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STUDIES ON EPIPHYTIC FAUNA OF SEAWEEDS AND ITS RELATIONSHIP WITH AMBIENT FAUNA OF SEAWATER AND SEDIMENT OF NORTHWEST COAST OF INDIA

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ABSTRACT

The range as well as mean values for numerical density, fresh weight and dry weight of the epiphytic fauna were lowest on *Padina tetrastomatica* from Okha and highest on *Acrosiphonia orientalis* from Diu. High species diversity of epiphytic fauna (> 8.0) was observed on *Caulerpa recemosa*, *Acrosiphonia orientalis*, *Padina gymnospora* and *Sargassum johnstonii*. Some of the species of epiphytic fauna showed host specificity as they were recorded only on particular species of seaweeds. The maximum epiphytic fauna (27 species) was recorded on *Caulerpa peltata* and *Veloniopsis pachynema*. The similarity index between stations showed close resemblance for epiphytic fauna. Very high number of epiphytic faunal groups (15) were observed on *Halimeda tuna*, *Caulerpa recemosa* and *Cystoseira indica*. The foraminiferan, gastropod, polychaete, ostrocod and bivalve formed very high proportion (12.39-34.75%) of epiphytic fauna on these seaweeds. The minimum numerical density, and fresh and dry weight of seawater zooplankton were observed at Diu, and the maximum at Veraval. None of the species of zooplankton were common to all four places of study. The maximum percentage of numerical density was constituted by *Hyperia medusarum*, *Conchoecia indica* and *Amhistegina lessonii* at different stations. The species diversity of zooplankton ranged from 1.26 at Diu to 4.12 at Veraval whereas, similarity index ranged from 27.27 at Veraval to 41.67 at Okha. Most or all (at Dwarka) species of zooplankton were found in epiphytic form also. The epiphytic form at four stations were quite similar. However, the reverse trend was observed for zooplankton. The species diversity for epiphytic fauna at 4 stations of study varied in a narrow range while it varied widely for zooplankton. All the groups of zooplankton except Mysid were found in epiphytic form. The group diversity of zooplankton ranged from 0.95 at Diu to 3.90 at Veraval. The fresh and dry weights as well as numerical density of benthic fauna ranged from 4.37$g.m^{-2}$, 0.97$g.m^{-2}$ and 1387 per m^{-2} at Veraval to 10.36 $g.m^{-2}$, 3.22 $g.m^{-2}$ and 5478 per m^{-2} at Dwarka respectively. The *Neries versicolar*, Tubiculous polychaete, *Amhistegina lessonii* and *Elphidium crispum* showed maximum numerical density. The species diversity of benthic fauna was low as it ranged from 0.54 at Veraval to 1.63 at Dwarka. However, the similarity index showed nearly close resemblance between different stations. All the species of benthic fauna recorded from Okha and Veraval were also found in epiphytic form in these places. However, 18.75 and 22.22% benthic fauna at Diu and Dwarka respectively were not found in epiphytic form. The similarity index for plankton and benthic fauna indicated near close resemblance at all the stations except Okha. The species diversity of benthic form was significantly less than planktonic form at different places of study. Some of the species of epiphytic, seawater zooplankton and benthic fauna were specific for a particular station. However, quite a number of a species of fauna were common to all four stations of study. It may be concluded that the zooplankton from seawater and benthic (micro and meio) fauna had significantly influenced the composition of epiphytic fauna of seaweeds. Similarly benthic fauna has also influenced the composition of planktonic fauna of seawater and *vice-versa.*

INTRODUCTION

The macro and meiofauna as well as seaweeds are important link in the marine food web. The relation of the phytal fauna with the seaweeds is very diverse. The seaweeds can be looked upon as the feeding and breeding ground for a multitude animal life. Apart from providing shelter from current and waves, and predators, the ecological advantages of the seaweed regions as a breeding habitat and feeding ground for young and juvenile fish have been emphasized (Fuse 1962 a, b and Mukai 1971). The seaweed regions provide an abundant oxygen for a variety of animals. The small epiphytic algae including diatoms and the detritus material deposited on the seaweed provide food for a number of animals. Many are known to feed on seaweeds itself while others depend on the rich particulate matter composed of detritus and microscopic organisms in the water when the algae are submerged. The significance and productive potentialities of phytal macrofauna in the littoral system are increasingly realized because of the ease with which the predators can find them, their high nutrient value and high turnover rates. In seaweed regions the phytal animals contribute more than the benthic animals towards fish production (Mukai 1971).

Considerable literature is available on the epiphytic fauna of seaweed from different parts of the world (Colman 1940, Hagerman 1966, Mukai 1971, Edgar 1983, Taylor 1998, Brooks & Bill 2001). No published literature is available on the epiphytic fauna of seaweeds from the west coast of India. However, some literature is available for the intertidal epiphytic fauna of seaweeds from east coast of India (Sarma 1974a,b, Sarma et al. 1981, Muralikrishnamurty 1983). However, considerable information is available on zooplankton (Peterson 1981, Goswami 1985, Shanmugam et al.1986, Hopkins 1988, Mitra et al. 1990, Paulinose et al. 1998, Nasser et al. 1998, Keister & Peterson 2003) and benthos (Ansari 1977, Harkantra & Parulekar 1981, Kenny & Rees 1996, Morton 1996, Harvey et al. 1998, Eleftheriou 2000, Frid et al. 2000, Warwick 2001, Fraschetti et al. 2002, Sconfietti et al. 2003) from India and abroad. These authors have not studied simultaneously the ambient fauna, inhabiting seawater and sediment along with epiphytic fauna. Although such organisms may have direct relation and affect quality and quantity of epiphytic fauna of seaweeds or seaweed fauna may affect the composition of zooplankton and benthic fauna. Therefore, it was thought desirable to study simultaneously the species diversity, numerical abundance, biomass and ecology of epiphytic, benthic and seawater planktonic fauna. The present study will be useful in understanding the relationship between seaweed epiphytic fauna in relation to their planktonic and benthic counterparts.

MATERIALS AND METHODS

Seaweed samples were collected from the rocky inter tidal region of Okha (lat. 22°30’N, long. 69°03’E), Dwarka (lat. 21°15’N, long. 68°41’E), Veraval (lat. 20°54’N, long. 69° 53’E) and Diu (lat. 20°43’N, long. 70°47’E) during lowest low tide of December 2003 (Fig. 1) when seaweed growth is luxuriant. In the present study different species of seaweeds belonging to green, red and brown algae were sampled based on their luxuriant growth/abundance from all the stations (Table 1). One kilogram of each species of seaweed was collected in triplicate from all the stations and transferred to separate plastic containers. The seaweed samples were preserved in 5% formalin in 1:2 ratio of seaweed/formalin solution and kept overnight. The epiphytic fauna from the preserved seaweed samples was separated by vigorously shaking 1 kg of seaweed with 10 litres of filtered seawater for 10 minutes on a rotary shaker and the resultant seawater was filtered through 62µm mesh sieve. The same seaweed was used further two times with another 10 litres filtered seawater at each time to separate attached fauna by the above process. The fauna retained on the sieve at each time was pooled together and preserved in 150 mL of 4% formalin with seawater. The epiphytic fauna from each species of seaweed was separated like this. The numerical density and biomass of epiphytic fauna are expressed per 100 g wet weight of fresh alga.

