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Seasonal Abundance of Benthic Communities in Coral Areas of Karah Island, Terengganu, Malaysia

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Abstract

Benthic communities are important to marine ecosystem and form important food source for most marine organisms especially fish. Study of this biota is important as it could be an indicator to overall aquatic productivity. Benthic communities in Karah Island, Terengganu, Malaysia were studied to find their relationship with different monsoon seasons and types of substrate. Surveys were conducted 4 times; two times each during pre-monsoon phase (September - October) and post-monsoon phase (April - May). Samples of benthic fauna in coral and non-coral areas were taken using a hand corer and Smith McIntyre grab respectively. *In-situ* measurements were done to obtain physico-chemical parameters of salinity, temperature, pH, and dissolved oxygen. The results show that both macrobenthos and meiobenthos were more dominant during pre-monsoon season (25,836.8 inds.m^{-2} and 137,496.8 inds.m^{-2}, respectively) as compared to post-monsoon season (21,573.1 inds.m^{-2} and 100,404.6 inds.m^{-2}, respectively). In terms of family, Polychaeta was the most abundant macrobenthos (26,300.2 inds.m^{-2} or 55.5%) while Harpacticoida was the most abundant meiobenthos (97,910.1 inds.m^{-2} or 41.2%) during pre-monsoon and post-monsoon seasons. Benthic fauna were found in higher amounts in coral areas and decreases with distance from shoreline.

Key words: Benthic fauna, coral areas, monsoon seasons, South China Sea

Introduction

Soft-bottom communities are one of the least studied biological components of the tropics. They have been considered relatively unimportant since they appear barren, unpopulated and unproductive (Onate-Pacalioga, 1994). The shift of emphasis to detrital food chains in some of the highly productive areas like seagrass beds has pointed out the significance of soft-bottom communities as sites of energy transformation by converting plant matter to animal biomass (Onate-Pacalioga, 1994).

The abundance of benthic fauna is a biological parameter that may indicate overall aquatic productivity of the bottom sediments. They are also the main source of food for both migratory and permanent faunas as well as higher predators in the food chain. Moreover, benthic communities are widely used in monitoring the effect of marine pollution as the organisms are mostly sessile and readily integrate the effects of pollutants. It has been suggested that benthic fauna might be used as an integrating indicator of water quality within an area (Giere, 1993). Any fluctuation in their quality and quantity will directly affect the abundance of demersal fishes that are important fishery resources in the sea. Therefore, a benthic study may be used as baseline information to evaluate the existing demersal stocks and may serve as a baseline study of future investigations on environmental changes in this area (Giere, 1993). The objective of this study is to determine the relationship between benthic communities with different monsoon seasons and types of substrate.

Materials and Methods

The study was conducted in coral areas of Karah Island (Lat. 5′37.3″ N, Long. 103′04″ E), Terengganu, Malaysia (Figure 1). Samplings were conducted 4 times; two times during pre-monsoon phase (September – October) and two times during post-monsoon phase (April - May). Seven stations were determined for sample collection of which two stations (Station 1 and Station 2) were located inside the coral area and five other stations were located outside the coral area. Station 1 and Station 2 being parallel to the shoreline lie on a 100 m transect and each transect had 5 sampling points as replicates (Figure 2).

Using Hydrolab multimeter, 4 water physico-chemical parameters namely Salinity (ppt), Temperature (°C), Dissolved Oxygen (mg/L) and pH (units) were determined in every stations. In addition, data at Station 1 (S1) and Station 2 (S2) were also recorded for every replicate point (r1 – r5). Data were recorded at 3 different layers of surface, middle and bottom. Data from these layers were then considered as replication for analysis.

