.	+	+	+		+		+					+				
	DIVISION-PHAEOPHYTA																
1.	*Levringia boergensenii* Kylin	+															
2.	*Colpomenia sinuosa* Derb. et. sol	+															
3.	*Chnoospora fastigiata* J. Ag.	+	+														
4.	*C. minima* (Hering) papenfuss	+	+														
5.	*C. bicaneliculata* Krishnamurthy & Thomas		+														
6.	*Dictyopteris delicatula* Lamom.	+	+	+		+		+									
7.	*Dictyota dichotoma* (Huds.) Lamom.	+	+	+		+		+									
8.	*Dictyota* sp.												+				
9.	*Dictyota* sp.												+				
10.	*Padina tetrastromatica* Hauck.	+	+	+	+	+		+				+	+			+	
11.	*Padina* sp.							+					+				
12.	*Spatoglossum asperum* J. Ag.	+						+					+				
13.	*Stoechospermum maculatum* J. Ag.	+	+					+					+				
14.	*S. marginatum* (Ag.) Kuetz.	+	+	+		+							+				
*15.	*Lobospira variegata* (Lamx.) Womersly	+						+									
16.	*Sargassum wightii* Greville							+									
17.	*Sargassum* sp.													+			
18.	*Sargassum* sp.					+											
19.	*Sargassum* sp.	+	+														
20.	*Sargassum* sp.							+									
	DIVISION-RHODOPHYTA																
1.	*Acrochaetium iyengarii* Boerg			+													
2.	*Dermonema frappieri* (Mont et. Millardet) Boergs.	+	+	+										+			
3.	*Gelidium micropterum* Kuetz.		+														
4.	*Gelidium pusillum (Stackh.) Le Jolis*	+	+	+		+		+		+	+	+	+	+	+	+	
5.	*Gelidium* sp.		+														
6.	*Chondrococcus hornemanii (Mert.)*	+	+	+		+											
7.	*Amphiroa anceps* (Lamk.) Decsne	+	+														
8.	*Amphiroa brasiliana* Taylor	+	+														

Table 1 *(Contd.)*

Sl. No.	Name of algae	Station															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
9.	*A. fragilissima* (L.) Lamour.	+															
10.	*A. foliacea* Lamour	+															
11.	*Amphiroa* sp.							+									
12.	*Cheilosporum spectabilis* Harv.	+	+	+		+		+									
13.	*Jania* sp.					+											
14.	*Grateloupia comorinii* Boergs.	+	+														
15.	*G. filicina* (Wulf.) Ag.									+	+	+	+	+	+	+	+
16.	*G. lithophila* (Boergs.)	+	+	+		+	+	+	+	+		+			+	+	+
17.	*Grateloupia* sp.					+											
18.	*Solieria robusta* (Grev.) Kylin	+				+											
19.	*Sarconema filiforme* (Sond.) Kylin	+	+														
20.	*Hypnea musciformis* (Wulf.) Lamour	+				+											
21.	*Hypnea nigrescens* (Grev.) J. Ag.	+						+					+				
*22.	*Hypnea horrida* Boergs.	+															
23.	*Hypnea pannosa*		+														
24.	*Hypnea* sp.	+	+	+		+	+	+		+	+				+	+	+
25.	*Hypnea* sp.												+	+			
26.	*Hypnea* sp.	+															
27.	*Hypnea* sp.	+	+	+		+		+	+				+				
28.	*Gracilaria corticata* J. Ag.	+	+	+		+	+	+		+		+	+	+	+	+	+
29.	*G. crassa* Harv	+															
30.	*G. disticha* J. Ag.	+															
31.	*G. folifera* (Forsk.) Boergs.	+					+						+		+	+	+
32.	*G. fergusonii* J. Ag.		+														
33.	*G. verrucosa* (Huds.) Papen										+						
34.	*Gracilaria* sp.	+															
35.	*Gelidiopsis gracilis* (Grun.) Vickers	+															
36.	*G. intricata (Ag.) Vickers*	+	+														
37.	*G. repens* (Kuetz.) Schmitz.	+	+	+		+		+	+				+				
38.	*G. variabilis* (Grev.) Schmitz.	+	+	+		+	+	+	+	+	+	+	+				
39.	*Gymnogongrus pygmaeus* (Grev.) J. Ag.	+	+	+		+		+									
40.	*Sarcodia ceylanica* Harvey							+									
41.	*Botryocladia leptopoda* (J. Ag.) Kylin	+						+									
42.	*Rhodymenia* sp.	+															
43.	*Champia parvula* (Ag.) Harv. (*Champia compressa* Harv. Var. Scindica (Harv) Boerg					+		+									
44.	*Centroceros clavulatum* (Ag.) Mont.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
45.	*Ceramium fimbriatum* Setchel & Gardner	+															