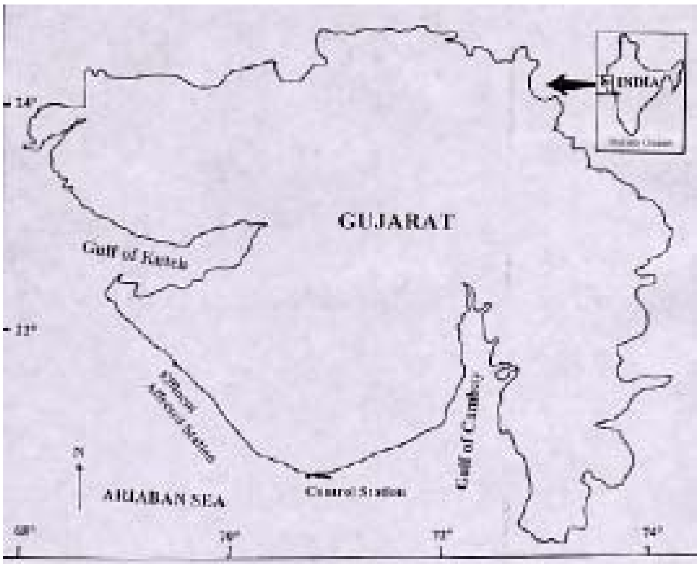

Fig. 1. Map showing sampling stations.

The benthos samples were also collected from the region where the seaweeds were sampled for epiphytic fauna. To estimate the benthic fauna, sediment samples were collected by using Van veen grab. The benthic macro and meiofauna were separated by sieving the sediment samples through 500µm and 63µm mesh sieve respectively. The epiphytic macro and meiofauna were also separated like this. The numerical density and biomass of benthos were expressed per m^2 of the sea floor. The zooplankton samples of seawater were also collected during high tide from all the stations and their numerical density and biomass were analyzed as per the method described earlier (Tewari et al. 2001).

All the fauna belonging to epiphytic, zooplanktonic and benthic groups and seaweeds were identified to species level by using standard manuals and books (Borgesan 1946-1957, Taylor 1960, Santhanam & Srinivasan 1993, Apte 1998, Oza & Zaidi 2001). The species and group diversities of fauna were calculated according to the Shannon-Weaver (1949) formula as described below.

$$H' = \Sigma \, Pi \log_e pi$$

Where, pi = proportion of the ith species or group in the collection and H' = diversity of a theoretically infinite population.

The Similarity Index (S) was calculated by using the following formula (ICMAM 1998).

$$S = (2C/a + b) \times 100$$

Where 'C' = number of species or group common at any two stations, 'a' = number of species or group at one station and 'b' = number of species or group at the other station. The similarity index for epiphytic, planktonic and benthic fauna were calculated by comparing Diu with other three stations separately. However, the epiphytic fauna with planktonic and epiphytic fauna with benthos for comparison purpose was calculated by taking same station for these two types of fauna (e.g., Okha with Okha and so on).

RESULTS

The distribution of different epiphytic fauna and their species diversity on different seaweeds are presented in Table 1. One hundred species of epiphytic fauna were recorded from 33 species of seaweeds from Okha, Dwarka, Veraval and Diu. A total number of 72, 68, 69 and 56 species of epiphytic fauna were found harbouring 13, 12, 15 and 13 species of seaweeds from the above four stations respectively. High species diversity of epiphytic fauna (more than 8) was observed on *Caulerpa recemosa*, *Acrosiphonia oreintalis*, *Padina gymnospora* from Diu and *Sargasssum johnstonii* from Dwarka. However, the least species diversity (0.93) was observed on *Padina tetrastomatica* from Okha ($p < 0.01$). Two species of green, 4 species of brown and 7 species of red seaweed also harboured significantly high species diversity (4 to 6.53) of epiphytic fauna from all the places of study ($p < 0.01$). The mean species diversity of epiphytic fauna was high at Diu and Dwarka (4.30 and 4.22 respectively) and the least 2.79 at Okha followed by Diu > Dwarka > Veraval > Okha ($p < 0.01$).

Seventy eight species of epiphytic fauna had widespread distribution as they were recorded from all the four stations. However, Veliger larva, *Temora discaudata*, *Penilia avirostris* and post larva of *Penaeus indicus* were recorded only on *Codium dwarkense, Hypnea musciformis, Champia indica* and *Padina tetrastomatica* respectively. Similarly *Rosalina bertheloti, Cyclogyra involvens, Cymbaloporetta squammosa* and *Elphidium reticulatum* were found only on *Ulva fasciata, Gelidiopsis intricata, Acrosiphonia orientalis* and *Codium veravalensis* respectively. However, *Epoinades rapandus, Globigerina agglutinata, Globigerinoides sacculifer* and *Loxostomum rostrum* were found inhabiting on *Gracilaria corticata, Sargassum tenerrimum, Codium tomentosum* and *Enteromorpha compressa* respectively. It seems that these species of epiphytic fauna have some sort of host specificity (Table 1). However, further studies are required to confirm this finding.

The maximum number of epiphytic fauna (27 species) were recorded on *Caulerpa peltata* and *Veloniopsis pachynema* from Veraval and Dwarka respectively. However, *Padina gymnospora* from Diu and *Enteromorpha compressa* from Dwarka also harboured significantly high ($p < 0.01$) number of epiphytic fauna (11). The least number of epiphytic fauna was observed on *Grateloupia filicina* at Diu. The similarity index for Veraval, Dwarka and Okha as compared to Diu varied in a very narrow range (62.40 to 62.90). Therefore, the distribution of epiphytic fauna at all these places is significantly similar ($p < 0.05$).

The percent composition of different groups of epiphytic fauna on different species of seaweeds from the four stations of study is presented in Tables 2, 3, 4 and 5. Eighteen groups of epiphytic fauna were observed on 33 species of seaweed from all the four stations. All the groups of epiphytic fauna were recorded on 12 species of seaweeds from Dwarka and 14 species of seaweeds from Veraval. However, 14 faunal groups from Okha and 12 faunal groups from Diu were observed on 13 species of seaweeds at each place. All the groups of epiphytic fauna except Cyclopoid on *Enteromorpha compressa* and Cumicid on *Ceramium rubrum* were recorded from Dwarka and Veraval respectively. *Halimeda tuna, Caulerpa recemosa* and *Cystoseira indica* from Dwarka, Veraval and Veraval respectively also contained very high number of epiphytic faunal groups (15). The least number of epiphytic faunal groups (4) were observed on *Caulerpa veravalensis* and *Grateloupia filicina* from Veraval and Diu respectively ($p < 0.01$). The Foraminiferan, Gastropod, Polychaete, Ostracod and Bivalve formed very high proportion of epiphytic fauna (12.39 to 34.75%) on these seaweeds. Foraminiferan, Amphipod (except *Caulerpa veravalensis* from Veraval) and Ostracod

Table 1: Species and species diversity of epiphytic fauna on different seaweeds.

