Ecological studies on the fauna associated with economic seaweeds of South India-1. Species composition, feeding habits and interrelationships

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Introduction

A great deal of information is available on the fauna associated with seaweeds of temperate waters (Wieser, 1952 for review; Chapman, 1955; Southward, 1958; Wieser, 1959; Sloane *et. al.*, 1961; Fuse, 1962; Mc Lean, 1962; Ledoyer, 1962, 1964, 1966; Ohm, 1964; Glynn, 1965; Hagerman, 1966; Moore, 1971; Alcala *et al.*, 1972: Makkaveeva, 1976). There are many scattered references to the associations of animals to marine algae from the Indian coasts. However, in depth studies on the nature of relationships, distribution and abundance of animal populations on seaweeds are lacking except for a few recent studies (Joseph, 1972; Sarma and Ganapati, 1972; Sarma, 1974). The present study was undertaken during 1968–71 to ascertain the species composition, feeding habits and inter-relationships in the dominant groups of animals associated with economic seaweeds of South India.

Material and Methods

Extensive collections were made from the seaweed beds located in the Gulf of Mannar, Palk Bay and the adjacent groups of islands during the period 1968–71. Most of the samplings were made by diving with the aid of mask and snorkel. Underwater algae were enclosed from top to bottom with large polyethylene bags and the algae removed from the holdfasts without disturbing the fauna. The samples were brought to the laboratory and kept under observation to study the nature of relationship to the algae and feeding habits. Later, the algae were thoroughly shaken in water to dislodge the fauna. The macrofauna retained by the meshes of a seive (1.0 mm) were sorted under a dissection microscope and preserved in 5% formalin or 70% alcohol for later identification. In addition to these collections, periodic samplings were made from the intertidal regions of Gulf of Mannar and Palk Bay where extensive algal beds exist. Several samples collected from Keelakarai, Kachathivu, Thiruchendur and Cape Comorin were also examined. The food and feeding habits were studied in the laboratory by offering various species of freshly collected undamaged algae to freshly collected animals kept in aquaria or glass troughs containing filtered seawater. After the feeding period (usually overnight), the algae were removed, cleaned and prepared into herbariums.

Results and Discussion

The results of the analysis for species composition are given in Table 1. The major constituents of the fauna present on 16 species of Chlorophyta, 11 species of Phaeophyta and 17 species of Rhodophyta are discussed below.

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Table 1. Substrata-wise composition of the major groups of phytal fauna. The numbers against the species refer to the serial numbers of the algae listed in the appendix to the table. The frequency of occurrence is classified into abundant, moderate and occasional.

	Abundant	Moderate	Occasional
PORIFERA			
Callyspongia diffusa (Ridley)	14, 15, 37	30, 32, 34, 38	29
Halichondria panicea Johnston	34	37, 39	
Haliclona exigua (Kirkpatrick)	30, 37		
H. tenuiramosa (Burton)		17	
Mycale tenuispiculata (Dendy)	37	18, 19	30
Prostylyssa oculata (Kieschnick)	37	39, 40	
Sigmadocia fibulata (Schmidt)	37	34, 37	
S. petrosioides (Dendy)	12, 13	42, 43, 44	8, 9
S. pumila (Lendenfeld)		37, 39	4
Spirastrella inconstans (Dendy)	14, 15	37	29
Spongia officinalis Linn. var. *ceylonensis* Dendy	30	29	
Tedonia anhelans (Lieberkuhn)	37	30, 34	32
BRYOZOA			
Electra indica Menon & Nair	33	34, 35	
Thalamoporella hamata Harmer	24, 25, 26, 27	22, 23	
T. rozieri Audouin	24, 25, 26, 27	22, 23	
POLYCHAETA			
Cirratulus filiformis	5, 6	8, 9, 11	10
Clymene insecta (Ehlers)	5, 6	8, 9, 10, 11	
Dasychone cingulata Grube	5, 6, 40, 41	14, 15	8, 9
D. serratibranchis Grube	5, 6, 40, 41	14, 15	8, 9
Diopatra neopolitana Delle Chiage	4, 36	33	

