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DIVERSITY AND DISTRIBUTION OF HARPACTICOID COPEPODS FROM TAMILNADU COAST, INDIA

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INTRODUCTION

The Harpacticoid Copepod inhabiting the different sediment habitat of Tamilnadu was studied from 2006 and 2007. A brief description of the density, sediment characters, total organic carbon, and vertical distribution in different sediment habitats, diversity and cluster analysis is given. The density of total Copepod individuals in these intertidal sediments ranged from 26 animals/100 cm^3 to 1440 animals/100 cm^3. Several genera and species regarded as widespread and cosmopolitan were recorded. The distribution of Copepod species discussed in relation to the nature of the substratum. Highest densities of harpacticoids were recorded at Thondi during 2006 and 2007 (Fig. 2 & 3), while lowest density was observed at Tuticorin and Nagaipattinam respectively during 2006 and 2007. The similarity in the harpacticoid copepod fauna between various stations in the estuary is discussed.

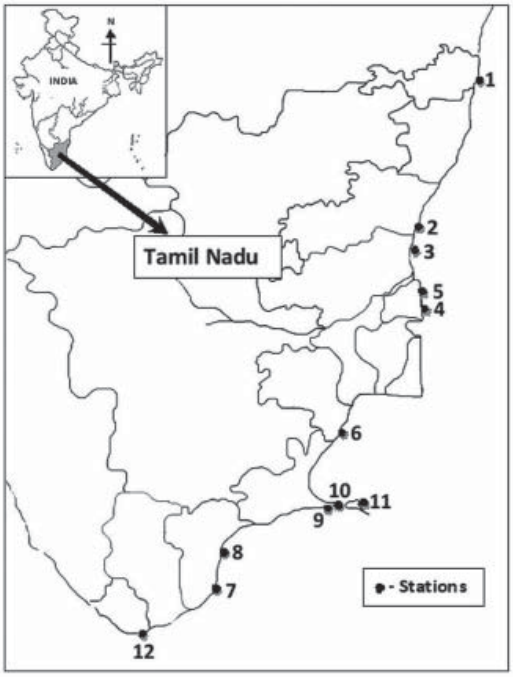

Fig. 1. Study areas

(1. Chennai, 2. Pondicherry, 3. Cuddalore, 4. Karaikal, 5. Nagapattinam, 6. Thondi, 7. Thiruchendur, 8. Tuticorin, 9. Mandapam, 10. Pamban, 11. Rameswaram, 12. Kanyakumari)

MATERIALS AND METHODS

Abundance of meiofauna was analysed in terms of localities within stations using the multivariate analyses cluster analysis and multidimensional scaling MDS. There were performed based on the Bray–Curtis similarity index after fourth root transformation by means of the PRIMER software (Clarke and Warwick, 1994). The significance of differences in spatial variability between localities was determined using One-way analyses of variance (ANOVA). Tests for differences in structure of meiofaunal assemblages were based on k-dominance.

RESULTS

Abundance of harpacticoid copepods

Harpacticoid copepods were the second most dominant group of meiofauna. Their density varied from 85 to 145 ind. 10 cm^{-2}, 98 to 397 ind. 10 cm^{-2}, 80 to 475 ind. 10 cm^{-2}, 45 to 285 ind. 10 cm^{-2}, 45 to 180 ind. 10 cm^{-2}, 175 to 530 ind. 10 cm^{-2}, 120 to 320 ind. 10 cm^{-2}, 25 to 120 ind. 10 cm^{-2}, 155 to 235 ind. 10 cm^{-2}, 125 to 305 ind. 10 cm^{-2}, 40 to 230 ind. 10 cm^{-2} and 90 to 195 ind. 10 cm^{-2} at stations 1-12 respectively during 2006 (Table 1-12).