Seaweed species	Okha		Dwarka		Veraval		Diu	
	Faunal species*	Sp. divers.	Faunal species*	Sp. divers.	Faunal species*	Sp. divers.	Faunal species*	Sp. divers.
Green algae								
Caulerpa recemosa (Forskal) J. Agardh	-	-	-	-	-	-	2, 5, 9, 12, 16, 22, 23, 28, 36, 38, 46, 48, 54, 57, 60, 67, 75,77, 80, 81, 86, 89, 97	8.27
Caulerpa peltata Lamouroux	-	-	-	-	7,8,9,11,12,17,23,27,28,38, 44, 45,48,52,54,57,64,67, 72,77,80, 81,84,90,91,97,99	1.83	-	-
Caulerpa taxifolia (Vahl) C. Agardh	1,2.5,6,9,16,23,30,33, 39,40,57,60,61,75,79	3.74	-	-	-	-	-	-
Caulerpa scalpelliformis (K. Brown & Turner) C. Agardh	1,5,9,16,27,28,30,36, 38, 48,57,58,60,67,68, 77,87	2.89	-	-	-	-	-	-
Codium veravalensis Thivy & Chauhan	-	-	-	-	1,2,12,16,24,30, 36,46,47, 57,60,72,75	3.13	-	-
Cladophora prolifera (Roth) Kutzing	-	-	-	-	-	-	2,5,9,12,23,30,36,39,40, 50,57,58,61,65,67,72,75, 77,81,86,89,98	4.93
Codium dwarkense Borgesan	5,9,12,16,20,23,38,50, 57,58, 59, 68,79,100	2.04	-	-	-	-	-	-
Codium tomentosum Sta-house	-	-	-	-	2,16,20,23,30,35,38, 57,60,77,79,81,84, 86, 89	1.75	-	-

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Enteromorpha compressa (Linnaeus) Nees	-	-	1,5,8,11,15,16,18,27, 31,33,36,43,47,52,61, 68,73,75,77,80,85,91, 96,97,98	4.16	-	-	-	-
Halimeda tuna (Ellis & Solander) Lamouroux	2,5,7,11,13,18,23, 29,33,36,42,48, 52,61,78,91,95,97,99	3.26	3,6,10,12,15,18,20,22, 27,36,41,52,56,66, 78,82,93,96	3.46	-	-	-	-
Acrosiphonia orientalis (J. Agardh) P. Silva	-	-	-	-	-	-	2,5,9,12,16,20,21,28,29,30, 72,75,77,80,81,97	8.93
Ulva fasciata Delile	5,14,16,26,30,32,38, 46,49,53,57,59,60, 76,85	2.37	2,5,9,10,12,16,18,28, 29,30,38,56,57,60,62, 75,79,80,84,96,97,99	3.17	1,2,5,9,12,23,30,33,57, 61,67,75,77,79,80,85	3.92	2,5,9,12,16,23,28,30,38,44 50,54,57,67,73,77,80,97	2.47
Velonia aegagropila C. Agardh	-	-	-	-	-	-	5,12,16,23,30,36,38,42,50,57 61,65,67,72,81,97	3.62
Veloniopsis pachynema (G. Martens) Borgesan	-	-	2,3,5,9,11,23,30,36,38, 45,50,56,57,60,61,62, 67, 72,73,75,79,81,84, 88,96,99	3.53	5,9,12,16,23,36,48,57, 67,72,75,77,81	2.34	-	-
Red algae								
Amphiroa anceps (Lamarck) Decaisne	-	-	5,9,12,16,23,27,29,30, 36,56,57,61,67,73,75, 79,81,84,96	4.28	2,5,9,12,16,23,23,30,38, 50,57,60,61,67,70,75, 79,81,85,97	3.63	9,12,16,29,30,38,50,57, 61,67,72,75,77,80,81,97	2.67
Ceramium rubrum Auclorum	2,5,9,14,38,46,49,50, 57,73,75,77,78,81,87	5.48	-	-	2,5,9,16,2.3,28,29,30,38, 50,56,57,61,67,72,77, 81,84	4.46	2,5,9,12,16,20,30,36,38, 41,50,57,61,72,75,77	2.44
Champia indica Borgesan	5,16,28,29,30,31,32, 36, 49, 50, 53, 54, 57, 60,63,78,81,91	2.78	-	-	-	-	-	-
Gelidiopsis intricata (C. Agardh) Vickers	-	-	1,2,5,12,16,19,30,36, 38,57,61,66,67,72,75, 79,82, 83	4.71	-	-	2,9,12,29,30,36,38,50, 57,59,65,70,77,80,81,97	1.84

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Gracilaria corticata (C. Agardh) J. Agardh	2,5,9,16,23,26,30, 36, 38,46,49,56,57, 61, 62,67,72,75,78, 95,96,99	5.92	-	-	2,5,8,15,23,30,36,38,57, 72,79,80,81,84	3.59	-	-
Grateloupia filicina (Lamouroux) C. Agardh	-	-	-	-	-	-	2,12,16,38,56,57,61,75 75,77,81,97	1.54
Halymenia venusta Borgesan	-	-	2,8,12,16,30,38,49, 57, 67,72,75,77,82, 84	4.28	-	-	-	-
Hypnea musciformis (Wulfer) Lamouroux	5,10,12,14,16,17,38, 54,57,59,61,81,92	2.93	-	-	-	-	-	-
Laurencia cruciata Harvey	-	-	-	-	2,5,9,16,23,27,30,33,36, 38,50,56,57,61,67,72, 75,81,85,97,98	5.93	-	-
Scinia hatei Borgesan	5,15,16,20,22,25,30, 38,46,57,77,81	1.24	2,5,9,12,16,20,30,36, 38, 49,50,54,57,58,67, 72,75,84,95,97	4.53	-	-	-	-
Brown algae								
Cystoseira indica (Thivy & Joshi) Mairh	-	-	-	-	2,5,9,16,25,26,31,32,34, 50,57,61,68,73,82,88	3.96	5,30,33,36,37,42,50,54, 56,68,72,80,82,	3.63
Padina gymnospora (Kutzing) Sonder	-	-	-	-	1,2,5,9,16,23,30,36,38, 46,57,60,61,67,72,75, 79,80,84,85,87	6.53	2,5,9,12,16,23,28,30,36, 38,39,42,50,56,57,61,67, 70,71,72,75,77,80, 81,94,97	8.25
Padina tetrastomatica Hawk	5,9,14,16,25,27,35, 38,57,60,69,81	0.93	5,7,8,10,16,30,38,45, 49, 50,56,57,61,67, 72,75,77,84,97	2.99	1,2,5,9,16,23,27,38,50, 57,61,77,79,81	2.37	-	-

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Sargassum johnstonii Setchell & Gardner	-	-	2,9,13,16,30,36,38, 57,67,72,75,77,84	8.13	-	-	-	-
Sargassum plagiophyllum C. Agardh	-	-	4,5,9,28,29,36,38,53, 57, 74,75,77,79,81,85	5.63	-	-	-	-
Sargassum swartzii C. Agardh	5,9,12,16,23,30,36, 37,46,54,57,58,60, 75,93,97	1.29	-	-	-	-	-	-
Sargassum tenerrimum C. Agardh	-	-	-	-	2,5,9,16,23,29,30,34,38, 48,51,55,57,61,67, 75,79,80,82	4.53	5,29,30,33,37,50,54, 66,68,72,80,82,97	3.40
Spatoglossum asperum J. Agardh	4,5,6,7,13,16,22,23, 29,32,36,44,51,53, 57,72,77,81,88,96	1.43	4,5,9,12,16,23,29,38, 46, 50,57,67,72,75, 77, 79,81,97	1.73	1,2,5,9,12,16,23,30,38,55, 57,60,67,70,72,75,79,80 81,86,89,97	2.68	-	-
Total number of seaweed species	13		12		15		13	
Total number of faunal species	72		68		69		56	
Mean species diversity	2.79		4.22		3.75		4.30	
Similarity index with reference to Diu	62.50		62.90		62.40		-	

