Distribution of Macrobenthos in the South China Sea, Area I: Gulf of Thailand and East Coast of Peninsular Malaysia.

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ABSTRACT

A study on the macrobenthos profile was conducted using the research vessel MV SEAFDEC in almost all parts of the Gulf of Thailand and the East Coast of Peninsular Malaysia. A total of 44 stations were located within the Gulf of Thailand and 37 within that of East Coast of Peninsular Malaysia. Two cruises were carried out during the pre-and post-north-east monsoon. Macrobenthos showed greater density in Malaysian waters during the pre-monsoon period with 2500 individuals (at an average 67.6 individuals/m^2) compared to the Gulf of Thailand which showed 860 individuals (average 19.5 individuals/m^2). However, sampling after the monsoon has indicated quite the reverse, with 2680 individuals (60.9 individuals/m^2) found in the Gulf of Thailand compared to 620 individuals (16.8 individuals/m^2) in the East Coast of Peninsular Malaysia. All samples from both cruises were dominated by polychaete worms, followed by crustacea. Other groups such as echinoderms, molluscs, nemertians and sipunculids were also observed in lesser quantities. In terms of diversity, the Gulf of Thailand showed less families/taxa before the monsoon (with 20 families) than after the monsoon (with 35 families). The reverse holds true for the east coast of Peninsular Malaysia when 33 families were uncovered before the monsoon compared to 26 families after the monsoon. Among the dominant families/taxa were the polychaetes Cirratulidae, Orbiniidae, Eunicidae and Maldanidae; caridean shrimps and ophiuroids (brittle star).

Introduction

The role and importance of macrobenthos in the marine ecosystem has long been known and discussed. These organisms, mostly comprising the marine invertebrates, are greatly diversed biologically especially those found on the continental shelf. They form a major food item for the bottom feeders like demersal fish. Moreover, certain macrobenthic species are themselves of commercial importance as, for example, the prawns, crabs and cockles.

These benthic organisms have a normally limited movement, and as such are easily exposed to threats from pollution. A number of assessment and monitoring studies have made use of these organisms as an important element of measurement to indicate the quality of the marine ecosystem within the areas to be developed.

Comprehensive surveys on the macrobenthic profile found within the waters of Malaysia and Thailand are rarely conducted due to the various logistic problems and high costs incurred. Some previous studies worth mentioning, although these were conducted on a much smaller scale, are those by Chua *et al.* (1980), Othman *et al*. (1989) and Lotfi *et al*. (1994) in the waters of Malaysia, and Aryuthaka *et al.* (1991) and Sanguansin (1986) in the Gulf of Thailand.

Such surveys are gaining in importance due to man-made activities which exert undue and adverse pressures on the marine habitat have greatly increased. Some examples of these activities are those related to petroleum/gas drilling, shipping, commercial fishing and recreational fishing. Alongi (1990) believed that such benthic studies are greatly needed in the tropics to provide the required basic data for comparison to any critical disorders that might arise in future. This paper outlines the preliminary results on the macrobenthic profile within the studied area obtained during the collabora-

tive research survey between the SEAFDEC departments of Thailand and Malaysia.

Materials and Methods

The study area covered almost all parts of the Gulf of Thailand and the East Coast of Peninsular Malaysia. A total of 81 stations were selected in this survey using the research vessel MV SEAFDEC (Figure 1). Two cruises were carried out for the pre-monsoon and post-monsoon period. The first cruise started from September 4th to October 4th 1995 (pre-monsoon), while the second was from 23rd April to 23rd May 1996 (post-monsoon).

Bottom sediment was taken using a Smith-Mclntyre grab with an estimated opening of 0.05m^2. Due to the limited time, only one grab sample was collected at each station. Sediment samples were washed and sieved through two types of sieve of mesh size 2.00 mm and 0.5mm. The animals were hand picked using a pair of forceps. All specimens were preserved with 10% formalin in sea water and subsequently transferred in 70% ethanol back to the MFRDMD laboratory. Samples were identified under the dissecting microscope to the family level.

