

## Zooplankton Abundance in the Laccadive Sea (Lakshadweep)

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Zooplankton abundance from the samples collected during the 31st cruise of *R V Gaveshani* (March-April 1978) in the Laccadive Sea (Lakshadweep) was studied. Major planktonic groups showed patchy distribution of abundance in the surveyed region. Copepods were dominant constituents of zooplankton population at all stations. Two harpacticoid copepod species, viz. *Microsetella norvegica* (Boeck) and *Miracia efferata* Dana, were associated with the blue green alga *Trichodesmium erythraeum*. Decapods were better represented in the oceanic region. The gravid females of red bathypelagic prawns, *Acanthephyra sanguinea*, adults and juveniles of *Gennadas* sp. and *Parapenaeus* sp. were recorded in greater numbers around Kalpeni, Androth and Minicoy islands. Zooplankton biomass values at the oceanic stations varied from 4.5 to 37.5 ml/200 m<sup>3</sup>. These values were compared with the zooplankton biomass values reported for some regions of the Indian Ocean.

Zooplankton studies from the Indian Ocean received considerable impetus during the International Indian Ocean Expedition (IIOE) when a series of atlases showing the distribution of biomass and abundance of different planktonic groups in the Indian Ocean were prepared from the collected samples<sup>1-6</sup>. Some investigations were carried out on the zooplankton standing stock in the north and northeastern part of the Arabian Sea<sup>7</sup> and in the Bay of Bengal<sup>8</sup>.

Studies on the zooplankton population in the Laccadive Sea are rather meagre<sup>9,10</sup> and whatever information is available, is confined to atolls<sup>11-13</sup>. The present paper deals with the zooplankton abundance and distribution of major groups and dominant species in the Laccadive Sea.

### Materials and Methods

Zooplankton samples (50) collected during the 31st cruise (March-April 1978) of *R V Gaveshani* were used. Samples were collected mostly from the oceanic region, but a few collections were also made along the continental shelf (Fig. 1). Two series of vertical collections were made, one with the Indian Ocean Standard Net<sup>14</sup>, usually from 200 to 0 m and the other with modified HT net<sup>15</sup> from water column above the thermocline layer up to the surface (90 to 0 m). From 6 stations (865 to 870), zooplankton samples were also collected from 500 to 0 m. The depth of the sampling stations along with the date and time of collection are given in Table 1. Zooplankton samples were analysed for determination of biomass and for numerical abundance of major groups and their species wherever possible. Zooplankton biomass was determined by displacement volume method. Depending on the volume of zooplankton sample, a subsample of 4-10%

was examined. The number of organisms was calculated for the whole sample and computed per 10 m<sup>3</sup>.

### Results

*Zooplankton biomass*—The values during the present study were quite poor for the oceanic stations (av. 14.7 ml/200 m<sup>3</sup>). The highest biomass value was obtained at st 863 located near the Kavaratti Atoll.

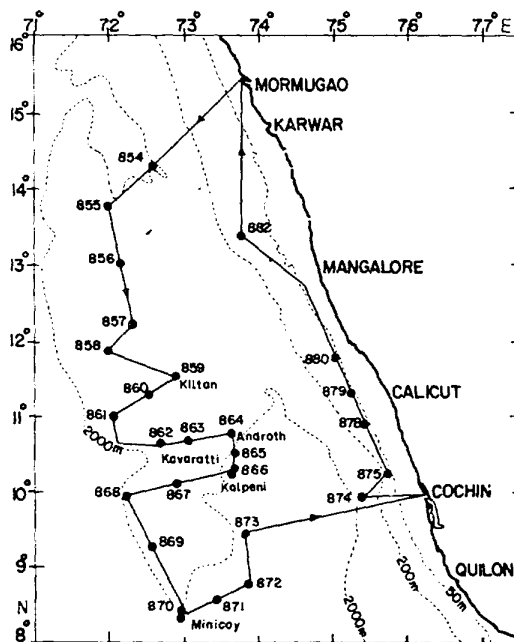


Fig. 1—Location of stations

Zooplankton biomass values were higher for the shelf stations (av. 29.9 ml/200 m<sup>3</sup>; Table 1).