A hand corer with 4.3 cm inner diameter was used to collect samples in Station 1 and Station 2. A 0.05 m^2 Smith-McIntyre grab was used to collect

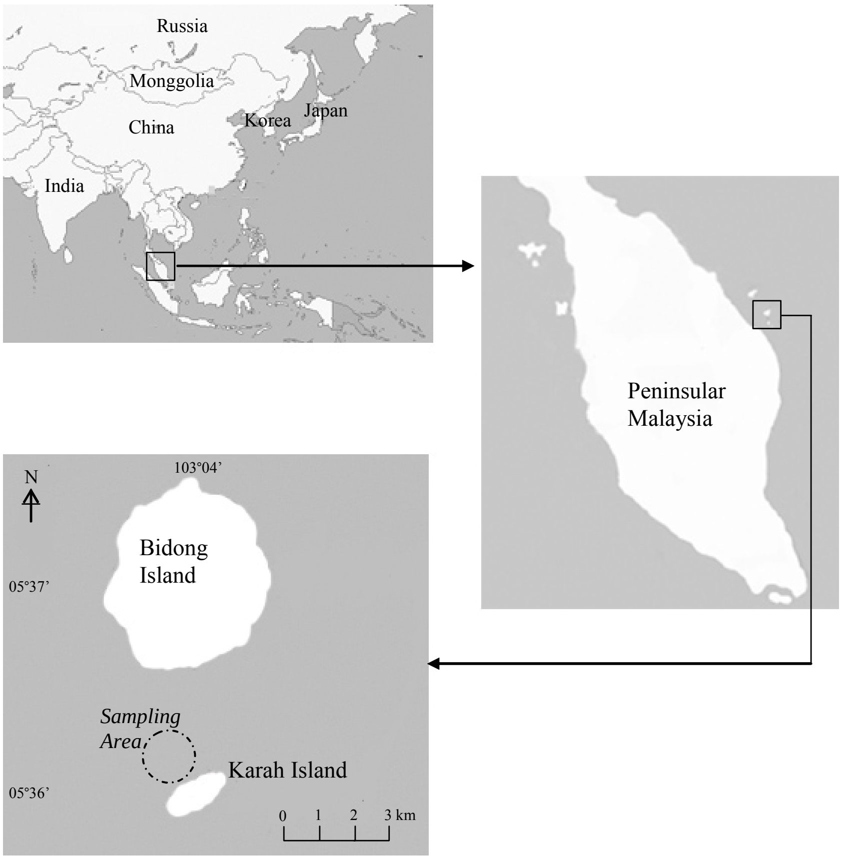

Figure 1. Maps showing location of the study area.

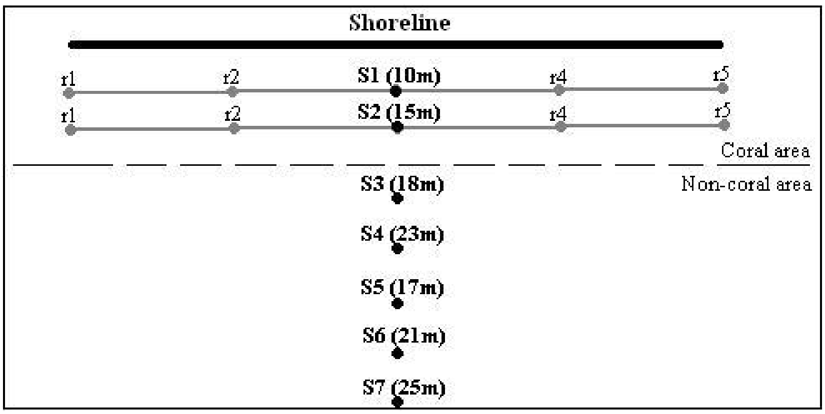

Figure 2. Location of sampling points and depths of stations (in bracket).
S = stations; r = replicates.

samples outside the coral reef area (Stations 3 to Station 7) and 3 replications were collected at every station. Organisms collected were then fixed with 10% formalin in seawater. In laboratory, samples were filtered through 500µm mesh screen and 42µm net to separate into macrobenthos and meiobenthos, respectively. Samples of macrobenthos were then transferred into 10% formalin containing Rose Bengal stain for identification, while meiobenthos samples were transferred into 5% formalin with addition of the same stain. These methods were applied with some modifications based on Holme and McIntyre (1984), Aswandy *et al.* (1991) and Zaleha *et al.* (2001). Identification of macrobenthos was done using dissecting microscope and compound microscope was used for detailed observation. Compound microscope was also used to identify meiobenthos. The identification of these organisms was made based on methods proposed by Sterrer (1986). Shannon-Weaver index was used to determine diversity index of macrobenthos as well as meiobenthos. A small amount of samples (100 g) were taken for the analysis of sediment sizes using dry sieving method as proposed by Brown and McLaachlan (1990) and McBride (1971).