- absent

*Species names for the corresponding numbers mentioned in Table 1

1. *Amhistegenia madagascariensis* d' Orbigny
2. *Amhistegina lessonii* d' Orbigny
3. *Aplysia* sp.
4. Amphipod egg
5. Bivalve juvenile
6. *Bolivinita quadrilatera* (Schwager)
7. Brittle star
8. *Bullia mauritiana* (Gray)
9. *Calcarina calcar* d' Orbigny
10. *Cerithedia fluviatilis*
11. *Chiton* sp.
12. *Cibicides lobatulus* (Walker & Jacob)
13. *Cibicides pseudoungerianus* (Cushman)
14. *Cibicides refulgens* Montfort
15. *Clavulina difformis* Brady
16. *Conchoecia indica*
17. *Conorboides advena* (Cushman)
18. *Crassostrea cuculata*
19. *Cyclogyra involvens* (Ruess)
20. *Cymbaloporetta bradyi* (Cushman)
21. *Cymbaloporetta squammosa* (d' Orbigny)
22. *Discarbis parisiensis* (d' Orbigny)
23. *Elphidium crispum* (Linne)
24. *Elphidium reticulatum* Cushman
25. *Eponides antillarum* (d'Orbigny)
26. *Eponides rapandus* (Fichtel & Moll)
27. *Euphausia diomediae*
28. *Evadne tergestina*
29. Fish egg
30. Gastropod juvenile
31. *Gavilinopsis praegeri* (Heron-Allen and Earland)
32. *Gigacuma halei*
33. *Glabratella tabernacularis* (Brady)
34. *Globigerinita glutinata* (Egger)
35. *Globigerinoides ruber* (d' Orbigny)
36. *Globigerinoides sacculifer* (d' Orbigny)
37. *Hauerina miocenia* Cushman
38. *Hyperia medusarum*
39. *Littorina scaba* Linne
40. *Longipedia coronata*
41. *Loxostomum limbatum* (Brady)
42. *Loxostomum limbatum var. constulatus* (Cushman)
43. *Loxostomum rostrum* Cushman
44. *Loxostomum truncatum* Phleger and Parker
45. *Lumbrineries* sp.
46. *Macrosetella gracilis*
47. *Massilina annectens* Schlumberger
48. *Metacalanus aurivilli*
49. *Metis juossemei*
50. *Microsetella gracilis*
51. *Miliolinella circularis* (Bornemann)
52. *Modiolus metcalfei*
53. *Nannocalanus minor*
54. Nauplii
55. *Neoconorbina crustata* (Cushman)
56. *Neries versicolar*
57. *Nonion depressulum* (Walker and Jacob)
58. *Ocypoda macrocera*
59. *Oridorsalis umbonatus* (Ruess)
60. *Paracalanus parvas*
61. *Parathemisto* sp.
62. *Penaeus indicus* - mysid stage
63. *Penilia avirostris*
64. *Placenta placenta* (Linne)
65. *Planorbulina mediterranensis* d' Orbigny
66. *Planorbulinella larvata* (Parker and Jones)
67. Planula larva of Coelenterate *Aurilia auritta*
68. *Podon* sp.
69. Post larva of prawn *Penaeus indicus*
70. *Quinqueloculina crassa* d'Orbigny var. subcuneata Cushman
71. *Quinqueloculina seminulum* (Linne')
72. *Quniqueloculina agglutinata* Cushman
73. *Quniqueloculina cuvieriana* d' Orbigny
74. *Quniqueloculina lamarckiana* (d' Orbigny)
75. *Quniqueloculina rhodiensis* Parker
76. *Rosalina bertheloti* (d' Orbigny)
77. *Rosalina bradyi* (Cushman)
78. *Rosalina floridana* (Cushman)
79. *Rosalina globularis* d' Orbigny
80. *Sapphirina nigromaculata*
81. Setiger larva
82. *Siphonina reticulata* (Czjzek)
83. *Spirillina decorata* (Brady)
84. *Spirillina lateseptata* Terquem
85. *Spirillina limbata* Brady var. denticulata Brady
86. *Spirillina limbata var. papillosa* Brady
87. *Spiroloculina antillarum* d' Orbigny
88. Star fish
89. Strobila larva of coelentrate *Aurilia aurita*
90. *Sunetta effosa* Hanley
91. *Tellina radiata* Linne
92. *Temora discaudata*
93. *Triloculina irregularis* (d' Orbigny)
94. *Triloculina planciana* d'Orbigny
95. *Triloculina transversestriata* (Brady)
96. *Trochus radiatus* Gmelin.
97. *Tubiculous polychaete*
98. *Turbo coronatus* Gmelin
99. *Turitella terebra* Linne
100. Veliger larva

(except *Veloniopsis pachynema* from Dwarka and U*lva fasciata* from Veraval) were present on all species of seaweeds from all the places of study. The Foraminiferan showed very high percentage of group composition (80% and above on six species of seaweeds ($p < 0.01$). The Amphineuran were recorded only on *Enteromorpha compressa* and *Veloniopsis pachynema* from Dwarka and *Caulerpa racemosa* and *Ceramium rubrum* from Veraval. The average values for percentage proportion of different groups of epiphytic fauna at all four stations of study indicated the trend: Foraminiferan > Bivalve > Coelenterate larva > Copepod > Echinoderm > Amphineuran. Other groups did not show a definite trend of variation. The group diversity ranged from 2.15 at Okha to 4.15 at Diu and followed the trend Diu > Dwarka > Veraval > Okha.

The result on the numerical density and biomass of epiphytic fauna on different seaweeds are shown in Table 6. The numerical density of epiphytic fauna ranged from 4340 on *Padina tetrastomatica* at Okha to 77440 per 100 g on *Acrosiphonia orientalis* at Diu whereas the average numerical density in all seaweeds varied from 15488.23 at Okha to 30979.39 per100 g at Diu ($p < 0.01$). Very high numerical density was also observed at *Sagrassum johnstonii* from Dwarka (58240 per 100 g), *Padina gymnospora* from Diu (66150 per 100 g) and *Caulerpa racemosa* from Diu (69760 per100 g *,* $p < 0.01$).

The fresh and (dry) weights of epiphytic fauna ranged from 1155 (385) on *Padina tetrastomatica* at Okha to 14785 (4415 g per 100 g) on *Acrosiphonia orientalis* at Diu, whereas the average fresh and (dry) weight biomass of epiphytic fauna varied from 3606.9 (1301.33) at Okha to 6411.07 (2176.76 g per 100 g) at Diu ($p < 0.05$). The *Caulerpa racemosa* and *Padina gymnospora* from Diu and *Sargassum johnstonii* from Dwarka also recorded very high biomass of epiphytic fauna [12235 (4586) to 13289 (4327) g per 100 g, Table 6].

The results on the numerical density, biomass and species diversity of zooplankton of seawater in the vicinity of seaweed epiphytic fauna are depicted in Table 7. The minimum numerical density, and fresh and dry weights of zooplankton were observed at Diu, and the maximum values of these parameters were observed at Veraval. The fresh weight, dry weight and numerical density ranged from 1158- 5146 mg/m^3, 375- 1471 mg/m^3 and 4800- 21060 per m^3 respectively in the study regions ($p < 0.01$). However, the total number of zooplankton species ranged from 8 at Diu to 16 at Okha and Dwarka ($p < 0.01$). None of the species of zooplankton were common to all the four places of study. However, *Mysidopsis indica*, *Sapharina nigromaculata*, *Spirillina lateseptata* and *Triloculina transvertricata* were observed only at Okha, while *Metis jousseamei*, *Parathemisto* sp. and Tubiculous ploychaete were found only at Dwarka, and *Cyclogyra involvens* was recorded only from Diu. The maximum percent numerical density of zooplankton at different stations was exhibited by *Hyperia medusarum* (26.68%) at Okha, *Hyperia medusarum* (33.78%) at Dwarka, *Conchoecia indica* (24.44%) at Veraval and *Amhistegina lesssonii* (35.00%) at Diu ($p < 0.01$). The least percentage numerical density (2.22%) of zooplankton at Okha was exhibited by 7 species, while at Dwarka *Metis jousseamei* showed least percentage of numerical density (1.21%). Similarly at Veraval 5 species of zooplankton showed least percentage of numerical density (1.28%), and at Diu 6 species of zooplankton showed least value (5.00%).

