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# AN INSIGHT ON THE FLORA SPECIES AND MEIOFAUNA DISTRIBUTION AT PANTAI KELANANG MANGROVE FOREST, MORIB, SELANGOR

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## ABSTRACT

Mangrove forest at Pantai Kelanang was famous for its diverse marine wildlife and various density of flora and meiofauna distributed at Morib shorelines. Moreover, the diverse marine wildlife, variation of flora and meiofauna distribution at Kelanang mangrove area has never been documented. Kelanang mangrove forest is also surrounded within heavy industrial activity zoning along the Malacca Straits. The objective of this study is to determine the diversity and distribution density of the mangrove flora and meiofauna at different intertidal zones influenced by prolonged human activities. Block sampling technique with quadrat analysis was used in this study. There are two major plants species belonging to Avicennia and Sonneratia families that have been discovered, where the average diameter at breast height was recorded between 3.3 to 32 cm and the average height ranged between 2.0 to 14.5 m. Whereas, Nematoda was found to be the largest distributed meiofauna compared to other meiofauna taxa such as Harpacticoida, Copepoda, Oligochaetea and Polychaetea. Flora species at Kelanang mangrove forest are less diverse at different intertidal zones and the meiofauna diversity were less at the mid- and high-intertidal zones. This finding may be a direct consequence of the influence of heavy industrial activities along the Malacca Straits.

**Key words:** Avicennia, sonneratia, nematoda, copepoda, oligochaetea and polychaetea

## INTRODUCTION

Various mangrove flora and meiofauna are widely distributed at the Pantai Kelanang shoreline located in southern Selangor. The mangrove flora at the coastal shorelines has undoubtedly adjusted to live in harsh environments (lower pH and oxygen level with high organic matter concentration are the indicators of polluted coastal environment) and heavy industrial activities around it and yet this mangrove thrived and distributed near the equator along the Malacca Straits. Different intertidal zones nurture different types of mangrove flora where it is also known as halophytes. There are various layers of plants that fit to grow primarily in high saline or in an arid habitat (Grigore *et al*., 2014). The mangrove vegetation assisted and balanced out shorelines and at the same time minimised the overwhelming effect of catastrophic events such as hurricanes, tsunamis and climate change by enhancing salinity and increase of temperature at the coastal area (Hasanuzzaman *et al*., 2014; Giri *et al.*, 2008). Importantly, various complex bio-network generated in the mangrove ecosystem is crucial to equilibrate and protect the coastlines, as well as numerous vital marine life from various nature detrimental effects. There are distinctive zones with various assorted variety of mangroves plant species and these zones are divided into seaward zone, intertidal zone, and landward zone, where in the intertidal zone lies a rich assemblages of biodiversity and is a highly productive area. A few common woody plant species are largely distributed in the diverse intertidal zones of the mangrove forest which act as a buffer along the

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coastlines and the open sea. Furthermore, mangrove plants consist of about 70 known species from over 20 very extraordinary angiosperm families (Duke, 1995).

Meiofauna (invertebrate < 1 mm) can be found at the bed floor and in the sediment of the mangrove forest. Most active meiofauna are found within 2 cm layer of the mangrove sediment (Sasekumar, 1994). The type of meiofauna most commonly found at the mangrove bed floor are nematodes, ostracism and harpacticoid copepods although their structure is similar possibly due to similarity between habitats. Besides, the meiofauna density is highly associated with the organic content as well as the reduction of particle size and the pH values of the mangrove sediment (Rosa & Bemvenuti, 2005). The diverse composition of meiofauna species in the sediment are generally measured by some aspects such as food availability, organic matter and tidal exposure. A higher content of organic matter in the sediment would initiate a high oxygen demand in that particular area. There are more detritus accumulating in the sediment and thus contributing to more fauna organisms in the area (Mirto *et al*., 2014). The meiofauna feed on bacteria to maintain their existence. Moreover, their likelihood of choice is more towards protozoa which can be found in the roots of *Rhizophere* and act as their preferred food source (El-Serehy *et al*., 2016). Nevertheless, there is no research been done at this area on the mangrove flora and meiofauna diversity near these coastal shorelines. This study was done to document the information about mangrove flora and meiofauna species distribution at Pantai Kelanang coastal line.

## MATERIALS AND METHODS

### Sampling sites

Pantai Kelanang is located six kilometers from Morib shoreline at Banting in Selangor. Moreover, it is a recreational area and frequently visited by public. The mangrove forests are distributed near the beach at 2°45'40.559" N and 101°26'6.157" E. Distribution of the mangrove plants is due to the topography features which is affected by the strong tides and also the ocean currents during monsoons. There were three basic vegetation zones found in Pantai Kelanang which were the low-intertidal zone, mid-intertidal zone and high-intertidal zone (Figure 1).