Results and Discussion

Physico-Chemical Parameters

The physico-parameters recorded in this study were Temperature, Salinity, Dissolved Oxygen and pH. Generally, all those parameters recorded a small variation between stations where the variation for temperature recorded 0.27°C, salinity (0.29 ppt), dissolved oxygen (0.63 mg/l) and variation of pH was (0.03 units). Physico-chemical parameters recorded during the study period showed little fluctuation, and changes in abundance of benthic communities could not be explained in terms of these environmental factors. Study by Lotfi (1994) in nearby area (Redang Island) also recorded a little variation of the parameters.

Sediment Size

Analyses of sediment size were done two times (post-monsoon and pre-monsoon). Generally the result showed that sediments from stations outside coral reef area could be categorized as ‘coarse sand’ based on the phi value (0-0.1). Meanwhile, sediments inside the coral area could be categorized as ‘very coarse sand’ with all stations recorded a moderate type of sorting with a mixture of large and medium sized sediments.

Macrobenthos

Overall, Polychaeta was recorded as the most dominant macrobenthos (Figure 3). Station 1 and Station 2 which were located inside the coral area recorded average density of 13,538.33 and 13,833.33 Inds.m^{-2}, respectively. These stations showed almost similar density probably due to both of them were located near each other. Polychaeta was the most dominant group in both stations with 53.16% in Station 1 and 52.57% in Station 2. Crustacea was the second most abundant group in Station 1 where they occupied 21.15%, while Station 2 was dominated by Nematoda with 20.88%. In terms of diversity, Polychaeta was also found as the most diverse with 21 families, while Crustacea was represented by 9 families. The average density of macrobenthos recorded in this study (719 Inds.m^{-2}) is higher compared to the study by Piamthipmanus (1998) with an average of 185 Inds.m^{-2} and Ahmad *et al*. (2002) with an average of 578 Inds.m^{-2}.

Samples taken from outside coral area also recorded Polychaeta as the most dominant group with Station 3 recorded the highest density (881.67 inds. m^{-2}). Crustacea was recorded as the second most dominant group with density ranged from 263.33 inds.m^{-2} to 556.67 inds.m^{-2}. Among the 5 stations outside the coral area, Station 3 recorded the highest density of 6,840.00 inds.m^{-2}. The domination of Polychaeta in this study was similar to the result of the study by Othman *et al.* (1994) and Onate *et al.* (1994). Both of the studies recorded Polychaeta as the most dominant group, followed by Crustacea.

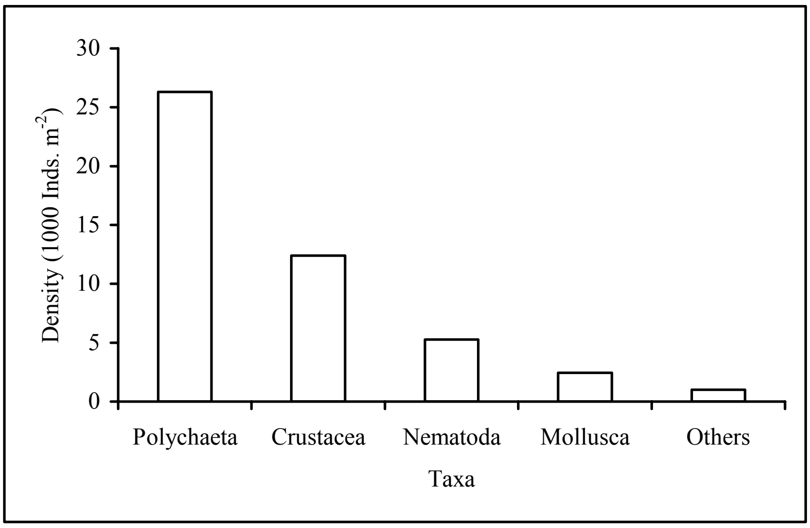

Figure 3. Total macrobenthos composition of all stations.