The species diversity of zooplankton ranged from 1.26 at Diu to 4.12 at Veraval ($p < 0.01$) whereas similarity index ranged from 27.27 at Veraval to 41.67 at Okha ($p < 0.05$). The results indicate that the four stations were considerably dissimilar with reference to species diversity and similarity index (Table 7). Most or all (at Dwarka) species of zooplankton were found in epiphytic form also at their respective stations. However, *Sapharina nigromaculata* and *Spirillina lateseptata*

Table 2 : Percentage composition of different groups of epiphytic fauna on seaweeds at Okha.

Seaweed species	Am phi- pod	Anne- lid larva	Biva- lve	Clado ceran	Coelen- terate larva	Cope- pod	Crus- tacean larva	Cumi- cid	Euph -ausid	Fish egg	For amini feran	Gast- opod	Ost- rocod	Poly- chae te
Caulerpa taxifolia	9.97		1.51			0.30	-	-	-	-	87.02	0.60	0.60	-
Caulerpa scalpelliformis	1.19		4.76	5.95	7.15	4.76	-	-	1.19		69.05	1.19	4.76	-
Codium dwarkense	8.57		11.43	2.87		2.87	-	-	-		60.00	-	14.26	-
Halimeda tuna	3.47	4.86	6.25	0.69	1.39	2.78	1.39	2.08	-	-	14.58	5.56	14.17	52.78
Ulva fasciata	2.70		10.81	-	-	13.51	-	-	-	-	56.77	2.70	13.51	-
Ceramium rubrum	7.64	1.39	20.14	-	-	3.47	-	-	-	-	60.42	-	6.94	-
Champia indica	5.09	6.78	5.09	5.09	-	35.59	8.47	3.39	-	1.69	15.25	3.39	10.17	
Gracilaria corticata	39.40	-	4.18	-	2.09	1.49	8.96	-	-	-	37.91	3.88	1.19	0.90
Hypnea musciformis	21.95	2.44	12.20	-	-	2.44	4.88		-		39.02	4.88	12.19	-
Scinia hatei	2.50	2.50	2.50	-		2.50	-	-	-	-	65.00	20.00	5.00	-
Padina tetrastomatica	3.23	3.23	6.45	-	-	3.23	3.23	-	3.23	-	61.28	-	16.12	-
Sargassum swartzii	3.45	-	25.86	-	-	5.17	3.45	-	-	-	44.83	1.72	12.07	3.45
Spatoglossum asperum	17.14	8.57	2.86	2.86		25.71	11.43	2.86	2.86	5.71	11.43	-	-	8.57
Mean (%)	9.72	2.29	8.77	1.34	0.81	7.98	3.29	0.64	0.56	0.57	47.89	3.38	7.77	5.05
Group diversity	2.15													

at Okha, *Temora discaudata* at Veraval and *Cyclogyra involvens* at Diu were found only in planktonic or benthic form. The epiphytic fauna at four stations was quite similar. However, the reverse trend was observed for zooplankton as the similarity index varied widely (27.27 to 41.67). The species diversity for epiphytic fauna at 4 stations of study varied in a narrow range (2.79-4.30), while it varied widely for zooplankton (1.26-4.12; Table 1 & 4; $p < 0.05$). Thirteen groups of zooplankton were observed throughout the study region. Maximum groups (10) were observed at Okha while the least number of groups (6) were observed at Diu ($p < 0.01$). All the groups except Mysid of zooplankton were also found in epiphytic form. The Mysid was recorded only in planktonic form from Okha. The group diversity ranged from 0.95 at Diu to 3.90 at Veraval ($p < 0.01$) and followed the trend Veraval > Dwarka > Okha > Diu (Table 7).

The data on biomass, numerical density and species diversity of benthic fauna are presented in Table 8. The fresh (dry) weight ranged from 4.37 (0.97) at Veraval to 10.36 (3.22) g/m^2 at Dwarka ($p < 0.01$). Similar trend was shown by numerical density of benthos and it varied from 1387 at Veraval to 5478 per m^2 at Dwarka ($p < 0.01$). Twenty seven species of benthic fauna were observed throughout the study area. The minimum (11 species) benthic fauna was observed at Veraval while maximum (18 species) was observed at Dwarka ($p < 0.01$). *Elphidium crispum* and fish egg were found only at Okha whereas *Cyclogyra involvens*, *Modiolus metcalfei*, *Oliva gibbosa*, *Sapharina nigromaculata*, *Sunetta effosa* and *Turitella terebra* were found only at Dwarka. *Lumbrineries* sp. was observed only at Veraval, whereas *Quinquiloculina aggutinata* and *Quinquiloculina parkeri* were recorded only at Diu. However, 6 species of benthic fauna were common to all the 4 stations. The maximum percent numerical density was shown by *Neries versicolar* (18.65%) and Tubiculous polychaete (74.37%) belonging to Polychaete at Okha and Dwarka respectively ($p < 0.01$). However, *Amhistegina lesonii* (30.43%) and *Elphidium crispum* (20.35%) belonging to Foraminiferan exhibited maximum numerical density at Veraval and Diu respectively ($p < 0.01$). The least percentage of numerical density 0.83% at Dwarka to 3.39% at Okha, and a number of species (3-9) at each place exhibited such density ($p < 0.01$). The species diversity of benthic fauna at four places of the study varied in a narrow range (0.54 at Veraval to 1.63 at Dwarka, $p < 0.05$) indicating a poor species diversity in these region. The total number of groups of benthic fauna ranged from 5 at Veraval to 8 at Okha ($p < 0.05$). However, the similarity index also varied in a normal range (55.17 to 59.26) showing nearly a close resemblance of species at four stations of study ($p < 0.05$).

All the species of benthic fauna recorded from Okha and Veraval were also found in epiphytic form in these places. However, 22.22% species of Dwarka and 18.75% species at Diu were not found in epiphytic form at these two places. The *Oliva gibbosa*, *Sunetta effosa*, *Telina* sp. and *Turitella terebra* at Dwarka and *Quinqueloculina parkeri* at Diu were not recorded in epiphytic form but only present in benthic form. *Microsetella gracilis* and *Rosalina globularis* were found in benthic form at Diu and not found in epiphytic form at that place. However, they were found in epiphytic form at Okha and Veraval respectively (Table 1 & 5).

The similarity index of planktonic fauna at respective places was compared with that of benthic form of same place. The similarity indices were 41.38, 47.06, 48.00 and 50.00 at Okha, Dwarka, Veraval and Diu respectively. The results indicate that the fauna at these places was nearly similar however, it was comparatively less similar at Okha and more similar at Diu. However, the species diversity of benthic forms was significantly less than planktonic forms at different places of study.

DISCUSSION

A close relation exists between number of phytal animals and specific surface of algae of which latter is represented by shape, height,consistency and degree of branching (Weiser 1952). High species diversity and very high number of epiphytic fauna on *Acrosiphonia orientalis* and *Caulerpa recemosa* and *Padina gymnospora* from Diu and *Sargassum johnstonii* from Dwarka have been observed in the present study. Similar results for *Acrosiphonia indica* (*Spongomorpha indica*-taxonomic synonym) *Caulerpa taxifolia* and *Sargassum* sp. have been observed (Sarma & Ganapati 1973). These authors have stated that high species on these three algae is due to tufted shrub like structure of *Acrosiphonia*, axils of bipinnate, erect fronds of *Caulerpa* and coarser shrub like structure of *Sargassum*. The high species and group diversity of epiphytic fauna on different seaweeds have been observed at Diu, while they are least at Okha. This might be due to comparatively high turbidity of seawater containing high detritus matter which deposits on seaweed surfaces at Diu in contrast to Okha where seawater is comparatively clear and detritus deposition is less. Dahl (1948) has observed that the amount of detritus on the thalli profoundly influences the density of the inhabiting animals, whereas the volume of detritus on thalli of seaweed is largely influenced by various factors such as water condition, current and secretion of mucus matter from the thalli etc. (Mukai 1971).