**Faunistic composition—Copepoda:** Copepods (Figs 2A and B) formed a major component of zooplankton community at all stations, constituting 52.7 to 81.4% of total plankton counts. Their population density was slightly higher in the column samples (200-0 m) taken at stations 868, 871 and also at stations located along the continental shelf. The maximum number recorded being 5164.0/10 m<sup>3</sup> at station 875. A total of 106 copepod species were identified from the samples collected above the thermocline layer (Table 2). Most of them (75.47%) were calanoid copepods. The harpacticoid copepods were recorded in small numbers and were represented in the samples by 6 species such as *Longipedia scotti*, *Microsetella norvegica*, *M. rosea*, *Macrosetella gracilis*, *Miracia efferata* and *Clytemnestra scutellata*. Two of these species, viz. *M. norvegica* and *M. efferata*, were invariably associated with the blue green alga *Trichodesmium erythraeum* and were recorded in greater numbers whenever samples contained filaments of blue green alga (Table 3). The cyclopoid copepods were represented by 20 species and majority of them belonged to the family Sapphirinidae.

Spatial variations in the abundance of copepod species were also observed. Species of the genera

*Nannocalanus*, *Paracalanus*, *Metacalanus* and *Temora* were recorded more in samples collected from the northern stations whereas species of the genera *Scolecithrix*, *Heterorhabdus*, *Tortanus*, *Sapphirina* and *Copilia* were more abundant from the southern stations. Variations in the occurrence of copepod species in relation to time of collection of samples were also noticed. Members of the genera *Rhincalanus*, *Clausocalanus*, *Centropages*, *Lucicutia*, *Haloptilus*, *Euchirella*, *Pleuromamma*, *Calanopia* and *Acartia* were abundant in the day samples while species of the genera *Nannocalanus*, *Eucalanus*, *Euchaeta*, *Heterorhabdus*, *Sapphirina* and *Copilia* were relatively in greater numbers in the night samples.

**Chaetognatha:** This group (Figs 3A and B) was well represented in all plankton samples, being second only to copepods in numerical abundance. They were recorded in greater numbers in the samples taken around Androth and Kalpeni islands. Species of the genera *Sagitta*, *Pterosagitta* and *Krohnitta* were encountered in the collections. *Sagitta enflata* and *S. regularis* were the most abundant species in the samples from the shelf.

**Decapod larvae:** Crab zoeae, megalopa larvae, developmental stages of lucifers, juveniles and adults of prawns of the families Palaemonidae, Pandalidae, Hippolytidae, Hoplophoridae, Pasiphaeidae, Alpheidae, Thalassinidae and Penaeidae constituted decapod population (Figs 4A and B) in the samples. Species of the families Thalassinidae, Hippolytidae and Penaeidae were quite common. The family Penaeidae was represented by *Gennadas* sp. and *Parapenaeus* sp. The gravid females of *Acanthephyra sanguinea* belonging to the family Hoplophoridae were caught in large numbers in the plankton hauls taken from 500 m depth.

**Fish larvae:** Fish larvae were fairly well represented in all the plankton collections, occurring in greater numbers in the samples taken below the thermocline layer. The highest population density (66/10 m<sup>3</sup>) was recorded at station 870, situated near Minicoy island (Figs 5A and B). Fish larvae of the families Holocentridae and Apogonidae were common in the plankton samples.

## Discussion

Zooplankton biomass in the Laccadive Sea during the present study showed a patchy distribution. Biomass values during the 10th cruise (6 to 15 October 1976) and 13th cruise (7 to 18 December 1976) were reported<sup>9,10</sup> to increase in the northern and southern areas of the region surveyed. The zooplankton biomass values during the 10th, 13th and 31st cruises to the atolls in the Laccadives varied from 1.9 to 80, 6.2 to 84 and 4.5 to 37.5 ml/200 m<sup>3</sup>. During all the 3 cruises, the

Table 1—Details of Collections and Zooplankton Biomass Values of Samples Collected with Indian Ocean Standard Net during March-April 1978

