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Effects of Environmental Factors on Polychaete Assemblage in Penang National Park, Malaysia

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***Abstract*—**Macrobenthos distribution along the coastal waters of Penang National Park was studid to estimate the effect of different environmental parameters at three stations, during six sampling months, from June 2010 to April 2011. The aim of this survey was to investigate different environment stress over soft bottom polychaete community along Teluk Ketapang and Pantai Acheh (Penang National Park) over a year period. Variations in the polychaete community were evaluated using univariate and multivariate methods. A total of 604 individuals were examined which was grouped into 23 families. Family Nereidae was the most abundant (22.68%), followed by Spionidae (22.02%), Hesionidae (12.58%), Nephtylidae (9.27%) and Orbiniidae (8.61%). It is noticeable that good results can only be obtained on the basis of good taxonomic resolution. The maximum Shannon-Wiener diversity (H′=2.16) was recorded at distance 200m and 1200m (August 2010) in Teluk Ketapang and lowest value of diversity was found at distance 1200m (December 2010) in Teluk Ketapang.

***Keywords*—**Polychaete assemblage, environment factor, Pantai Acheh, Teluk Ketapang.

I. Introduction

THE assemblage structure of existing organisms differs in space and time in response to many physical and biotic parameters. Ecology is the integrated survey of the relation of living organisms, comprising human beings, to their environment. Though bottom macrobenthic communities have numerous advantages as indicators, they are exceedingly complicated, including a great variety of organisms and generally a large number of species. In this case, analysis of some taxonomic structures appears to be more appropriate [2].

One of the valuable marine organisms to tolerate contamination is the Polychaetes for the reason that they live at the interface of water-sediment. This layer is both biologically reactive and chemically active [13]. Polychaetes occupy almost all marine and estuarine sediments [5] and are often the predominant constituent of the macrobenthic communities both in terms of individuals and number of species [10-16].

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Polychaetes perform an important role in ecosystem processes of macrofauna assemblages such as recycling, pollutant metabolism and in the interment of organic matter [10].

In marine macrobenthic organisms, Polychaetes is one of the most momentous groups. They are often the predominant macrobenthic taxon in these sediments in terms of numbers, both numerically of species and abundance, and may make up more than half of the organisms in soft bottom habitats. Polychaetes could hence be good indicators of species richness and assemblage models in macrobenthic assemblages [6].

II. Material and Method

A. Survey of Study Area

The study was conducted at two sites in Penang coastal water bimonthly for period of one year. Two sites (Teluk Ketapang and Pantai Acheh), which are located around the North West coastal waters of Penang National Park, were selected as the sampling sites. Pantai Acheh was chosen due to near to mangrove forest and Teluk Ketapang was assumed be minimally altered by anthropogenic activities of stress. At each sites, 6 sampling stations was chosen. The coverage area of each sample was be recorded by using a model 12X Garmin Global Positioning System (GPS). The selection of sampling sites was determined after considering different factors. Samples were collected during one year (June 2010 to April 2011). Three replicate samples were taken at each sampling site by means of a Ponar garab (6"x6"). Macrobentho's samples were sieved over 0.5 mm mesh. The residues retained on the sieves were fixed in 5% formalin with the addition of Rose Bengal to stain the animals in the samples. . Physical parameters (temperature, salinity, dissolved oxygen *in situ*, pH and Total Suspended Solid (TSS)) and chemical parameter (chlorophyll-a level) of sea water around the sampling sites were collected and measured at proper depth to determine the effects of exogenous environmental factors on the bimonthly distribution and abundance of macrobenthic community in the sampling sites in the coastal waters of Penang. A measurement of salinity, dissolved oxygen, pH and temperature was recorded in-situ by using a model YSI 30 SCT meter meanwhile the rest of the parameters was analyzed in the laboratory.