Twelve species of epiphytic fauna have shown host specificity for 12 species of seaweeds from 4 places of the study. This might be due to the presence of detritus and phytoplankton on seaweed surface as well as liking of epiphytic fauna to feed on a particular species of seaweeds. It has been

Table 3 : Percentage composition of different group of epiphytic fauna on seaweeds at Dwarka

Seaweed species	Am phi-neuran	Am phi pod	Anne-lid larva	Biva-lve	Clado ceran	Coelen-terate larva	Cope-pod	Crus-tacean larva	Cycl o-poid	Cumi-cid	Ech ino-derm	Eu ph-ausid	Fish egg	For amini feran	Gast-Opod	Moll-uscan larva	Ost-rocod	Poly-chae te
Enteromorpha compressa	0.44	9.73	3.10	5.31	1.33	1.77	2.22	3.10	-	0.88	0.88	0.88	2.22	30.97	12.39	1.33	7.96	15.49
Halimeda tuna	-	10.00	1.33	2.00	-	1.33	2.00	2.67	-	1.33	1.33	1.33	2.00	26.68	12.67	0.67	9.33	25.33
Ulva fasciata	-	14.00	-	10.00	0.67	1.34	1.34	2.66	2.66	-	-	-	0.67	44.67	11.33	-	0.66	10.00
Veloniopsis pachynema	0.24	49.27	0.48	0.73	-	0.72	0.97	7.25	-	-	0.48		1.04	22.95	2.42	-	-	14.49
Amphiroa anceps	-	19.79	2.08	0.52	-	5.21	-	-	-	-	-	1.56	-	51.56	10.95	-	5.73	1.56
Geliodiopsis instricata	-	3.37	-	0.48	-	2.40	-	-	-	-	-	-	-	89.90	3.37	-	0.48	-
Halymenia venusta	-	3.09	-	-	-	1.03	1.03	-	-	-	-	-	-	46.39	20.62	-	27.84	-
Scinia hatei	-	5.24	-	1.75	-	3.49	0.87	0.44	-	-	-	-	-	17.03	61.14	0.44	1.31	8.29
Padina tetrastomatica	-	15.79	-	0.81	-	0.81	1.63	-	-	-	0.40	-	-	37.25	17.00	-	2.02	24.29
Sargassum johnstonii	-	2.68	-	-	-	0.22	-	-	-	-	-	-	-	45.32	49.55	-	2.23	-
Sargassum plagiophyllum	-	1.63	0.27	0.54	0.82	-	0.82	-	-	-	-	-	-	64.85	28.07	-	3.00	-
Spatoglossum asperum	-	8.24	1.18	1.18	-	1.18	2.35	-	-	-	-	-	1.17	35.29	43.53	-	2.35	3.53
Mean (%)	0.06	11.90	0.70	1.94	0.24	1.63	1.10	1.34	0.22	0.18	0.26	0.31	0.59	42.74	22.75	0.20	5.24	8.58
Group diversity	4.03																	

Table 4 : Percentage composition of different group of epiphytic fauna on seaweeds at Veraval.

Seaweed species	Am phi-neuran	Am phi pod	Anne-lid larva	Biva-lve	Clado ceran	Coelen-terate larva	Cope-pod	Crus-tacean larva	Cycl o-poid	Cumi-cid	Ech ino-derm	Eu ph-ausid	Fish egg	For amini feran	Gast-Opod	Moll-uscan larva	Ost-rocod	Poly-chae te
Caulerpa recemosa	0.83	5.76	1.65	13.22	1.65	4.96	0.83	0.86	4.96	-	0.83	0.83	-	28.93	5.76	-	4.76	23.97
Caulerpa veravalensis	-	-	-	-	-	-	2.16	-	-	-	-	-	-	94.97	0.71	-	2.16	-
Codium tomentosum	-	14.29	2.04	-	-	-	4.08	-		-	-	-	-	63.97	8.16	-	8.16	-
Ulva fasciata	-	1.19	-	1.19	-	1.19	-	-	7.14	-	-	-	-	88.10	1.19	-		-
Veloniopsis pachynema	-	17.44	2.33	3.49	-	2.33	2.33	2.33	-	-	2.33	1.16	-	47.65	-	-	16.28	-
Amphiroa anceps	-	8.99	5.62	1.12	-	1.12	2.25	-	-	-	-	-	-	70.79	4.49	-	3.37	2.25
Ceramium rubrum	0.52	6.28	5.24	6.61	0.52	1.57	2.62	1.05	1.05	-	0.52	0.52	2.09	34.75	15.71	0.52	12.57	8.38
Gracilaria corticata	-	28.57	1.43	2.14	1.06	-	-	-	1.43	-	-	-	-	36.43	9.28	-	7.86	12.86
Laurencia cruciata	-	6.11	0.51	2.04	-	0.25	0.25	-	-	-	-	0.25	-	36.64	2.30	-	0.25	51.40
Cystoseira indica	-	7.41	4.76	4.23	1.06	2.65	3.70	1.58	-	-	2.12	2.65	2.65	32.80	14.29	1.58	12.17	6.35
Dictyota dichotoma	-	21.84	2.30	2.30	-	2.30	-	2.30	-	3.45	-	-	1.15	49.43	3.45	-	5.72	5.72
Padina tetrastomatica	-	17.65	-	3.92	-	6.86	1.96	-	0.98	-	-	-	-	63.73	2.94	-	1.96	-
Sargassum tenerrimum	-	48.18	-	0.91	-	3.64	0.91	-	0.91	-	-		0.91	28.18	12.73	-	4.55	-
Spatoglossum asperum	-	13.64	1.50	6.06	-	1.50	1.51	-	3.03	-	-	-	-	60.61	3.03	-	4.56	4.56
Mean	0.07	14.10	1.96	3.37	0.31	2.24	1.61	0.58	1.39	0.25	0.41	0.39	0.49	52.59	6.00	0.15	6.04	8.25
Group diversity	3.56																	

- absent; Columns headings as per Table 3.

Table 5: Percentage composition of different group of epiphytic fauna on seaweeds at Diu.