The Shannon-Wiener Index (1949) is used to calculate the Diversity Index (H) and Eveness Index (J). The formula is as follows:-

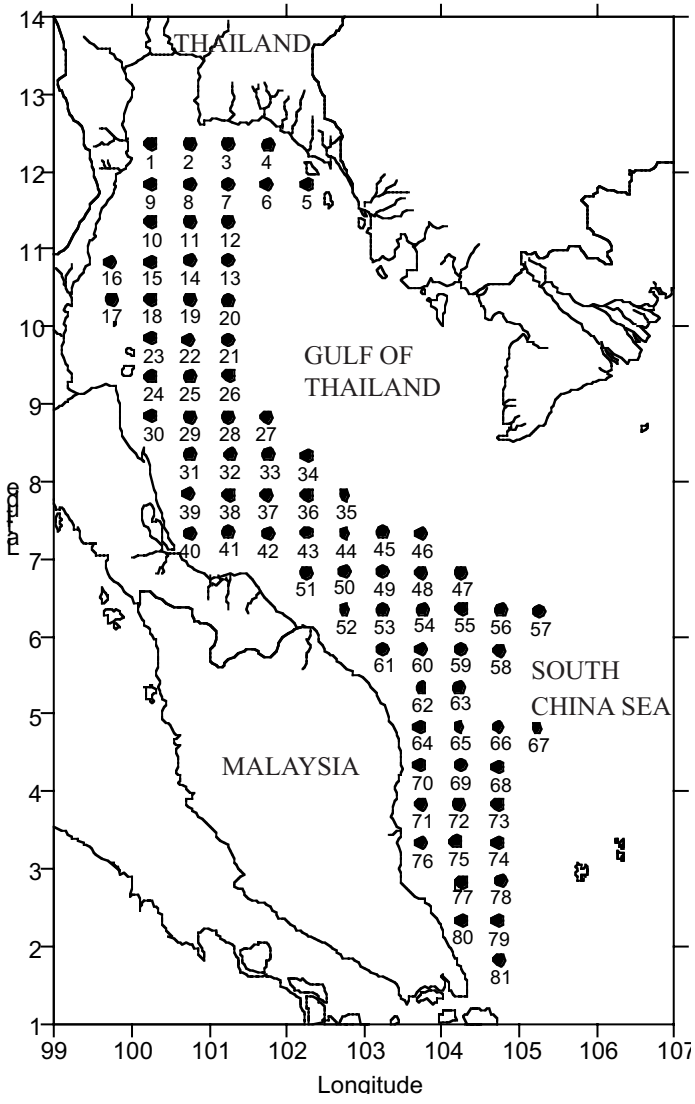

Fig. 1. Survey area and sampling locations in the Gulf of Thailand and South China Sea.

$$H = -S\ P_i\ \log_2\ P_i \quad \text{.....(i)}$$

where $P_i = n_i/N$

n_i = the number of individuals of the species

N = the total number of individuals

The diversity index can measure species richness (H) and species eveness (J)

$J = H/\log_2 S$ ..... (ii) where S = number of species

Results and Discussion

From the 81 stations examined, a total of 44 stations were located within the Gulf of Thailand and 37 off the East Coast of Peninsular Malaysia. This paper compares the results obtained from the two areas during the pre- and post-monsoon cruises. In this study, polychaetes were identified up to the family level, while the other benthic specimens were identified according to their relevant taxa.

Individual macrobenthic organisms showed greater density in Malaysian waters during the pre-monsoon period with 2500 individuals (at an average 67.6 individuals/m^2) compared to the Gulf of Thailand which showed 860 individuals (average 19.5 individuals/m^2) (see Table 1).

A similar sampling after the monsoon indicated quite the reverse, with 2680 individuals (60.9 individuals/m^2) found in the Gulf of Thailand compared to 620 individuals (16.8 individuals/m^2) on the East Coast of Peninsular Malaysia. In general, the macrobenthic abundance in this study is considerably less than those obtained by Othman *et al.* (1987) and Lotfi *et al.* (1994) in Terengganu waters, and Menasveta & Hongskul (1988) in the Gulf of Thailand. Each group of polychaetes, crustacea and others also showed a similar pattern in abundance.

All the obtained samples were dominated by the polychaete worms, with Crustacea second in abundance. Other groups of organisms observed in lesser quantities are the Echinoderms, Molluscs, Nemertians and Sipunculids. The percentage of contribution by the polychaete is large in both waters during the pre- and post-monsoon period, ranging from 53-72% (Table 1). Domination by the polychaete is a natural phenomenon in soft bottom substrates as shown in the studied area (Fauchald, 1997). Its dominance in the waters of the East Coast of Peninsular Malaysia is slightly greater before the monsoon (at 72%) than after (at 71%). In the Gulf of Thailand, the difference is more pronounced with its percentage before the monsoon at 67.4%, which declines to 53% after the monsoon. Crustacea showed a greater percentage (20.9 - 35 %) in the Gulf of Thailand compared to those in the East Coast of Peninsular Malaysia (of 13.6 - 16.1 %)