Table 1 (continued)

	Abundant	Moderate	Occasional
Eunice antennata Savingy	5, 6, 14, 15	9, 10, 11	7
Lepidonatus tenuisetosus (Gravier)	38, 39, 40	41	24
Lysilla pambensis Fauvel	7	14, 16	
Odontosylis gravelii Fauvel	5, 6	37, 40	
Perinereis cultrifera Grube	3	34	4
Platynereis dumerelli Aud, & M. Ed.)	3, 4, 5, 6	39, 40	34
Polyophthalmus pictus (Dujardin)	40	34	33
Pseudonereis anomala Gravier	39, 40	34	33
Streblosoma persica (Fauvel)	39, 40	34	
Syllis (*Typosyllis*) *krohnii* Ehlers	39, 40	34	33
S. prolifera Krohn	39, 40	34	33
Thelepus plagiostema Schmarda	39, 40	34	
AMPHIPODA			
Amphelisca zamboangae Stebbing	22, 24, 25	23	26, 27
Amphilochus schubarti Schell	22, 24, 25	23	40
Amphtihae indica (M. Ed.)			
Atylopsis latipalpus Walker & Scott	24, 25	22, 23	40
Atylus minikoi Walker	7, 8, 9	22, 24, 25	38, 39, 40
Cyproidea ornata Haswell	22, 23, 24, 25	7, 8, 9, 10, 11	38, 39, 40
Elasmopus pectenicrus (Bate)	24, 25	7, 8, 9, 10, 11	38, 39, 40
E. sokotrae Walker & Scott	24, 25	7, 8, 9, 10, 11	38, 39, 40
Hyale diplodactyla Stebbing	1, 2	3, 4, 38, 39	40
H. hawaiensis (Dana)	1, 2	3, 4, 38, 39	33, 40

Table 1 (continued)

	Abundant	Moderate	Occasional
H. honolulensis Schell	1, 2	3, 4, 38, 39	33, 40
Leucothoe furcae (Savingy)	1, 2, 3, 4	38, 39, 40	23, 24, 25
L. spinicarpa (Abildgard)	1, 2, 3, 4	38, 39, 40	22, 24, 25
Lysianassa cinghalensis Stebbing	1, 2, 3, 4	38, 39, 40	22 24, 25
Maera inaequipes inaequipes (Costa)	1, 2, 3, 4 5, 6	7, 8, 9, 10, 11, 38, 39, 40	22, 24, 25
M. inaequipes serrata Schell	1, 2, 3, 4 5, 6	7, 8, 9, 10, 11, 38, 39, 40	22, 24, 25
M. pacifica Schell	1, 2, 3, 4 5, 6	7, 8, 9, 10, 11, 38, 39, 40	22, 24, 25
M. quadrimana (Dana)	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 38, 39, 40	22, 24, 25
Melita fresneli (Audouin)	1, 2, 3, 4, 5 6	7, 8, 9, 10, 11, 38, 39, 40	22, 24, 25
M. orgasmos Barnard	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 38, 39, 40	22, 24, 25
Orchomenella affinis Holmes		38, 39, 40	22, 24, 25
Paracalliope indica Barnard		38, 39, 40	22, 24, 25
Podocerus brasiliensis (Dana)		38, 39, 40	22, 24, 25
Shoemakerella nasuta (Dana)		4, 24, 25	
Socarnella bonnieri Walker		22, 24, 25	
Stenothoe gallensis Walker		22, 24, 25	

Table 1 (continued)

