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Trend of Meiobenthos Density and Composition in Karah Island, South China Sea

(Corak Kepadatan dan Komposisi Meiobentos di Pulau Karah, Laut China Selatan)

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ABSTRACT

Meiobenthos in Bidong Archipelago in coastal water of the South China Sea is hypothesised to have a certain trend of distribution particularly in the island ecosystem where it is usually having different type of sea bottom. Nonetheless, since it is located in a tropical area, the trend at the sub-tidal could be less obvious due to absent of clear season. Meiobenthic sampling was carried out in Karah Island, an island in Bidong Archipelago, from the intertidal, towards the sub-tidal zone covering the coral and non-coral area to see the trend in the density and composition. A transparent hand core was used to collect benthos samples. Nematoda and harpacticoid copepods dominated the intertidal and sub-tidal zone respectively. Harpacticoid copepods were higher in density in the non-coral sediment than the coral area. This could be due to the high content of silt and clay in the coral area (2.98% of silt and clay). The 2-dimension MDS analysis on the density data indicated the highest degree of scattering and an over-lapping condition for those intertidal and sub-tidal samples respectively. ANOSIM result showed that the degree of similarity was lower at the intertidal (70%) than the sub-tidal (reaching 90%) in the first sampling before both became no significant different in the second sampling. It could indicate the stable condition in the subtidal than the intertidal ecosystem. The comparatively low density of meiobenthos could indicate their response towards the environmental condition in the area which will only be confirmed by long term ecological study.

Keyword: Harpacticoid; island; meiobenthos; nematoda; South China Sea

ABSTRAK

Meiobentos di Kepulauan Bidong di perairan Laut China Selatan mungkin mempunyai corak taburan yang tertentu terutamanya di dalam ekosistem pulau dan terdapat jenis permukaan dasar yang berbeza-beza. Walau bagaimanapun, oleh kerana ia terletak di kawasan tropika, corak di kawasan pasang-surut mungkin kurang jelas berikutan daripada ketiadaan kesan musiman. Pensampelan meiobentos telah dijalankan di Pulau Karah, sebuah pulau di Kepulauan Bidong, dari kawasan antara pasang-surut, menuju zon pasang-surut yang meliputi kawasan karang dan tanpa karang, untuk memerhatikan corak kepadatan dan komposisi. Nematoda dan harpaktikoid copepod mendominasi masing-masing di zon antara pasang-surut dan pasang-surut. Harpaktikoid copepod mempunyai kepadatan yang lebih tinggi di sedimen tanpa karang berbanding zon karang. Ini berkemungkinan disebabkan oleh kandungan liat dan lumpur yang tinggi di dalam kawasan karang (2.98% liat dan lumpur). Analisis 2-dimensi MDS ke atas data kepadatan menunjukkan aras serakan yang paling tinggi berlaku di kawasan antara pasang-surut dan keadaan bertindih berlaku kepada sampel dari kawasan pasang-surut. Keputusan ANOSIM menunjukkan aras keserataan adalah rendah di zon antara pasang-surut (70%) berbanding zon pasang-surut (mencapai 90%) di dalam pensampelan pertama sebelum kedua-dua kawasan menunjukkan tiada persamaan signifikan di dalam pensampelan kedua. Ini menunjukkan keadaan stabil ekosistem pasang-surut berbanding zon antara pasang-surut. Kepadatan meiobentos yang rendah secara bandingan mungkin menunjukkan tindak balas terhadap keadaan persekitaran yang hanya dapat disahkan melalui kajian ekologi jangka panjang di kawasan ini.