### Sampling technique

Studies was carried out and measured by using quadrat sampling method. Many researchers have utilized this method to measure the number and distribution of trees (Cox, 1990). In each sampling plot, a 100 $m^2$ quadrat with size of 10 m x 10 m was used to calculate the number of mangrove trees. However, there was no subplot within a plot because of the difficulty of movements at the sampling site. A major advantage of using quadrat method was easy to handle and compatible to measure vast trees distribution at the sites of interest. The quadrats were laid on the sites based on block sampling technique (Dodd, 2011). This technique was particularly useful because of the mangrove location and the plans distribution are largely scattered and dispersed. The block sampling technique was particularly useful in this study

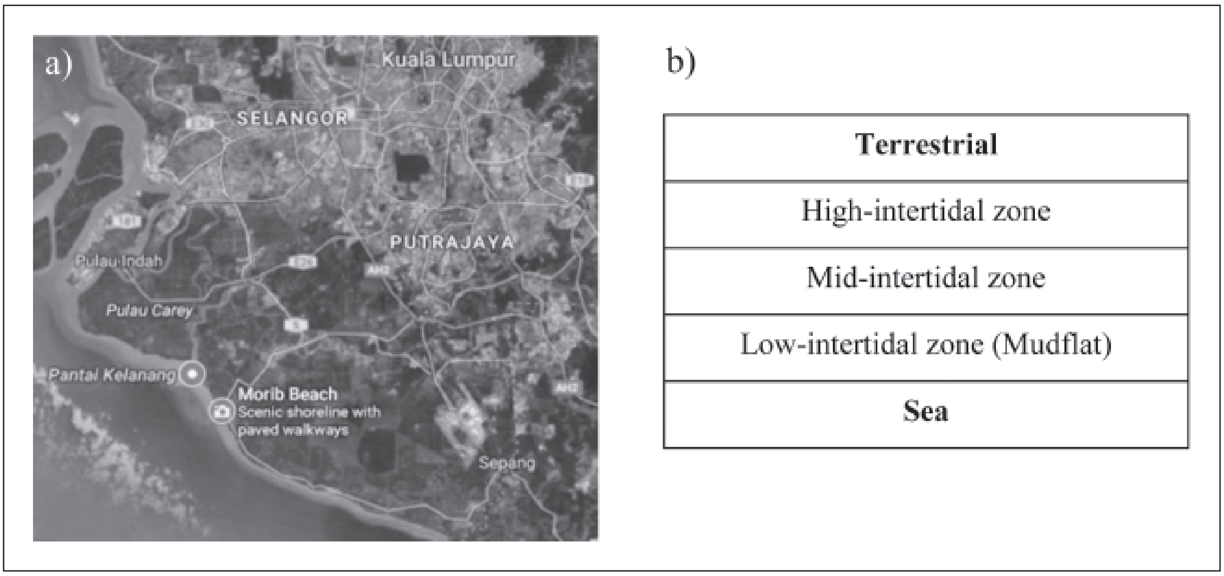


**Fig. 1.** a) Study area in Pantai Kelanang, Selangor, (Source: Google Map) b) Subdivision of mangrove area.

because of the limited movement and distraction of the pneumatophore root during sampling.

**Data collection**

***Trees identification***

For mangrove trees, the height and diameter breast height (DBH) of each tree in the plot was recorded in the data sheet. The trees were tagged using an environmental friendly spray to avoid redundancy. Tree with height greater or equal to 1.3 m were measured using a 1.3 meter pole from the ground whereas, the classification of the plants was based on the diameter of the tree. Classification of a tree is based on its diameter that is greater than 3 cm while others, which are less than 3 cm are considered as sapling (Ashton & Macintosh, 2002). The trees inside each quadrat were identified and manually counted as described by (Rivera *et al*., 2017). Individual trees, that were found within the plot were identified by analysing their morphology based on the features of the flower, leaf, bark and fruit. All of the trees were measured and recorded while the sapling was not included.

In this study, the height of a tree was measured by estimation due to the limitation of movements at the sampling site. Randomly, a five meter long pole was used to estimate the height of trees. The pole was placed behind the tree and the height was then estimated. Average height of mangrove plants were between 10–15 m (Sasekumar & Loi, 1983). At each site, five replicates of readings were obtained. The locality of each site was measured using GPS Garmin 60. The parameters such as relative density, relative frequency, relative dominance and the importance value were calculated using standard formula.