In terms of diversity, the Gulf of Thailand showed less families/taxa before the monsoon (with 20 families) than after (with 35 families). The reverse holds true for the East Coast of Peninsular Malaysia where 33 families were observed before the monsoon as opposed to 26 families afterward. Shannon's Index of diversity for all samples in all areas is rather high, ranging from 4.04-4.62, while the Evennes Index showed a range from 0.9 - 0.96 (Table 1). This indicates non-domination within the area by any specific family. A clear domination by any species would indicate non-stability in the benthic habitat.

The less species richness obtained is, however, indicative of the low number of families observed throughout the study. This could perhaps be attributed to the single replicate taken at each of the stations, this being unavoidable due to the tight time schedule followed during the sampling.

The number of families recorded at each station is considerably lower compared to previous studies within the same area. Tables 2 and 3 show the relative abundance andnumber of families of macrobenthos, as well as the other groups at each station. In the Gulf of Thailand, the greatest numbers werelocated at stations 4 and 13 during the post-monsoon cruises where 580 and 340 individuals/m^2 were recorded from 11 and 10 families, respectively. For the study areas off Malaysia, station 52 was identified as providing the highest number on the pre-monsoon cruise (6 families, 180 individuals/m^2), and station 77 on the post-monsoon (7 families, 160 individuals/m^2).

Figure 2 shows the abundance of each family of macrobenthos in the Gulf of Thailand. In

Table 1. Summary of distribution analyses of macrobenthos in the Gulf of Thailand and the East Coast of Peninsular Malaysia.

Gulf of Thailand

	Polychaete		Crustacea		Others		Total	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Total	580	1420	180	960	100	300	860	2680
Average	13.2	32.3	4.1	21.8	2.3	6.8	19.5	60.9
Percentage	67.4	53	20.9	35.8	11.6	11.2	100	100
No. of family	15	25	3	5	2	5	20	35
Diversity index							4.04	4.59
Evenness index							0.93	0.9

East Coast of Peninsular Malaysia

	Polychaete		Crustacea		Others		Total	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Total	1800	440	340	100	360	80	2500	620
Average	48.6	11.9	9.2	2.7	9.7	2.2	67.6	16.8
Percentage	72	71	13.6	16.1	14.4	12.9	100	100
No. of family	24	20	5	4	4	2	33	26
Diversity index							4.62	4.22
Evenness index							0.92	0.96

general, almost every family recorded lower numbers during the pre-monsoon comprising the polychaete families i.e. Cirratullidae, Maldanidae and Eunicidae, and the Thallassinoids crustacean. These families were dominant in both of the cruises. On the other hand, all families of macrobenthos generally accord higher individuals during the pre-monsoon cruise compared to post-monsoon (Figure 4). Among the dominant families are the polychaetes Orbiniidae, Eunicidae and Maldanidae; caridean shrimp and ophiuroids (brittle star).

Generally, the different environmental changes that are known to occur before and after the monsoon in both areas are rather significant and more detailed investigation pertaining to its influences is needed. More so, when the study area is actually located far from shore. The influence of the monsoon has been numerously recorded in the coastal areas and estuaries. Alongi (1990) concluded that the effects of the monsoon are greatly felt in coastal areas that receive some form of sedimentation from the land (eg. river run-offs) during and after the monsoon. These shallow areas would normally experience greater disturbance from the turbulent ocean currents compared to offshore areas with greater depths.

