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Benthic mollusc assemblages in subtidal coastal waters of Penang National Park, Malaysia

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Abstract. Benthic molluscs were sampled bimonthly from October 2010 to September 2011. Four sampling sites were selected (Teluk Bahang, Teluk Aling, Teluk Ketapang and Pantai Acheh) based on difference human activities in surrounding coastal waters of Penang National Park. Sampling activities were done starting at 200 m from the subtidal shoreline until 1200 m offshore. A total of 432 benthos samples were collected using 6' X 6' Ponar grab. From this study, 25 species from 21 families and 25 genera were identified. Particle size analysis was done and revealed Penang National Park coastal waters is a muddy area with more than 80% of the sediment samples diagnosed as mud. Whereas, in Teluk Bahang and Teluk Aling, the starting transects (200 m to 400 m) were consisted mixture of particle size but the proportion of particle size gradually changed to mud towards the shore. Based on Pearson's Correlation, it was found that Nuculanidae, *Megastomia* sp., and *Timoclea* sp. showed positive correlations with sandy particles (1000 µm-250 µm) with r values ranging 0.88 to 0.96 at $p<0.01$. The density of benthic molluscs was found highest in Teluk Bahang followed by Teluk Aling, Teluk Ketapang and Pantai Acheh with overall mean value 613.6 molluscs/m^2. Penang National Park coastal waters are all considered shallow as the depth never exceeding 10 m.

Key words: Benthic molluscs, particle size, shallow water, Penang National Park.

Introduction

Benthic organisms are bottom-living animals, generally dominated by invertebrates. Benthic community play an important process as it functions to maintain population structures in many organisms (Gaston, 1996) and become a reliable indicator to environment. Molluscs are part of the benthic community and have a widespread distributions. Their life style which relatively appeared less mobile would eventually reflect the site-specific conditions and respond to changes in habitat that occur during sampling or long before the sampling (Roldan, 2003). Benthic molluscs that live at bottom of the seafloor play important roles in accelerating the detritus decomposition and other major ecological processes through their nature life style (Cuomo & Zinn, 1997). Furthermore, the composition and abundance of benthic molluscs over a period of time may determine the health status of an ecosystem (Zahoor et al., 2010). The diversity of benthic communities also reflects water quality conditions, with a high diversity generally indicating good water quality (Hynes, 1984). The objective of this research was to study the distribution pattern and diversity of benthic molluscs' assemblages along the coastal waters of the Penang National Park, Malaysia.

Material and methods

Sampling Sites.

There were four sampling sites named Teluk Bahang, where entrance of Penang National Park and fishing village are located; Teluk Aling, location of Centre of Marine and Coastal Studies (CEMACS) situated; Teluk Ketapang, no obvious activities were occurred at this site and Pantai Acheh, a mangrove area with extended mudflat. The sampling sites are shown in Figure 1. The research study was started in October 2010 and ended in September 2011 with 6 times data collection taken in alternate month except the last data collection (6^{th}). At every sampling site, there were 6 sampling points named S1, S2, S3, S4, S5 and S6 with 200 meter distance with each other. A hand-operated 6'x 6' Ponar grab was used to grab the benthic molluscs in three replicates. Benthos samples were washed through on 0.5 mm sieve and retained organisms on the sieve were transferred into 8'x10' plastic bags and fixed in 10% formalin with the addition of Rose Bengal (1 mg/L).