Table 1 *(Contd.)*

Sl. No.	Name of algae	Station														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
46.	*Griffithsia corallina* (Lightf.) Ag. *(Griffrthsia rhizophora* (Grun) Weber Van Bosse)	+	+	+		+											
47.	*Spyridia insignis* J. Ag.	+	+	+		+							+				
48.	*Nitophyllum* sp			+		+											
49.	*Caloglossa leprieurii* (Mont.) J.A.								+								
50.	*Caloglossa* sp.								+								
51.	*Martensia pavonia* J. Ag.					+											
52.	*Dictyurus purourescens* Bony	+															
53.	*Polysiphonia tuticorenensis* Boergs.	+	+														
54.	*Polysiphonia* sp.					+											
55.	*Chondria armata* Kuetz.					+											
56.	*Laurencia flagelliformis* J. Ag.	+															
*57.	*L. nidifica* J. Ag.		+														
58.	*Laurencia* sp.	+															
*59.	*L. brandenii* Saito & Womersely	+				+											
*60.	*L. brongniartii* J. Ag.											+					
61.	*L. Paniculata* J. Ag.											+					
62.	*L.cruciata* Harve		+														
*63.	*L. flagellifera* J. Ag.	+															
64.	*Laurencia* sp.	+	+														
65.	*Acanthophora specifera (Vahl.) Boergs.*	+						+					+				
66.	*Bryocladia thwaitessi* Harv.	+															
67.	*Enantiocladia prolifera* (Greve) Falk	+															
68.	*Corynomorpha prismatica* J. Ag.	+	+														
69.	*Leveillea jungermannioides* (Mert. et. Her. Harv.)	+															
70.	*Neurymenia fraxinifolia* (Mert.) J. Ag.	+	+														
71.	*Scinia carnosa* Harv.	+															
72.	*Porphyra kanyakumariensis* Krishnamurthy & Baluswami	+		+													

*Species reported for the first time from India

Nine species were found to occur in estuarine habitats (table 2). Of these, three species of *Enteromorpha*, viz. *E. clathrata*, *E. intestinalis* and *E. ovata*, are restricted to the estuarine habitat. Six species of sea grasses have also been collected, of which three have already been reported earlier (Nair et al. 1982). Out of the six species, five are inhabitants of Cape Comorin, while two are found to occur in the Ashtamudi Estuary (table 3) *Najas graminea* is restricted to the estuarine habitat while *Halophila ovalis* occurred both in marine and estuarine habitats. The remaining four species are strictly marine.

Qualitative survey of the littoral flora was carried out during three periods of the year, viz. premonsoon,

Table 2 *Estaurine algae*

Sl. No.	Name of algae	Station			
		17	18	19	20
1.	*Ulva fasciata* Delilile	+			
2.	*U. lactuca* (Linn.) Le Jolis	+			
3.	*Enteromorpha clathrata* (Roth.) J. Ag.		+		
4.	*E. flexuosa* (Wulf.) J. Ag.			+	
5.	*E. intestinalis* (Linn.) Link.			+	
6.	*E. linza* J. Ag.	+			
7.	*E. ovata* Thivy & Visalakshmi		+		
8.	*Cladophora fascicularis* (Mertens) Kuetz.				+
9.	*Caloglossa leprieurii* (Montange) J. Ag.			+	