Kata kunci: Harpaktikoid; Laut China Selatan; meiobentos; nematoda; pulau

INTRODUCTION

Karah Island, as one of the islands in Bidong Archipelago in the South China Sea, is known for the Vietnamese refugee camp in the 1970s. Sakri et al. (2006) demonstrated that meiobenthos in Karah Island was dominated by the harpacticoid copepods particularly during pre-and post-monsoon season. They also found that benthic abundance was highest in the coral zone. Mizubayashi et al. (2013) found that colored dissolved organic matter (CDOM) in the islands might protect the benthic fauna from the harmful ultraviolet ray (UVR). This could contribute to the coral health and support abundance of meiobenthic fauna particularly the harpacticoids. Corals in the islands were also reported to induce the healthy microbial environment due to their mucus content (Nakajima et al. 2009). Scavenger invertebrates of 1 mm size and above in the coral area were reported in high abundance and dominated by Isopoda (Nakajima et al. 2013).

Meiobenthos normally increased their number under warm weather (Lopez-Canovas & Lanana 2001). There should be differences in term of composition and abundance of organism on an exposed environment such as the beaches if compared to the marine bottom. Venekey et al. (2014) confirmed the role of rain and tidal cycle on the meiobenthic community on the intertidal area in Brazil. At the sub-tidal area, bottom hydrodynamic could give more influence on the taxon dominated the benthic community (Lopez-Canovas & Lanana 2001) such as harpacticoid copepods. Harpacticoids were potentially quick in recovery from general perturbation (Grego et al. 2014) as the animal has fast reproductive rate. It is seemed that many factors control the community at different habitat. A study on the possible effect of climate change onto harpacticoid copepod population in an estuary showed that climate change could resulted in the population decline thus in long term gave negative impact on the stability of food chain and productivity in a coastal ecosystem (Richmond et al. 2007). Nonetheless, the trend of the faunal density and composition could be thought as consistently maintained due to more or less stable sea bottom condition in the tropical region. This paper aimed to report on the meiobenthos density and composition as to see the indication of any climate change effect shown by the community from the Karah Island of Bidong Archipelago.

Materials and Methods

Field Sampling

The field sampling was carried out at Karah Island (05° 35.857 N, 103° 03.7176 E) in August and December 2012 (Figure 1). Three different microhabitats/stations were chosen for the study; the intertidal zone (A), coral zone (B) and non-coral zone (C). A 50 m transect was laid and three random quadrat samplings were held along transect in each station. A total of five replicates samples were obtained using a hand-core technique. The samples were collected by SCUBA divers in the sub-tidal zone. The maximum depth dived during the sampling was 6 m.

Laboratory Work

Meiobenthos samples were isolated from sediment following the standard sieving method with some modification as recommended by Zaleha et al. (2009). Since the sediment has more than 80% sands, decantation procedure was applied to retrieve the meiobenthos on 62 microns nylon sieve. Decantation process was started by pouring pre-sieved seawater into the sediment to stir and suspend the organism into the water. It was followed by carefully sieving them through a 62 microns sieve to collect the meiobenthos. The process was repeated for 5-6 times when there was no organism found on the sieve. All microscopic observation was carried out under a stereo and compound microscope (Leica DM500 model). Density of meiobenthos was analysed using the PRIMER v6.0.2 software package. The multivariate analysis data were square root transformed prior to construction of Bray-Curtis similarity matrix (Clarke et al. 2006) and two-dimensional ordinations of assemblages were subsequently made using non-metric multidimensional scaling (nMDS).

Results

All *in situ* environmental parameters collected from the study area showed a stable water physico-chemical condition. The warm temperature, high dissolved oxygen, salinity and pH value indicated the normal condition of tropical marine water (Table 1). Generally the values decreased in the second sampling, in December if compared to the first sampling (in August).

Intertidal zone in the study area was sandy with coarser grain if compared to the sub-tidal area. On the other hand, unexpectedly the coral area had high percentage of silt and clay (Table 2). Sorting condition of the sediment was moderately well sorted, poorly sorted and well sorted in intertidal, coral area and non-coral area respectively