Table-1-12

Table 1. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 1 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	120	145	90	85	105	545	109	24.34

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	60	80	215	85	105	545	109	61.38

Table 2. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 2 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	310	157	98	228	397	1190	238	119.09

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	120	190	96	45	239	690	138	76.88

Table 3. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 3 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	475	180	80	120	260	1115	223	156.35

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	105	220	520	120	285	1250	250	168.04

Table 4. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 4 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	285	90	190	45	220	830	166	97.56

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	105	120	70	170	310	775	155	93.81

Table 5. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 5 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	80	90	155	180	45	550	110	55.79

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	20	80	10	90	25	225	45	37.08

Table 6. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 6 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	320	175	210	255	530	1490	298	140.56

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	735	345	950	440	230	2700	540	295.91

Table 7. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 7 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	320	145	230	120	245	1060	212	80.67

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	290	440	680	150	215	1775	355	211.36

Table 8. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 8 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	120	25	90	70	85	390	78	34.75

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	45	90	50	70	20	275	55	26.46

Table 9. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 9 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	205	235	195	215	155	1005	201	29.66

2007

S. No.	Fauna	Samples					Total	Mean	SD
		1	2	3	4	5			
1	Harpacticoid copepods	220	180	265	330	205	1200	240	59.06

Table 10. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 10 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	125	140	170	225	305	965	193	73.37

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	160	120	220	270	380	1150	230	101.49

Table 11. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 11 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	120	80	230	110	40	580	116	70.92

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	60	105	155	60	245	625	125	77.70

Table 12. Density of meiofauna communities (ind. 10 cm^{-2}) at Station 12 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	90	120	95	100	195	600	120	43.45

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Harpacticoid copepods	180	157	133	75	125	670	134	39.40

1	Harpacticoid copepods	120	145	90	85	105	545	109	24.34

During 2007, the fluctuation was from 60 to 215 no/10 cm^2, 45-239 no/10 cm^2, 105-520 no/10 cm^2, 70-310 no/10 cm^2, 10-90 no/10 cm^2, 230-950 no/10 cm^2, 150-680 no/10 cm^2, 20-90 no/10 cm^2, 180-330 no/10 cm^2, 120-380 no/10 cm^2, 60-245 no/10 cm^2 and 75-180 no/10 cm^2 at stations 1-12.

The mean harpacticoid copepods density ranged between 75 no/10 cm^2 and 298 no/10 cm^2 during 2006 and between 45 no/10 cm^2 and 540 no/10 cm^2 during 2007. Highest densities of harpacticoids were recorded at station 6 during 2006 and 2007 (Fig. 2 & 3), while lowest density was observed at stations 8 and 5 respectively during 2006 and 2007 (Fig. 2 & 3).

Species composition of harpacticoid copepods

A total of 9 species belonging to 9 genera were recorded. The number of species in stations various ranged between 4 and 9. The dominant harpacticoid copepods were Leptastacus sp. (1.69-10.43%), Diathrodes sp. (1.36-7.12%), Tisbe furcata (1.19-6.99%) and Euterpina acutifrons (0-5.96%). Three species namely Leptastacus sp, Tisbe furcata and Diathrodes sp. occurred in all the 12 stations, two other species namely (Metis sp. and Cylindropsyllus sp.) were occurred sporadically.

Family level composition of harpacticoid copepods

A total of 8 families namely Canullidae, Tachidiidae, Thalestridae, Diosaccidae, Cylindropsyllidae, Metidae, Tisbidae, and Tetragonicipitidae were identified. The dominant families were in descending order Cylindropsyllidae (1.69-11.38%), Thalestridae (1.36-7.12%) and Tisbidae (1.19-6.99%).

Families such as Canullidae and Tetragonicipitidae were occurred sporadically in less numbers.

Diversity indices of harpacticoid copepods

The highest diversity was observed in station 9, which was more sandy in nature (Table 13). The lowest was observed at station 4; it must be also stated that the sediment here was muddy.

Table 13. Diversity of harpacticoids species at various stations of Tamil Nadu Coast during 2006 and 2007.