Table 3 *Sea grass*

Sl. No.	Sea grass	Station	
		1	17
1.	*Najas graminea* V. minor		+
2.	*Halophila ovalis* (R. Br.) Hook	+	+
3.	*Halodule uninervis* (Forssk.) Ascherson	+	
4.	*Cymodocea serrulata* (R. Br.) (Ascherson & Magnus)	+	
5.	*Syringodium isoetifolium* (Ascherson) Dandy	+	
6.	*Thalassia hemprichii (Ehrenberg) Ascherson*		

monsoon and postmonsoon. The premonsoon survey yielded several species many of which are new records for the Kerala coast. The impact of rainfall on the incidence and growth of algae was evident during the monsoon survey which was characterized by the following observations.

(1) A partial or total destruction of certain species which were common during the hot, highly saline premonsoon season was evident.

(2) Appearance and development of several new forms not noticeable during the premonsoon period and whose incidence was confined to the monsoon period.

(3) Colonisation of algae in areas of the shore not occupied during the premonsoon, more especially in the upper levels of the intertidal zone.

The destruction of algae during the monsoon was mainly confined to the higher levels of the intertidal zone. Certain species, more especially those belonging to the Phaeophyta and caulerpales of the Chlorophyta, irrespective of their position in the tidal region, were adversely affected. The degree of destruction varied from station to station. Certain species were most susceptible during the transition period between the premonsoon and the monsoon. They were *Centroceras clavulatum, Caulerpa* sp., *Grateloupia* sp., *Valoniopsis pachynema, Stoechospermum* sp., *Dictyota* sp., *Spatoglossum asperum, Chondrococcus hornemanii, Acanthophora specifera* and *Padina tetrastromatica.*

The destruction of the premonsoon forms during the rainy season at Tikkodi was almost total. The exceptions being *Gracilaria* sp., *Gelidium* sp. and *Lobospira* sp. At Kottikulam, Kasargod and Mahi *Grateloupia filicina* and *G. lithophila* were partially destroyed. *Centroceras clavulatum* almost disappeared from all the stations. *Chondrococcus* sp. and *Caulerpa* sp., which exhibited lush growth in Quilon, Kovalam, Muttom and Cape, were more or less completely destroyed at Tikkodi.

Despite this elimination of several species, the maximum algal growth was noticed during the monsoon season. Thus, some species such as *Enteromorpha flexuosa, E. linza, Ulva fasciata, Cladophora fascicularis* and *Dermonema frappieri* exhibited lush growth and developed into quite conspicuous forms over the upper levels of the intertidal zone indicating their preference for the meteorological and hydrographical conditions prevailing during that period.

Another interesting observation was that some species were common to all the stations while others were apparently restricted to certain stations only. Thus, *Enteromorpha* spp., *Chaetomorpha antennina, Cladophora fascicularis, Gelidium pusillum, Gracilaria corticata* and *Centroceras clavulatum* were commonly present in almost all stations. Out of 127 algal forms, 78 were found to occur at Cape Comorin and 27 species were restricted to this station.

The intertidal distribution of algae with respect to depth was studied at four representative stations, viz. Cape Comorin, Kovalam, Quilon and Tikkodi (figure 2, 3, 4 & 5). This observation is the first of its kind for south-west coast and enables one to get some basic information on the distribution of different algal elements in the intertidal zone.

At Cape Comorin, the distribution pattern showed 34 algal species, of which 7 were restricted to the higher tidal region, 17 to the mid tidal region and 7 to the lower tidal region. Three species were found scattered both in the higher and the mid tidal zones. *Laurencia* sp. was found to exhibit a wider range of distribution occurring both in the higher and the lower tidal regions.