B. Data Analysis

To test the differences in abundance, richness, evenness and diversity in the polychaete community among the four fixed parameters considered: bimonthly (from June 2010 until April 2011), with 3 stations (200m,600m, 1200m), with two sampling sites levels (A, B) and depth, with three levels (3,6,9 m) was utilized. If the variances were significantly different ($P = 0.05$), data were transformed into $\sqrt{X} + 1$ and $\ln(X + 1)$ if variance was still heterogeneous. Shannon-Wiener diversity (H'), Margalef's species richness (d), Peilou's evenness (J') and Abundance was studied.

To under-stand which environmental factors had the greatest influence on macrobenthos characteristics for stations sampled, Principal Components Analysis was implemented to a correlation matrix of environmental variables for all sampling stations, and then plotted in two-dimensional space.

III. Result

Due to the macrofaunal assemblage, a total of 604 specimens were gathered, and distributed into 20 various taxonomic groups.

Polychaete was second groups of the macrofauna assemblage comprises of 12.31% of the total abundance. A total of 604 individuals were examined which was grouped into 23 families.

Family Nereidae was the most abundant (22.68%), followed by Spionidae (22.02%), Hesionidae (12.58%), Nephtylidae (9.27%) and Orbiniidae (8.61%). The maximum Shannon-Wiener diversity (H'=2.16) was recorded in distance 200m and 1200m (August) in Teluk Ketapang and lowest value of diversity was found in distance 1200m (December) in Teluk Ketapang (Fig. 1).

Low in evenness was observed in station 200m (October) in Pantai Acheh and highest evenness was found at Pantai Acheh in 600m in February.

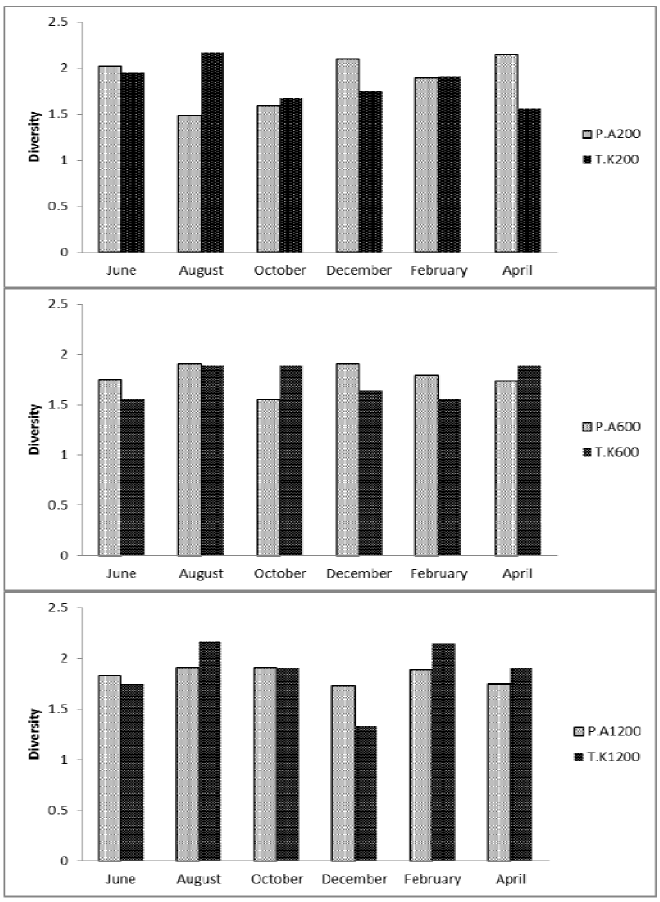
The highest richness (3.47) was recorded in distance 200m and 1200m (August) in Teluk Ketapang and lowest richness (1.67) was observed in Teluk Ketapang in 1200m (December). The pH values ranged between 8.16 and 8.6. Percentages of organic matter ranged between 1.01% and 4.48%. The highest values were shown in the shallow stations.