From figure 4, it can be seen that macrobenthos density decreases away from the coral area. S1 and S2 which were located inside the coral area recorded higher densities as compared to stations outside the coral area. Among the stations outside coral area, S3 which was the nearest station to the coral area recorded the highest density and the furthest station from the coral area (S7) recorded the lowest density. The decreasing pattern of macrobenthos density could be related to the importance of coral reef area.

Based on figures 5 (a) and 5 (b), density of macrobenthos was found to be higher during pre-monsoon season (September and October) as compared to post-monsoon season (April and May). According to Sudara (1994), during the rainy season, nutrients from the land find its way to the sea and this addition of nutrients provides the means of allowing phytoplankton to increase. In relation to this study, the increase of phytoplankton population during rainy season (September and October) would increase the composition of zooplankton and macrobenthos. In a study by Lotfi *et al.* (1994), density of macrobenthos was recorded the highest during pre-monsoon season (September). The study showed a distinct decrease of macrobenthos during middle of the year (May and June) as compared to that of the beginning (March) and end of the year (September and October).

The Diversity index of macrobenthos was determined to be 1.289. This value being higher than 1, shows that macrobenthos in Karah Island has a good variation.

Meiobenthos

Meiobenthos may be classified into six major groups, namely Harpacticoida, Polychaeta, Nematoda, Ostracoda, Calanoida and ‘others’ (groups that are small in numbers). Overall, Harpacticoida was found to be the most dominant group which accounted for 42% while the second most dominant group was Nematoda with 31% (Figure 6). Only 2% of the other groups were recorded in this study. Harpacticoida was found in the highest number in all the stations except in Station 1 which was dominated by Nematoda with 39.1% as compared to Harpacticoida with only 30.6% (Figure 7). The biggest percentage difference between Harpacticoida and Nematoda was recorded in S4 with 31.4% and the other stations recorded a percentage difference between 7.3 to 27.1 %. The dominant species inhabiting in this study area recorded a slight similar percentage with that recorded in study by Zaleha *et al.* (2004) and Shabdin (1990). Total density of Meiobenthos of all stations recorded as 237 901.4 Inds. m^{-2}. Total density of meiobenthos in this study is higher than that recorded by Shabdin (1990) and Zaleha *at al.* (2001) that might indicate the higher fertility of study area.

Similar to macrobenthos, density of meiobenthos also decreases away from coral area (Figure 8). Both stations inside the coral area recorded a higher density compared to the stations outside the area. The highest density was recorded in Station 1 and the lowest in Station 7. Station 1 that was covered by more live corals recorded higher density macrobenthos than Station 2 although both stations were located inside the coral area. This result showed the importance of live coral as provider of meiofauna.

Deeper bottom tends to have a more stable environment and thus is able to support higher density of meiobenthos (Zaleha *et al*., 2001). The deeper bottom in Station 4 was able to support higher density of meiobenthos as compared to the shallower bottom

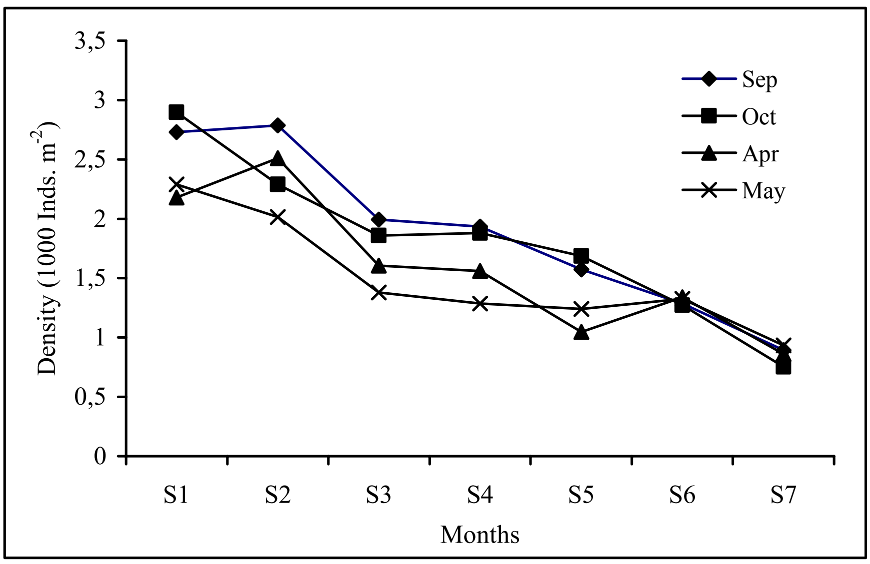

Figure 4. Density of macrobenthos for different sampling stations.