Stations	S	N	D	J’	H’(log^2)	1-Lambda’
1	6	109	1.066	0.9673	2.5	0.823
2	9	238	1.462	0.7999	2.536	0.7551
3	8	223	1.295	0.8853	2.656	0.8053
4	4	166	0.5869	0.9745	1.949	0.7384
5	7	110	1.276	0.8495	2.385	0.7718
6	6	298	0.8776	0.9135	2.361	0.781
7	5	212	0.7467	0.9814	2.279	0.791
8	5	78	0.9181	0.903	2.097	0.7529
9	9	201	1.508	0.9401	2.98	0.8628
10	8	193	1.33	0.9669	2.901	0.863
11	8	116	1.473	0.9256	2.777	0.8391
12	5	120	0.8355	0.9647	2.24	0.7843

Note- (S = Number of species; N = Number of animals; D = Margalef Richness; J’ Evenness; H = Shannon - Wiener diversity, l- Lambda – Simson richness).

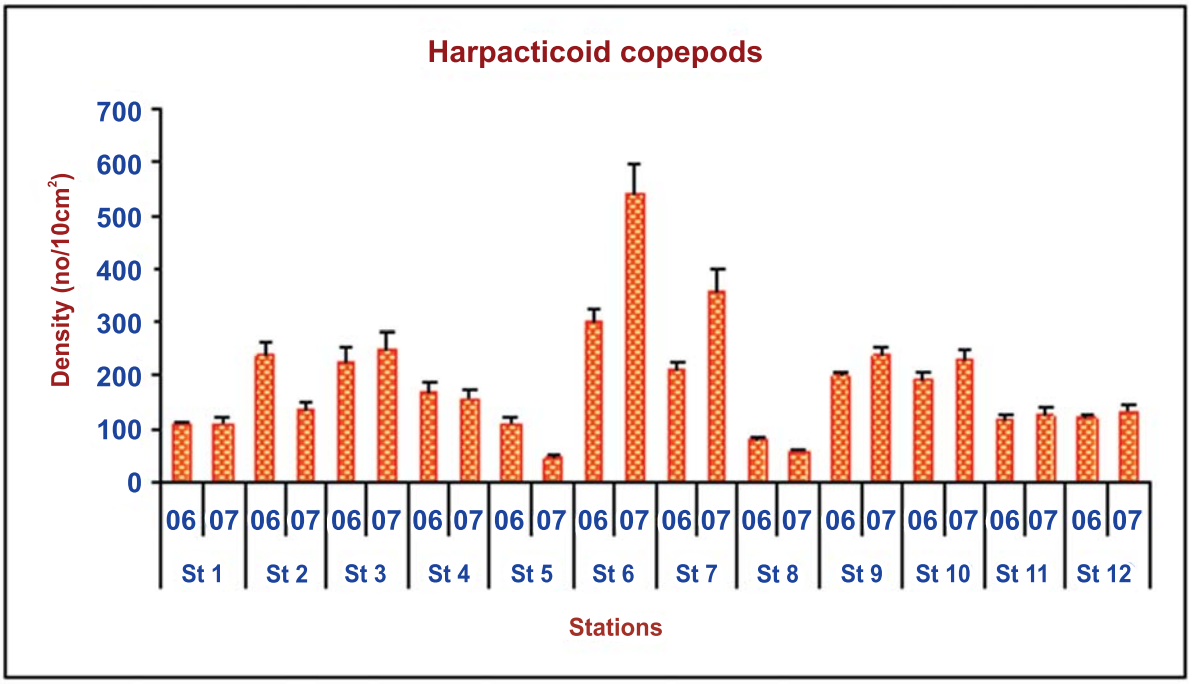

Fig. 2. Mean density of harpacticoid copepods of Tamil Nadu coast during 2006 and 2007 (average of five replicates)