Distribution of algae at Kovalam showed the incidence of 24 algal species, of which 10 were confined to the higher tidal region, 8 to the mid tidal region and 4 to the lower tidal region. *Amphiroa* sp. and *Gracilaria*

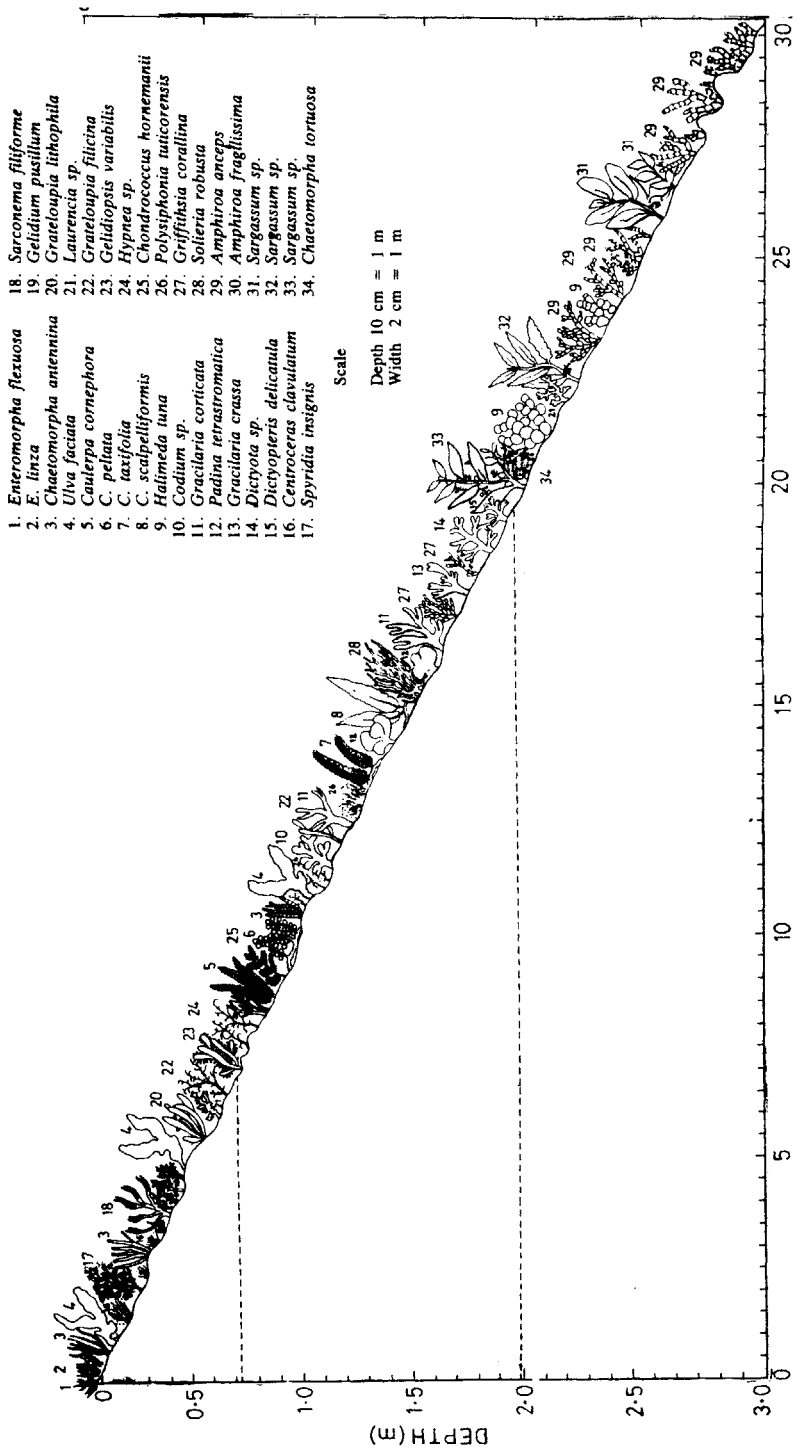

Figure 2 Diagrammatic transact showing algal distribution with respect to depth in Cape Comorin