Date of collection	Station No.	Time of collection (hrs)	Depth of sampling stations(m)	Biomass value (ml/200 m <sup>3</sup> )
21.3.78	854	1210	2000	11
21.3.78	855	1755	1500	25
22.3.78	856	0300	1400	20
22.3.78	857	1300	1600	13
22.3.78	858	2115	1500	10
23.3.78	859	0700	1000	7.5
23.3.78	860	1400	1800	6
24.3.78	861	0200	1600	14
25.3.78	862	2215	1000	17.5
26.3.78	863	0500	1800	37.5
26.3.78	864	1300	950	11
26.3.78	865	1830	2000	24.5
27.3.78	866	0100	1750	7.8
27.3.78	867	0930	1800	10
27.3.78	868	1800	1400	4.5
28.3.78	869	0300	2000	21.5
29.3.78	870	1645	2000	8.6
30.3.78	871	2230	1900	16
3.4.78	874	2000	1200	14
4.4.78	875	2230	70	32
4.4.78	878	0700	57	11.1
4.4.78	879	1140	50	10
4.4.78	880	1630	52	66.7

Table 2—Population Density of Common Copepod Species of Different Families Collected above Thermocline Layer  
[Numbers in parentheses indicate station number]

Species	Maximum population density (No/m <sup>3</sup> )	Species	Maximum population density (No/m <sup>3</sup> )
<b>Calanidae</b>			
<i>Nannocalanus minor</i> (Claus)	14.1 (859)		
<i>Canthocalanus pauper</i> (Giesbrecht)	9.1 (867)		
<i>Undinula vulgaris</i> (Dana) var. <i>typica</i> Sewell	23.7 (873)		
<i>U. darwini</i> (Lubbock) var. <i>Symmetrical</i> Sewell	64.1 (855)		
<b>Eucalanidae</b>			
<i>Eucalanus crassus</i> Giesbrecht	28.1 (854)		
<i>E. subcrassus</i> Giesbrecht	11.2 (882)		
<i>E. monachus</i> Giesbrecht	17.6 (867)		
<i>E. mucronatus</i> Giesbrecht	31.4 (856)		
<i>E. attenuatus</i> (Dana)	15.1 (858)		
<i>E. pseudattenuatus</i> Sewell	8.8 (874)		
<i>E. elongatus</i> (Dana)	12.5 (864)		
<i>E. subtenius</i> Giesbrecht	4.7 (865)		
<i>Rhincalanus cornutus</i> Dana	1.9 (872)		
<i>R. nasutus</i> Giesbrecht	6.5 (860)		
<b>Pseudocalanidae</b>			
<i>Clausocalanus arcuicornis</i> (Dana)	7.7 (868)		
<i>Calocalanus pavo</i> (Dana)	18.3 (855)		
<b>Paracalanidae</b>			
<i>Paracalanus parvus</i> (Claus)	44.1 (856)		
<i>P. aculeatus</i> Giesbrecht	91.6 (855)		
<i>Acrocalanus gibber</i> (Giesbrecht)	17.2 (859)		
<i>A. gracilis</i> Giesbrecht	151.8 (854)		
<i>A. monachus</i> Giesbrecht	31.2 (869)		
<i>A. longicornis</i> Giesbrecht	14.5 (860)		
<b>Euchaetidae</b>			
<i>Euchaeta marina</i> (Prestandrea)	36.4 (867)		
<i>E. concinna</i> Dana	21.5 (856)		
<i>E. wolfendeni</i> A. Scott	9.6 (869)		
<i>Euchaeta</i> sp.	11.7 (860)		
<b>Actideidae</b>			
<i>Euaetideus</i> sp.	15.1 (860)		
<i>Euchirella bella</i> Giesbrecht	4.6 (867)		