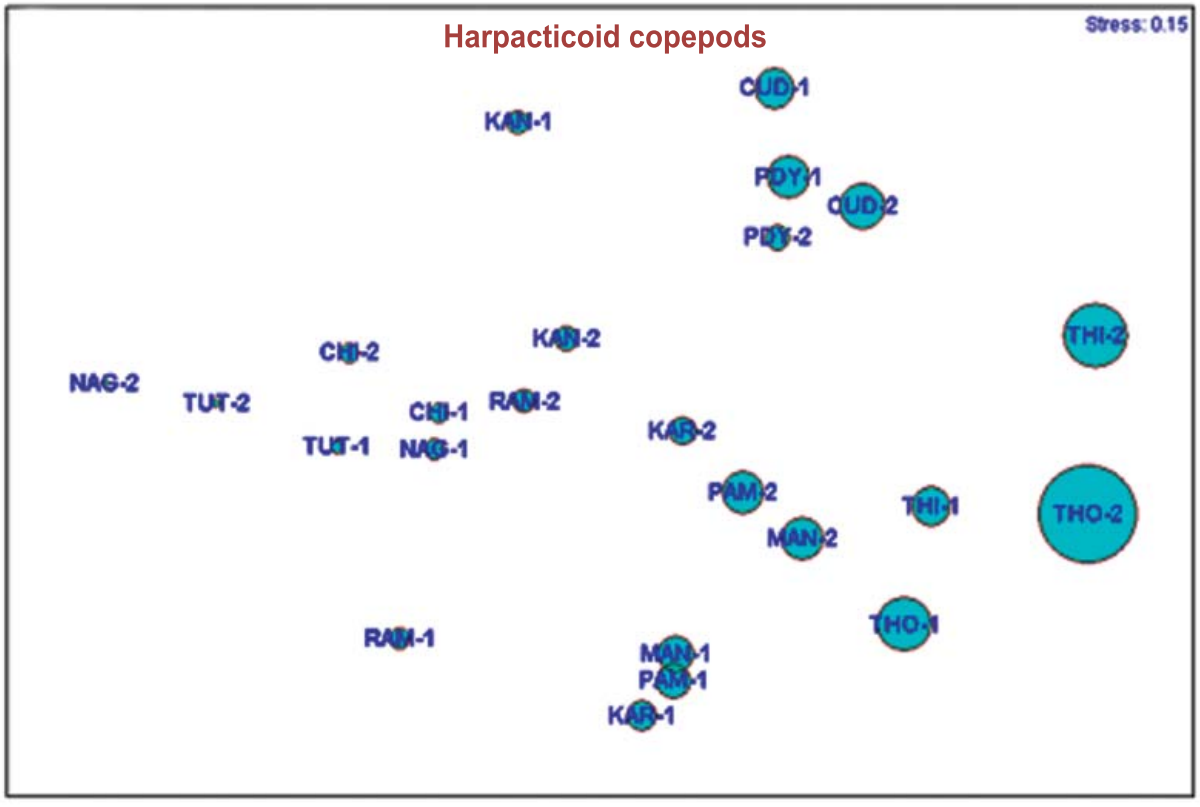

Fig. 3. MDS for harpacticoid copepods of Tamil Nadu coast during 2006 and 2007. CHI-Chennai; PDY-Puducherry; CUD-Cuddalore; KAR-Karaikal; NAG Nagapattinam; THO-Thondi; THI-Thiruchendur; TUT-Tuticorin; MAN Mandapam; PAM-Pamban; RAM Rameswaram; KAN Kanyakumari; 1 2006: 2-2007.

No significance differences in the abundance of harpacticoid copepod between the station (p>0.05 level) (Table 14).

Table 14. One-way ANOVA of all species of harpacticoid copepods and different stations.

Factor	SS	Df	Ms	F(cal))	P(F<=F(cal))		F(0.05)
A (Between Groups)	5360.00	11	487.27	1.208	N.S. (P>0.05)	0.292	1.890
R(A) (Within Groups)	38732.67	96	403.47				
AR (Total)	44092.67	107					

The k-dominance curves for the harpacticoid copepod species and stations show that in terms of dominance and diverse are not similar (Fig. 4). The k-dominance curves were no significant different from the stations. Nonetheless, at stations 8 is the most highly dominated. Probably because station 8 is situated very close to Tuticorin Port, which was highly polluted. In general harpacticoid copepods are decreasing with increasing pollution. These findings support the results of ANOVA and MDS analysis. The differences between the other stations are less amenable interpretation as the curves cross (Fig. 4).