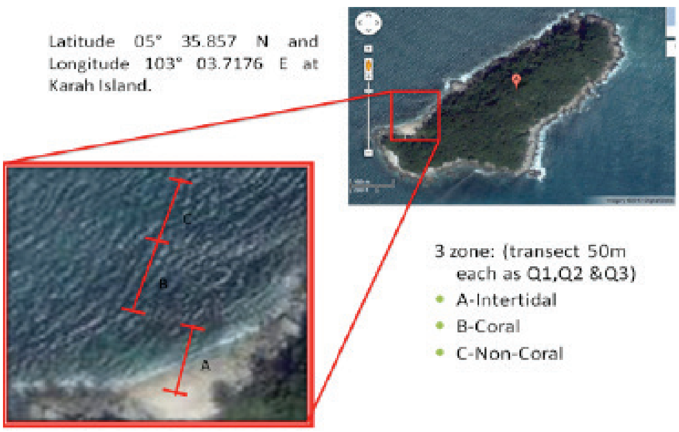

FIGURE 1. Google map showing the sampling area at Karah Island, Bidong Archipelago. (www.googlearth.com.my)

TABLE 1. Some physico-chemical water parameters in Karah Island in 2012

	Sampling 1	Sampling 2
Temperature, °C	29.40	28.95
Percentage dissolved oxygen, % DO	79.25	72.10
Dissolved oxygen, mg/L	5.01	4.59
Salinity, ppt	32.60	32.43
pH	8.22	8.18

TABLE 2. Sediment characteristic of the sampling area at Karah Island, 2012

PSA	Intertidal	Coral	Non coral
Mean (x) Phi	1.18	1.53	1.02
Sorting	0.6	1.06	0.46
Skewness	0.06	2.81	-0.05
Kurtosis	3.01	15	3.14
Texture analysis			
% sand	84.21	82.2	83.5
% silt	0	2.72	0
% clay	0	2.98	0

following the classification by Folk & Ward (1957). Nevertheless, all areas could be regarded as having sandy sediment as the sand content was >80%.

DENSITY AND COMPOSITION OF MEIOBENTHOS

In general, the density increased as the station move towards the sub-tidal zone, except at the mid tide level on the beach (Figure 2). In the sub-tidal zone, the density was higher in the area of without coral community as in C2 and C3 than the coral area (B1, B2, B3).

Nematoda was the most dominant taxon with the percentage of contribution to the total meiobenthos between 10 and 70%. The percentage was highest at the intertidal zone (Figure 3). The second dominant group, the copepods ranged from 8% to almost 60% with the high percentage was found in the sub-tidal zone particularly in the non-coral area. At the sub-tidal area, the dominance of nematodes was drastically altered by the harpacticoid copepods. The copepods over-shadowed the density of nematodes at B2 and B3 in coral zone. They further suppressed nematodes by drastic increase of density in all stations at non-coral zone.

It is interesting to note that the coral and non-coral area showed their possibility as the important breeding ground for the harpacticoid copepods. The density of the adults, copepodites and naupliar stage generally increased towards outside the coral area (Figure 4). Different copepod stages were recorded in different density. The naupliar stage also showed their higher occurrence mostly at the sub-tidal and none was found at the high tide level on the beach.

The 2-dimension MDS analysis on the density data for all samples produced a clear diagram showing the separation of meiobenthic density between the intertidal and the sub-tidal zone. The samples from the intertidal zone had the highest degree of scattering (Figure 5). On the other hand, there was an over-lapping condition for those sub-tidal samples.

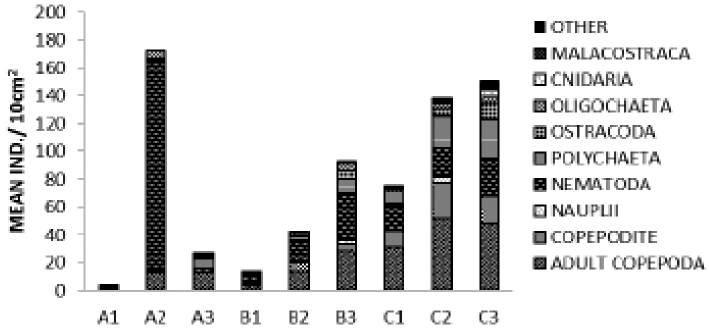

FIGURE 2. Density of meiobenthic fauna (Ind./10 cm^2) in the intertidal (A1, A2, A3), coral zone (B1, B2, B3) and non-coral zone (C1, C2, C3) in Karah Island