	Abundant	Moderate	Occasional
ISOPODA			
Dynamene bidentata (Adams)	20, 21	12, 41	
Dynamenella spp.	41	8, 9, 12, 20, 21	
Eulaphognathia insolita (Stebbing)	8, 9, 10, 11	14, 15	
Exosphaeroma spp.		8, 9, 10, 11, 12, 14, 15,	
Idotea emarginata (Adams)	8, 9, 10, 11	12, 14, 15,	
Sphaeroma walkeri Stebbing		12, 14, 15	20, 21
Synidotea variegata	20, 21	8, 9, 10, 11, 16	
OSTRACODA (Unidentified)	40	37, 41	31, 42, 43, 44
HARPACTICOIDA			
Amphiascopsis cinctus (Claus)	5, 6, 7, 8, 9, 10, 11	39, 40	41
Diosaccus truncatus Gurney	5, 6, 8, 10, 11, 16	17, 18, 40, 41	
Enhydrosoma spp.	5, 6, 8, 9, 10, 11	16, 41	
Eudactylopus striatus Sewell	5, 6, 8, 9, 10, 11	41	
Laophonte cornuta Phil	5, 6, 8, 9, 10, 11, 40	41	
L. hirsuta (Thompson and Scott)	5, 6, 8, 9, 10, 11, 40	41	
L. meinerti Brady	5, 6, 8, 9, 10, 11, 40	41	

Table 1 (continued)

	Abundant	Moderate	Occasional
Longipedia coronata claus	5, 6, 8, 9, 40, 41	7, 10, 11	
Orthopsyllus linearis Claus	5, 6, 8, 9, 40, 41	7, 10, 11	
Parastenheli littoralis (Sars)	40, 41	7, 10, 11	
Pyhllopodopsyllus minor (Thomp & Scott)	5, 6, 8, 9	40, 41	
Porcellidium fimbriatus (Claus)	5, 6, 8, 9	7, 10, 11, 40, 41	
P. clavigerum Pesta	5, 6, 8, 9, 40, 41	7, 10, 11	
TANAIDACEA			
Leptochelia spp.	5, 6, 39, 40, 41	16	
DECAPODA			
Alphaeus strenuus Dana		34	
Arcania septemspinosa (Fabricius)		34	
Charybdis orientalis (Dana)		34	
Hippolyte ventricosa M. Ed.		34	
Hyastenus planasius (Adams & White)		34	
Menaethius monoceros Latreille		34	
Paguristes incomitatus Alcock	38, 39	34	33
Paramithrax aculeatus (M. Ed.)	5, 6	34	33
Platygraspus minutus M. Ed.	5, 6	34	33
Hyastenus planasius (Adams and White)	5, 6	34	
Schizophrys aspera (M. Ed.)	5, 6	34	
GASTROPODA			
Aplysia benedicti Eliot		4, 34	38, 39
A. lineolata Adams & Reeve		4, 34	38, 39

Table 1 (continued)

	Abundant	Moderate	Occasional
Berthelinia sp.		5, 6	
Cerithium granosum Kiener	38, 39	17, 18, 37	12, 13, 34
C. morus (Lamarck)	38, 39	17, 18, 37	12, 13, 34
C. purpurascens Sowerby	38, 39	17, 18, 37	12, 13, 34
C. rugosum Wood	38, 39	17, 18, 37	12, 13, 34
C. scabridum Wood	38, 39	17, 18, 37	12, 13, 34
C. corallium Defrance	38, 39	17, 18, 37	12, 13, 34
C. splendens Sowerby	38, 39	17, 18, 37	12, 13, 34
Colina pupaeformis Adams		5, 6	
Euchelus atratus Gmelin		5, 6	
Littorina subgranosa Franenfeld		2	
L. scabra Linn		2	
L. undulata Gray		2	
L. ventricosa Philippi		2	
Nerita albicilla Linn		3, 4	
N. chamaeleon Linn		3, 4	
N. maura Brod		3, 4	
N. costata Chem		3, 4	
Nodilittorina phramidalis (Quoy & Galmer)		2	
N. milligrana Philippi			28
Patella cermica Adams			2
Pyrene flavida Lam			33, 35
P. mindorensis Reeve			33, 35
P. pusilla Dunker			33
P. undata Duct			33
P. versicolor Sowerby		34	35
P. zebra Gray		33	35
Trochus stellatus Gmelin		3, 4	
T. radiatus Gmelin		3, 4	