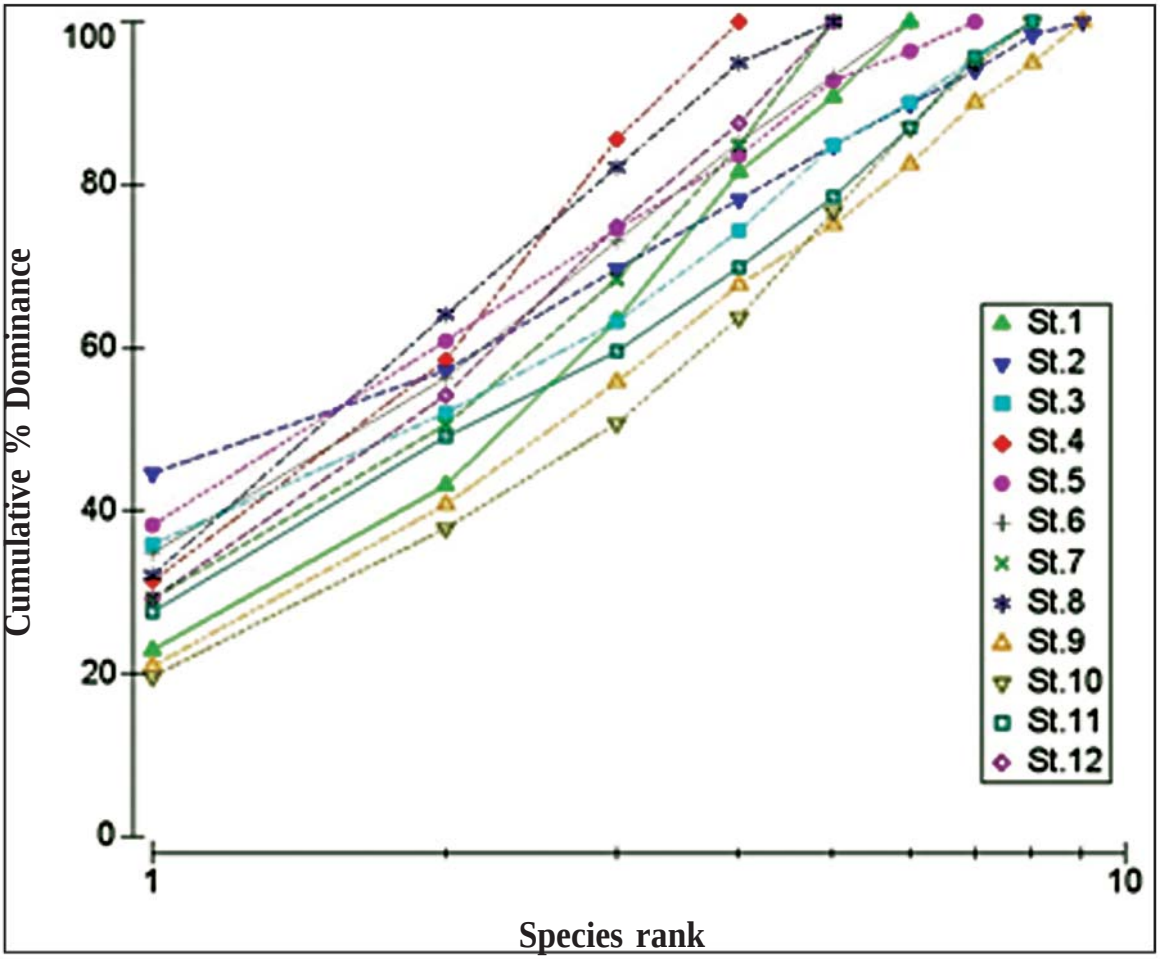

Fig. 4. k-dominance curves for harpacticoid copepods species at the 12 stations of Tamil Nadu coast.

Vertical distribution of harpacticoid copepods

The abundance of the harpacticoid copepods was maximum (130 ind. 10 cm^{-2}; 12% of the total fauna) in the top portion 2-4 cm of the sandy sediment (Fig. 5a, b, c & 12). In muddy sediments, the density was highest (290 ind. 10 cm^{-2}; 15% of the total abundance) in the top portion (0-2 cm) the sediment (Figs. 5d, e, f, g, h, j & k).