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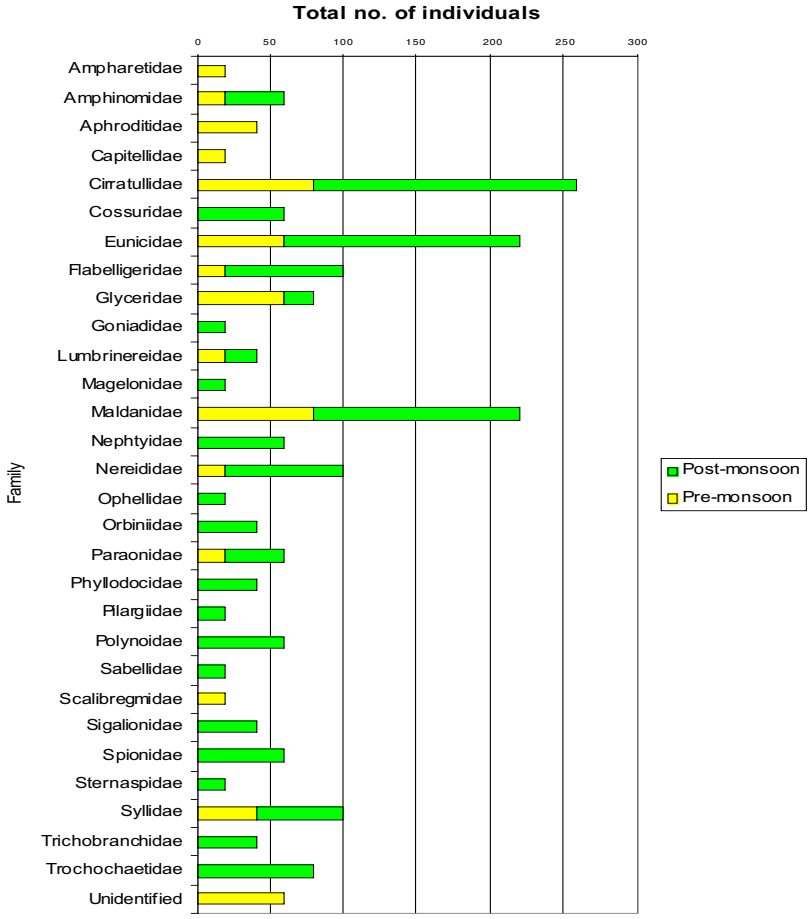

Fig. 2a. Total number of individuals contributed by each polychaete families in the Gulf of Thailand

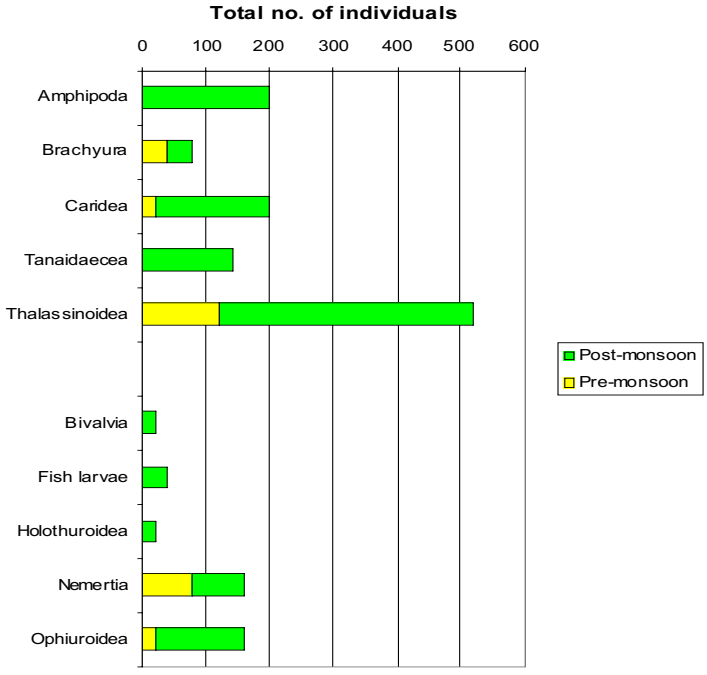

Fig. 2b. Total number of individuals contributed by crustacean and other taxa (families) in the Gulf of Thailand.