Table 1 (continued)

	Abundant	Moderrte	Occasional
T. niloticus Linn		4	
T. polychroma Reeve			4
T. costatus Gmelin			4
Tectarius malaccanus Philippi			3, 4
Turbo intercostalis Menker		3, 4	
BIVALVIA			
Crassostrea cristagalli L.			34
Modiolus striatus Hanley	5, 6, 40, 41	3, 7, 8, 9, 10, 11, 17, 18, 21, 24, 25, 26, 27, 30, 32, 33, 34, 38, 39	
Musculus pygmaeus Glynn	5, 6, 40, 41		
M. strigatus (Hanley)	5, 6, 40, 41		
ECHINODERMATA			
Ophiactis savingnvi (Muller & Trosthel)	12, 13, 14, 15	7, 8, 9, 10, 11	
Ophiothrix variegata Duncan	12, 13, 14, 15	7, 8, 9, 10, 11	
Ston opneustes variolaris (Lamarck)		22, 24, 25	23, 26, 27

Appendex to *Table I*

Sl. No.	Species of algae
(1)	(2)
	CHLOROPHYTA
1.	*Enteromorpha compressa* Linn
2.	*E. flexuosa* (Wulf.) J. Ag.
3.	*Ulva beytensis* Thivy & Sharma
4.	*U. lactuca* Linn
5.	*Chaetomorpha clavata* (Hooker) Kuetz
6.	*Cladophora fascicularis* (Mertens) Kuetz
7.	*Caulerpa clavifera* (Turn.) Ag.
8.	*C. racemosa* (Forssk) Web. v. Boose
9.	*C. scalpelliformes* (R. Br.) Web. v. Bosse
10.	*C. sertularioides* (Gmel.) Howe
11.	*C. taxifolia* (Vahl.) Ag.
12.	*Codium adhaereus* Anderson
13.	*C. decorticatum* (Woodw) Harvey
14.	*Halimeda gracilis* Harv. ex. J. Ag
15.	*H. opuntia* Lamour
16.	*Cladophoropsis zollingeri* (Kuetz) Boergs.
	PHAEOPHYTA
17.	*Dictyota bartayresiana* Lamour
18.	*Padina pavonica* (L.) Thivy ex Taylor
19.	*P. gymnospora* (Kuetz) Vickers
20.	*Spatoglossum asperum* J. Ag.
21.	*Stoechospermum marginatum* (Ag.) Kuetz.
22.	*Cystoseira trinodis* (Forsskal) J. Ag.
23.	*Hormophysa triquetra* (L.) Kuetz.
24.	*Sargassum aquifolium* (Turn.) C. Ag.
25.	*S. wightii* Greville

Appendix to *Table 1* (continued)

Sl. No.	Species of algae
(1)	(2)
26.	*Turbinaria conoides* Kuetz
27.	*T. ornata* J. Ag.
	RHODOPHYTA
28.	*Porphyra vietnamensis* Tanaka et Ho.
29.	*Gelidium micropterum* Kuetz
30.	*Gelidiella acerosa* (Forssk) Feldm
31.	*Chondrococcus hornemanii* (Mert) Schmitz
32.	*Jania adhaerens* Lamour
33.	*Gracilaria corticata* J. Ag.
34.	*G. edulis* (Gmel.) Silva
35.	*G. foliifera* (Forssk.) Boergs
36.	*G. verrucosa* (Hunds) Papenfuss
37.	*G. crassa* Harvey
38.	*Hypnea musciformis* (Wulf) Lomour
39.	*H. valentiae* (Turn) Mont
40.	*H. pannosa* J. Ag.
41.	*Champia parvula* (Ag.) Harvey
42.	*Acanthophora spicifera* (Vahl.) Boergs
43.	*Laurencia obtusa* (Huds.) Lamour
44.	*L. papillosa* (Forssk.) Greville.