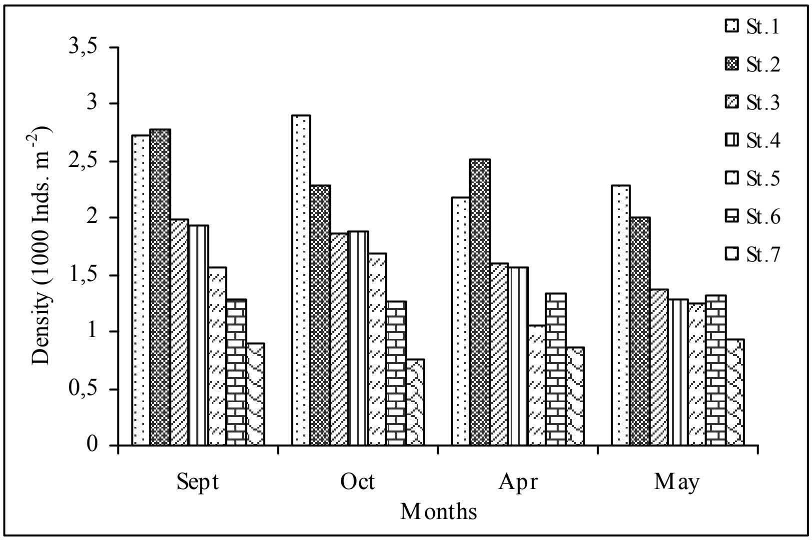

Figure 5(a). Density of macrobenthos in different monsoon seasons.

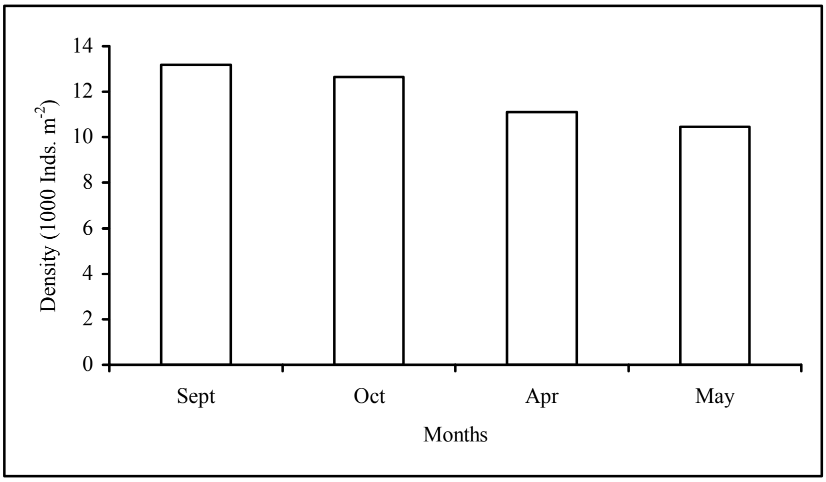

Figure 5(b). Total density of macrobenthos in different monsoon seasons.