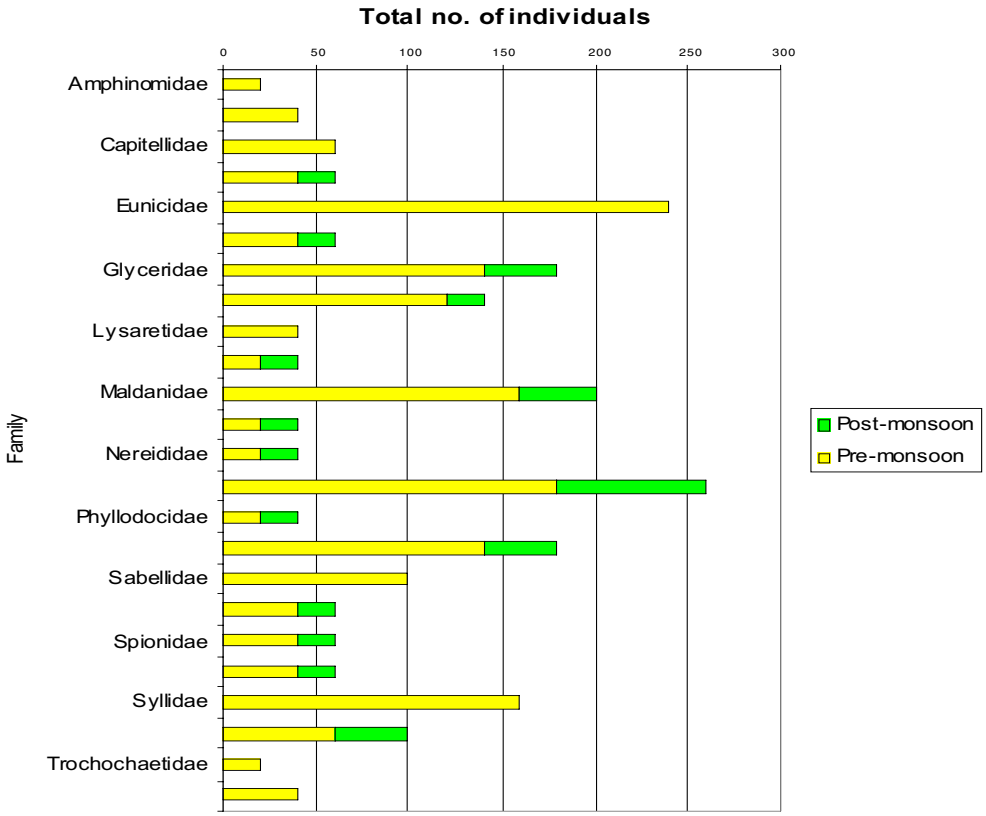

Fig. 3a. Total number of individuals contributed by polychaete families in the East Coast of Peninsular Malaysia.

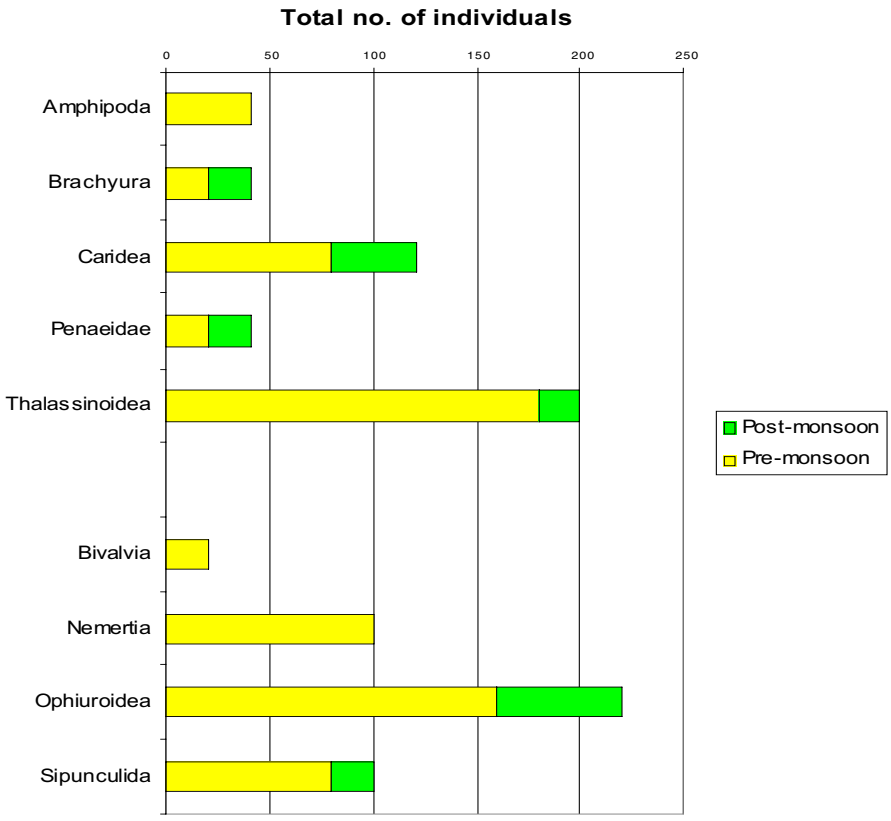

Fig. 3b. Total number of individuals contributed by crustaceans and other families (texa) in theEast Coast of Peninsular Malaysia.

Table 2. Abundance of macrobenthos at stations located in the Gulf of Thailand.