Different portion of sandy sediments showed the abundance of 12-128 ind. 10 cm^{-2}, 8-80 ind. 10 cm^{-2} and 3-30 ind. 10 cm^{-2} at 0-2 cm, 4-6 cm and 6-10 cm respectively. In muddy sediments, harpacticoid copepods varied from 12 to 185 ind. 10 cm^{-2}, 5 to 60 and 6 to 10 ind. 10 cm^{-2} at 2-4 cm, 4-6 cm and 6-10 cm depth intervals respectively.

The harpacticoid copepods were totally absent at the depth of 10-15 cm depth interval in both the sediment types. In this study, abundance of harpacticoid copepods were decreasing with increasing depth (Fig. 5).

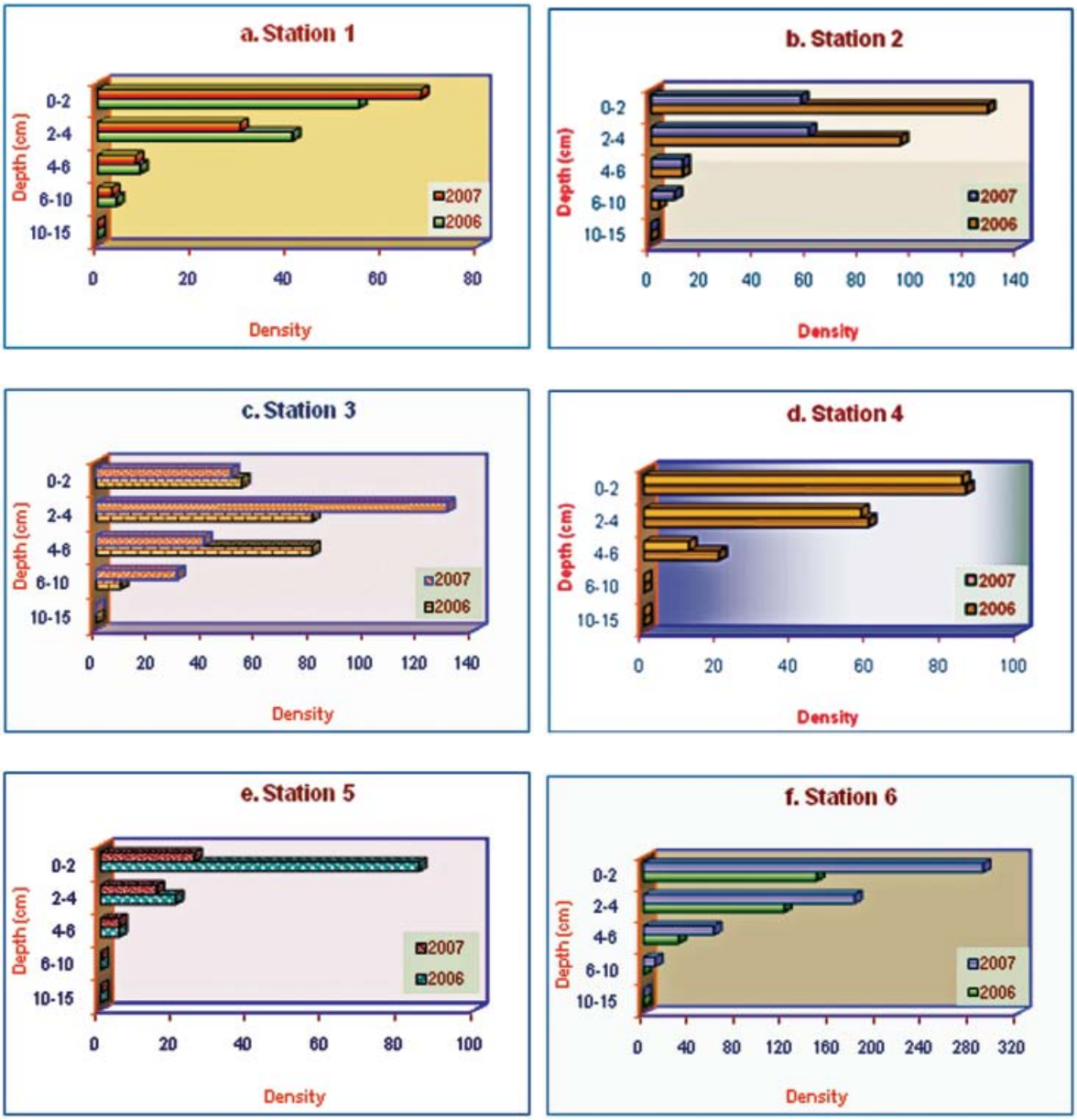

Fig. 5. Vertical distribution of harpacticoids of Tamil Nadu coast at stations 1-6.

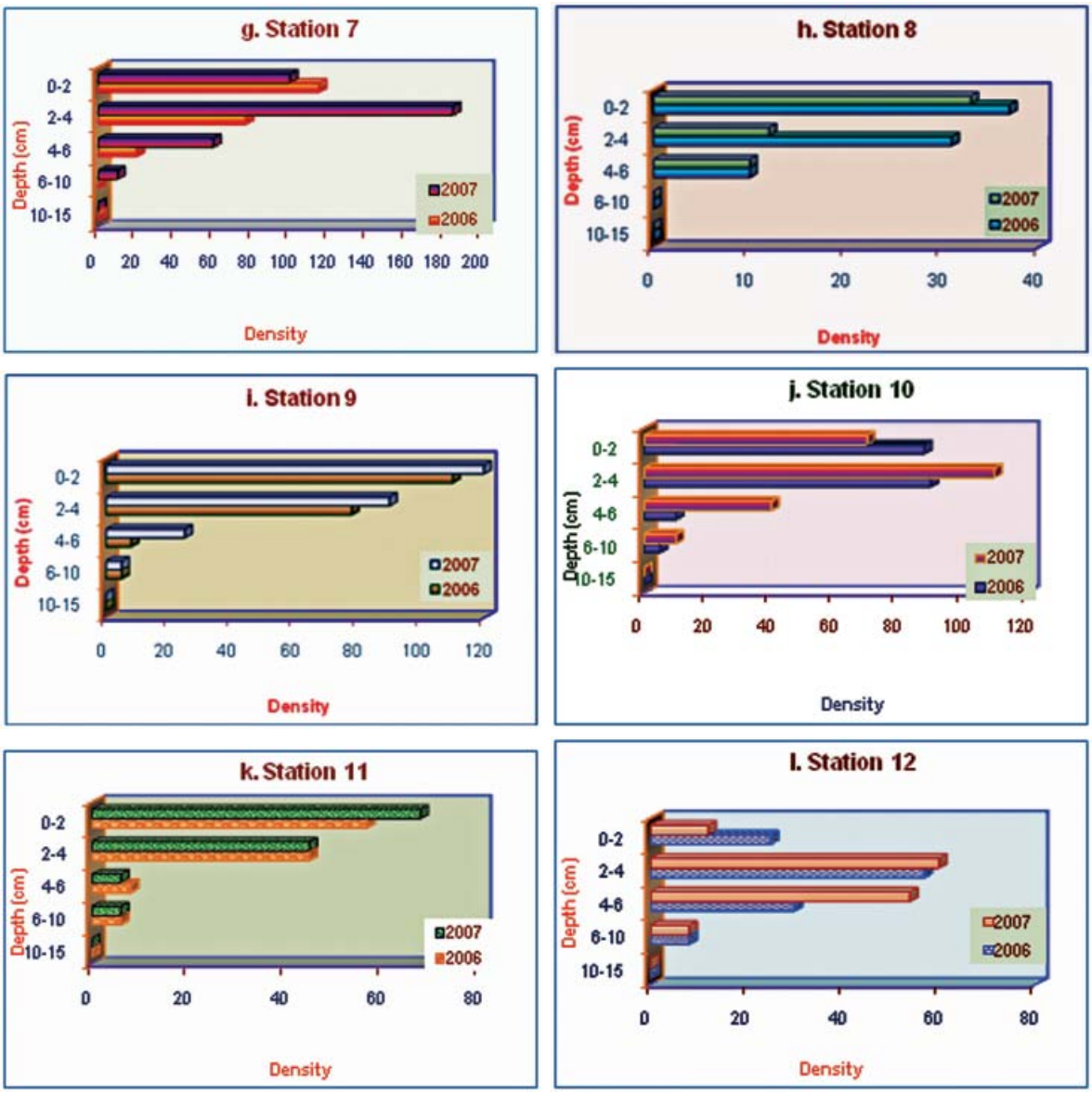

Fig. 5. Vertical distribution of harpacticoids of Tamil Nadu coast at stations 7-12.