Porifera - 12 species

The most abundant sponges growing on seaweeds are *Callospongia diffusa, Halichondria panicea, Haliclona exigua, Mycale tenuispiculata, Prostylyssa oculata, Sigmadocia fibulata, S. petrosioides, Spirastrella inconstans, Spongia officinalis* var. *ceylonensis* and *Tedania anhelans. Gracilaria crassa* was maximum affected by overgrowths of sponges, followed by *Gelidiella acerosa* and *Gracilaria edulis. Hypnea valentiae, Halimeda gracilis* and *H. opuntia* were also often observed to house moderate to good overgrowths by sponges.

Bryozoa—3 species.

The most common bryozoan growing on algal fronds is *Electra indica.* This species is most abundant on *Gracilaria corticata,* often covering the entire length of the algae except the growing tips. This species of bryozoan seems to be very specific to species of *Gracilaria* like *G. corticata, G. edulis* and *G. foliifera.* When present, all individuals in the *Gracilaria* colony are encrusted with the luxuriant overgrowth of the animal colony. According to Menon (Pers. comm.) the growth of this species of bryozoan depends on the growth of alga and during seasons when algal growth is minimal, the encrusting colony either stops growing or grows downwards along the axis of the alga. So, once an encrustation takes place on an algal axis, all through its life, the alga is subjected to full encrustation except at the growing tips. Several colonies of such encrusted *G. corticata, G. edulis* and *G. foliifera* have been obtained from the algal beds located in the Gulf of Mannar and the cultivation ropes at Krusadai island. *Thalamoporella hamata* and *T. rozieri* colonies are common on species of *Sargassum* and *Turbinaria,* but not on other algal species.

Polychaeta—17 species.

The majority of polychaetes inhabiting algal fronds are tube dwelling or living in the sediments retained by the holdfasts. *Diopatra neopolitana* constructs a tube using pieces of algal fronds and sand particles mixed with mucous secreted from the body. Most of these pieces of algae grow to large sized plants anchored to the polychaete tubes. The bulk of the population of *G. verrucosa* at the Rameswaram port region is anchored to such tubes constructed by polychaetes. This species is also found to live in tubes made by rolling the edges of the thalli of *Ulva lactuca* and *Gracilaria corticata.* Species like *Perinereis cultrifera, Platynereis dumerilli, Pseudonereis anomala,* although primarily carnivores, have been observed in the laboratory to feed on fronds of green algae, especially *Ulva lactuca.* Species like *Dasychone cingulata, D. serratibranchis, Lysilla pambensis, Eunice antennata, Odontosyllis gravelli, Syllis (Typosyllis) krohnii* and *Syllis prolifera* are abundant in the sediments retained by algae. *D. cingulata* and *D. serratibranchis* have been found in very large numbers (up to 48800 individuals/m^2) living inbetween luxurient growths of *Chaetomorpha clavata, Cladophora fascicularis, Hypnea pannosa* and *Champia parvula.*

Amphipoda—26 species.

Isopoda—7 species.