Pre-monsoon				
Stations	Abundance (no. of family)			
	Polychaete	Crustacea	Others	Total
8	80 (3)	-	-	80 (3)
14	20 (1)	-	-	20 (1)
19	20 (1)	-	-	20 (1)
25	80 (3)	-	-	80 (3)
27	60 (3)	80 (1)	-	140 (4)
28	40 (2)	-	-	40 (2)
29	40 (2)	-	-	40 (2)
30	20 (1)	-	-	20 (1)
31	60 (3)	40 (2)	-	100 (5)
32	20 (1)	20 (1)	-	40 (2)
35	-	-	40 (1)	40 (1)
38	20 (1)	-	-	20 (1)
39	-	40 (2)	40 (1)	80 (3)
40	20 (1)	-	-	20 (1)
41	60 (3)	-	-	60 (3)
42	20 (1)	-	20 (1)	40 (2)
51	20 (1)	-	-	20 (1)
Post-monsoon				
Stations	Abundance (no. of family)			
	Polychaete	Crustacea	Others	Total
2	60 (3)	-	20 (1)	80 (4)
4	360 (8)	180 (2)	40 (1)	580 (11)
6	20 (1)	20 (1)	-	40 (2)
7	40 (2)	20 (1)	40 (2)	100 (5)
8	20 (1)	40 (2)	-	60 (3)
11	140 (6)	60 (1)	-	200 (7)
13	180 (5)	120 (3)	40 (2)	340 (10)
14	80 (3)	40 (2)	20 (1)	140 (6)
18	100 (4)	160 (2)	60 (3)	320 (9)
19	60 (2)	140 (2)	40 (2)	240 (6)
21	120 (6)	20 (1)	20 (1)	160 (8)
23	80 (3)	-	-	80 (3)
24	40 (2)	160 (1)	-	200 (3)
26	20 (1)	-	20 (1)	40 (2)
38	20 (1)	-	-	20 (1)
41	60 (3)	-	-	60 (3)
51	20 (1)	-	-	20 (1)

Table 3. Abundance of macrobenthos at stations located in the East Coast of Peninsular Malaysia.

Pre-monsoon				
Stations	Abundance (no. of family)			
	Polychaete	Crustacea	Others	Total
45	40 (2)	-	-	40 (2)
47	80 (4)	-	-	80 (4)
48	20 (1)	-	-	20 (1)
49	40 (2)	-	-	40 (2)
50	20 (1)	20 (1)	-	40 (2)
52	180 (6)	-	-	180 (6)
53	20 (1)	-	-	20 (1)
54	40 (2)	20 (1)	20 (1)	80 (4)
55	20 (1)	20 (1)	20 (1)	60 (3)
57	-	40 (2)	-	40 (2)
58	60 (2)	-	40 (1)	100 (3)
59	80 (4)	20 (1)	40 (2)	140 (7)
61	20 (1)	-	40 (2)	60 (3)
62	40 (2)	20 (1)	-	60 (3)
63	40 (2)	-	40 (1)	80 (3)
64	40 (2)	20 (1)	-	60 (3)
65	40 (1)	-	20 (1)	60 (2)
66	40 (2)	-	20 (1)	60 (3)
67	60 (3)	-	40 (1)	100 (4)
68	20 (1)	-	-	20 (1)
69	100 (5)	20 (1)	20 (1)	140 (7)
70	80 (2)	-	-	80 (2)
71	40 (1)	-	-	40 (1)
72	60 (3)	20 (1)	20 (1)	100 (5)
73	60 (3)	60 (2)	-	120 (5)
74	40 (2)	-	-	40 (2)
75	160 (5)	-	-	160 (5)
76	20 (1)	20 (1)	-	40 (2)
77	140 (6)	20 (1)	-	160 (7)
78	20 (1)	20 (1)	-	40 (2)
79	40 (2)	-	40 (2)	80 (4)
80	140 (4)	20 (1)	-	160 (5)
Post-monsoon				
Stations	Abundance (no. of family)			
	Polychaete	Crustacea	Others	Total
45	40 (2)	-	-	40 (2)
48	20 (1)	-	-	20 (1)
53	20 (1)	-	-	20 (1)
54	40 (2)	20 (1)	20 (1)	80 (4)
58	60 (2)	20 (1)	40 (1)	120 (4)
62	40 (2)	20 (1)	-	60 (3)
68	20 (1)	-	-	20 (1)
72	60 (3)	20 (1)	20 (1)	100 (5)
77	140 (6)	20 (1)	-	160 (7)

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