DISCUSSION

Meiofauna densities in the seagrass bed were significantly related, with a time log, to change in bacterial standing stock, indicating that microbes may be an important resource (Danovaro, 1996). The increase of detritus, which provides the main food for the distribution and abundance of meiofauna, is suggested to be the reason for the high meiofauna densities observed in the seagrass bed.

Harpacticoid copepods ranked to be second. The highest diversity was observed in Mandapam, which was more sandy in nature (Table, 13). The lowest was observed at Karaikal; it must be also stated that the sediment here was muddy. The abundance of the harpacticoid copepods was maximum (130 ind. 10 cm^{-2}; 12% of the total fauna) in the top portion 2-4 cm of the sandy sediment. In muddy sediments, the density was highest (290 ind. 10 cm^{-2}; 15% of the total abundance) in the top portion (0-2 cm).

Harpacticoid copepods were found as the most abundant meiofaunal taxa in both seagrass blades and canopy sediment or detritus (Hicks and Coull,

1983). This study in general, harpacticoid copepods were increased in coarser sand. However, a lower density of harpacticoid copepods was observed at Nagapattinam (station 5) and Tuticorin (station 8). It is situated near the harbour, which was considerably organically enriched due to harbour activities. The copepods are generally susceptible to pollution stress. Moreover, harpacticoids are more sensitive to pollutants than nematodes, which make them good indicators of pollution (Coull and Chandler, 1992, Mc.Lachlan and Brown, 2006).

SUMMARY

The present study has been undertaken to provide information on the species composition, community structure and vertical distribution of meiofauna and the taxonomy of the most dominant group i.e. nematodes on intertidal areas of Tamil Nadu coast, India. As a result of the present study it could be understood that, Harpacticoid copepods ranked to be second. In general, harpacticoid copepods were increased in coarser sand. However, a lower density of harpacticoid copepods was observed at Nagapattinam (station 5) and Tuticorin (station 8). It is situated near the harbour, which was considerably organically enriched due to harbour activities. The copepods are generally susceptible to pollution stress. Secondly, at stations 11 (Rameswaram) and 12 (Kanyakumari) were also lowest density of meiobenthic community. Probably due to that fact of human impact. Rameswaram and Kanyakumari stations are a favorite tourist spot of south India and attracts thousands of people every day. Because, the famous temple is situated in Rameswaram, it was highly disturbed by human interference. There are anthropogenic activities in the beaches causing disturbance which may be the possible reason for less diversity of meiofauna compared to protected and undisturbed sandy beaches. Organic enrichment has been seen to influence the density of harpacticoid copepods.

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REFERENCES

Clarke, K.R and Warwick, R.M. 1994. Similarity-based testing for community pattern: The two-way layout with no replication. *Marine biology*. Berlin, Heidelberg, **118**: 167-176.

Coull B.C, Chandler G.T. 1992. Pollution and meiofauna- field, laboratory, and mesocosm studies. *Oceanog. Mar. Biol. Ann. Rev.*, **30**: 191-271.

Danovaro, R. 1996. Detritus-bacteria-meiofauna interactions in a seagrass bed Posidonia oceanic of the NW Mediterranean, *Marine Biology*, **127**(1), 1-13.

Hicks, G.R.F. and B.C. Coull, 1983. The ecology of marine meiobenthic harpacticoid copepods. *Ocea. Mar. Biol. Ann. Rev.*, **21**: 67-175.

Mc.Lachlan, A. and Brown, A.C. (2006) The ecology of sandy shores. Academic Press, Burlington, Massachusetts.

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