<i>Euchirella</i> sp.	16.1 (863)		
<b>Scolecithricidae</b>			
<i>Scolecithrix danae</i> (Lubbock)	29.1 (872)		
<i>Scolecithrix</i> sp.	13.7 (868)		
<b>Centropagidae</b>			
<i>Centropages orsinii</i> Giesbrecht	61.0 (854)		
<i>C. alcocki</i> Sewell	13.6 (882)		
<i>C. furcatus</i> (Dana)	21.1 (864)		
<i>C. trispinosus</i> Sewell	16.4 (865)		
<i>C. tenuiremis</i> Thompson & Scott	24.5 (882)		
<i>C. dorsispinatus</i> Thompson & Scott	84.9 (874)		
<i>C. elongatus</i> Giesbrecht	14.5 (860)		
<i>C. gracilis</i> (Dana)	10.1 (862)		
<i>Centropages</i> sp.	131.6 (865)		
<b>Pseudodiaptomidae</b>			
<i>Pseudodiaptomus serricaudatus</i> (T. Scott)	23.4 (873)		
<b>Temoridae</b>			
<i>Temora discaudata</i> Giesbrecht	19.1 (859)		
<b>Metridiidae</b>			
<i>Pleuromamma abdominalis</i> (Lubbock)	17.6 (860)		
<i>P. xiphias</i> (Giesbrecht)	40.7 (867)		
<i>Pleuromamma</i> sp.	2.8 (864)		
<b>Lucicutiidae</b>			
<i>Lucicutia flavicornis</i> (Claus)	51.6 (864)		
<i>L. ovalis</i> Wolfenden	39.4 (859)		
<i>Lucicutia</i> sp.	18.1 (865)		
<b>Heterorhabdidae</b>			
<i>Heterorhabdus</i> sp.	61.7 (870)		
<b>Augaptilidae</b>			
<i>Haloptilus longicornis</i> (Claus)	18.3 (867)		
<i>Haloptilus</i> sp.	18.3 (861)		
<b>Arietellidae</b>			
<i>Metacalanus aurivilli</i> Cleve	18.6 (857)		
<b>Candaciidae</b>			
<i>Candacia bradyi</i> A. Scott	91.9 (854)		
<i>C. pachydaetyla</i> (Dana)	21.0 (856)		
<i>C. discaudata</i> A. Scott	52.8 (869)		
<i>C. aethiopica</i> (Dana)	15.3 (856)		
<i>Candacia</i> sp.	77.3 (871)		
<b>Pontellidae</b>			
<i>Labidocera acuta</i> (Dana)	29.6 (854)		
<i>L. bengalensis</i> Krishnaswamy	121.0 (860)		
<i>L. kroyeri</i> (Brady)			
var. <i>gallensis</i> Thompson & Scott	89.3 (862)		
<i>L. euchaeta</i> Giesbrecht	34.7 (865)		
<i>L. detruncata</i> (Dana)	9.4 (873)		
<i>L. acutifrons</i> (Dana)	16.4 (862)		
<i>L. laevidentata</i> (Brady)	31.1 (869)		
<i>Calanopia elliptica</i> (Dana)	61.7 (866)		
<i>C. minor</i> A. Scott	55.1 (857)		
<i>C. thompsoni</i> A. Scott	17.1 (859)		
<i>Pontella danae</i> Giesbrecht			
var. <i>ceylonica</i> Thompson & Scott	91.0 (860)		
<i>P. securifer</i> Brady	20.6 (855)		
<i>P. fera</i> Dana	14.2 (855)		
<i>P. andersoni</i> Sewell	22.3 (869)		
<i>Pontellopsis scotti</i> Sewell	31.5 (865)		
<i>P. regalis</i> (Dana)	16.4 (857)		
<i>P. herdmani</i> Thompson & Scott	52.6 (873)		
<i>Pontellina plumata</i> Dana	33.0 (874)		