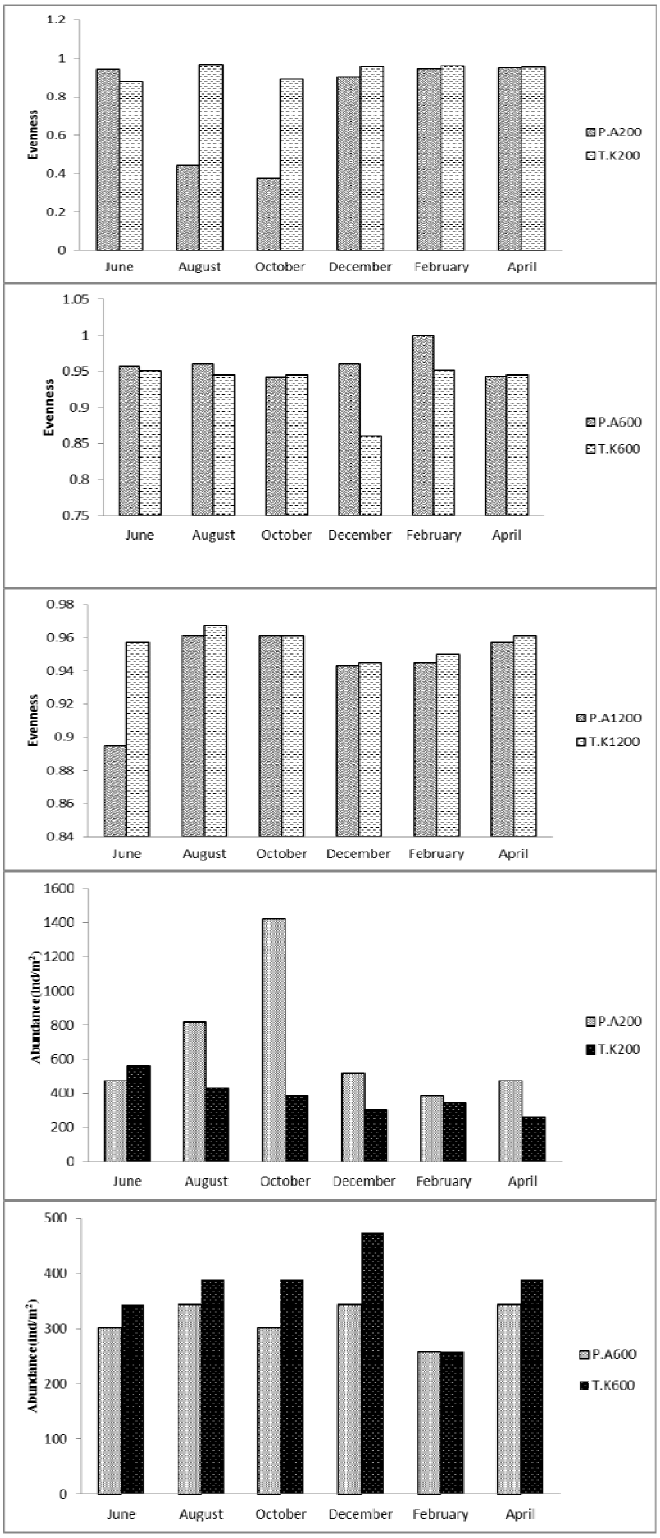
Salinity was around 28.43% and 30.03‰ in all the stations. Temperature range of all sampling stations was observed between 29.27°C and 31.6°C.

The survey region is described by the heterogeneity of sediments particle size (Table I). Silt and clay were dominated in all sampling stations. The 200 m distance in Pantai Acheh was described by the presence of lowest percentage of silt and clay rather than other stations.

TABLE I
NUMBER OF ORGANISMS PER METER SQUARE AT DIFFERENT STATIONS AND MONTHS IN TELUKKETAPANG AND PANTAI ACHEH, PENANG, MALAYSIA