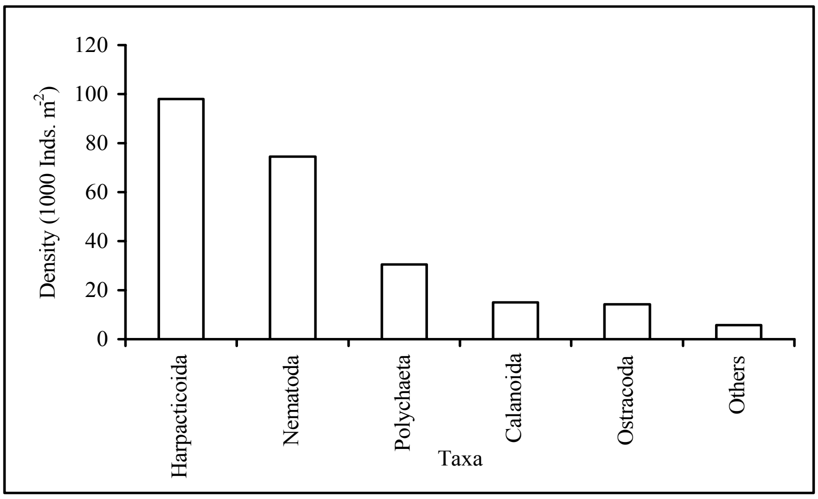

Figure 6. Meiobenthos composition of Karah Island.

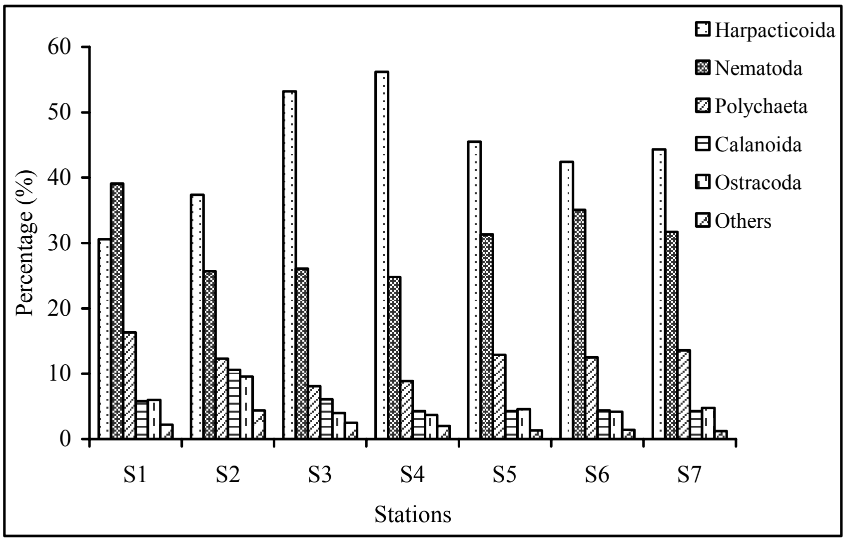

Figure 7. Dominance of meiobenthos for different sampling stations.

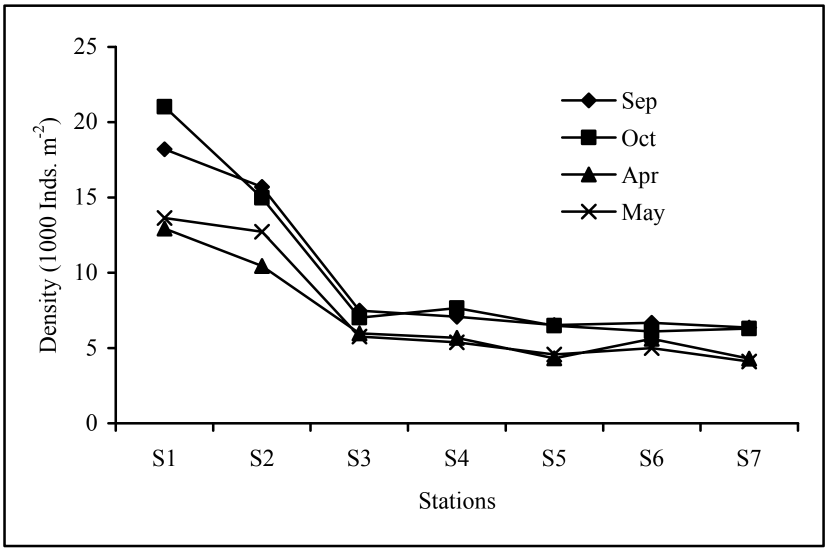

Figure 8. Density of meiobenthos for different sampling stations.

in Station 3. Similarly, the deeper bottom in Station 6 supported more meiobenthos as compared to Station 5 with shallower bottom. Nonetheless, Station 7 recorded a contrary result. This station with the deepest bottom recorded the lowest density of meiobenthos. This might be due to fact that this station was located the furthest away from the coral reef area.