Ostracoda—Many species

Harpacticoida—13 species

Tanaidacea—1 species

These groups of animals constitute the bulk of temporal fauna on seaweeds. Many of the amhipods and isopods are known to feed on soft seaweeds, generally the greens. Species of *Hyale, Maera,* and *Melita* feed vigorously on species of *Enteromorpha, Chaetomorpha* and *Ulva* in the laboratory. Many harpacticoids and ostracods are known to browse on epiphytic algae. Isopods are common on algae like species of *Caulerpa, Codium, Halimeda, Cladophoropsis, Spatoglossum* and *Stoechospermum.* Large numbers of isopods are frequent on decaying blades of *Nitophyllum marginale.* Many species of ostracods find shelter in between the fronds of algae. *Hypnea* spp. harbour the majority of them in between the bushy branches. Harpacticoid copepods and tanaidaceans were abundant on species of *Chaetomorpha, Cladophora, Hypnea* and *Champia.* The abundance of these groups depended either on the quantity of sediments retained or on the level of occurrence of the algae. This is in striking contrast to the dominance of amphipods and ostracods which prepare algae which are either flat and sheet like or slender and bushy with entangling branches supporting lesser quantities of sediments. Tanaidaceans seen to associate with the algae only for substratum. Other than providing protection from severe wave action, predation and desiccation, the algae function as an ideal habitat with abundant supply of food of animal origin.

Decapoda—11 species.

The decapods inhabiting seaweeds are the snapper—shrimps, hermit crabs and spider crabs. All eleven species listed are found on *Gracilaria edulis* cultivated at Krusadai island. They primarily depend on the algae for substratum. However, under the stress of starvation hermit crabs scrap the blades of softer algae with their powerful chelae and feed on the small particles of algae and epigrowths (discussed latter). Good examples of camouflage, by covering their carapaces with algae, are seen in spider crabs. Species such as *Hyastenus planasius, Paramithrax aculeatus* and *Schizophrys aspera* often carry small pieces of *Ulva lactuca, Gracilaria corticata* or *Sasgassum* sp. on their carapace. Sometimes tufts of algae are seen growing permanently attached to the antennular region of the crabs. It is interesting to see crabs moving inbetween rocks carrying the bushes of algae on their heads. Such displays appear to be either methods to attract the unsuspecting prey or to escape unnoticed by predators.

Gastropoda - 36 species.

Gastropods outnumber all other animal groups on seaweeds in species diversity. Many are scavengers, detritus feeders or feeding on the minute flora attached to rocks. But quite a

few are preferentially algivores. The detailed food preferences in major algivorous gastropods have been discussed elsewhere (see Part 3 of this series of papers). The major algivores are *Aplysia benedicti, A. lineolata, Pyrene versicolor, P. zebra, Trochus stellatus, T. radiatus and Turbo intercostalis.* During March - April large swarms of *Aplysia* spp. frequent the nearshore waters of the Gulf of Mannar and Palk Bay. Such large scale appearances of the sea-hares are certain to have devastating effects on many algal speices. During underwater observations large numbers of *Aplysia* are often seen browsing on underwater algal growths all through the year. Species of *Pyrene, Turbo* and *Trochus* generally occur at the infralittoral fringe. Large numbers of *Pyrene* are often met with on the algal bed situated north of the bathing ghat at Rameswaram island, feeding profusely on *Hypnea* spp. *P. versicolor* densities as high as 40 individuals per metre length of cultivation rope has been recorded from the *Gracilaria edulis* cultivation grounds at Krusadai island. Juveniles of *P. zebra* seem to prefer seagrass as the best liked food while the adults browse on a veriety of algae. Browsing by other gastropods (other spp. of *Pyrene*, and *Trochus, Nerita* spp.) is negligible as most of these species are scattered in distribution. *Nodilittorina* spp., *Littorina* spp. and *Patella cermica* browse on small quantities of intertidal algee. *Berthelinia* sp., *Colina pupaeformis* and *Euchelus atratus* although not common, are seen associated with *Chaetomorpha clavata* and *Cladophora fascicularis.*

Bivalvia - 4 species

Modiolus striatus is the most abundant bivalve present on marine algae of this region. Extensive fouling by this species is common on species of *Chaetomorpha, Cladophora, Hypnea* and *Champia.* Green, brown and red algae with moderate to abundant numbers of *Modiolus* are common at the Kundukal point and Pamban regions. *Musculus strigatus* and *Musculus pygmaeus* are two species of minute bivalves present exclusively attached to the holdfasts of *Chaetomorpha clavata, Cladophora fascicularis, Hypnea pannosa* and *Champia parvula.*

Echinodermata—3 species.