Station	200m P.Aceh	600m P.Aceh	1200m P.Aceh	200m T.Ketapan g	600m T.Ketapan g	1200m T.Ketapa ng
Polychaete	**Ab.ab**	**Ab.ab**	**Ab.ab**	**Ab.ab**	**Ab.ab**	**Ab.ab**
Amphinomidae	6	1	0	1	0	2
Cossuridae	5	0	2	1	0	0
Lumbrinereida e	4	3	3	0	0	0
Scalibregmidae	1	0	0	0	0	2
Cirratulidae	1	0	0	0	1	0
Magelonidae	2	0	0	1	0	2
Spionidae	22	6	7	10	10	7
Nephtylidae	6	5	4	5	6	5
Orbiniidae	4	4	5	6	4	5
Glyceridae	5	4	4	3	3	2
Nereidae	21	9	9	11	8	6
Pilargiidae	1	1	2	0	1	3
Hesionidae	6	6	6	4	12	6
Goniadidae	3	2	2	2	2	3
Syllidae	0	1	0	0	0	0
Sigalionidae	0	0	0	1	1	0
Phyllodocidae	2	0	1	0	0	0
Pectinariidae	0	0	2	1	0	1
Terebellidae	1	1	0	2	0	1
Ampharetidae	0	0	0	3	1	1
Sabellidae	1	0	0	1	1	2
Sternaspidae	3	0	1	1	1	1
Flabelligeridae	1	1	2	0	1	1
Total	95	44	50	53	52	50





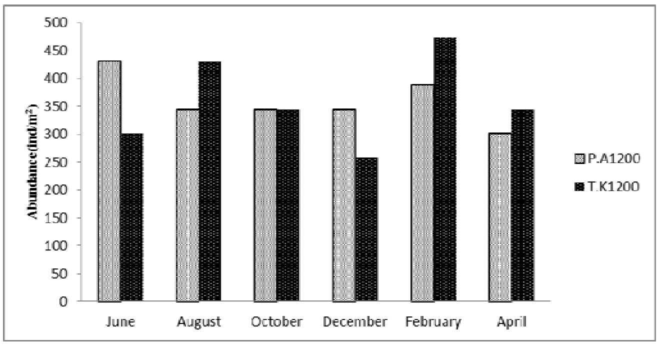


Fig. 1 Mean diversity, evenness and abundance of Polychaete assemblage at sampling months, for each station (200m, 600m and 1200m) and for two locations (Teluk Ketapang and Pantai Acheh)

IV. DISCUSSION

This study displayed a clear spatial change in macrobenthic community structures in relation to environmental parameters such as sediment particle size, organic matter and depth in the coastal water. Additionally, the three stations with a distance of 200m until 1200 m in two locations are exposed to various abundance and depth. Pantai Acheh shoreline of 200m is shallow is exposed to high loads of organic matter compared with Teluk Ketapang, which is less affected by pollution. The increment of organic contaminants possibly enlarged the nutrient load leading to high oxygen consumption rates. A the distance is further from the shore at Station 600m with 6m deep and station 1200m possibly considered a clean with no apparent source of anthropogenic activities. Variations in the polychaete community composition found at distances 600m and 1200m are presumably due to other parameters, unrelated to sediment composition since the particle size at these sampling station is more silt, although it probably could effect on macrobenthic.

Many investigations have revealed in which the spatial distribution of macrobenthic along a subtidal gradient is related to sediment particle size and/or organic matter [1-4-7]. The high percentage of organic matter was observed in station 200m in Pantai Acheh and 1200m in Teluk Ketapang that have shown a positive relation with abundance, diversity and richness of macrobenthic. High percentages of sediment with grain size ≥125 µm revealed to have an increased in macrobenthic abundance. This may aid in expounding the higher abundance of macrobenthic organisms detected at station 200m, particularly for the deposit feeders. It has been reported that the sediment type (sand vs. mud) is one of the parameters responsible for the spatial distribution of macrobenthic families according to feeding kinds [9-13].

Polychaete community variations at the sampling stations adjacent to the coast displayed the existence of change in sensitivity levels in polychaete families to pollution impact. It is useful to investigation the behavior of these families for early discovery of this new disturbance. Spionidae, Nereidae and Nephtylidae were found predominant organisms in station 200m at Pantai Acheh and Spionidae, Hesionidae, Nereidae, Orbinidae and Nephtylidae was observed in Teluk Ketapang. [8] observed that some polychaete species were greatly opportunistic and responded quickly to environmental disturbances.

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