Seaweed species	Amphipod	Annelid larva	Bivalve	Cladoceran	Coelenterate larva	Copepod	Crustacean larva	Cyclopoid	Fish egg	Foraminiferan	Gastopod	Ostrocod
Caulerpa reecemosa	2.29	0.92	0.92	0.92	0.92	2.75	0.46	4.58	-	78.90	3.67	3.21
Cladophora prolifera	2.57	1.71	0.85	-	0.85	1.71	-	-	-	90.60	0.43	0.85
Acrosiphonia orientalis	4.88	2.44	1.62	1.62	-	1.62	-	2.44	1.63	69.11	2.44	9.76
Velonia aegagropila	23.12	2.15	1.08	-	-	1.08	1.08	-	-	69.34	-	1.61
Amphiroa anceps	16.95	1.69	3.39	-	1.69	1.69	-	1.69	1.69	45.76	20.34	3.39
Ceramium rubrum	3.12	-	1.24	-	-	2.48	-	-	-	88.82	2.48	1.86
Gelidiopsis intricate	13.43	5.97	-	-	1.49	2.99		1.49	1.49	49.25	17.91	2.99
Grateloupia filicina	22.50	5.00	-	-	-	-	-	-	-	55.00	-	2.50
Cystoseira indica	4.65	3.72	5.58	1.40	3.26	3.26	1.40	0.93	3.26	42.79	13.94	5.58
Dictyota dichotoma	9.42	5.13	2.99	2.56	3.42	2.56	0.85	0.85	2.56	42.74	8.97	2.98
Padina gymnospora	10.21	0.68	2.04	0.68	2.04	0.68		1.36	-	58.50	18.36	4.08
Sargassum tenerrimum	8.42	4.95	7.92	1.98	3.47	2.48	2.48	0.99	4.46	34.65	13.85	6.43
Ulva fasciata	10.43		1.74	0.87	0.86	1.74	0.86	12.17	0.87	61.74	4.38	3.48
Mean	10.15	2.64	2.26	0.77	1.38	1.93	0.55	2.04	1.23	60.54	8.21	3.98
Group diversity	4.15											

- absent

reported that the epiphytic phytoplankton, detritus and seaweed can affect the distribution and abundance of epiphytic fauna, which attracts the number of detritus feeding organisms like Foraminiferan (Mukai 1971, Sarma 1974a). It is noteworthy that most of the epiphytic fauna belongs to Foraminifera.

The least number of epiphytic faunal groups have been observed on *Caulerpa veravalensis* and *Grateloupia filicina*. This might be due to presence of a toxin in these two seaweeds. Caulerpin and Caulerpicin are the toxins reported from *Caulerpa* and have different degrees of toxicity to man and animals (Baslow 1969, Arasaki & Arasaki 1983, Naidu et al. 1993). The literature search including internet search could not reveal any published literature on toxins from *Grateloupia*. Therefore, it could be an interesting topic to work upon. The *Sargassum* from west coast of India harboured 8120 to 58240 per 100 g of alga faunal density, which was significantly higher than those reported from east coast of India (894.2 to 22255.0 per 100 g of alga). Similar trend was observed with *Ulva fasciata* (Sarma 1974a,b).

It is reported that some of the species of seaweeds of India, a tropical region, contain more varied and richer animal life than the temperate littoral flora (Sarma 1974b). However, these data and comparison with temperate algae do not agree with this conclusion. In the present study, the species of *Cladophora*, *Ceramium* and *Sargassum* contain 29250, 8120-58240 and 12880-32256 numbers per 100 g of alga, whereas *Chladophora* and *Sargassum* from Plymouth, United Kingdom and Mukashima, Japan respectively contained 1100-9480 and 2000-9400 numbers per 100 g of algae while, Ceramium form Plymouth contained 2320-48560 numbers per 100 g of alga (converted from dry weight to fresh weight assuming 20% dry weight in fresh seaweed (Weiser 1952, Mukai 1971). Since, there is a disparity, and qualitative and quantitative variations of phytal fauna depend on quite a number of factors, therefore, the authors think that it will be quite premature to draw such conclusion with limited data.

The total count of zooplankton of seawater in the seaweed growing region is significantly higher

Table 6: Numerical density and biomass of epiphytic fauna on different species of seaweeds.

Seaweed species	Okha Numerical density (No. per 100g)	Okha Fresh weight (g/100g)	Okha Dry weight (g/100g)	Dwarka Numerical density (No. per 100g)	Dwarka Fresh weight (g/100g)	Dwarka Dry weight (g/100g)	Veraval Numerical density (No. per 100g)	Veraval Fresh weight (g/100g)	Veraval Dry weight (g/100g)	Diu Numerical density (No. per 100g)	Diu Fresh weight (g/100g)	Diu Dry weight (g/100g)
Caulerpa recemosa	-	-	-	-	-	-	-	-	-	69760	13289	4327
Caulerpa *Peltata*	-	-	-	-	-	-	5350	1255	467	-	-	-
Caulerpa taxifolia	26853	5828	1985	-	-	-	-	-	-	-	-	-
Caulerpa scalpellifomis	10500	3110	1015	-	-	-	-	-	-	-	-	-
Codium veravalensis	-	-	-	-	-	-	18070	5130	1815	-	-	-
Cladophora prolifera	-	-	-	-	-	-	-	-	-	29250	6121	2515
Codium dwarkense	8960	1729	625	-	-	-	-	-	-	-	-	-
Codium tomentosusm	-	-	-	-	-	-	6370	1715	673	-	-	-
Enteromorpha compressa	-	-	-	27572	5830	2023	-	-	-	-	-	-
Halimeda tuna	17424	4328	1286	18255	4086	1428	4357	1612	437	-	-	-
Acrosiphonia orientalis	-	-	-	-	-	-	-	-	-	77440	14785	4415
Ulva fasciata	9472	2815	926	14502	3320	1338	20160	4454	1011	12190	2812	992
Velonia aegegropila	-	-	-	-	-	-	-	-	-	23250	5517	1926
Veloniopsis pachynema	-	-	-	13781	3188	1125	10492	2196	887	-	-	-
Amphiroa anceps	-	-	-	22648	5878	2152	19224	4065	1216	15340	3982	1037
Ceramium rubrum	32256	6629	2358	-	-	-	23111	5166	1928	12880	3620	1028
Champia indica	12744	3325	1312	-	-	-	-	-	-	-	-	-
Gelidiopsis intricata	-	-	-	24960	6231	2716	-	-	-	8375	1712	618
Gracilaria corticata	39458	9325	3815	-	-	-	20930	4887	1915	-	-	-
Grateloupia filicina	-	-	-	-	-	-	-	-	-	8069	1518	517
Halymenia venusta	-	-	-	25220	6128	2185	-	-	-	-	-	-
Hypnea musciformis	15200	3392	1072	-	-	-	-	-	-	-	-	-
Laurencia cruciata	-	-	-	-	-	-	38972	8315	2816	-	-	-
Scinia hatei	6080	1518	568	25642	6325	2615	-	-	-	-	-	-
Cystoseira indica	-	-	-	-	-	-	28381	5962	2547	27456	5685	2275
Dictyota dichotoma	-	-	-	-	-	-	35577	8125	2856	28548	6237	2618
Padina gymnospora	-	-	-	-	-	-	40327	10218	3117	66150	12915	4389
Padina tetrastomatica	4340	1155	385	19095	4016	1816	15360	3110	1256	-	-	-
Sargassum johnstonii	-	-	-	58240	12235	4586	-	-	-	-	-	-
Sargassum plagiophyllum	-	-	-	37434	7112	2315	-	-	-	-	-	-
Sargassum swartzii	8120	1622	572	-	-	-	-	-	-	-	-	-
Sargassum tenerrimum	-	-	-	-	-	-	29040	6126	3262	25250	5314	1988
Spatoglossum asperum	9940	2835	983	1190	3120	1185	20460	4845	1716	-	-	-
Total	201347	47611	16902	299249	67469	25484	336181	83856	30179	430188	89029	30573
Mean	15488.23	3662.39	1300.15	24937.42	5622.42	2123.67	21011.31	4932.71	1775.24	30727.71	6359.21	2183.79

- absent

Table 7: Biomass, numerical density and species diversity of zooplankton of seawater in the vicinity of seaweed epiphytic fauna.