*Meiofauna Identification*

The sediment obtained during the fieldwork was brought back to the laboratory. There are several procedures involved in the separation of meiofauna from the sediment, which are concentration, sorting and finally counting (Uhlig *et al*., 1973). Concentration is the enrichment of meiofauna in respect of sediment particles in the samples. While sorting and counting, fauna was classified into taxonomical groups and specimens were counted as well as recorded for each sediment sample. Samples were stained with Rose Bengal and were left overnight. Formalin fixed sediment was then washed using decantation technique (Giere, 2009). The identification of meiofauna was done with reference to the book entitled Meiobenthology (Giere, 2009).

**Data analysis**

The diversity of plant species is simply measured by manually counting its species (Macarthur, 1965). To measure species diversity, Shannon Wiener Index and Simpson Index were used. While meiofauna density is the number of individuals of a given species which occurred within a given sample unit or study area.

## RESULTS AND DISCUSSION

There were some mangrove flora and meiofauna species identified and recorded at the study area. There was only one dominant species identified at the high-intertidal zone known as *Rhizophora apiculata.* From findings, 86 individuals were found in four plots and each plot has different number of individuals. The mid-intertidal zone was highly populated by *Avicennia* sp. (Figure 2). Besides, there were no plant individuals detected at the low-intertidal zone as it was covered with heavy mudflat. The conversion from mangrove area to mudflats can lead to destabilization of shorelines that negatively impact their resilience to extreme weather events (Ecology Society of America, 2018).

The various diversity indexes were calculated using mathematical measures to know species richness and their distribution in the study area. The density for mangroves species *Avicennia* sp. and *Sonneratia* sp. were 0.29 and 0.11, respectively (Table 1). Based on Shanon-Wiener Diversity Index (H'), the diversity at mid-intertidal zone was at 0.59. Evenness (E) showed the value of 0.54. Furthermore, Simpson's Index (D) showed that both species dominance at the mid-intertidal zone was at 0.59. Depending on the mangrove plant species, there are many biotic and abiotic factors affecting the distribution of the mangrove tree population which involves the surrounding air temperature, relative humidity and light intensity (Delgado-sanchez, 2001). This is because it is essential and crucial for plant growth and development. Besides, to study the morphology of plants, it is also recommended to acquire the plant's leaf, flower and fruits for detailed identification and classification. Moreover, the usage of quadrat sampling technique gives more precise measurements on the diversity and density of mangrove plant in a largely open area.

Meiofauna is symbiotically associated with the mangrove community. There are significant associations existing between meiofauna assemblage and local mangrove sediment conditions (Abdullah

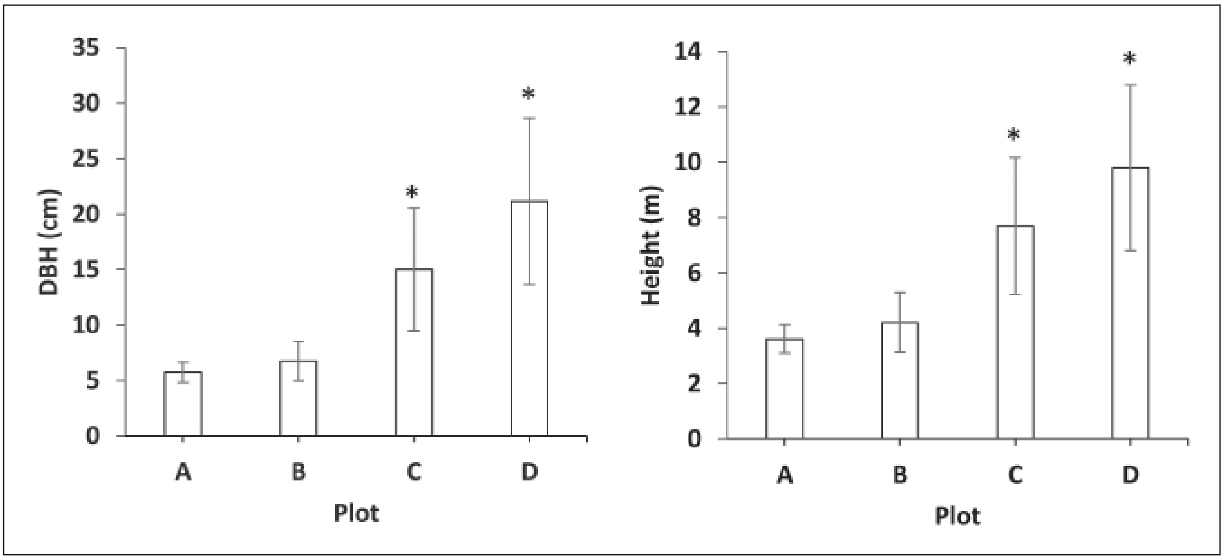


**Fig. 2.** Mean DBH of mangrove tree in Plot A, B, C and D. Values are represented as mean ± SE with n=4. Mean height of mangrove tree in Plot A, B, C and D. Values are represented as mean ± SE with n=4.