Ophiothrix variegata and *Ophiactis savingnvi* are found living inbetween the holdfasts of *Codium* spp. and *Halimeda* spp. Their association with the algae seems to be only for shelter. Accum ulations of the sea urchin *Stomopneustes variolaris* around the holdfasts of *Cystoseira trinodis, Sargassum wightii* and *S. aquifolium* were common sights during underwater observations at the Krusadai, Pulli, and Pullivasal islands and in the Palk Bay. However, more evidence is required to show whether they actually browse on the holdfasts of these algae.

It has been observed that many species inhabiting marine algae depend on them as a source of food. The most common browsers are polychaetes, amphipods, isopods and gastropods. Numerous recent investgations have shown that many polychaetes, isopods and decapods are capable of digesting food of plant origin (see Pandian, 1975 for review). Elyakova (1972) after studying 37 spceies of marine invertebrates from different phyla and

habitats revealed that several molluscs and crustaceans exhibit high cellulase activity. Thus, it is apparent that the role of seaweeds is certainly more than providing shelter.

The feeding by algivores result in partial or total destruction of the algal fronds. Characteristic patterns are made on the fronds by each group of predator. Amhipods feeding on *Ulva* make small holes of irregular shapes with wavy edges (Fig. 1 a). Polychaetes generally cut deep into the blades of *Ulva*, resulting in long incisions leading towards the centre (Fig. 1b). *Trochus* does nod feed at a stretch on *Ulva*, but prefers to take small bites of the alga while crawling over it, resulting in small smoth-edged holes of circular or oval outline (Fig. 1 c). *Turbo* makes incisions similar to those made by polychaetes, but with corrugated edges (Fig. 1 d). While this species readily starts feeding right from any part of *Ulva*, tougher algae like *Padina* (Fig. 1 e) and *Stoechospermum* are always attacked from the edges. The incision pattern is similar to that made on *Ulva*. Species of *Aplysia* feed on most species of algae by 'cropping' the growing edges. As a result of this cropping, the whole bunch of alga appears as if it were cropped by mechanical means (Fig. 1 f). Under stress of starvation, hermit crabs have been observed to scrap the blades of *Ulva* and *Padina* releasing small particles of algal matter and epigrowths. They are directed towards the mouth by the feeding currents. Such scrapping with the chelae of the crabs result in numerous slit like holes on the fronds (Fig. 1 g).

The algal fauna can be divided into two groups: sessile and non-sessile. Examples of the first type which are attached to the algae throughout their lives are sponges, bryozoans and bivalves listed earlier. All others fall into the second group. The sessile organisms depend on the algae only for substratum, while the dependence of the non-sessile fauna could be for abode (eg. many polychaetes, tanaidaceans and decapods), protection from predators, waves and dessiccation (eg. many amphipods, few ostracods and harpacticoids) or for food (eg. other polychaetes, amphipods, isopods, ostracods, harpacticoids and gastropods).

The feeding relationships of the algal fauna are also varied. Many are filter feeders, detritus feeders, scavengers or carnivores, without any direct dependence on algae. The algivores range from minute crustaceans to large-sized gastropods. A few organisms are known to suck juices from the algae (Hagerman, 1966). The algivores play a prominent role in the life of many algal species. Large scale browsing by many gastropods during the sporulation of algae will have adverse effects on the quantum of recruitment. Also, browsing on freshly laid cultivation ropes has a biological role in determining the survival of the cultivated species.