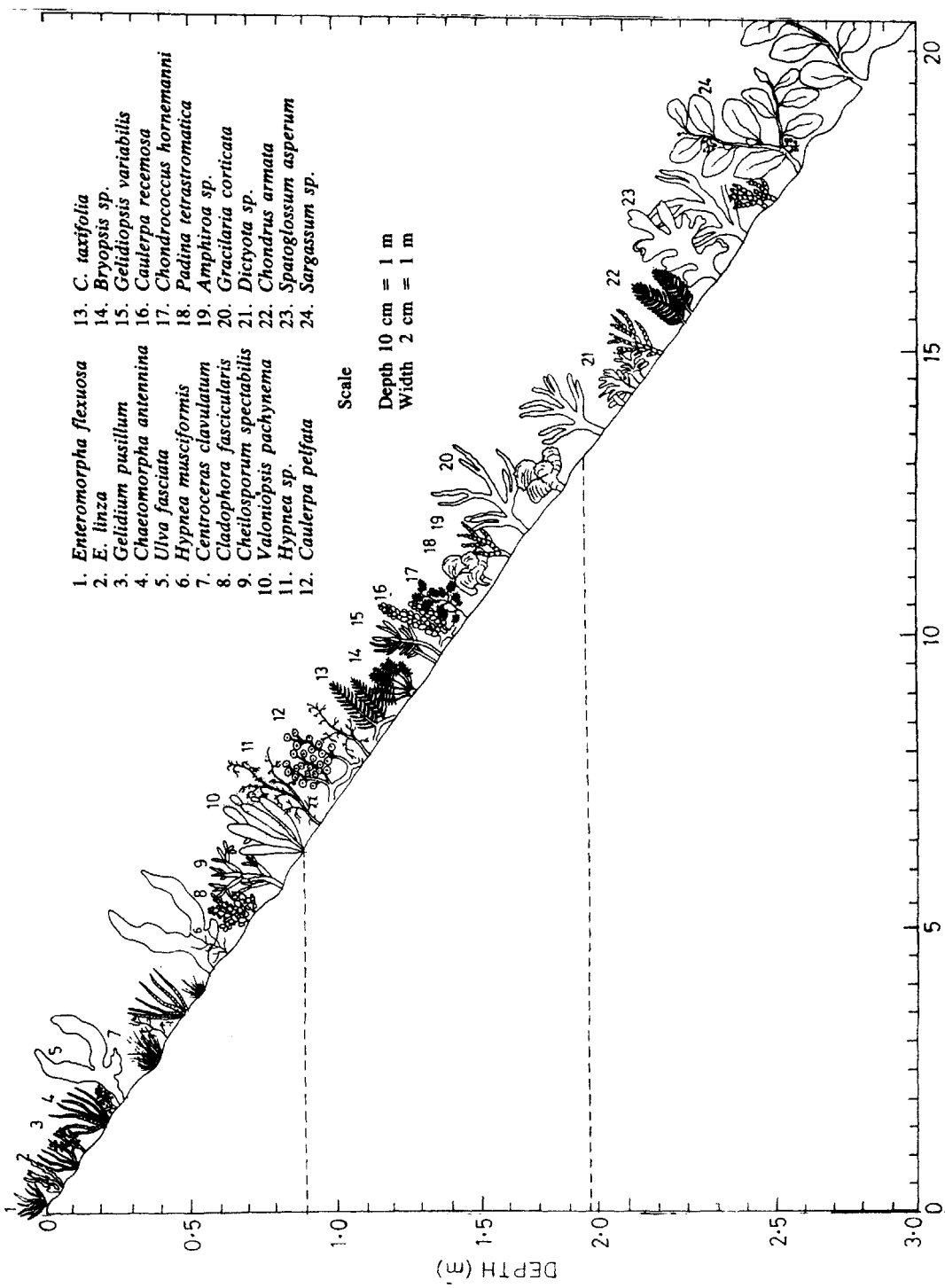

Figure 3 Diagrammatic transect showing algal distribution with respect to depth in Kovalam