Station	Okha	Dwarka	Veraval	Diu
Fresh weight (mg m^{-3})	3118	4364	5146	1158
Dry weight (mg m^{-3})	963	1262	1471	375
Numerical density (No. m^{-3})	11070	20020	21060	4800
Group & Species	***Percentage of total numerical density***			
Amphipod				
Hyperia medusarum	26.68	33.78	5.13	-
Parathemisto sp.	-	2.60	-	-
Annelid				
Setiger larva	-	9.09	3.85	5.00
Coelenterate				
Planula larva of *Aurilla aurita*	-	1.29	1.28	-
Copepod				
Metis jousseamei	-	1.21	-	-
Microsetella gracilis	8.89	2.60		5.00
Paracalanus parvus	2.22	2.60	-	-
Temora discaudata	2.22		1.28	
Crustacean				
Nauplii	2.22	-	-	5.00
Cyclopoid				
Sapharina nigromaculata	6.67	-	-	-
Euphausid				
Euphausis diomediae	-	1.29	-	-
Foraminiferan				
Amhistegina lessonii	8.89	-	19.35	35.00
Calcarina calcar	2.22	1.29	2.56	-
Conorboides advena	-	-	1.28	-
Cyclogyra involvens	**-**	***-***	***-***	***5.00***
Cymbaloporetta bradyi	-	-	2.56	-
Elphidium crispum	-	1.29	6.41	-
Globigerinoides sacculifer	***6.67***	***2.60***	***3.85***	***-***
Nonion depressulum	8.89	2.60	-	5.00
Quinqueloculina agglutinata	4.44	3.91	3.85	
Quinqueloculina rhodiensis	-	9.09	1.28	-
Spirillina lateseptata	***2.22***	***-***	***-***	***-***
Triloculina tansverstricata	2.22	-	-	-
Gastropod				
Juvenile gastropod	2.22	22.08	-	20.00
Mysid				
Mysidopsis indica	4.44.	-	-	-
Ostrocod				
Conchoecia indica	8.89	-	24.44	-
Pisces				
Fish egg	-	-	1.28	5.00
Polychaete				
Tubiculous polychaete	-	2.60	-	-
Total number of species	16	16	14	8
Species diversity	2.98	3.91	4.12	1.26
Total number of group	10	8	7	6
Group diversity	2.21	3.28	3.90	0.95
Similarity index with reference to Diu	41.67	33.33	27.27	-

- absent

Table 8: Biomass, numerical density and species diversity of benthos in the vicinity of seaweed epiphytic fauna.

Station	Okha	Dwarka	Veraval	Diu
Fresh weight (g m^{-2})	3118	4364	5146	1158
Dry weight (g m^{-2})	963	1262	1471	375
Numerical density (No. m^{-2})	11070	20020	21060	4800
Species	***Percentage of total numerical density***			
Annelid				
Setiger larva	3.39	-	-	1.69
Bivalve				
Bivalve juvenile	5.08	-	-	18.64
Modiolus metcalfei	-	1.65	-	-
Sunetta effosa	-	1.65	-	-
Telina sp.	-	1.65	-	-
Copepod				
Microsetella gracilis	3.39	-	-	1.69
Crustacean				
Nauplii	5.08	1.65	4.35	1.69
Cyclopoid				
Sappharina nigromaculata	-	1.65	-	
Foraminiferan				
Amhistegina lessoni	5.08	3.31	30.43	18.64
Calcarina calcar	6.78	0.83	4.35	3.40
Conchoecia indica	8.47	0.83	4.35	-
Cyclogyra involvens	-	***0.83***	-	-
Elphidium crispum	3.39	0.83	26.08	20.35
Globigerinoides sacculifer	-	3.31	4.35	1.69
Nonion depressulum	13.57	1.65	8.69	10.18
Quinqueloculina agglutinata	-	-	-	1.69
Quinqueloculina parkeri	-	-	-	1.69
Quinqueloculina rhodiensis		0.83	4.35	-
Rosalina bradyi	***1***1.87	-	-	1.69
Rosalina globularis	-	0.83	-	1.69
Gastropod				
Gastropod juvenile	10.17	0.83	4.35	10.18
Oliva gibbosa	-	1.65	-	
Turitella terebra	-	1.65	-	-
Pisces				
Fish egg	5.08	-	-	-
Polycheate				
Lumbrineries sp.	-	-	4.35	-
Neries versicolar	18.65	-	-	1.69
Tubiculous polychaete	-	74.37	4.35	3.40
Total number of species	13	18	11	16
Species diversity	0.82	1.63	0.54	0.65
Total number of group	8	7	5	7
Group diversity	0.61	1.25	0.24	0.38
Similarity index with reference to Diu	55.17	58.82	59.26	-

- absent

(4800-21060 per m^3) than those reported from other plant populated region (1618-3806 per m^3, Shanmugam et al. 1986). This might be due to more congenial atmosphere provided by seaweed for the better growth of zooplankton. However, it is an interesting topic that needs further investigation. Normally, the copepods form highest proportion of zooplankton (70.98-94.2%, Goswami 1985, Shanmugam et al. 1986). However, in the present investigation the numerical density in the single group of zooplankton did not give such high proportion. The dominant groups were Amphipod, Ostracod and Foraminiferan at different places of the study. Such dissimilarity might be due to release of extracellular products by seaweeds, which might have selective growth inhibition against Copepods (Fogg 1962, Berglund 1969, Lefev're 1972, Pedersen & Fridborg 1972). Most of the zooplankton of seawater and benthic (micro and meio) fauna were recorded in epiphytic form from different seaweeds during the study, which might be due to migration of zooplankton and their growth on a more favourable substrata like seaweeds. Migration has been reported extensively (Renon et al. 1985, Schababherger et al. 2000, Hays et al. 2001). In the present study similarity index and the species diversity for epiphytic fauna varied in a narrow range, while they varied widely for zooplankton of seawater. This might be due to better food availability, protection against predators and shelter from wave action to epiphytic fauna in the former case, while in the latter the migration and invasion by other fauna from neighbouring areas kept these parameters to fluctuate much.

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The epiphytic microbial communities of seagrass (Cymodocea rotundata and Thalassia testudinum) along with sediments and seawater of the seagrass ecosystem of Andaman Sea were assessed for heterotrophic bacterial communities. Young leaves of C. nodosa and T. testudinum sediments and water samples were collected from two different locations at Burmanala and Havelock island. Young leaves were swabbed and transferred into Alkaline peptone water along with 1 gm of sediments and 1 ml of seawater for initial microbial enrichments, followed by culture of microbes in Salt Yeast Extract Agar. Thi-osulp Abstract: In the present study, a total of ten seaweed species collected from the Kollam coast (Indian ocean). were subjected to antifouling assays against the common fouling organisms such as Balanus amphitrite, Mytilus edulis and three biofilm forming bacteria, Vibrio sp., Colwellia sp.Â sterile seawater and used for bioassay. Appropriate. amount of seaweed extracts were pipetted on the. exposed foot and repulsive activity was recorded. immediately after the treatment.Â mussel, Mytilus edulis. From these results it was Marine fouling and its prevention. Contrib. nÂ° 580. understood that the seaweed, L. brandenii seemed to be Woods Hole Oceanographic Institution, Annapolis The present inventory of marine fauna is far from complete, which leaves immense scope for further taxonomic studies. Discover the world's research. 17+ million members.Â A check list of marine fungi recorded from India is compiled on the basis of the present studies along the coast of Daman, Diu Island, Gujarat, Goa and Maharashtra and published literature. Distribution of 207 species of marine fungi (14 Labyrinthulomycota, 4 Chytridiomycota, 4 Oomycota, 139 Ascomycota, 3 Basidiomycota and 43 Mitosporic fungi) reported so far from marine habitats along various coastal states, Islands and Union territories of India.