**Table 1.** Density, relative density, frequency, relative frequency, coverage, relative coverage and Importance Value Index (IVI) of mangroves in mid-intertidal zone (a) and (b) in Pantai Kelanang

| Species | No. of individuals | D | RD(%) | F | RF(%) | C | RC(%) | IVI |
|---|---|---|---|---|---|---|---|---|
| a) *Avicennia* sp. | 29 | 0.29 | 72.5 | 7.25 | 72.5 | 4.27 | 0.09 | 145.09 |
| *Sonneratia* sp. | 11 | 0.11 | 27.5 | 2.75 | 27.5 | 41.46 | 0.91 | 55.91 |
| b) *Rhizophora apiculata* | 86 | 0.86 | 100 | 21.5 | 100 | 11904.88 | 100 | 300 |

Note: D=Density, RD=Relative Density, F= Frequency, RF=Relative Frequency, C=Coverage, RC=Relative Coverage and IVI= Important Value Index with n=4.

**Table 2.** Density of meiofauna at different zone. Values are represented as mean ± SD with n=4

| Meiofauna groups | No. of individual (no/10cm$^2$) | | |
|---|---|---|---|
| | *High-intertidal zone* | *Mid-intertidal zone* | *Low-intertidal zone* |
| Nematodes | 13.00±2.62 | 22.12±13.15 | 59.40±18.29 |
| Copepods | 0.40±0.22 | 0.79±0.53 | 1.83±1.33 |
| Oligochaetes | 0.08±0.10 | 0.09±0.12 | 0.13±0.19 |

& Lee, 2017). Based on the results, the meiofauna in this study mostly were dominated by Nematoda followed by Copepode and Oligochaeta (Table 2). Nematodes are known to be a bio-indicator and also act as breakdown machinery in nature. High pollution and human activities are often represented by the ground for intentional abandoning of waste for all sorts of unwanted material including sewage, industrial run-off and chemicals as well as excessive organic matter at the shorelines that had caused the increase in nematodes population in the mid-intertidal zone of the mangrove area.

The assemblage of meiofauna in the mangrove sediment was affected by the type of sediment itself (Pan *et al*., 2013). In this study, the abundance and productivity of meiofauna was found to be high in the low-intertidal area. This is because in the soft sediment at the low-intertidal area, there are micro-algae and bacteria deposited on the sediment to decompose most organic matter. The sediment content acts as a food source and shelter for most meiofauna in the area. Moreover, the highest density of meiofauna was found in low-intertidal zone with 61.350±19.47 ind. 10 cm$^{-2}$ and the lowest density in high-intertidal zone was with 13.475±2.70 ind. 10 $cm^{-2}$.

The data obtained in this study is useful to other researchers in this area as a baseline. In addition, it is suggested that more studies should be conducted in this area in the future to meet the needs for accurate and reliable information on the diversity of the mangrove flora and meiofauna population. The differences on the output can be attributed to several factors and future studies need to focus on which factors play the dominant role when it comes to diversity and density of mangroves plant species linked to heavy human activities around the mangrove area. It is suggested that, other researchers can add to this study by completing its physiological data such as soil type at high-intertidal zone to look at their effect on mangrove flora. Soil type is another parameter that may have an effect to the diversity and density of mangrove plant species at the high-intertidal zone. Besides, this study only covers the composition of meiofauna in the area, however it could be expanded by including the abundance and the diversity of meiofauna species directly related to the degree of human activity around this area. Furthermore, in future studies data about the mangrove structure should be involved and relate all the environmental factors such as temperature, light intensity, salinity, organic content and others physical factors which can be directly linked to the distribution of meiofauna.

## CONCLUSION

The results concluded that the mangrove flora is less diverse where only three families of mangrove flora species were found at Pantai Kelanang coastal shorelines. However, the meiofauna diversity and population were found to be more diverse inhabited mostly by Nematodes in the sediments of the coastal shorelines. Future studies have to be conducted in order to prevent the destruction of mangrove forest and its meiofauna population by heavy human activities in order to maintain a balanced and healthy mangrove ecosystem.

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