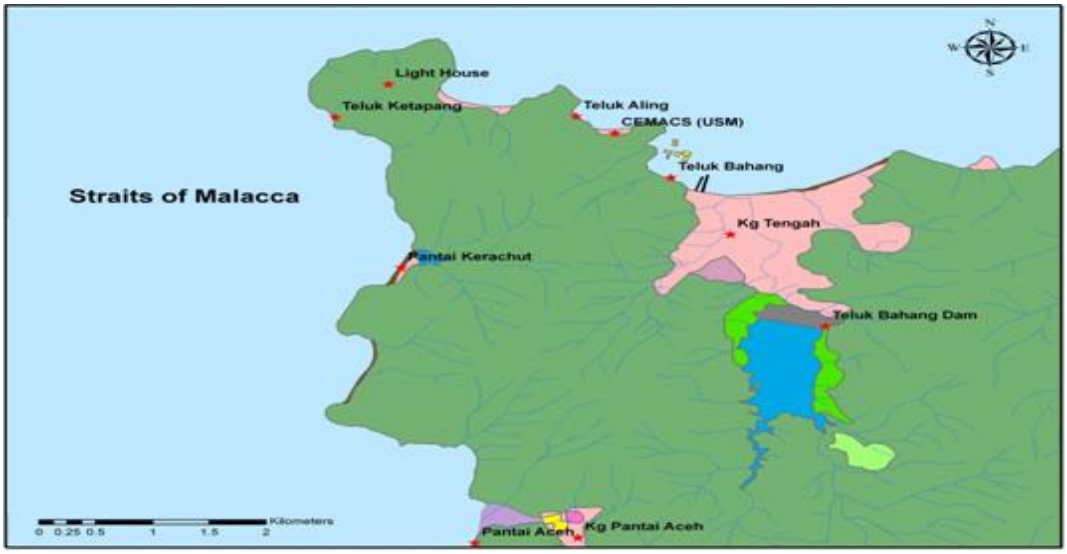

Figure 1: Location of four sampling sites; Teluk Bahang, Teluk Aling, Teluk Ketapang and Pantai Acheh.

Benthic analysis.

The samples were brought to CEMACS laboratory and were re-screened from the 10% formalin by washing it repeatedly on 0.5mm sieve. All material remained on the sieve were transferred in Petri dish for further sorting and identification. The benthic molluscs were identified until species level when possible. The identification of these organisms were made based on Abbott (1991), Graham (1992), Okutani (2000), and Shabdin and Rosniza (2010). For final preservation, 70% alcohol was used and stored in 20 ml vials.

Water quality assessments such as Total suspended solids (TSS), nitrate, phosphate, and ammonia analysis were done. For sediment analysis, dry sieving method was used as proposed by Brown and McLaachlan (1990).

Data analyses of water quality parameters and sediment type were used to find correlations between these parameter with benthic molluscs' assemblages by using Pearson's Correlation in Statistical Package for The Social Sciences (SPSS) version 12.0.

Results and discussions

Throughout the one year data sampling, total abundance of molluscs collected from 432 samples were 186,675.3 molluscs/m^2 with approximately 1:1 ratio of live and dead assemblages. Total species counted were 36 species, however 11 species were never sampled live. Thus, the live species count was 25 species from 21 families and 25 genera (Table 1). Teluk Bahang recorded the highest abundance among 4 sampling sites (66,293.7 molluscs/m^2) whereas Teluk Aling recorded highest species found (21 molluscs). The total abundance found in Teluk Aling, Teluk Ketapang and Pantai Acheh were 44,219.7 molluscs/m^2, 39,572.6 molluscs/m^2, and 36,589.2 molluscs/m^2 respectively.

Table 1: Benthic molluscs found in Penang National Park coastal waters. Present species denoted as + sign whereas absence as – sign.

Genus/ Species	Teluk Bahang	Teluk Aling	Teluk Ketapang	Pantai Acheh
Corbula sp.	+	+	+	+
Nuculanidae	+	+	+	-
***Nucula* sp.**	+	+	+	+
Sacella bellula	+	+	+	+
Placuna placenta	-	-	+	-
Siliqua sp.	+	+	+	-
Timoclea sp.	+	+	+	-
Vaceuchelus sp.	+	+	+	+
Ethaliella sp.	+	+	+	+
Cyclichnidae sp.	+	-	+	+
***Retusa* sp.**	+	+	+	+
Ringicula propinquans	+	+	+	+
Megastomia sp.	+	+	-	-

Columbellidae	+	+	+	+
Zafra sp.	-	+	+	-
Olivella sp.	-	+	-	-
Calayptraeidae sp. 1	+	-	+	+
Crepidula sp.	-	+	-	-
Melanella sp.	-	+	+	+
Natica onca	-	+	+	
Lucidesta sp.	+	+	+	+
Turritella sp.	+	+	+	-
Dentalium octangulatum	+	+	+	+
Dentalium sp.	+	+	+	+
Cadulus sp.	-	-	-	+

Retusa sp. was the most dominant species found in three sampling sites except in Pantai Acheh which most dominated by *Nucula* sp. (bivalve). Overall, Pantai Acheh recorded the highest species diversity (H' = 1.58), species dominance (D = 0.74), and species evenness (0.77) of the 4 sampling sites. Water quality parameter did not showed any significant different (ANOVA, $p>0.05$) among the sampling sites. Particle size analysis showed that most of the coastal area was covered with mud with more than 80% of the sediment composed of silt and clay content. Pearson's Correlation was tested and only correlated with sediment analysis. Nuculanidae, *Megastomia* sp., and *Timoclea* sp. showed positive correlations with sandy particles (1000 µm-250 µm) with r values ranging 0.88 to 0.96 at $p<0.01$ (Table 2).