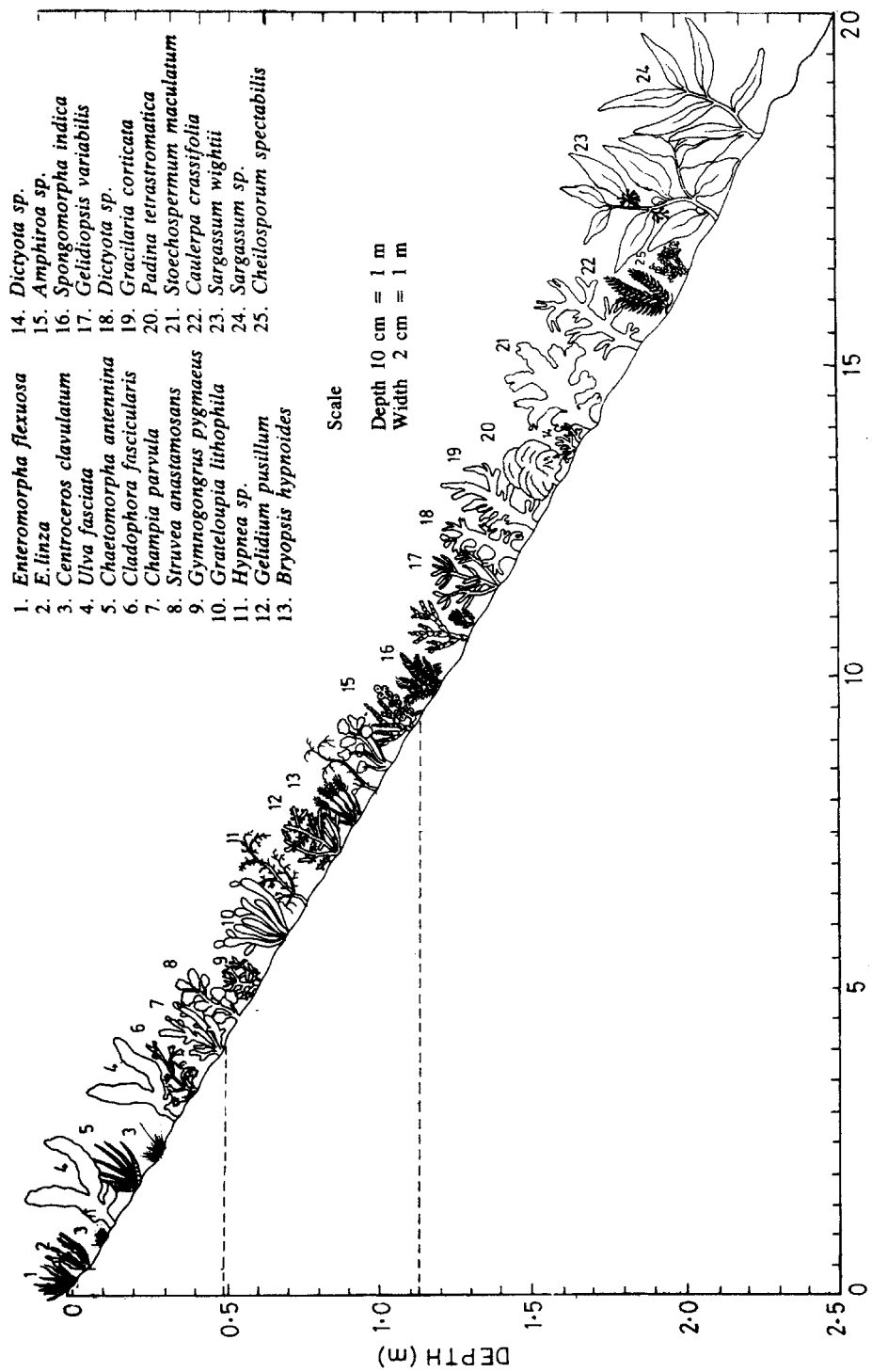

Figure 4 Diagrammatic transect showing algal distribution with respect to depth in Quilon