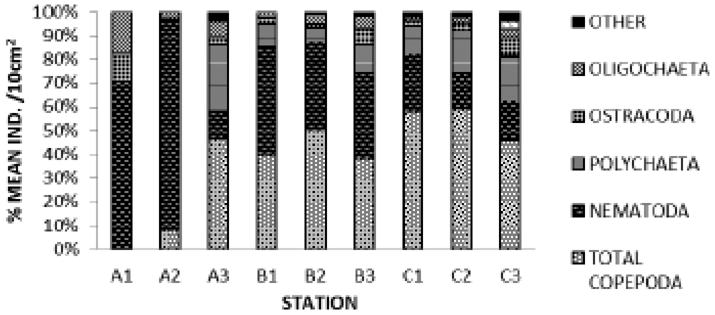

FIGURE 3. Composition of meiobenthic fauna (%) in the intertidal (A1, A2, A3), coral zone (B1, B2, B3) and non-coral zone (C1, C2, C3) in Karah Island

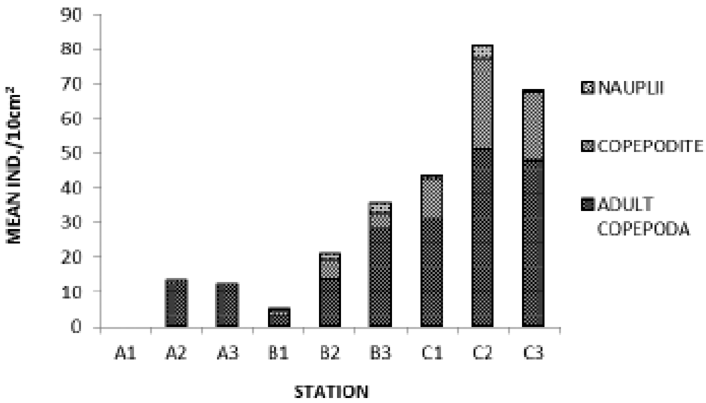

FIGURE 4. Composition of different copepod life stage in the intertidal (A1, A2, A3), coral zone (B1, B2, B3) and non-coral zone (C1, C2, C3) in Karah Island

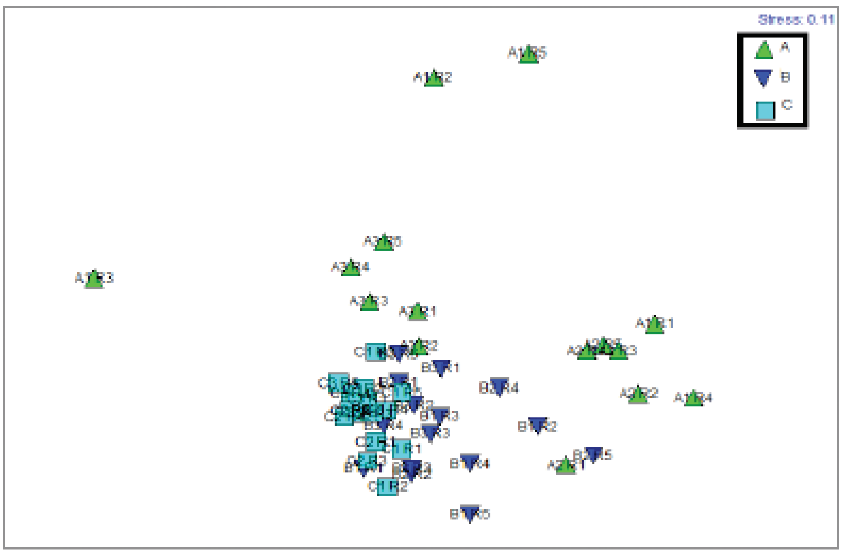

FIGURE 5. Non-metric multi-dimensional scaling for all samples (2d: 0.11, 3d:0.08) in the intertidal (A1, A2, A3), coral zone (B1, B2, B3) and non-coral zone (C1, C2, C3) in Karah Island