Generally, benthic molluscs are sedentary organisms and able to response to any physiochemical disturbance in their habitat. Human disturbances such as habitat modification (Auster et al., 1996), turbidity from wave actions (Bilotta & Braizer, 2008) and sediment changes (Churchill, 1989) might affect benthic molluscs' population.

Table 2: Correlation of particle size with benthic molluscs.

Benthic molluscs	Coarse Sand (1000µm-710µm)	Medium sand (425µm-250µm)	Fine sand (250µm-125µm)	Silt and clay (<63µm)
Nuculanidae	0.96**	0.94**	0.96**	- 0.94*
Timoclea sp.	0.95**	0.91**	0.88**	-
Megastomia sp.	0.96**	0.92**	0.90**	-

* Significant at p<0.05 **Significant at p<0.001

Nevertheless, some species are able to overcome these stresses and inhabit unfavorable environments (Wesselingh, 2006). This can be seen in Teluk Bahang, a fishing village with active human interferes with highest abundance of molluscs sampled compared to Teluk Aling, Teluk Ketapang, and Pantai Acheh. *Retusa* sp. a small molluscs species (size never exceed 2 mm) was the most abundant species found at all sampling site except in Pantai Acheh. Small-bodied species have a higher capacity to occupy a single space than do larger-bodied species, because their abundance is the limiting factor of inhabitance (Nee, Mooers & Harvey, 1992).

Teluk Bahang and Teluk Aling at distance of 200 m to 400 m were composed of sandy sediment. At these distances, three benthic molluscs were found to have a strong correlation with sandy particle (Table 2). Nuculanidae and *Timoclea* sp. are bivalves, which are usually buried in sediment, whereas *Megastomia* sp. is detritus decomposers. Coarse particles are believed to be high-energy habitats, because the currents and wave actions provide a greater availability of food for suspension feeding. Pantai Acheh on the other hand was dominated by *Nucula* sp., a bivalve species that usually prefer lower tidal levels, and inhabit well in firmer deposits (Kasinathah & Shanmugam, 1988). This species are often considered to be distributed offshore, because of feeding and larval settlement restrictions, especially in mangrove areas (Plaziat, 1984). This may explain the abundant occurrence of *Nucula* sp. throughout Pantai Acheh.

One of the most interesting findings in the present study was the collection of many dead mollusc; approximately 11 species were counted, but their populations were very low (0.1% of the total abundance). These molluscs were *Timoclea scabra*, *Paphia* sp., *Umbonium vestiarum*, *Turbonilla* sp., *Coralliophilia* sp., *Nassarius jacksonianus*, *Nassarius* sp., *Gemmula* sp., *Tomopleura* sp., *Calyptraeidae* sp. 2, and *Epitonium* sp. Dead mollusc could be found due to wave action (Poirier et al., 2010) or these species probably occurred in the area, but were unable to survive the harshness of environmental habitat (Foeckler et al., 2006). Furthermore, all of the sampling sites were classified as shallow coastal water, with the depth never exceeding 10 m. Absalao (1991) showed that the influence of storm

waves can disturb the sediment at a depth of less than 20 m and this would favor opportunist species able to withstand such physical disturbance.

Conclusions

Throughout the sampling sites, Teluk Bahang, Teluk Aling, Teluk Ketapang and Pantai Acheh hold a slightly different in species composition. High energy habitats, such as sandy areas supported a high abundance of molluscs. These areas showed distinct locality and abundance of mollusc species, especially Nuculanidae, *Timoclea* sp., and *Megastomia* sp. Overall, 21 families, 21 genera, and 25 species were recorded in the coastal waters of Penang National Park.

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