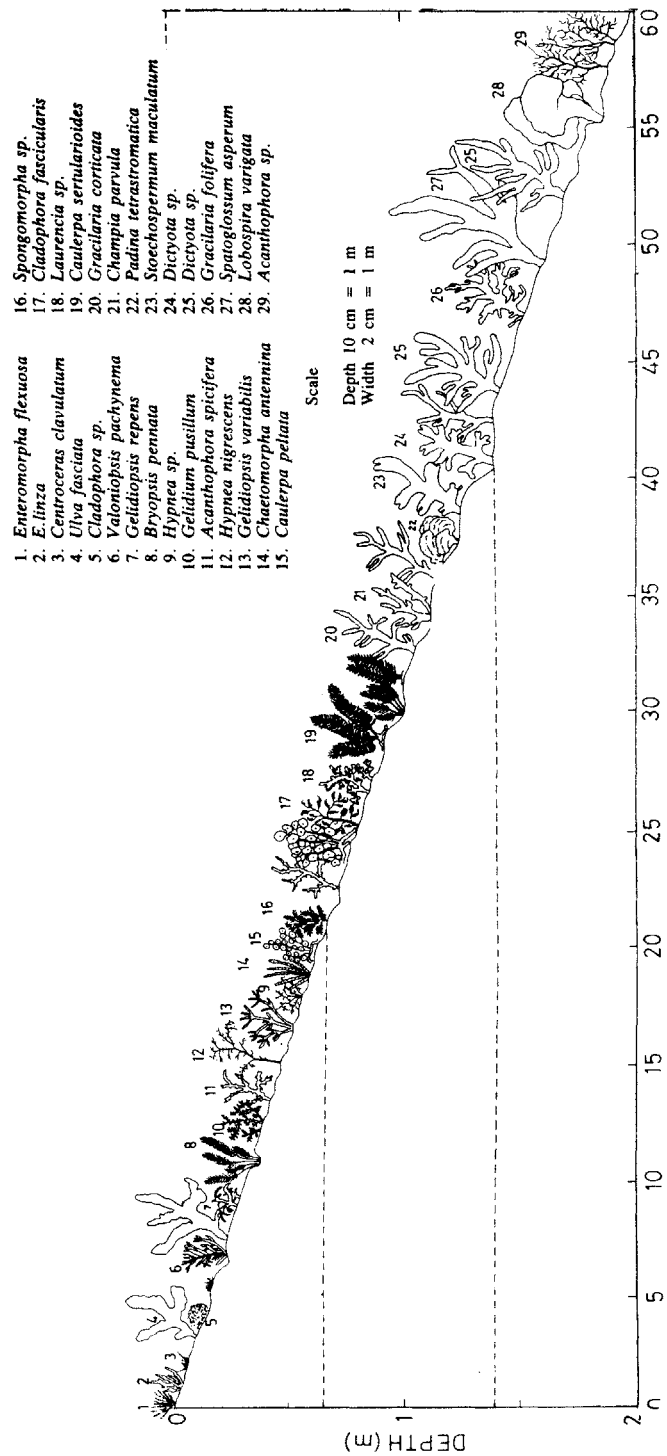

Figure 5 Diagrammatic transect showing algal distribution with respect to depth in Tikkodi

corticata were found to occur both in the mid and the lower tidal zones.

Twenty-five species were noticed in the intertidal zone at Quilon. Seven were limited to the higher, 6 to the mid and 11 to the lower tidal regions. *Amphiroa* sp. was found to occur both in the mid and the lower tidal regions.

Intertidal distribution at Tikkodi showed the occurrence of 29 species, of which 13 were restricted to the higher, 7 to the mid, and 5 to the lower intertidal regions. Three species, viz. *Gelidium pusillum, Acanthophora specifera* and *Caulerpa peltata* were seen distributed both in the high and the mid tidal regions. *Gracilaria corticata* was found to be distributed both in the mid and the low tidal regions.

The present study shows that along this stretch of coastline, Cape Comorin has the maximum algal resource, compared to other stations. Ten species were common for all the four stations, namely *Enteromorpha* spp., *Chaetomorpha antennina, Ulva fasciata, Gracilaria corticata, Padina tetrastromatica, Centroceras clavulatum, Gelidium pusillum, Gelidiopsis variabilis* and *Sargassum* sp. The nature of distribution of the species occupying different intertidal levels is attributable to their ability to endure the varying conditions of the intertidal zone with the ceaseless cycles of emergence and submergence and the associated wash, splash and spray.

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