Interesting interrelationships other than for food between the fauna and seaweeds are many. Many gastropods deposit their egg masses on the algae (Barkman, 1955). Perhaps most interesting species are the polychaete *Diopatra neopolitana* growing *Gracilaria verrucosa* on its tube and the spider crabs *Paramithrax aculeatus*, *Hyastenus planasius* and *Schizophrys aspera* culturing species of *Ulva*, *Gracilaria* and *Sargassum* on their carapaces.

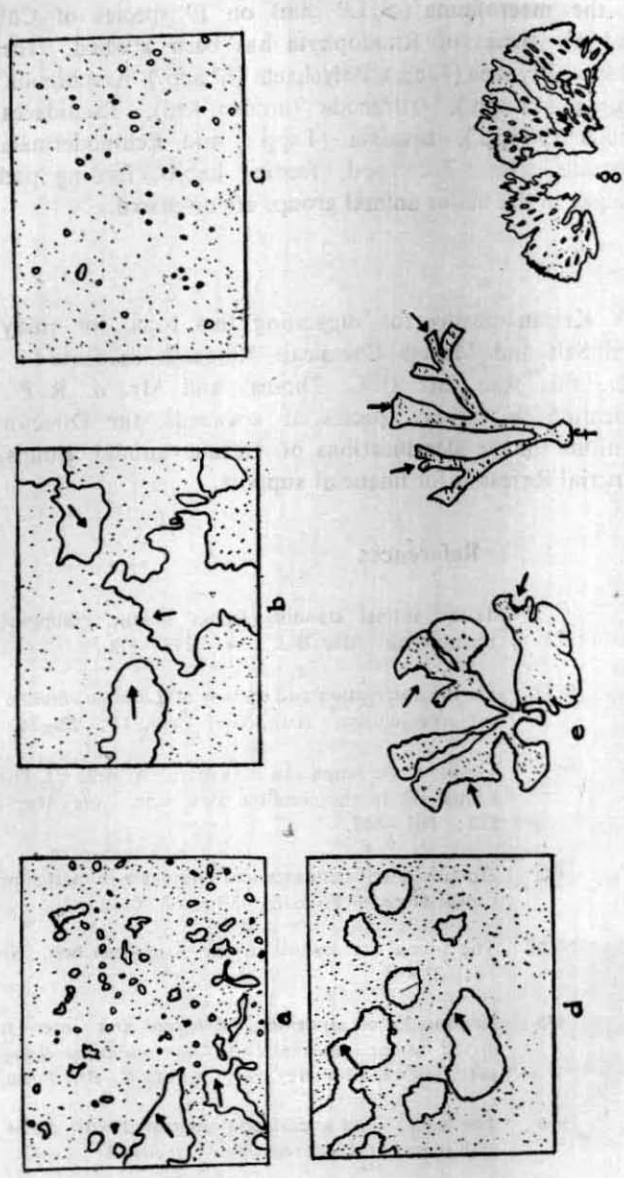

FIG. 1

Fig—1 The patterns made by various browsers on algae.

(a) amphipods on *Ulva*; (b) Polychaetes on *Ulva*;
(c) *Trochus* on *Ulva*; (d) *Turbo* on *Ulva*;
(e) *Turbo* on *Padina*; (f) *Aplysia* on *Gracilaria*;
(g) hermit crabs (starved) on *Padina*.

Abstract

The composition of the macrofauna (> 1.0 mm) on 19 species of Chlorophyta, 11 species of Phaeophyta and 17 species of Rhodophyta has been studied. The dominat organisms were: Porifera (12 spp.) Bryozoa (3 spp.), Polychaeta (17 spp.), Amphipoda (26 spp.). Isopoda (7 spp.), Harpacticoida (13 spp.), Ostracoda (unidentified), Tanaidacea (1 spp.), Decapoda (11 spp.), Gastropoda (36 spp.), Bivalvia (4 spp.), and Echinodermata (3 spp.), The species are listed substrata-wise. The food, feeding habits, feeding patterns and interrelationships to various algae in the major animal groups are discussed.

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