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Table 2—Population Density of Common Copepod Species of Different Families Collected above Thermocline Layer—Contd

Species	Maximum population density (No/m <sup>3</sup> )	Species	Maximum population density (No/m <sup>3</sup> )
Acartiidae		Oithonidae	
<i>Acartia danae</i> Giesbrecht	114.8 (868)	<i>Oithona plumifera</i> Baird	9.3 (863)
<i>A. negligens</i> Dana	17.5 (858)	<i>O. nana</i> Giesbrecht	57.8 (859)
<i>A. erythraea</i> Giesbrecht	89.3 (870)	<i>O. linearis</i> Giesbrecht	24.9 (855)
Tortanidae		<i>O. robusta</i> Giesbrecht	7.2 (855)
<i>Tortanus gracilis</i> (Brady)	171.6 (874)	<i>O. setigera</i> (Dana)	7.5 (860)
<i>T. forcipatus</i> Giesbrecht	50.1 (870)	Oncaeidae	
Longipediidae		<i>Oncaea confera</i> Giesbrecht	12.1 (870)
<i>Longipedia scotti</i> (Sars)	0.31 (857)	<i>O. venusta</i> Philippi	2.9 (856)
Ectinosomidae		Corycaeidae	
<i>Microsetella norvegica</i> (Boeck)	2.18 (871)	<i>Corycaeus speciosus</i> Dana	4.1 (865)
<i>M. rosea</i> (Dana)	0.29 (860)	<i>C. ovalis</i> Claus	8.1 (873)
Macrosetellidae		<i>C. gibbulus</i> Giesbrecht	16.5 (870)
<i>Macrosetella gracilis</i> (Dana)	0.30 (865)	<i>C. catus</i> F. Dahl	13.3 (866)
<i>Miracia efferata</i> Dana	1.13 (872)	Sapphirinidae	
Clytemnestridae		<i>Sapphirina nigromaculata</i> Claus	4.2 (871)
<i>Clytemnestra scutellata</i> Dana	0.21 (867)	<i>S. opalina</i> Dana	1.9 (863)
		<i>S. ovatolanceolata</i> Dana	5.5 (863)
		<i>S. metallina</i> Dana	19.5 (869)
		<i>Sapphirina</i> sp.	4.7 (863)
		<i>Copilia vitrea</i> (Haeckel)	3.4 (869)
		<i>C. mirabilis</i> Dana	10.2 (874)
		<i>C. quadrata</i> Dana	2.8 (863)
		<i>Copilia</i> sp.	1.3 (869)

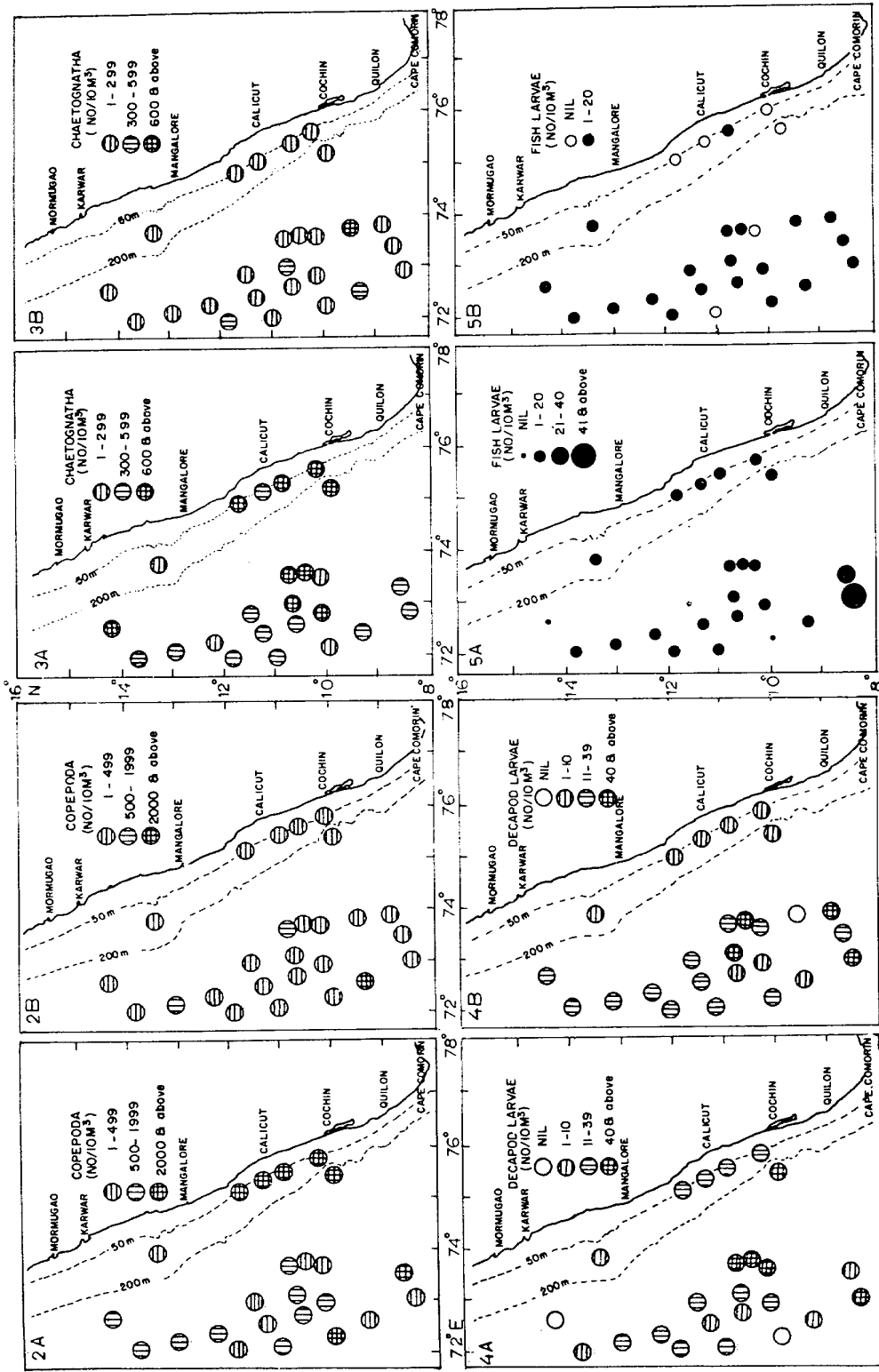
Table 3—Association of Harpacticoid Species (No./100 m<sup>3</sup>) with Blue Green Algae