DISCUSSION

In comparing the trend of differences of meiobenthos density and composition on the intertidal and in sub-tidal zone, the present finding could be explained by the possibility of more stable condition on the sea bottom. Intertidal zone is known to be more stressful particularly due to the temperature fluctuation and desiccation (Chen et al. 2012a). The condition is different at the sub-tidal area particularly in the island with the existence of the coral ecosystem which improved the sea bottom productivity level (Nakajima et al. 2009). Azovsky et al. (2005) reported that this type of stable microhabitat could be mostly dominated by short living micro-patches, harpacticoid copepods and other meiobenthos.

Harpacticoids were reported in higher density in the corals than the surrounding area in Bidong (Sakri et al. 2006). The present study showed the contrast result which might be best explained by changes in the environmental condition in the area and high percentage of clay and silt. Coral rubble zone could promote the colonisation of microbial communities as reported by Tribollet et al. (2006). This could further promote the colonisation of diverse species of harpacticoid copepods (Callens et al. 2011; Gheerardyn et al. 2009). Seprucci et al. (2013) noted on the importance of coral fragments and rubble from the outer reefs as trap for sediment, which might create heterogeneous micro-habitat suitable for some meiobenthos. Lesser favorable condition for life coral communities could give less grazing pressure thus some meiobenthos such as copepods could increase their population. As noted by Logan et al. (2008), the same condition happened in Heron Reef due to the increase grazing pressure on meiobenthos in the live coral area.

Other meiobenthos such as the malacostraca and cnidarians did not show significant existence and could be loosely found in the area due to the less suitability of the bottom substrate. Oigman-Pszczol and Creed (2006) found that this is highly related to coral community structure and composition in the study area.

Nematodes showed positive correlation with small grain such as mud and silt (Chen et al. 2012a). Nonetheless, silt and clay was only detected in the coral area in this study. Thus, other factors at Karah Island could support the dominance of nematodes on the intertidal zone. The intertidal area exposed more to the tidal change and desiccation at the same time. Nematoda in the area might be the most tolerant group when exposed to the extreme environment because of their preference to the moderately well sorted sediment type on the beach. Nevertheless, the density is very much lower than the density found in Sarawak coast (Chen et al. 2012b) which support the idea of less organic or mud found in the sediment in Karah Island.

The second most dominant group was harpacticoid copepods. As mentioned by Chertoprud et al. (2009), percentage of harpacticoid copepods found in meiobenthic community of island ecosystem in the South China Sea could be affected by the depth. The dominance for harpacticoid copepods in the non-coral area could be related to the colonization process on the available substrates. As the area was made up mostly by the coral rubbles, they could be regarded as substrates by the copepods. Callens et al. (2011) indicated the ability of different harpacticoid species to colonise on the dead coral fragments. The assemblage of harpacticoid species on different substrates could possibly depended on the substrates more than the hydrodynamic factors on the sea bottom (Gheerardyn et al. 2009). This could be related to the biofilm available in the area which become nutritive source and support population growth (Dahms et al. 2007). Mascart et al. (2015) also highlighted on the more importance effect of bottom substrate complexity to harpacticoid than the water movement. These possible factors in controlling the meiobenthos and harpacticoid copepods inhabiting the sea bottom of the island ecosystem in the South China Sea need further investigation.

Conclusion

The study has successfully determined the trend of density of meiobenthos following the vertical profile of the island, from the intertidal to the sub-tidal area. Meiobenthic faunal density and composition in the intertidal zone showed variability more than those inhabiting the sub-tidal zone. The dominance of nematodes on the intertidal and coral area was suppressed by harpacticoid copepods living in the non-coral area. The sedimentary parameters could possibly influence the trend. Other factors such as the substrate complexity and biofilm might play some role and this will need to be investigated further.

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