Inside the coral area however, the density of meiobenthos was observed to be indirectly related with the depths as both stations (Stations 1 and 2) were covered by different percentages of live coral. Similarly, the depth of sea bottom also showed weak relationship with density of meiobenthos outside the coral area. This might be due to the meiobenthos having higher tendency to associate with live corals in the coral reef area. According to Brown and McLaachlan (1990), the dominance of sand particles in coral sediment becomes preference habitat for various types of benthic fauna. The result could also be due to insignificant differences in depths recorded in this study that are able to support distinct difference of meiobenthos density.

Similar to results recorded for macrobenthos, meiobenthos also showed higher densities during rainy seasons of September and October (Figure 9). Total density of meiobenthos in all stations was the highest in October after a small increase from

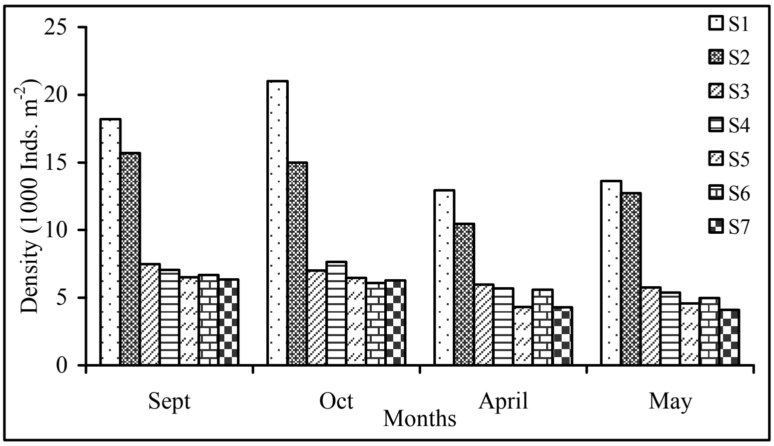

Figure 9 (a). Density of meiobenthos for different stations with different monsoons.

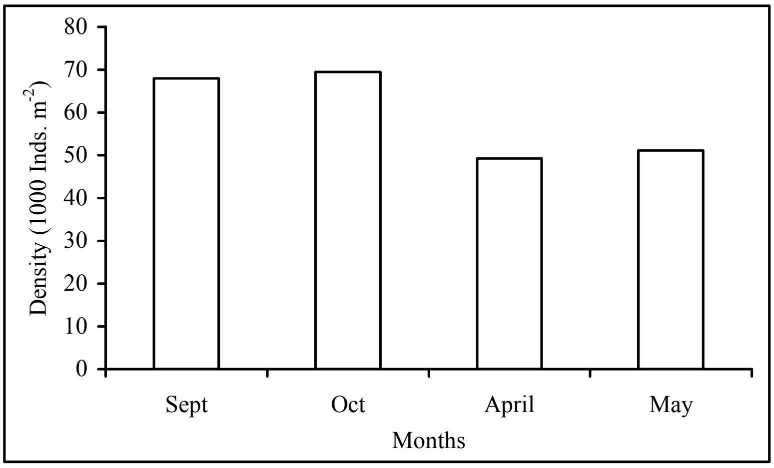

Figure 9 (b). Total density of meiobenthos in different monsoons.

September. During post-monsoon season (April and May), total density recorded a massive decrease.

Conclusion

Coral reef areas are important to marine organisms as they provide a wide variety of habitats and foods (Nybaken, 1997; and Wootton, 1992). Besides providing foods, healthy coral reefs have also been exploited by marine organisms as breeding ground and sheltering area (Brown and McLaachlan, 1990; Goldman and Talbot, 1976; Nybaken, 1997; and Wootton, 1992). This study had proved the importance of coral area to marine organisms especially benthos as this fauna was found in higher density in coral area and decreased away from coral area. Besides coral area, different monsoon seasons also affected the density of benthic community. Increasing of nutrients during pre-monsoon season (rainy season) had attracted more organisms to associate in this region (Damanhuri, 1998).

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