Station No.	Total No. of all harpacticoids	<i>M. norvegica</i>	<i>M. efferata</i>
854	180	102	64
855	60	34	18
856	50	26	16
857*	70	11	19
858	260	154	61
859	70	38	17
860*	50	10	2
861	130	52	65
862	160	48	93
863	100	27	30
864	220	91	88
865*	60	14	10
866	80	33	40
867*	30	5	1
868	200	109	72
869	180	85	63
870	480	218	113
871	150	55	81
872	170	64	78
873	270	116	130
874	198	102	80
882	32	14	11

\*Blue green algae (*Trichodesmium* spp) not observed in zooplankton samples

worked out stations were located mostly beyond the shelf. The difference in the biomass values may be due to seasonal variation. The first 2 cruises were undertaken during postmonsoon season while the 3rd cruise was during premonsoon months. The zooplankton biomass values recorded from the Laccadive Sea were low as compared to values reported from other regions of the Indian Ocean. During the IIOE collections, the highest value (187 ml/200 m<sup>3</sup>) was obtained off Somali coast and based on the same collections, the highest biomass values (> 60 ml) for 200 m column was reported for the southeastern coast of Arabian Peninsula<sup>16</sup>. Paulinose and Aravindakshan<sup>7</sup> obtained record zooplankton biomass values (560 ml/200 m<sup>3</sup>) in the north and northeastern part of the Arabian Sea.

Distribution of the major planktonic groups, viz. Copepoda, Chaetognatha, decapod larvae and fish larvae, also showed a patchy distribution of abundance. During the present study, population density of the various taxa was observed to be less compared to the values reported earlier<sup>9</sup> for the same area. This depletion in numerical abundance may be due to seasonal difference or due to the occurrence of bloom of blue green algae (*Trichodesmium* spp). Qasim<sup>17</sup> also observed the depletion in zooplankton population



Figs 2 to 5—Distribution of copepods (2), chaetognaths (3), decapod larvae (4), and fish larvae (5) [A, water column (200m-0m); and B, thermocline to surface]

during April 1968, when a bloom of *Trichodesmium erythraeum* occurred in the Laccadive Sea. In the bloom areas, copepods formed the dominant constituent of zooplankton community and 2 harpacticoid species, viz. *Microsetella norvegica* and *Miracia efferata*, were found in greater numbers whenever the plankton samples contained filaments of *Trichodesmium erythraeum*. Marumo<sup>18</sup> reported association of copepods and other organisms with the blue green alga, *Oscillatoria (Trichodesmium) erythraeum*. The decapods, especially the juveniles and adults of prawns were obtained in greater numbers in the plankton samples taken from 500 m to the surface near the atolls. Unusual abundance of gravid females of the red bathypelagic prawns of the family Hoplophoridae was observed around Kalpeni, Androth and Minicoy islands. It appears that these prawns are breeding in this region. The exploratory fishing operations in deeper waters (100-150 fm line) off southwest coast of India have brought to light the existence of large quantities of prawns<sup>19</sup>.

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